Influence mechanism of undergraduate students’ green innovation behavior: AMO perspective and multilevel empirical study

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Abstract
Purpose – To contribute to achieving the Sustainable Development Goals, this study aims to explore how to encourage innovative green behaviors among college students and the mechanisms behind the formation of green innovation behavior. Specifically, this study examines the influences of schools, mentors and college students themselves.

Design/methodology/approach – A multilevel, multisource study involving 261 students from 51 groups generally supported this study’s predictions.

Findings – Proenvironmental and responsible mentors significantly predicted innovative green behavior among college students. In addition, creative motivation mediated the logical chain among green intellectual capital, emotional intelligence and green innovation behavior.

Practical implications – The study findings offer new insights into the conditions required for college students to engage in green innovation. In addition, they provide practical implications for cultivating green innovation among college students.

Originality/value – The authors proposed and tested a multilevel theory based on the ability–motivation–opportunity framework. In this model, proenvironmental and responsible mentors, green intellectual capital and emotional intelligence triggered innovative green behavior among college students through creative motivation.

Keywords Proenvironmental and responsible mentors, Green innovation behavior, AMO, Green intellectual capital, Emotional intelligence

Paper type Research paper

1. Introduction
Sustainability is a global issue, and the United Nations (UN) has established 17 Sustainable Development Goals (SDGs) to be achieved by 2030. Among them, SDG4 (quality education) engages colleges and universities in the realization of sustainable development and calls for
some approach from them. As the main stakeholders of the university and a key force in the society of the future, the behavior of undergraduate students is critical to the achievement of the SDGs (Wang et al., 2013; Zsoka et al., 2013).

Green innovation behavior stands out as one of the fastest ways to promote sustainable development due to its inherently efficient nature. Understanding mechanisms that drive undergraduate students’ innovative green behavior can help universities and decision-makers in crafting effective strategies to foster sustainability and achieve the SDGs. Therefore, this study aims to contribute to the achievement of the SDGs by delving into the study of university students’ green innovation behavior.

However, there is a lack of in-depth research on the green innovation behavior of undergraduate students. Current studies in this realm have primarily focused on improving green awareness, producing green willingness and improving green ability (Hayles, 2019; Jie et al., 2019). Furthermore, most of these studies have approached the subject from the perspective of policies or educational methods (Hayles, 2019; Fu et al., 2018) with limited attention given to undergraduate environmental psychology (Song et al., 2022). Therefore, this study was conducted to fill the research gap on undergraduate students’ green innovation behaviors and aims to finding their facilitating mechanisms to act toward achieving the SDGs.

Further inquiries could delve into the influencing factors of teachers and students within the campus environment (Chaudhary, 2021). The authors aim to assist undergraduate students in harnessing their strengths in positive and innovative thinking, translating green ideas into innovative practices and ultimately achieving innovation performance (Nanath and Pillai, 2021). As such, this study focuses on the following research questions:

**RQ1.** How does undergraduate students’ green innovation behavior contribute to achieving the SDGs?

**RQ2.** How can undergraduate students be motivated to actively participate in green innovation behavior?

**RQ3.** How to form the influence mechanism of undergraduate students’ green innovation behavior through cross-level research among the two subjects: teachers and students?

2. Literature review

2.1 Undergraduate students’ green innovation behavior

Green innovation behavior is often researched in a corporate context. It refers to protection and green practices, including low carbon and energy consumption, throughout all aspects of their production processes (Zhang et al., 2015). Leadership, organization and environment affect employees’ green innovation behavior. Leadership levels encompass ethical, environmental, exploitative and environmentally specific transformational leadership (Yang and Liu, 2022; Singh et al., 2020). The organizational level includes environmental perceptions of corporate social responsibility and attitude, green human resource management (HRM) and perceived organizational support for the environment (Zhang et al., 2022; Singh et al., 2020). The environmental level includes environmental regulations (Peng et al., 2021).

Research on college students’ engagement with green initiatives has explored stakeholder (students, faculty and administrators) and environmental aspects. At the stakeholder level, factors such as individual environmental concerns, attitudes, knowledge and behavioral intentions have been identified as subjective and objective promoters of undergraduates’ green awareness (Omarova and Jo, 2022). However, despite strong attitudes toward
environmental issues, students’ knowledge and willingness to adopt energy-saving measures are limited (Cotton et al., 2016). The environmental level involves pro-environmental policies influencing students’ willingness to participate in green innovation (Fu et al., 2018; Sabokro et al., 2021).

