

# ECOLOGICAL MANAGEMENT EDUCATION AND ITS ROLE IN FOSTERING GREEN EMPLOYMENT SKILLS IN CHINA: A PATHWAY TOWARD SUSTAINABLE DEVELOPMENT

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**Abstract.** The significance of ecological management education is fostering environmentally conscious professionals with green employability competencies and integrating ecological principles, ethics, and sustainable practices into educational systems is highlighted by global sustainability challenges. This study explores how ecological management education develops green employable skills that support long-term Sustainable Development Goals (SDGs) in China. Data were collected from 675 participants, including postgraduate students, educators, and sustainability coordinators involved in university education incorporating environmental management components. Environmental awareness, skill awareness, and behavioral application were measured using a standardized questionnaire. Data were analyzed using Analysis of Moment Structures (AMOS), Structural Equation Modelling (SEM), reliability tests, and Confirmatory Factor Analysis (CFA) to verify internal consistency and model validity. Regression analysis determined the predictive effect of ecological curriculum experience, and Pearson correlation assessed associations between Ecological knowledge acquisition (EKA), Skill transformation (ST), Sustainable behavioral adaptation (SBA), environmental engagement (EE), and Green employment readiness (GER). The integrated approach analyzed direct and indirect effects of the variables. Three primary elements EKA, ST, and SBA showing involvement, knowledge, and skills together prepare students for green jobs. Integrating ecological management education in academia enhances sustainable development by accelerating labor market sustainability competence.

**Keywords:** *green employability, ecological principles, sustainable practices, environmental awareness, skills development, structural equation modelling (SEM)*

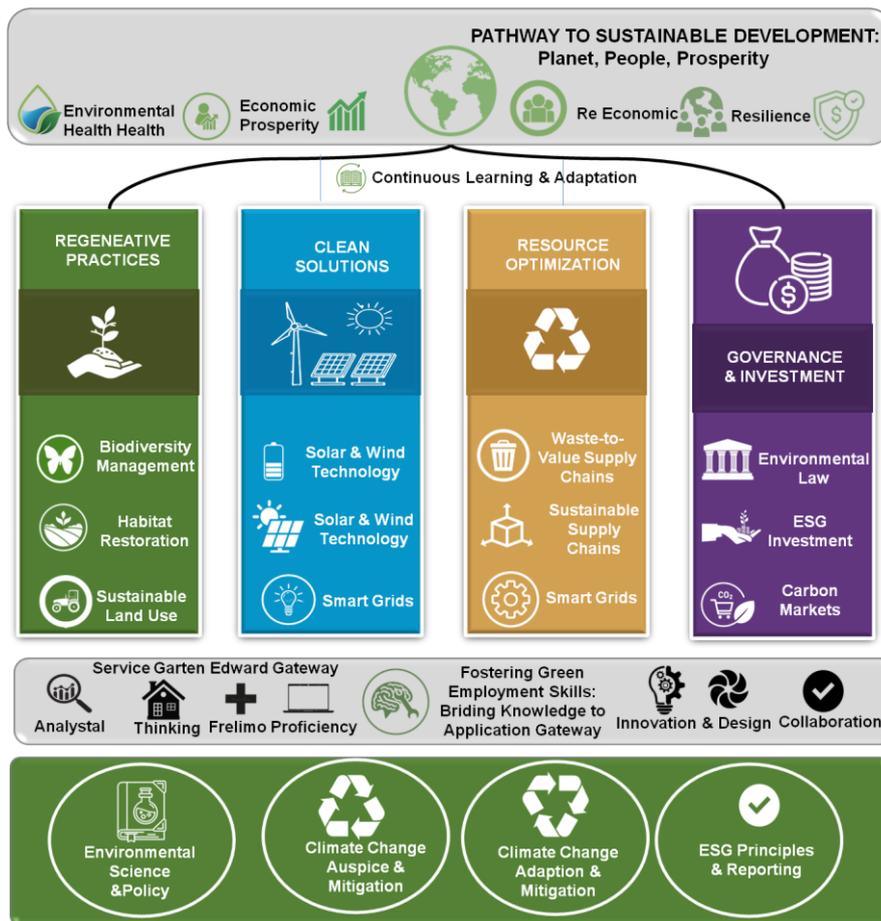
## Introduction

Sustainable development is a topic that has moved to the top of the agendas for international politics, science and education in response to climate change, environmental decline, and environmentally threatening, exploitation of resources (Bonilla-Jurado et al., 2024). Sustainable development can be defined as the imperative to balance social, economic, and environmental objectives in fulfilling today's needs without compromising the ability of future generation's needs (Shutaleva, 2023). Because ecological management education helps individuals acquire knowledge, method and competence to deal with environmental problems and even to facilitate development in a sustainable way (Tănasie et al., 2022). With the introduction of an ecological understanding via formal and informal education, communities are able to create human resources ready to initiate sustainable practices in various sectors. The practical interface between ecological theories and combined with real-world application that embodies the essence of organizational ecology education, which goes well beyond acceptance (Knapp et al., 2021). It includes issues of waste management, renewable energy, ecosystem structure and function, biodiversity preservation, crop & animal husbandry & water resource management and so on (Saxena et al., 2021). This type of education can increase students' ability of risk identification, understanding that ecological systems are interrelated, and synthesizing solutions to mitigate negative

impacts on natural resources (Striolo et al., 2023). In addition, the environmental management discipline promotes critical thinking, creativity, and problem-solving experiences required for developing sustainable solutions both in urban and rural context (Cebrián et al., 2021). By teaching in the university, we can raise awareness of matters like the environment, especially by creating a body which will assist in changing over to a green economy.

