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CASE STUDY

# Green transformational and transactional leadership in fostering green creativity among university students

**N. Saif[1], G.G.G. Goh[2,*], J.W. Ong[3], I.U. Khan[4]**

[1] *Department of Management Sciences, University of Science and Technology Bannu, Pakistan*

[2] *Knowledge Management, Economics and Quantitative Analysis Department, Faculty of Business, Multimedia University, Melaka, Malaysia*

[3] *Management Department, Faculty of Management, Multimedia University, Cyberjaya, Malaysia*

[4] *Department of Public Administration, Gomal University, Dera Ismail Khan, Pakistan*

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**ABSTRACT**

**BACKGROUND AND OBJECTIVES:** The current study investigates green transactional leadership for the first time in order to understand leader-follower relations in studying green behavior in higher education institutions. The aim of this study is to investigate the dynamic relationship between green transformational leadership, green transactional leadership and green creativity that are mediated by green intrinsic motivation.

**METHODS:** This study used adapted constructs from previous environmental research as well as a newly-developed green transactional leadership construct. Responses were obtained from university students working on their final-year projects. In order to evaluate the model, partial least squares structural equation modeling using Measurement model assessment was used to validate the structural and measurement model.

**FINDINGS:** Findings indicate that green intrinsic motivation significantly influences the relationship between green transformational leadership and green creativity (Beta=0.321; t=3.129), as well as green transactional leadership and green creativity (Beta=0.114; t=2.322). However, green transformational leadership is a stronger predictor in comparison to green transactional leadership in nurturing green creativity among students to provide viable solutions to existing products/processes. The R2 or contribution given by green transformational leadership and green transactional leadership on green creativity was 45.7 percent while the contribution of green transformational leadership, green transactional leadership and green creativity on green intrinsic motivation was 57.7 percent.

**CONCLUSION:** Policy makers must focus their attention on promoting green transactional and transformational leadership that will directly enhance students' motivation to promote the green creativity through innovative product/service model innovation.



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*Corresponding Author:
Email: *gggoh@mmu.edu.my*
Phone: 0124 303 307
ORCID: 0000-0001-7718-4686