This paper addresses the gap in existing research by examining the influencing mechanism behind undergraduate students’ green innovation behavior, aiming to expedite the achievement of SDGs. Drawing on previous studies, the authors define green innovation behavior as consciously generating or introducing new ideas into students’ academic and professional pursuits to reduce environmental impact or achieve SDGs. While innovative behavior is central to this study, creative self-efficacy emerges as a key driver for undergraduates in fostering innovation (Cai and Tang, 2021; Han et al., 2022). Additionally, psychological antecedents, including perceived support, individual attitude and necessary abilities, have been examined in relation to students’ innovative behavior. Innovation capability encompasses various factors such as knowledge, personality traits, education level and managerial skills (Han et al., 2022; Chang, 2018; Martin et al., 2017). In a mentoring system for Chinese undergraduates, teachers have more influence than administrators. Therefore, this study focuses on the main campus stakeholders (teachers and students) and the primary driver of innovative behavior (creative motivation) to investigate the mechanisms influencing undergraduates’ green behavior.

2.2 Proenvironmental and responsible mentors
A mentor serves as a teacher, counselor and advocate for a mentee. Mentoring results in a mutually beneficial professional relationship (West, 2023). Mentoring has long been proposed as a dynamic process that stimulates mutual learning and social interaction between mentors and students, suggesting that students benefit from mentoring relationships (Allen et al., 1997). Proenvironmental and responsible mentors add environmental protection to this definition, which concerns more with students’ interests.

While some studies have explored mentor tasks, such as encouraging attendance and providing feedback (Vaclavik et al., 2017; Weiss et al., 2019), and others have delved into relationship quality and mentor characteristics (Lianga et al., 2008; Rhodes, 2002), few have focused on mentors’ green behavior, particularly from the perspectives of both mentors and students. This study investigates the impact of teachers’ proenvironmentally responsible behavior on students’ green innovation behavior.

2.3 Green intellectual capital
Green intellectual capital, as defined by Chen (2008), combines intellectual capital and sustainability research, representing a comprehensive inventory of intangible assets, knowledge, talents and relationships. The composition of green intellectual capital includes distinctions, notably human capital and structural capital, as identified in previous studies (Roos and Roos, 1997). Human capital encapsulates an employee’s total knowledge, skills, ingenuity and ability to achieve goals (Coleman, 1988; Zhang, 2021). In contrast, structural capital encompasses the repository of patents, trademarks, computer hardware, software, databases, organizational culture and competencies within an organization, encompassing organizational infrastructure and innovative capital (Roos and Roos, 1997).

The transition to sustainability in the modern knowledge-based economy requires intellectual capital (Alvino et al., 2021). Accordingly, green intellectual capital is widely used in various types of research on sustainability. Chen (2008) explored the positive relation between green intellectual capital and the competitive advantages of firms. Other studies have confirmed that green intellectual capital promotes action performance and innovation in...
product production (Delgado-Verde et al., 2014). This study uses green intellectual capital to represent undergraduate students’ competencies in green innovation from intellectual factors.

2.4 Emotional intelligence

Salovey et al. (1993) defined emotional intelligence as the ability to appropriately interpret and effectively navigate emotional information. Emmerling and Cherniss (2003) expanded on this, viewing emotional intelligence as the capacity to counteract negative emotions, such as resentment and anxiety, with positive emotions such as self-assurance and empathy.

The study of emotional intelligence often involves analyzing individual differences in emotion regulation (Roberts, 2007), spanning various research areas such as professional success, well-being and social adjustment (Tiwari and Bhagat, 2021). In this paper, emotional intelligence is considered alongside green intellectual capital, offering a nonintellectual perspective on the green innovation of undergraduate students. This comprehensive approach aims to represent students’ abilities in green innovative behaviors.

2.5 Creative motivation

Amabile (1985) categorized motivation into two dimensions: internal and external. Internal motivation reflects an individual’s inclination and attitude toward a task, while external motivation is influenced by external incentives and punitive measures. Meta-analyses have consistently shown a positive correlation between intrinsic motivation and creativity (Liu et al., 2016; Cerasoli, 1998). Creativity tends to flourish when individuals are intrinsically motivated by the inherent interest, enjoyment, satisfaction and challenge of the work itself (Amabile, 1993). The theory of intrinsic motivation posits that situational factors, such as leadership and social relationships, can impact innovation by influencing intrinsic motivation (Amabile, 1985).