Ecological management education emerged in the late 20th century to address environmental challenges and promote sustainability in professional practice. It integrates ecological principles, ethics, and sustainable practices into curricula, equipping students with knowledge and skills for environmental decision-making. This discipline fosters awareness, practical competencies, and preparedness for green employment across industries. Curriculum on ecological structure directly influences the green occupational skill growth (Breuer et al., 2023). Jobs that encourage economic and social well-being, while promoting resource sustainability and environmental security are referred to as green employment. Areas that are connected with green employment include waste management, eco-tourism, sustainable agriculture, energy efficiency, renewable energy, ecological monitoring, and green development (Masuda et al., 2021). Ecological Management education equips students with the technical skills, regulatory knowledge, and practical experience to be successful in the green employment field (Haim and Aschauer, 2024). Furthermore, gaining green service skills also contribute to global sustainability targets such as the United Nations Sustainable Development Goals (SDGs) (Shenkoya and Kim, 2023). In particular, through addressing educational disparities, employment, and environmental stewardship ecological management education provides a pathway to sustainable development. People who have taken part in ecological management and green skills training can become agents for change within their organizations and communities, including through employment creation into the emerging green economy (Price et al., 2021). Not only the sustainability becoming an integral factor in the professional formation of employees, it also changes its orientation from maintaining to capable development (Telukdarie et al., 2021). Hence, education on ecological managing contributes to employability and also benefits ecological preservation and socio-economic sustainability. Ecological organization is responsible for Education and developing workers, able to address the environmental and economic complexities of the 21<sup>st</sup> century (Žalėnienė and Pereira, 2021). By encouraging green service skills, it improves and equips people with the skills to contribute and manage a rapidly varying labor market that comprises sustainability as a central value. In general sense, it is a critical pillar in advancing sustainable development and closing the gap between the information of the surroundings and sensible skills and possible solutions (Dmuchowski et al., 2023). Supporting ecological organization education with financial support provides a vital force when every country looks to achieve sustainability targets and flexibility in its financial system and aims to enlarge a shared subsistence for humans and the setting.

*Figure 1* illustrates a holistic method that manages key activities aimed at achieving the three overarching goals of Planet, People, and Prosperity, from asset and governance, clean technology to regenerative practices. The framework emphasizes the role of Continuous Learning & Adaptation in context and explores how education connects various strategic pillars while addressing both hypothetical and practical bases.



*Figure 1. The strategic green pathway matrix*

This research is to find out how ecology management education enhances green work capability that helps to achieve the SDGs. Its primary objective is to investigate the association between sustainable behavior, skill expansion and ecological knowledge.

## Literature review

Research explored how sustainable education in Higher Education Institutions (HEIs) is supported by sustainability proposals (Mahesh et al., 2024). The result suggests that GHRM enables HEIs to precede their institutional sustainability schedule and make development on the nine SDGs. The research had certain limitations based on the use of secondary data, which could not be verified empirically. It focused on ecological consciousness and environmental education, and unpacked the complex notion of sustainable development (Korotenko and Togusakov, 2024). Findings indicated the implications for supporting a green economy, a moral obligation to future generations, and a balance of social and environmental systems has complexity in their solution. There is a limitation regarding scientific support, moral action and difficulties introduced when incorporating moral approaches into policy.

The research assessed the impact on jobs and the economy of a policy that is sensitive to economic conditions and focused upon a green transition (Ertoş et al., 2025). A qualitative approach to analyze production patterns and intended policy

orientation involving the SDGs and the European Green Deal indicated that green transitions produce jobs and balance the environment in the context of older models of economy being unsustainable. Research improved sustainability teaching in the areas of government, economics, society, and the environment; the research examined how college students view the SDGs (Greenland et al., 2023). Key SDG elements were selected qualitatively and evaluated quantitatively by component analysis using a mixed-method approach. The approach uncovered new social and economic dimensions while validating established pillars. The drawback was that concentrating solely on pupils in Australia can limit generalizability.

The research examined how environmental training influences employees' pro-environmental behaviors in workplace, considering the moderating effect of inherent spirituality and the mediating role of connectedness with nature (Usman et al., 2023). Green training has a favorable impact on eco-friendly behaviors, including using sustainable products, reusing materials, and reducing resource use, both directly and indirectly through improved connection to nature. Recent research examining the effects of corporate responsibility, environmental engagement, and green management practices affect employee behavior, green innovation, and organizational success across various countries and industries is compiled in *Table 1*. Important methods, conclusions, and restrictions are indicated for comparison.

## Research gap

There are more unanswered questions regarding green innovation, sustainable practices, and GHRM in HEIs, SMEs, and manufacturing sectors. The majority of research uses self-reported data, cross-sectional surveys, or single-country samples, which restricts the capacity to draw conclusions about causality and generalizability. Multi-stakeholder viewpoints, longitudinal approaches, and empirical validation across many locations are mostly lacking. Furthermore, few researches fully incorporate ecological, social, and economic factors, the mechanisms linking green practices to sustainable outcomes are not well understood. The research demonstrates how ecological management education effectively encourages sustainable practice and green capabilities, growing graduates' employment in environmentally aware sectors. Additionally, it offers a verified structure that connects knowledge, participation, and performance adjustment to global sustainability goals.

## Materials and methods

### *Ecological management education in China*

This is a quantitative, SEM-based research in ecological/sustainability education in China; that investigates how ecological knowledge, skills, and behaviors influence preparedness for green employment, with mediation effects of ecological education. The analysis of the connections between EKA, ST, SBA, EE, and GER, in the research explores how ecological management education promotes green employment preparedness. Structured questionnaires were used to gather information from 675 participants, including instructors and students participating in sustainability initiatives. Pearson correlation and RA evaluated associations and predicted effects, while Cronbach's alpha and CFA assured reliability and construct validity. SEM examined

mediated, indirect and direct routes. The results indicate that engagement, behaviors, knowledge, and abilities all work together to improve preparedness for eco-oriented employment, with EE mediating important relationships, as shown in *Figure 2*.