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## INTRODUCTION

With the rapid growth, industrialization and economic development across the globe, the increase in environmental pollution has resulted in the need to utilize natural resources more efficiently by promoting sustainable development (Al-Dailami *et al.*, 2022). For this purpose, the community and companies need to unite to reduce the negative impact of industrial development through innovative, green and eco-friendly (Kamyaba *et al.*, 2019) processes e.g., microalgal biotechnology, toward sustainable development (Kamyaba et al., 2019). Many research studies focused on sustainable environmental objectives that can be achieved by promoting green creativity (GCT) approaches in production (Zameer *et al.,* 2020). GCT is the concept depicted in product/service characteristics through embedding and incorporating eco-friendly and resource-efficient attributes and/or processes. GCT can be evident as a catalyst in attaining competitive advantage through solving global ecological, contamination and other environmental issues. It is a common practice among business circles that sustainable development can be promoted by aligning human development with environmental concerns (Arslan *et al.,* 2022). Promoting GCT among all employees is the prime and utmost responsibility of the top management (Arici and Uysal, 2022). If organizational leaders possess the attitude for promoting environmental sustainability through thier enlightened vision. As a result, the outcome will be nurturing a workforce imbued with environmentally-friendly perspectives and approaches . Leadership therefore is the key approach in promoting creativity among followers. To this end, transformational leadership involves supervision that promotes creativity among workers through a stimulating and group goal behavior. Green transformational leadership (GTRF) stimulates employees to achieve organizational goals through the innovative approach of solving environmental issues and fostering a challenging culture to express their highest level of creativity (Li *et al.,* 2020). The previous literature mainly focused on studying GCT at the organizational level (Jia *et al*., 2018; Riva *et al.,* 2021), however in order to understand the concept of GCT, it is exigent to investigate it from an individual perspective, because organizational green creativity can be better understood from the point of view of individuals *vis-a-vis* leaders and employees (Riva *et al.,* 2021). The existing literature indicates the need to foster internal mechanisms to promote GCT because of the external pressure exerted by various stakeholders (Zhang *et al.,* 2020). In order to promote the green agenda in organisations, employees' intrinsic motivation is the most important aspect for sustainable development (Faraz *et al*., 2021; Shafi *et al.,* 2020). Employees' green intrinsic motivation (GIM) is the approach in which employees are motivated to apply the latest tools/ techniques to provide safeguards to nature without any financial benefits. GIM is the operative attitude related to one's internal locus of control and caring behavior for the natural environment due to the employee's actions associated with the production processes (Li *et al.,* 2020). Employees' internal feelings of satisfaction with safeguarding nature and promoting green products to conserve and protect the environment from damages caused by individuals or organizational actions (Joshi and Dhar, 2020). Employees' GIM is the driving force to regulate the behavior of employees while performing their jobs in the organization and working on innovative solutions for their existing product design that will minimise its impact on the natural environment (Ali *et al.,* 2020). Infusing the feeling of motivation and fostering a culture of innovation and creativity mainly depends on the active leadership role in the organization. In this regard, a number of research studies (Du and Yan, 2022; Zhang *et al.,* 2020; Farrukh *et al.,* 2022) investigated the significant contribution of GTRF in promoting eco-friendly and sustainability approaches among the employees. While the GTRF has seen significant interest in the environmental sustainability literature, green transactional leadership (GTRS) which emphasises the attainment of results, conformity to structures within the organisation and performance measurement to a set of established metrics has not been studied in depth (Bass and Avolio, 1993). GTRS involves leaders possessing formal authority and responsibility for maintaining routing and performance by using rewards and punishments among the employees in the organisation (Bass and Avolio, 1993). GIM is cultivated through the formation of a shared vision and the development of a professional attitude by the top management (Rizvi and Garg, 2020). In this regard, this unique management style is considered as the most appropriate style that develops the motivation of employees to promote creativity for a sustainable environment (Li *et al.,* 2020). In behavioral research, GTRF is considered as a vital force in relation to employees commitment, satisfaction and motivation

(Çop *et al.,* 2021). Results from previous studies (Li *et al.,* 2020) indicate that GTRF plays an important role in shaping employees' creativity, which is ultimately enhanced by the intrinsic-extrinsic motivation mechanism. A study by Li *et al.* (2020) found that employees' GIM is significantly associated with GTRF and employees green creativity among the Chinese manufacturing sector. Similar results are also quoted by (Faraz *et al.,* 2021) from Pakistan's energy sector. It was deduced that employees' GIM will enhance their self-efficacy to promote an eco-friendly environment. Similarly, the result from the study of Arici and Uysal, (2022) using a meta-analysis depict that most of the previous research studies investigated green transformational leadership with a focus on employees' GCT in various manufacturing environments. According to Rehman and Yaqub, (2021), GTFL is a significant contributor towards environmental concerns while focusing on the greening aspect of the hospitality sector's operations during the COVID-19 pandemic. Most of the studies (Zhang *et al.,* 2020; Farrukh *et al.,* 2022; Masum and Pal., 2020; Abu-Qdais *et al.,* 2020) investigated the GIM of employees through the lens of transformational leadership and the concept of transactional leadership is somewhat absent in organizational behavior and environmental research. It is worth mentioning that GTRF was measured using a six-item scale developed by Chen and Chang, (2013), while the Bass Model of Leadership assessed the concept of transformational leadership with 26 items. Similarly, a large number of research studies compared the Bass Model of Leadership approach from the lense of transformational and transactional leadership. Vargas-Hernandez, (2022) opined that GTRF is a major factor in the attainment of sustainable development goal in organisations and therefore requires adequate attention. However, the concept of GTRF has not been investigated to date. Hence, the major aim of the study is to investigate the concept of green transactional leadership for the first time in behavioral and environmental management domain among university students who are working on their final year project. The current study tries to investigate the impact of teaching facultys' green transformational and transactional approaches to enhance student's green creativity while working on their final year project. However, students' GIM is used as a possible mediator in the leader-member relationship. This study builds on the leader approach to enhance creativity of student through the inculcation of motivation among students to contribute towards a clean and green environment. It is also the objective of the study to investigate the mediating role of students' GIM on GTRS and GTRF in the Pakistan higher education sector to promote the green product development concept through students' GCT. The green product development concept is based on developing a new prototype, that students try to develop during the final year project which involves efficient use of natural resources and reducing the harmful effect of rapid industrialization. Across the globe, students from various specializations work on specific issues and then present viable solutions to the problem through prototype design for new product design or process reengineering. This study was conducted in Pakistan during 2021 and 2022.