Studies have demonstrated that intrinsic motivation contributes to individual growth and well-being, particularly in educational settings, enhancing students’ performance and achievements (Ryan and Deci, 2020). Some research has explored the interplay between internal motivation and external rewards and pressure, seeking ways to effectively motivate individuals (Qin and Luo, 2022). External motivation is typically examined in the context of task performance in the business realm (Deci and Ryan, 1980). In general, creative motivation promotes some behavior or performance. In this study, creative motivation serves as a mediating variable for undergraduate students’ green innovation behavior.

2.6 Ability–motivation–opportunity framework

In the AMO framework, individual ability (A), motivation (M) and external opportunity (O) affect individual performance (Anwar et al., 2020). Elbaz et al. (2018) defined ability as the capacity, knowledge, skills, competency and experience required to achieve a mission, whereas motivation was defined as the extent to which an individual is willing to execute a task. Chang et al. (2012) defined opportunity as “the exploration and usage of resources and chances through social connections to solve challenges in transmitting information.” The AMO theoretical model is mostly used in HRM performance research (Paauwe, 2009). Furthermore, the AMO theoretical model has been applied by numerous researchers to explain various behaviors, including knowledge management practices (Argote et al., 2003) and knowledge exchange (Kettinger et al., 2015). Many previous studies have used the AMO model to study employees’ green behavior (Anwar et al., 2020; Kim, 2022). This research applies the AMO theoretical model to the campus environment. AMO theory helps us to take into account a complete and comprehensive view of the factors to be focused on in promoting green innovation behavior among undergraduate students in our research.
3. Hypothesis development
This study utilized the AMO theoretical framework (see Figure 1) to investigate the factors influencing undergraduate students’ green innovation behavior involving both teachers and students. According to Anwar et al. (2020), positive behavior and performance stem from competence, motivation and exposure to external opportunities, this study posited that green intellectual capital and emotional intelligence (A) drive undergraduate green innovation behavior through creative motivation (M). Additionally, the authors hypothesized a cross-level effect of proenvironmental and responsible mentors (O) on the green innovation behavior of undergraduate students.

The authors theorized and examined a multilevel model that explaining how responsible tutors stimulate undergraduate students to engage in green innovation behavior. According to Gardner et al. (2020), leadership is a multilayered phenomenon because of the nonindependence of individual samples. Furthermore, mentors may play a crucial role in motivating subordinates and fostering teamwork in campus contexts, implying that green innovation behavior is not independent among students. Thus, a hierarchical linear model (HLM) was considered to examine the relationship between teachers and undergraduate students.

3.1 Proenvironmental and responsible mentors and green innovation behavior of undergraduate students
Proenvironmental and responsible leaders focus on social goals to create sustainable value and influence in their work, thereby increasing the likelihood of participating in creative activities (Tu and Lu, 2013; Rego et al., 2014). Similarly, undergraduate students’ recognition of teachers’ proenvironment attitudes also positively influences undergraduate students to participate in green innovation. In addition, responsible leaders will create an inclusive working environment and authorize employees to share knowledge (Maak and Pless, 2006), thereby enhancing employees’ self-esteem and encourage them to exert creative efforts (Niu et al., 2018; Dong and Zhong, 2021). As for undergraduate students, inclusive environment in school enhances their innovation endeavors. Accordingly, the following hypothesis has been proposed:

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H1. \text{Mentors who are proenvironmental and socially responsible play a crucial role in promoting the green innovation behavior of undergraduate students.}
\]

3.2 Green intellectual capital and green innovation behavior of undergraduate students
Green intellectual capital significantly positively impacts green innovation achievements (Chang and Chen, 2012; Delgado-Verde et al., 2014), further supporting environment-oriented

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innovation activities (Jirakraisiri et al., 2021). Green human capital helps employees improve work efficiency and reduce decision-making errors, achieving more environmentally friendly innovation (Nisar et al., 2021). Organizations with strong green structural capital encourage employees to think and act according to the concept of environmental protection, thereby creating a supportive atmosphere and promoting innovative behavior (Sawitri et al., 2015). Similarly, in the school environment, undergraduate students with more green intellectual capital will have greater ability and incentives to adopt green innovation behavior. Therefore, the following hypothesis has been proposed:

**H2.** Green intellectual capital promotes the green innovation behavior of undergraduate students.

### 3.3 Emotional intelligence and green innovation behavior of undergraduate students

People with high emotional intelligence are better able to perceive emotions; they use emotions in thinking and understand them more than others (Salovey et al., 1993). Some studies have demonstrated that regulating emotions generates stress and struggle, which may stifle innovation in the initial stages (Yang et al., 2021). However, emotional intelligence can help people manage these emotions constructively, preventing negative tension and struggle. Recognizing positive emotions in others and themselves promotes individual flexibility (Isen et al., 1992) and creativity (Isgett and Fredrickson, 2004), helping individuals engage in innovative behavior. Emotional intelligence allows individuals to control their emotions in adverse situations and facilitates information exchange (Michinov and Michinov, 2022). Cooperation and information sharing among individuals, such as undergraduate students, brought about by emotional intelligence promote innovative behavior. In line with previous studies, the following hypothesis has been proposed:

**H3.** Emotional intelligence promotes green innovation behavior in undergraduate students.

### 3.4 Creative motivation and green innovation behavior of undergraduate students

Intrinsic motivation, crucial for employee creativity, exhibits a robust correlation with creativity (Liu et al., 2016; Cerasoli, 1998). Creativity thrives when individuals find inherent satisfaction and challenge in their work (Amabile, 1993). Contextual factors like leadership and social relationships influence innovation by impacting intrinsic motivation (Amabile, 1985). A positive attitude links to increased green behavior in employees (Li et al., 2020), suggesting enhancing intrinsic motivation in undergraduates boosts environmentally conscious actions. Monetary incentives enhance creativity when individuals comprehend the need for creative actions (Chiu, 2018). Leadership recognition significantly fosters employee creativity and innovation (Kim and Cho, 2020). External opportunities catalyze green innovation (Li et al., 2020). Initiatives like research awards and mentor feedback effectively promote green innovation among undergraduates:

**H4.** Creative motivation promotes green innovation behavior in undergraduate students.

### 3.5 Proenvironmental and responsible mentors and creative motivation

Drawing from the self-determination theory, social situational events such as performance feedback can evoke feelings of competence and enhance intrinsic motivation (Deci and Ryan, 2000). Additionally, a supportive and connected environment fosters internal motivation
Proenvironmental and responsible mentors contribute to the internal motivation of undergraduate students by providing recognition, creating a secure environment and fostering a sense of connection. Similar to intrinsic motivation, extrinsic motivation becomes more prominent when individuals experience support for autonomy, competence and relatedness (Deci and Ryan, 2000). Studies suggest that, in addition to relevant feedback, incorporating extrinsic motivation involves identifying activities offering task-independent feedback and rewards (Ryan and Deci, 2020). Armstrong (2012) categorized external motivation into relational and transactional rewards, where praise and recognition fall under transactional rewards. Mentors play a crucial role in helping undergraduate students develop independent skills, motivating them and rewarding their performance through interaction and communication, thereby satisfying the need for relatedness. Building on the discussions in Subsections 3.4 and 3.5, this paper proposes the following hypothesis:

**H5.** Creative motivation mediates the relationship between proenvironmental and responsible mentors and green innovation behavior of undergraduate students.

### 3.6 Green intellectual capital and creative motivation

Studies emphasize the importance of social knowledge in structural capital, a component of green intellectual capital (Nanath and Pillai, 2021; Spender and Grant, 1996). Social knowledge comprises explicit and implicit facets within organizational knowledge (Spender and Grant, 1996). Implicit social knowledge, residing in individuals’ tacit experiences, is a key element in organizations (Radaelli et al., 2014). For undergraduate students, green intellectual capital involves sharing knowledge and experiences related to environmental protection. Students share their hidden social knowledge, fostering a green atmosphere within the team and expanding the green knowledge reservoir. This collaborative experience enhances intrinsic motivation for pursuing green careers. Self-determination theory posits that autonomy, competence and relationships can internalize external dynamics (Deci and Ryan, 2000). Therefore, undergraduates exchanging understandings of green intellectual capital enhance a sense of belonging, create external motivation and internalize it. Hence, the hypothesis is as follows:

**H6.** Creative motivation mediates the relationship between green intellectual capital and green innovation behaviors of undergraduate students.