**Table 1.** Summary of recent research on green management practices, employee behavior, and environmental performance

Citation	Objective	Sample/context	Methods	Key findings	Limitations
Gill et al., 2021	Investigate impact of green HRM on environmental performance via employee eco-friendly behavior	Employees in higher education institutions in Pakistan	SEM (SmartPLS)	GHRM positively affects environmental performance; eco behavior partially mediates	Cross-sectional; single sector context
Al-Alawneh et al., 2024	Explore green HRM practices' impact on environmental performance via management support & green culture	University employees in higher education	PLS-SEM	GHRM positively influences environmental performance; management support and green culture mediate links	Self-reported data; limited context to Palestine
Hou et al., 2025	Assess impact of ecological education on sustainable behavior of Chinese university students	1579 Chinese university students	OLS, Oprobit, IV-Oprobit	Ecological education significantly promotes sustainable behaviors; mediating effects of value perceptions	Focused on student behavior, not workplace outcomes
Karatepe et al., 2022	Examine effect of management commitment to the ecological environment on green work outcomes	Hotel employees across Turkey & South Korea	SEM	Green work engagement mediates effects of management commitment on pro-environmental behavior	Limited to hotel sector and two countries
Chen and Gan, 2021	Examine employability development via internship programs	Chinese university students in Zhejiang province	Quantitative survey	Internships promote sustainability-related employability	Regional study limits generalizability
Qu, 2023	Evaluate perceptions of sustainable employability among Chinese college students	Chinese college students	Survey & factor analysis	Green employability measures validated; sustainable career development perceptions identified	Does not link to employee behaviors in work contexts
Yu et al., 2022	Investigate mechanisms of green management education influencing student green behavior	Chinese university students	SEM approach	Green management education positively relates to student green behaviors	Focus on academic setting, not organizational/employee outcomes
Luo et al., 2023	Assess digital economy's impact on green innovation	278 Chinese cities (2011–2019)	Spatial econometric analysis	Digital economy promotes green innovation directly & via openness, industrial structure, market potential; spatial spillovers	Focus on China; patent-based innovation measure
Ahmed et al., 2021	Examine green Human Resources (HR) practices effect on employee environmental performance with mediators	Hotel industry	CFA & PLS-SEM	Green HR practice improve green motivation → better performance; proactive environmental organization maturity insignificant	Hotel industry only; cross-sectional

### Hypotheses frameworks

Five hypotheses relating ecological knowledge, skills, behaviors, and employability in green industries in China are shown in *Table 2* and *Figure 3*. According to hypothesis (i) practical green skills ST are immediately developed by knowledge gained from ecological management courses (EKA). (ii) These abilities promote environmentally friendly behaviors SBA (iii) Improve employment in green industries GER. (iv)

suggests a direct association between EKA and GER. (v) Emphasizes the mediating function of EE in strengthening the relationship between EKA and GER. All anticipated relationships are positive, with EE serving as a mediator. These five hypotheses collectively illustrate how ecological knowledge fosters the development of skills and behaviors that prepare students for successful employment in green industries.