## MATERIALS AND METHODS

The current study population consists of university students working on their final year project from various public and private sector universities in the Khyber Pakhtoonkhwa region of Pakistan. This study received ethical approval clearance (Reference no: EA3282021) from Multimedia University to commence data collection from the respondents. The sample consisted of 109 students from the University of Science and Technology Bannu, Gomal University, Karak University, CECOS University, Peshawar University and the University of Engineering and Technology. The selection of the students were based on a purposive sampling procedure with only students that are working on environmentally-friendly solutions through modification/redesign and innovative solutions to existing product/process design were selected for this study. Written informed consent was obtained from the respondents before they proceeded to complete the survey in which its participation was voluntary. This study applied the structural equation modeling technique using the Smart PLS software because the model consists of a mediating variable and a newly developed construct for GTRS. Smart PLS has been highly recommended in the case of small samples as in the current study simple size is also small. With its robust nature and predictive power for instrument reliability and validity (Hair *et al.,* 2017) Smart PLS is the choice of researchers.

### *Measurement*

GIM was measured using a 6-item scale by adapting the construct of Li *et al.,* (2020). On the other hand,

GCT was measured with a 6-item scale adopted from Chen and Chang, (2013). As the previous construct of GTRS consisted of only 6 items (Chen and Chang, 2013), while the concept of GTRF composed of 5 attributes which are namely articulating vision, intelectual stimulation, individualized consideration, group goal and inspirational motivation (Bass and Avolio, 1993) while Podsakoff *et al.* (1990) promulgated the attribute of leadership that is composed of articulating a vision, providing an appropriate model, fostering the acceptance of group goals, high performance expectations, individualized support, and intellectual stimulation. Hence, the newly-developed ítems for GTRF which are GTRF 7-9 are developed based on the work of Bass and Avolio, (1993). On the other hand, the GTRS construct was newly developed for this study in light of the recommendations of previous researchers such as Bass and Avolio, (1993) to incorporate elements of rewards and punishment. The details of the indicators/ ítems used for all the variables are presented in Table 2 for reference. The questionnaire consists of various adapted versions of constructs adopted from previous research and newly-developed items for GTRS and GTRF as discussed in detail (Table 1). GTRF is a 9-item construct that was adopted from Chen and Chang, (2013) with 3 new items added from the theoretical discussion by Bass and Avolio, (1993) to provide better clarity to the GTRF concept.

## RESULTS AND DISCUSSION

*Characteristics of the respondents*

The findings indicate that most of the respondents belong to University of Science and Technology Bannu. Most of the students belong to the 21 years and above age group and are studying for their 16 year Bachelor's degree. Results about specialization of studies indicate that the highest percentage of students belongs to management sciences followed by enginering. The respondents indicated that 39 percent (%) are engaged in final prototype development while 27% are in the conceptual development stage.