### 3.7 Emotional intelligence and creative motivation

High emotional intelligence enhances the ability to leverage positive emotions for idea generation and thought exploration, sustaining internal motivation (Parke et al., 2015; Hahn et al., 2011). Intrinsic motivation, driven by the pleasure of an activity and feelings of competence and self-realization (Miller, 1988), is further promoted by heightened emotional intelligence. Individuals with high emotional intelligence demonstrate better control over emotional responses, impacting external motivation positively (Chang et al., 2015). In campus settings, studies explore the link between emotional intelligence and academic motivation (Usan Supervia and Salavera Bordas, 2018). While the internal motivation–emotional intelligence relationship is robust, external motivation is also pivotal. Undergraduate students may undergo identity adjustments influenced by external motivational factors, enhancing their external motivation. This study hypothesizes as follows:

**H7.** Creative motivation mediates the relation between emotional intelligence and green innovation behaviors of undergraduate students.
4. Research methodology and data collection

4.1 Sample and procedures

The participants in this study were chosen from undergraduate students who engaged in tutorial programs or competitions in Chinese universities. This selection was based on two key factors. First, the Chinese Government and global universities have endorsed the strategic goal of green transformation, creating a robust green innovation atmosphere on campuses. This facilitated drawing significant conclusions by focusing on Chinese undergraduate students. Second, those participating in tutorial programs were closely connected with their tutors, making it easier to assess the tutors’ impact on the green field. Notably, the sample excluded students and tutors in environmental protection majors to investigate the general innovative green behavior of undergraduate students.

The authors conducted a presurvey involving 94 undergraduate students from 16 groups, with 74 valid questionnaires from 12 groups. The questionnaire exhibited high internal consistency (Cronbach’s alpha = 0.912), ensuring reliability. Feedback from the presurvey prompted revisions for readability and comprehension.

Live data were collected between October 8 and December 10, 2022, using improved questionnaires. The target group included participants in tutorial-based competitions or projects, such as innovation and entrepreneurship training programs and the challenge cup. Purposeful sampling was employed, involving 346 tutors who forwarded the questionnaire link to undergraduate students. Strict instructions ensured that tutors did not interfere, preserving the objectivity of students’ responses. With the help of tutors, the authors set up the online questionnaire platform to collect 286 questionnaires from 56 groups. After eliminating invalid responses, 261 valid paired questionnaires were obtained from 51 groups, meeting the data requirements for the cross-level model (Scherbaum and Ferreter, 2009). Of the 261 undergraduate students, 62.2% were female, and the majority were from management majors (57.8%). Table 1 presents the respondent profile using frequencies and percentages.

4.2 Measures

The questionnaire measured five key constructs: proenvironmental and responsible mentors, green intellectual capital, emotional intelligence, creativity motivation and green innovation behavior of undergraduate students. They were all measured on a seven-point Likert-type scale ranging from 1 (strongly agree) to 7 (strongly disagree).

4.2.1 Proenvironmental and responsible mentors. The authors measured proenvironmental and responsible mentors using six items developed by Wang et al. (2019). Undergraduate

<table>
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<tr>
<th>Variables</th>
<th>Sample characteristics</th>
<th>%</th>
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<tbody>
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<td></td>
<td>Medical science</td>
<td>3.9</td>
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Table 1. Sample information Source: Authors’ own creation
students were asked to rate their mentors' behavior. Proenvironmental and responsible mentors were assessed at the teacher level. To aggregate proenvironmental and responsible mentors at the individual level to the group level, the authors assessed $R_{wg}$. Results revealed that the mean score of $R_{wg}$ was 0.903, which supported aggregation.

4.2. 2 Green intellectual capital. Using a modified scale used by many scholars (Roos and Roos, 1997; Chen, 2008; Chang and Chen, 2012), the authors assessed green intellectual capital using a 15-item scale, including human capital and structure capital.

4.2. 3 Emotional intelligence. The authors evaluated emotional intelligence using a six-item scale based on the study by Law et al. (2004) and included four dimensions: self-emotional evaluation, emotional evaluation of others, emotional control, and emotional use.

4.2. 4 Creative motivation. Undergraduate students' creative motivation was rated by themselves using a 22-item scale developed by Amabile et al. (1994), encompassing internal and external motivation dimensions. A null model was developed to predict creative motivation and the results showed that the ICC (1) representing reliability of score within group and ICC (2) representing reliability of mean group score had values of 0.283 and 0.668 respectively. While ICC (2) fell short of the recommended index of 0.70, aggregation was suggested given sufficient between-group variances (Chen and Bliese, 2002).