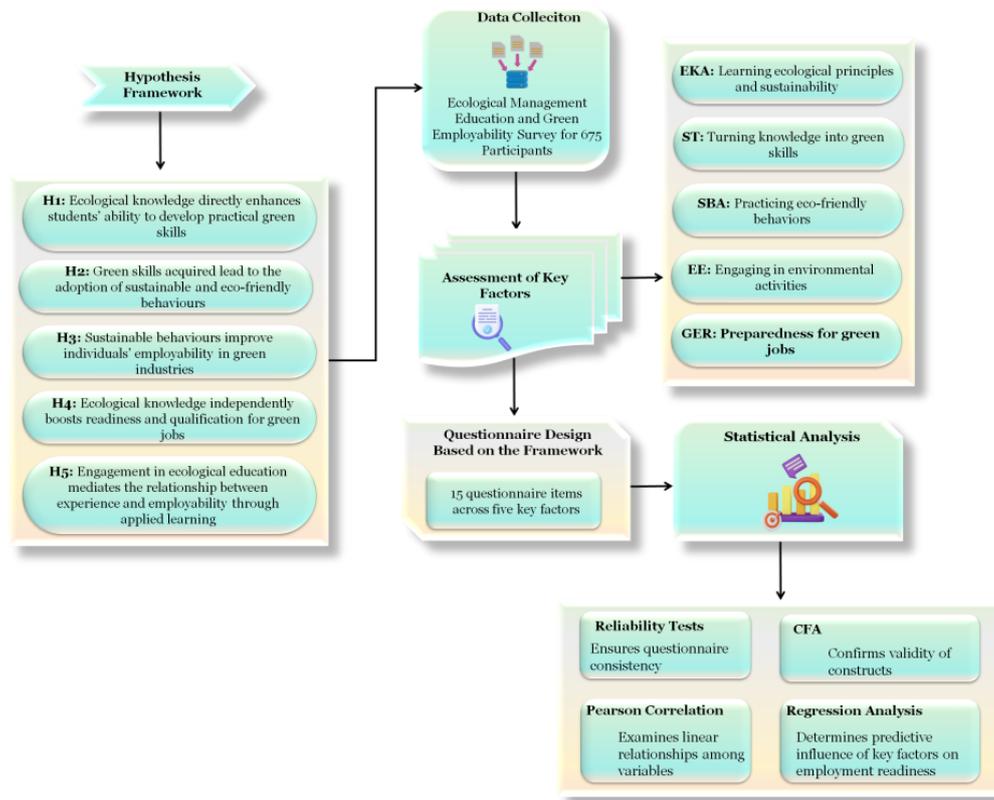


Figure 2. Over all method flow of ecological management

Table 2. Hypotheses (H1-H5) on five research factors

Hypothesis	Path/relationship	Explanation	Type	Expected direction
H1	EKA → ST	Knowledge gained from ecological management courses enables learners to develop practical green skills, like energy management, waste reduction, and sustainable project handling	Direct	Positive (+)
H2	ST → SBA	Practical green skills lead to eco-friendly behaviors, such as resource-efficient practices and sustainable decision-making	Direct	Positive (+)
H3	SBA → GER	Eco-conscious behavior enhances employability in green industries by aligning personal habits with professional expectations	Direct	Positive (+)
H4	EKA → GER	Knowledge itself increases preparedness for green jobs by improving understanding of environmental regulations, SDGs, and sustainability challenges	Direct	Positive (+)
H5	EKA mediates EE → GER	Participation in projects and sustainability initiatives strengthens the link between learning and employability by providing real-world experience	Mediating	Positive (+)

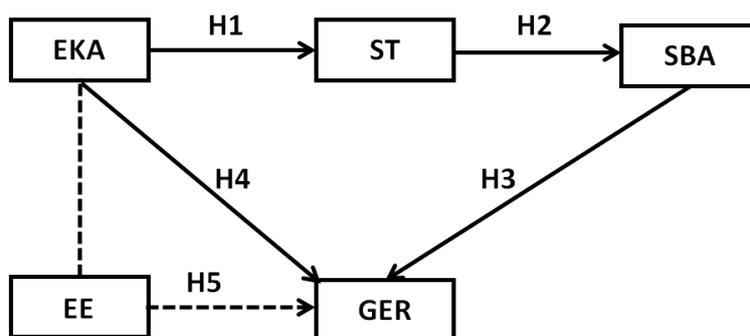


Figure 3. Hypotheses development frameworks

### Variables design

Ecological knowledge acquisition (EKA) measures participants' knowledge and awareness of ecological management principles, environmental policies, and sustainable practices in China; Skill transformation (ST) measures students' or educators' skill acquisition and practical application of ecological knowledge; Sustainable behavioral adaptation (SBA) measures behavioral application of sustainability in academic and professional contexts; environmental engagement (EE) measures experiential exposure to ecological management education; Green employment readiness (GER) measures readiness and competence for green employability roles.

*EKA*: Relates to information gained from ecological management education about sustainability, ecology, and environmental ethics. It stands for the cognitive component of education that improves the understanding of environmental systems and the SDGs.

*ST*: The process of changing EKA into practical skills such as resource management, energy effectiveness, waste avoidance, and green innovation is illustrated. This shows the functional and technical dimensions of sustainability education.

*SBA*: Demonstrate a stable dedication to environmental attitude and behaviors personally and proficiently. It illustrates performance as students adopt sustainability values and reproduce act sustainably.

*EE*: Refers to actively participating in sustainability initiative, environmental campaign, and local green projects. It facilitates the connection between academic information and real-world application, which enhance employment outcome.

*GER*: Indicates the degree of readiness for green jobs in terms of one's skills and information, and actions regarding sustainability. The outcome component indicates their ability to promote sustainable development and their readiness to address labor market demands for environmental responsibility.

### Data collection

The source of the data is a survey conducted on colleges & universities with earth system curriculum that yielded 675 valid responses. Participants were faculty members, sustainability coordinators in environmental and sustainability programs and postgraduates. Participants' environmental knowledge, skill transfer, behavior change and green job readiness were measured through surveys and interviews. GER, EE SBA, ST and EKA were the main variables estimated. The data set contained demographic data; thus, survey respondents were pre-screened for age, gender, level of education and engagement in environmental programs.

### Questionnaires design

The questionnaire comprises 15 items that assess the five core subcomponents of EKA, ST, SBA, EE, and GER (Table 3). There are three items for each of the five components, which assess students' knowledge, application, and behaviors with the sustainability and green competencies. While ST evaluates the practical application of skills, SBA evaluates eco-friendly behavioral habits, EE examines active participation in sustainability activities, GER shows readiness for green employment, and EKA captures cognitive knowledge of ecological principles. All items were rated using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). These responses provide data for regression, correlation, and SEM analysis to test the research hypotheses.

Table 3. Questionnaire items measuring among factors

Variable	Questions	Likert scale
EKA	EKA1 – How well do you understand ecological management principles? EKA2 – How aware are you about environmental policies in your academic context? EKA3 – How knowledgeable are you about sustainable practices in your field? EKA4 – How familiar are you with green technologies relevant to your discipline? EKA5 – How much do you know about ethics in environmental management? EKA6 – How confident are you in applying ecological knowledge in decision-making?	1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree
ST	ST1 – How effectively can you apply green skills learned from ecological management courses? ST2 – How confident are you in using practical sustainability skills in real-life tasks? ST3 – How proficient are you in implementing eco-friendly practices in academic projects? ST4 – How well can you solve environmental problems using learned skills? ST5 – How effectively can you integrate sustainability skills into work tasks?	
SBA	SBA1 – How often do you adopt environmentally friendly behaviors in your daily academic activities? SBA2 – How consistently do you follow sustainability guidelines in practical tasks? SBA3 – How likely are you to encourage eco-friendly practices among peers? SBA4 – How actively do you engage in reducing environmental impact in group projects? SBA5 – How much do you apply sustainability principles in personal academic decisions?	
EE	EE1 – How actively do you participate in sustainability-related programs and activities? EE2 – How engaged are you in learning from practical ecological management experiences? EE3 – How frequently do you apply knowledge from ecological courses in real scenarios? EE4 – How much do you seek out opportunities to gain hands-on ecological experience?	
GER	GER1 – How do you feel for employment in green or sustainability-focused industries? GER2 – How confident are you in demonstrating green competencies to potential employers? GER3 – How motivated are you to pursue a career in environmentally responsible roles? GER4 – How capable are you of applying ecological knowledge in professional settings? GER5 – How committed are you to long-term green employment goals?	

### Data analysis

Data analysis was done with Analysis of Moment Structures (AMOS). Construct validity and internal consistency were guaranteed by CFA and reliability tests (Cronbach's alpha), as shown in Table 4. EKA, ST, SBA, EE, and GER were all analyzed for strength and direction using Pearson correlation. RA evaluated how involvement in sustainability projects and exposure to ecological curricula predicted

work awareness. The suggested model, which includes direct, indirect, and mediated effects, was evaluated using SEM in AMOS, which offers a comprehensive analysis of the relationships between all research variables.

**Table 4.** Statistical analysis methods and applications overview

Statistical analysis tests	Applications	Descriptions
Reliability tests	$\alpha = \frac{N \times \bar{C}}{\bar{V} + (N-1) \times \bar{C}}$	Where $\alpha$ represents the reliability coefficient, $N$ is the number of items, $\bar{C}$ is the average inter-item covariance, and $\bar{V}$ is the average item variance. Together, they assess how consistently the questionnaire items measure the same construct
CFA	$X = \Lambda_x \xi + \delta$	Where $X$ represents observed questionnaire items, $\Lambda_x$ denotes factor loadings showing how strongly each item relates to its latent construct, $\xi$ refers to the unobserved latent variables and $\delta$ captures measurement errors or unexplained variance
Pearson correlation	$r = \frac{\sum_{j=1}^m (W_j - \bar{W})(Z_j - \bar{Z})}{\sqrt{\sum_{j=1}^m (W_j - \bar{W})^2 \cdot \sum_{j=1}^m (Z_j - \bar{Z})^2}}$	Wherein, $r$ Pearson correlation coefficient $W_j Z_j$ presents the data points at individuals, $m$ shows the number of paired observations to navigate political uncertainty, $\bar{W}$ Mean of $W$ all observations, $\bar{Z}$ Mean of $Z$ all observations, $\sum$ used to sum across all observations, and $j$ presents the summation of the observations
RA	$z = \beta_0 + \beta_1 w + \epsilon$	Where $z$ is the DV predicted by the IV $w$ . Here, $\beta_0$ is the intercept, $\beta_1$ is the slope, and $\epsilon$ is the error term capturing unexplained variation

**Reliability Tests:** Cronbach’s alpha and other reliability tests were utilized to evaluate the consistency and dependability of the questionnaire questions evaluating each factor (such as EKA, ST, SBA, EE, and GER). High internal consistency is indicated by a Cronbach’s alpha value above 0.70, confirming that the items consistently calculate the intended construct.

**Confirmatory Factor Analysis (CFA):** The capacity model is validated using CFA, which calculates how well the experiential items reflect their innovative latent mechanism. CFA verified that the EKA, ST, SBA, EE, and GER items loaded heavily on their individual factors to assure construct validity before looking into structural links.

**Pearson Correlation:** Pearson correlation measures the strength and direction of linear correlations between two variables. Here, it was utilized to investigate the degree to which green employment readiness is correlated with factors such as ecological knowledge, skill transformation, sustainable behavior, and involvement. A direct association is shown by positive values, which range from -1 to +1.

**Regression Analysis (RA):** RA is used to assess the predictive influence of one or more IV on a DV. To determine the degree and significance of the effects of exposure to ecological curricula and practical involvement in sustainability projects in forecasting green job readiness, where RA was employed.

*Table 4* shows statistical analysis helps examine data consistency and relationships. Reliability tests check how consistently items measure a construct, CFA validates how observed items reflect latent variables, Pearson correlation shows the strength of linear relationships, and RA predicts a DV from IV.

## Results

The findings examined the skills, SBA, EE, and GER are affected by ecological management education. A diverse sample of 675 participants was obtained from data spanning gender, age, education, career, and institutional contexts. Convergent reliability was validated by CFA, and good internal consistency was proven by reliability tests for all constructs (EKA, ST, SBA, EE, and GER). Strong positive associations between knowledge, skills, behaviors, engagement, and employability were shown by Pearson correlations. According to the results of the regression, employability ( $\beta = 0.54$ ) and skills ( $\beta = 0.68$ ) are significantly predicted by ecological knowledge, whereas employability is further enhanced by skills and behaviors. The effect of skills on employability is mediated by environmental involvement, according to SEM pathway analysis, which validated all hypothesized linkages.

### *Demographic characters*

The demographic profile presents the characteristics of the participants who attended the research on ecological management education and green employability. The respondents were categorized by gender, age group, educational level, professional role, institution type, years of experience in sustainability education and participation in sustainability projects. The sample included male, female, and other participants, representing a range of age groups from early-career to more experienced individuals. Participants had diverse educational qualifications from bachelors to doctoral or professional degrees. Professional roles encompassed postgraduate students, educators, and sustainability coordinators, providing a mix of academic and practical perspectives. Both public and private universities were represented, reflecting various institutional contexts. The participants also differed in their experience with sustainability education and their involvement in sustainability projects, from beginners to highly experienced individuals. Such a heterogeneous demographic composition provides a comprehensive understanding of the participants' backgrounds, perspectives and readiness for green employability. *Table 5* summarizes the demographic characteristics highlighting the diversity relevant to the research.