4.2. 5 Green innovation behavior of undergraduate students. The green innovation behavior of undergraduate students was also rated by themselves using a five-item scale based on the scale developed by Scott and Bruce (1994). The authors conceptualized this behavior and ran a null model, finding that the ICC (1) value was 0.31, supporting multilevel analyses. The ICC (2) value of 0.70 indicated satisfactory conditions for multilevel analyses. Thus, the results supported the use of HLM in the study.

4.2. 6 Control variables. Building on previous research on employees' green behavior (Alt and Spitzeck, 2016), this study controlled for undergraduate gender, major, and group size.

5. Analysis and results

5.1 Confirmatory factor analyses

The authors computed the average variance extracted (AVE) and composite reliability (CR) to assess the convergent validity of these variables. Table 2 indicates that these constructs' AVE and CR values were above 0.50 and 0.80, respectively, demonstrating acceptable convergent validity of this study's key variables as in the study by Fornell and Larcker (1981).

5.2 Hypothesis testing

Considering that the sample contains relationships between groups, this study performed HLM to test the hypothetical model. The means, standard deviation, and correlations among study and control variables are all presented in Table 3. All data analyses were performed by using SPSS Statistics 26 and HLM 6.08 Trial.

First, a null model of creative motivation and undergraduate students' green innovation behavior (Model 1, Model 5) was constructed. Second, the authors took creative motivation (Model 1–Model 4) and undergraduate green innovation behavior (Model 5–Model 12) as dependent variables, respectively, and gradually added independent variables, such as intellectual capital (Model 2, Model 7), emotional intelligence (Model 3, Model 8) and proenvironmental responsible mentorship (Model 4, Model 9). Finally, to demonstrate the mediating role of creative motivation, the authors gradually added it to the multilevel linear regression model (Model 10–Model 12). Given that the data distribution was quasinormally distributed, the fixed effects estimates with robust standard errors from the HLM 6.08 report were adopted.
<table>
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<td>CM22</td>
<td>0.600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Measurement validity assessment  
Source: Authors’ own creation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (Individual): N = 261</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Gender</td>
<td>0.6130</td>
<td>0.4879</td>
<td>0</td>
<td>0.052</td>
<td>-0.248***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Major</td>
<td>2.9157</td>
<td>2.6543</td>
<td>-0.036</td>
<td>-0.266***</td>
<td>0.558***</td>
<td>-0.254***</td>
<td>0.782***</td>
</tr>
<tr>
<td>3. Green intellectual capital</td>
<td>2.1155</td>
<td>0.9206</td>
<td>-0.084</td>
<td>-0.266***</td>
<td>0.558***</td>
<td>-0.254***</td>
<td>0.782***</td>
</tr>
<tr>
<td>4. Emotional intelligence</td>
<td>2.1099</td>
<td>0.8612</td>
<td>-0.094</td>
<td>-0.266***</td>
<td>0.558***</td>
<td>-0.254***</td>
<td>0.782***</td>
</tr>
<tr>
<td>5. Creative motivation</td>
<td>2.4285</td>
<td>0.9543</td>
<td>-0.001</td>
<td>-0.254***</td>
<td>0.782***</td>
<td>0.594***</td>
<td>-0.183**</td>
</tr>
<tr>
<td>6. Green innovation behavior of undergraduates</td>
<td>2.5188</td>
<td>1.2426</td>
<td>-0.030</td>
<td>-0.254***</td>
<td>0.782***</td>
<td>0.594***</td>
<td>0.530***</td>
</tr>
<tr>
<td>Level 2 (group): n = 51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Group size</td>
<td>5.1176</td>
<td>0.5156</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proenvironmental and responsible mentors</td>
<td>2.1945</td>
<td>0.9017</td>
<td>-0.189</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Results of descriptive statistics  
Notes: ***p < 0.001; **p < 0.01  
Source: Authors’ own creation
H1 suggests that proenvironmental and responsible mentors would promote the green innovation behavior of undergraduate students. Results are shown in Table 4. Proenvironmental and responsible teachers were positively related to the green innovation behavior of undergraduate students (Model 9, $\gamma = 0.7846, p < 0.001$). Thus, $H1$ was supported.

$H2$ proposes that green intellectual capital would promote the green innovation behavior of undergraduate students. The results in Table 4 illustrate that the effect of green intellectual capital in predicting green innovation behavior of undergraduate students was positive (Model 7, $\gamma = 1.0711, p < 0.001$). Therefore, $H2$ was supported.