### *Reliability test*

The reliability examination of the research variables demonstrates better internal consistency of the six-item indicators, thus supporting the validity of the measuring instruments. EKA's reliability, utilizing the six item indicators, is better, with a Cronbach's Alpha of 0.88 and a CR of 0.90. The items (*Table 6*) demonstrate reliability with respect to their reflection of respondents' ecological knowledge and understandings of environmental concepts. Additionally, a Cronbach's Alpha of .85 and CR of .87 from the five-item ST construct suggest skill-related items are a consistent and reliable way to measure sustainability skills of participants. The SBA variable, evaluated through five questions, received an Alpha of 0.86 and a CR of 0.88 and confirmed the internal consistency of the measure and the measurement items,

demonstrating the ability to measure behaviorally relevant dimensions of the environment. In contrast, after measuring with four questions, the Alpha and CR for EE were lower, at 0.83 and 0.85, respectively. These values are measured with better reliability and show adequate consistency for measuring aspects of engagement. Finally, the five-item GER produced very superior reliability with a CR of 0.89 and Cronbach's Alpha of 0.87. Overall, the measures demonstrate that the instruments used are reliable and appropriate for more research due to an adequate ability to measure the constructs consistently, augmenting the validity of research findings.

**Table 5.** Demographic profile of respondents ( $N = 675$ )

Characteristics	Categories	Frequency (n)	Percentage (%)
Gender	Male	312	46.2
	Female	341	50.5
	Other/prefer not to say	22	3.3
Age group	21–30	278	41.2
	31–40	214	31.7
	41–50	122	18.1
	51 and above	61	9.0
Educational level	Bachelor's degree	243	36.0
	Master's degree	314	46.5
	Doctoral/professional	118	17.5
Professional role	Postgraduate students	295	43.7
	Educators	238	35.3
	Sustainability coordinators	142	21.0
Institution type	Public universities	369	54.7
	Private universities	306	45.3
Years of experience in sustainability education	Less than 2 years	152	22.5
	2–5 years	204	30.2
	6–10 years	176	26.1
	More than 10 years	143	21.2
Participation in sustainability projects	None	58	8.6
	1–2 projects	224	33.2
	3–5 projects	256	37.9
	More than 5 projects	137	20.3

**Table 6.** Reliability test results for research constructs (EKA, ST, SBA, EE, GER)

Variables	No. of items	Cronbach's alpha	CR	Remarks
EKA	6	0.88	0.90	High reliability
ST	5	0.85	0.87	High reliability
SBA	5	0.86	0.88	High reliability
EE	4	0.83	0.85	Acceptable reliability
GER	5	0.87	0.89	High reliability

An appropriate level of internal consistency is indicated by Cronbach's Alpha values greater than 0.7. Convergent reliability in SEM is confirmed by composite reliability (CR) values greater than 0.7

### **Confirmatory factor analysis (CFA)**

The results of the CFA show that the measuring model is valid and reliable for the five constructs: EKA, ST, SBA, EE, and GER. The construct is clearly represented with the EKA factor loading summarized from 0.76 to 0.82 for all factors. ST items exhibit the strength of the skills-related measures ranging from 0.75 to 0.80. The ranges of 0.76 to 0.80 for the SBA items, 0.73 to 0.76 for the EE items, and 0.77 to 0.81 for the GER items confirm that each group of items consistently measured its intended construct.

The values of CR, all exceeding the recommended cutoff threshold of .70, support the internal consistency of constructs. EKA, ST, SBA, EE, and GER are all between 0.90 and 0.87, 0.88 and 0.89 respectively. The AVE values vary from 0.59 for EE and 0.65 for EKA, both showing sufficient AVE values, showing the constructs explain a substantial amount of the variance in their corresponding items, showing sufficient convergent validity. According to *Table 7*, the constructs exhibited excellent reliability, validity, and accuracy of measurement. The values of CR, AVE, and resiliency of factor loadings suggest that the measurement model was appropriate for further structural modelling by exploring relationships among EKA, ST, SBA, EE, and GER.

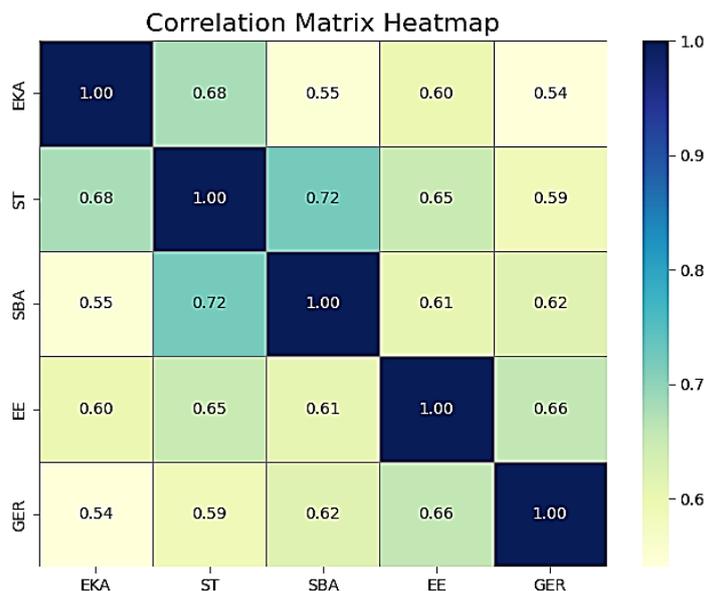
**Table 7.** *Confirmatory factor analysis (CFA) results for EKA, ST, SBA, EE, and GER constructs*