$H3$ proposes that emotional intelligence would promote the green innovation behavior in undergraduate students. Results (see Table 4) presented a positive effect of emotional intelligence on the green innovation behavior of undergraduate students. (Model 8, $\gamma = 0.6749, p < 0.001$). Hence, $H3$ was supported.

$H4$ proposes a correlation between creative motivation and the green behavior of undergraduate students. Table 4 revealed a positive influence of creative motivation on the green innovation behavior of undergraduate students (Model 6, $\gamma = 1.0245, p < 0.001$), supporting $H4$.

$H5$ posits that the connection between proenvironmental and responsible mentors and undergraduate students’ green innovation behavior is mediated by creative motivation. In alignment, $H1$ proposes that proenvironmental mentors foster green innovation behavior, whereas $H4$ reveals a positive influence of creative motivation on this behavior. Adding creative motivation weakened the impact of proenvironmental mentors on green innovation behavior (Model 12, $\gamma = 0.2691, p < 0.001$). Using causal step approach, $H5$ is supported.

$H6$ suggests that creative motivation mediates the relationship between green intellectual capital and undergraduate students’ green innovation behavior. Path analysis confirms the significance of creative motivation in predicting green innovation behavior (Model 6, $\gamma = 1.0245, p < 0.001$). Green intellectual capital positively influences creative motivation (Model 2, $\gamma = 0.8070, p < 0.001$), supporting $H6$.

$H7$ states that creative motivation mediates the relationship between emotional intelligence and green innovation behavior. Emotional intelligence positively predicts creative motivation (Model 3, $\gamma = 0.5928, p < 0.001$). After adding creative motivation, emotional intelligence maintains a significant relation with green innovation behavior (Model 11, $\gamma = 0.9769, p < 0.01$), indicating complete mediation. $H7$ is thus supported.

6. Discussion

6.1 Discussion of results

This study aligns with SDG 4 by addressing the need to equip learners with knowledge and skills for sustainable development. Fostering sustainable knowledge, particularly through undergraduate students’ green innovation behavior, contributes to environmental protection and promotes attitudes conducive to sustainability. The study indirectly supports resource utilization, aids in reducing urban carbon emissions and drives innovation in green products, allowing students to design environmentally friendly products.

Proenvironmental and responsible mentors in campus settings were found to positively influence the green innovation behavior of undergraduate students, echoing findings in enterprise settings. The closer relationship between tutors and students compared to leaders and employees enhances the impact of proenvironmental attitudes on students’ green innovation.

To foster green innovation behavior, the paper suggests enhancing undergraduate students’ green intellectual capital and emotional intelligence. Previous researches support the positive impact of green intellectual capital on innovation achievements and performance
Outcome variables | Creative motivation | Green innovation behavior of undergraduates
--- | --- | ---
Independent variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 | Model 11 | Model 12
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Level 1 (Individual): \(N = 261\)
Gender | -0.0204 | 0.0687 | 0.0819 | -0.0554 | -0.1121 | -0.0876 | 0.0016 | 0.0079 | -0.1517 | -0.0330 | -0.0703 | -0.0880 | 0.0554
Major | -0.0477 | -0.0121 | -0.0210 | -0.0378 | -0.0208 | 0.0181 | 0.0119 | 0.0035 | -0.0136 | 0.0242 | 0.0220 | 0.0283 | 0.1121
Green intellectual capital | 0.8070*** | 1.0711*** | 0.5816*** | 0.1008
Emotional intelligence | 0.5928*** | 1.0245*** | 0.6749*** | 0.0016 | 0.0079 | -0.1517 | -0.0330 | -0.0703 | -0.0880 | 0.0554
Creative motivation | 0.0876 | 0.0016 | 0.0079 | -0.1517 | -0.0330 | -0.0703 | -0.0880 | 0.0554
Level 2 (Group): \(N = 51\)
Group size | -0.2603 | -0.1089* | -0.2279 | -0.1135* | -0.3045 | -0.0297 | -0.0919 | -0.2633 | -0.0935 | -0.0276 | -0.0379 | 0.0142
Proenvironmental and responsible mentors | 0.5528*** | 0.0919 | 0.0379 | 0.0505
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
\(R^2\) | 0.0241 | 0.5290 | 0.2059 | 0.0656 | 0.0011 | 0.5536 | 0.4925 | 0.1211 | 0.0167 | 0.2284 | 0.4900 | 0.5472
\(\delta^2\) | 0.0549 | 0.5916 | 0.3316 | 0.7564 | 0.0143 | 0.6276 | 0.6224 | 0.2674 | 0.8187 | 0.2177 | 0.4970 | 0.0523
\(T_{00}\) | 0.6291 | 0.2963 | 0.4996 | 0.6238 | 1.0623 | 0.4831 | 0.5493 | 0.9512 | 1.0642 | 0.4238 | 0.4852 | 0.4819
\(T_{10}\) | 0.2407 | 0.0589 | 0.0818 | 0.0147 | 0.4545 | 0.0892 | 0.0311 | 0.1747 | 0.0014 | 0.0302 | 0.0812 | 0.0505