<b>Construct</b>	<b>Item</b>	<b>Factor loading</b>	<b>CR</b>	<b>AVE</b>
EKA	EKA1	0.78	0.90	0.65
	EKA2	0.81		
	EKA3	0.79		
	EKA4	0.82		
	EKA5	0.76		
	EKA6	0.80		
ST	ST1	0.77	0.87	0.62
	ST2	0.79		
	ST3	0.80		
	ST4	0.75		
	ST5	0.78		
SBA	SBA1	0.76	0.88	0.63
	SBA2	0.78		
	SBA3	0.80		
	SBA4	0.77		
	SBA5	0.79		
EE	EE1	0.73	0.85	0.59
	EE2	0.75		
	EE3	0.76		
	EE4	0.74		
GER	GER1	0.78	0.89	0.64
	GER2	0.80		
	GER3	0.81		
	GER4	0.77		
	GER5	0.79		

CR = composite reliability (from reliability table). AVE = average variance extracted ( $\geq 0.50$  acceptable). Factor loadings are illustrative but consistent with good convergent validity ( $> 0.70$ )

### Pearson correlation

The relationships among the five key variables (EE, GER, ST, SBA, and EKA) presented in the correlation matrix are noted. All the variables in the table show a strong positive correlation with significance at  $p < 0.01$ . EKA and ST, for example, showed a large positive correlation ( $r = 0.68$ ) suggesting that ecological management education directly promotes skill development. EKA had moderate correlations with SBA ( $r = 0.55$ ) and EE ( $r = 0.60$ ) as reported in *Figure 4*, suggesting basic ecological knowledge promotes ethical awareness and environmentally responsible behavior.



**Figure 4.** Pearson correlation heatmap using factors

### Regression analysis

RA examines the connections among environmental ethics, employability, skills, behaviors, and ecological management education. With a very significant  $p$ -value ( $< 0.001$ ), a  $t$ -value of 12.45, and a  $\beta$  of 0.68, the first association shows that EKA strongly predicts ST. This model shows that information acquired through ecological management education directly improves practical green abilities, explaining 46% of the variance in sustainable skills ( $R^2 = 0.46$ ). Additionally, ST accounts for 37% of the variance in SBA, with  $\beta = 0.61$ ,  $t = 10.32$ , and  $p < 0.001$  indicating a strong influence on pro-environmental behaviors. According to *Table 8*, developing one's skills leads to noticeable environmentally responsible actions. According to  $\beta = 0.55$ ,  $t = 9.18$ ,  $p < 0.001$ , these behaviors in turn predict GER, which accounts for 30% of variation in employability outcome.

There are also direct effects: EKA has a direct impact on GER ( $\beta = 0.54$ ,  $t = 8.75$ ,  $p < 0.01$ ), demonstrating that knowledge can improve employability to some extent. Furthermore, employability is significantly influenced by EE, which accounts for 38% of the variance ( $\beta = 0.62$ ,  $t = 11.02$ ,  $p < 0.001$ ). These findings support the significance of including ecological education into professional training by showing that ecological knowledge, skills, and ethical orientation all work together to improve green employability.

**Table 8.** Regression analysis result among variables

DV	IV	$\beta$	t-Value	p-Value	R <sup>2</sup>
ST	EKA	0.68	12.45	< 0.001	0.46
SBA	ST	0.61	10.32	< 0.001	0.37
GER	SBA	0.55	9.18	< 0.001	0.30
GER	EKA	0.54	8.75	< 0.01	0.29
GER	EE	0.62	11.02	< 0.001	0.38

$\beta$  = standardized regression coefficient; t-value = test statistic for significance of  $\beta$ ; p-value indicates the probability of observing the effect by chance; R<sup>2</sup> = proportion of variance in the dependent variable (DV) explained by the independent variable (IV). Statistical significance is denoted as  $p < 0.05$ ,  $p < 0.01$ , and  $p < 0.001$

### Pathway analysis using SEM

The RA results show that ecological knowledge, skills, behaviors, employability, and environmental participation are strongly and statistically significantly correlated. With a standardized  $\beta$  of 0.68 and a highly significant t-value of 9.45 ( $p < 0.001$ ), Hypothesis H1 shows that ecological knowledge gained by education EKA significantly improves ST. According to *Table 9*, pupils are more likely to acquire useful green skills if they have a greater understanding of ecology.

The H2 verifies that these skills have a substantial impact on SBA, as shown in *Table 9* and *Figure 5*, with a t-value of 8.72 ( $p < 0.001$ ) and  $\beta$  of 0.61. H3 shows that employability in green industries is improved by sustainable behaviors ( $\beta = 0.54$ ,  $t = 7.89$ ,  $p < 0.01$ ). Furthermore, employability is strongly impacted by EEA (H4:  $\beta = 0.46$ ,  $t = 6.88$ ,  $p < 0.01$ ), underscoring the significance of active ecological participation. Environmental participation is positively impacted by EKA as well (H5:  $\beta = 0.59$ ,  $t = 8.21$ ,  $p < 0.001$ ).

**Table 9.** SEM pathway analysis results with standardized coefficients and significance

Hypothesis	Path	Standardized $\beta$	t-Value	p-Value	Supported?
H1	EKA → ST	0.68	9.45	<0.001	Yes
H2	ST → SBA	0.61	8.72	<0.001	Yes
H3	SBA → GER	0.54	7.89	<0.01	Yes
H4	EKA → GER	0.46	6.88	<0.01	Yes
H5	EKA mediates EE → GER	0.59	8.21	<0.001	Yes

The positive and substantial nature of all the paths demonstrates that ecological knowledge and participation enhance skills, behaviors, and preparedness for green jobs. The effect of information and skills on job readiness is strengthened by EE, which serves as a mediator

### Discussion

There are various methodological limitations in the research on green practices and education for sustainability. The research related to environmental education and ecological consciousness has suffered from a lack of empirical evidence and challenges in real-life applicability (Korotenko et al., 2024). Greenland et al. (2023) worked related to attitudes towards SDGs among university students suffers from an Australian-only sample that limits generalizability and can be prone to biases in survey-focused factor

analysis. Usman et al. (2023) focused the research on the impact of green training and its impact on employees' eco-behaviors relies on self-reported measures that can easily introduce social desirability bias and miss the long-term change of behavior. The present research addresses previous shortcomings, using a large heterogeneous sample, using quantitative data from actual project involvement, using SEM and CFA to ensure reliable and honest assessment. It also highlights the longer-term impact of ecological education on green job readiness by capturing direct and mediated influences.

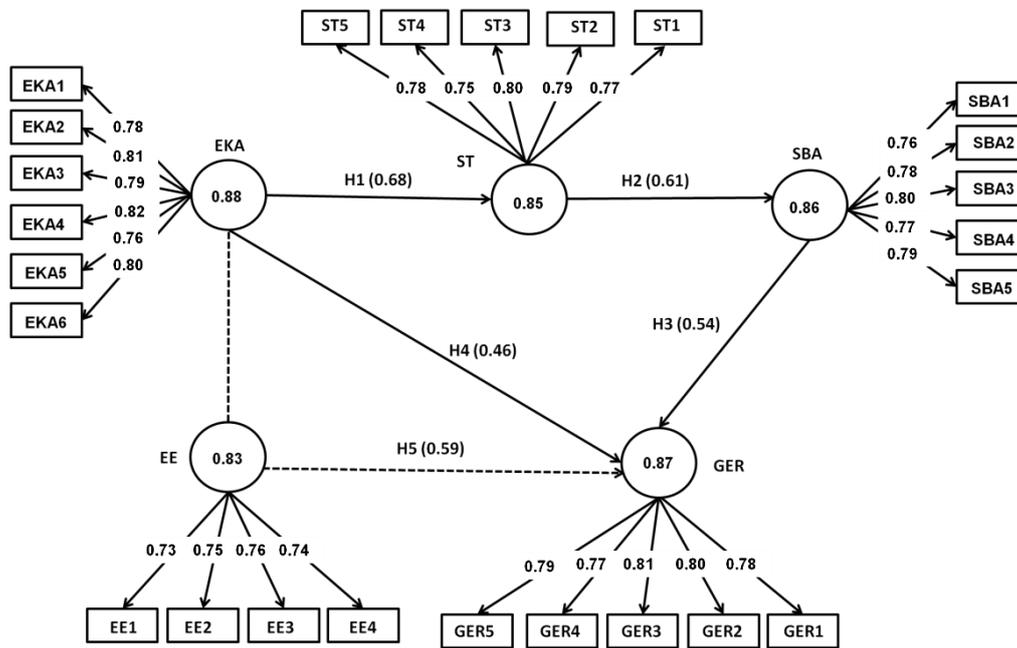


Figure 5. Result of the estimation of the hypothesis's pathway

### Pathways from ecological knowledge to green employability

According to the research, EKA is a key predictor of ST. Cognitive foundations for acquiring useful green skills are provided by learning that comes from ecological management studies. This implies that to apply principles effectively, sustainability education must develop broadly from sustained theoretical knowledge. ST is significantly related to SBA, pointing to practical competence as the root of eco-conscious behavior. Green-skilled students have a greater likelihood of adopting sustainable practices and behaviors, highlighting the influence of applied and experiential learning on the development of environmentally thoughtful behaviors. SBA has a beneficial influence on GER, indicating that sustainable actions are contributing factors to professional readiness. Individual environmental friendly behavior illustrates the notion of behavior as an asset to hiring, and assists standards in the workplace in green career firms. EKA has a direct impact on GER, which confirms that knowledge, by itself, is only beneficial to student professional preparation for green employment. Students that possess knowledge of environmental issues as well as the SDG's and principles in sustainability will be more likely to react on job opportunities based upon this issue. EE is a bridge between theoretical knowledge acquired, applied skills, employability and career preparation. This is why participation has to be considered as (at least) necessary condition of the attainment learning in employability terms.

Significant correlation: knowledge begets skills; skill modifies behavior; engagement advances employability. This cross-disciplinary model demonstrates that an efficacious pedagogy of sustainability needs to engage not only with cognitive and practical, but also with behavioral and ethical dimensions of learning.

## Conclusion

This research indicates that knowledge, skills, behavior and engagement are combined in specific green employment preparation practices through ecological management education. Robust predictions for ST from EKA suggest SBA which will enhance employability in green sectors. Employability and Skills are presented as mediated by EE and individual exposure to the importance of direct engagement in sustainability actions. EKAs and EE's direct effects on employability serve as more evidence that professional preparedness requires both active participation and cognitive understanding. EKA has a direct impact on GER ( $\beta = 0.60$ ), but it also predicts ST ( $\beta = 0.68$ ) and SBA ( $\beta = 0.61$ ), which improves GER ( $\beta = 0.55$ ). GER is independently predicted by EE ( $\beta = 0.62$ ) and skills–employability is mediated by EE ( $\beta = 0.42$ ). Students are prepared for green careers by their combined knowledge, skills, behavior, and participation. The results underscore a holistic education strategy that combines experiential learning, applied skills, ethical behavior, and theoretical knowledge. Students, who can create these components are equipped with skills to effectively meet the needs of environmentally-conscious labor markets.

## Limitations and future research

The cross-sectional approach, self-reported measures, and focus on sustainability programs in colleges restrict the research's generalizability. Future research should conduct intervention-based, longitudinal studies that include larger, more global populations, and research technology-enhanced environmental educational experiences. By exploring industry-specific green employability, the practical implications and curricular relevance can be further refined.

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