Notes: ***\(p < 0.001; **p < 0.01; *p < 0.05\)
Source: Authors’ own creation
(Delgado-Verde et al., 2014; Chang and Chen, 2012), as corroborated by the current study. Additionally, students with high emotional intelligence are found to be more likely to implement innovative green behaviors, aligning with findings from prior studies highlighting the connection between emotional intelligence, personal flexibility and creativity (Isgett and Fredrickson, 2004; Isen et al., 1992).

Encouraging creative motivation emerges as a key factor in promoting undergraduate students’ green innovation behavior. While past research has often emphasized internal motivation, this study supports the role of external motivation, in line with findings by Wallace et al. (2016). The study concludes this sub-section by addressing RQ1 and discussing each influencing factor (RQ2), comparing them with previous research and highlighting both similarities and differences.

6.2 Implications for practice
The study findings underscore the importance of incorporating tutorial systems into green innovation management, advocating for systematic responsibility and green training for college mentors, who play a pivotal role in conveying professional standards and ethical values to trainees. The low scores regarding mentor encouragement for bold exploration and innovation highlight the need for colleges and universities to enhance mentor support for undergraduate students’ innovative behavior. Financial backing for mentors involved in environmental projects and training programs on socially responsible and green innovation behaviors could be implemented to address this issue and foster proenvironmentally responsible mentors.

Furthermore, the study emphasizes the role of green intellectual capital and emotional intelligence in driving the implementation of undergraduate students’ green innovation behavior. Colleges and mentors should organize activities to facilitate knowledge exchange, improve green intellectual capital and address concerns about the inclusivity of organizational recognition for students’ innovative behaviors. Providing active encouragement, both spiritually and financially, is crucial to boosting undergraduate students’ motivation for green innovative behaviors. Emphasizing emotional intelligence, the study recommends mindfulness courses and education to help undergraduate students manage emotions in their daily studies and lives, fostering positive emotions that encourage exploration and the assimilation of new information.

Finally, the study aligns with SDG 4, emphasizing the role of higher education institutions in guiding university environmental policy. Universities are urged to lead in sustainable development by updating curriculum development with contemporary sustainable courses. Promotion mechanisms for mentors with environmental awareness, cultivation of a green campus culture, funding for college students’ green innovation, collaboration with environmentally friendly companies and the promotion of commercialization of green innovation outcomes are suggested to advance sustainable practices.

7. Conclusion
This paper, drawing on AMO theories, constructs a conceptual model to elucidate the cross-level influence mechanism of undergraduate students’ green innovation behavior, answering RQ3. The authors successfully developed a cross-level model on both teacher and student sides, adapting to the campus environment. Proenvironment and responsible mentors were found to facilitate green innovation behavior, with creative motivation mediating between teacher-student variables and students’ green innovation behavior. The study supports all direct and indirect hypotheses, offering theoretical and practical significance.
However, certain limitations exist. First, the short duration of the questionnaire might not capture the evolving nature of undergraduate students’ green innovation behavior throughout their college careers. Future research could extend the study time and incorporate dynamic monitoring to revisit the mechanism of action. Additionally, exploring mentors’ participation is a potential research direction. Second, the lack of overseas data limits the study’s global perspective. Future research should gather data from various nations to comprehensively understand the global mechanism of action in fostering green innovation. Thirdly, the focus on individual behavior overlooks team-level factors in innovative practices led by mentors. Future research should explore team-level mediating factors like horizontal member exchange, team climate and task conflict. Finally, this study addresses only a fraction of the factors influencing undergraduate students’ green innovation behavior. Job insecurity and information sharing are among the potential factors warranting exploration in future research to uncover more impact mechanisms on undergraduate innovation behavior.

References


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