*Measurement model assessment (Smart PLS)*

SmartPLS 4 was used to measure the model assessment that consists of composite reliability (CR) which measures the internal consistency, factor loading for each item of the construct, distinctive reliability for each indicator and average extracted variance (AVE) to measure convergent validity and discriminant validity (Hair *et al.,* 2017). In the current study, each construct is reflective in nature; hence partial least square structural equation modeling technique is the appropriate procedure to understand the nature of various adopted constructs (Hair *et al.,* 2017). In this regard, factor loadings for all the items are higher than the threshold level of 0.60 as recommended by Legate *et al.,* (2021). The assessment results of the measurement model in Table 2 indicate the items measuring the variables together with the factor loadings and AVE obtained. As presented in Fig. 1, the highest factor loading in transformational leadership belongs to item GTF2, while green creativity's highest loading is for item GCT3, and the newly-developed green transactional leadership's highest loading belongs to item GTRS2. Although the factor loading of green intrinsic motivation items GIM1 (0.699) and GIM5 (0.681) are lower than 0.7, the overall model assessment based on AVE is good, therefore not creating any problem for further analysis. Hence, these two GIM ítems were retained. Item (question) loading on the relevant factors (construct) indicate the correlation between the ítems or questions and its relevant factors. Factor loading values for the items reported are within the range of -1 to 1. The results in Table 2 indicate that that the item loadings are higher than 0.6 and loaded well on their respective factors. The item loadings in Smart PLS are calculated based on algorithms during the measurement model assessment stage, hence if the values satisfy the assumptions as recommended by Hair *et al.,* (2017) and Legate *et al.,* (2021), the statistical model is therefore ready for further bootstrap analysis to determine the path relationships. Table 2 also indicate that the composite reliability (CR) values are higher than 0.60 and the AVE

Table 1: Measurement method (questionnaire and scaling)

| Variable | Indicators | Reference |
|---|---|---|
| Green Transformational Leadership (GTRF) | 1-6 | Chen and Chang, (2013) |
| | 7-9 | Newly developed based on Bass and Avolio, (1993) |
| Green Transactional Leadership (GTRS) | 1-4 | Newly developed based on Bass and Avolio, (1993) |
| Green Intrinsic Motivation (GIM) | 1-7 | Li *et al*., (2020) |
| Green Creativity (GCT) | 1-6 | Chen and Chang, (2013); Li *et al*., (2020) |

Table 2: Assessment result of measurement model

| Construct | | Indicator | Loading factor | Composite reliability | Cronbach alpha | AVE |
|---|---|---|---|---|---|---|
| GTRF | GTRF1 | The project leader inspires the team with his/her environmental plans for adding features related to new product/services development. | 0.804 | 0.891 | 0.914 | 0.592 |
| | GTRF2 | The project leader provides a clear environmental vision for adding features related to new product/services development. | 0.854 | | | |
| | GTRF3 | The project leader always guides the team to work together for the same environmental goals while developing new product/services. | 0.768 | | | |
| | GTRF4 | The project leader always encourages the team to achieve the environmental goals through adding features related to green product/services development. | 0.802 | | | |
| | GTRF5 | The project leader always acts with considering environmental beliefs for the development of any product/services prototypes. | 0.721 | | | |
| | GTRF6 | The project leader always encourages the team to add green ideas during product/services development. | 0.709 | | | |
| | GTRF7 | The project leader always inspires the team to apply latest technology with minimum hazard for environment. | 0.751 | | | |
| | GTRF8 | The project leader always envisions the team to think environmental issue before designing any product/service model. | 0.743 | | | |
| | GTRF9 | The project leader always focuses on group goal behavior for sustainable environment. | 0.756 | | | |
| GIM | GIM1 | Coming up with new green ideas for new product/services design is always enjoyable. | 0.699 | 0.944 | 0.929 | 0.709 |
| | GIM2 | Solving environmental issues through new product/services model is always enjoyable. | 0.899 | | | |
| | GIM3 | Tackling environmental tasks that can give innovation to new product/services model is always enjoyable. | 0.921 | | | |
| | GIM4 | Improving existing green ideas during the design phase of new product/services model is always enjoyable. | 0.870 | | | |
| | GIM5 | New green ideas to facilitate the community through new product/services model is exciting. | 0.681 | | | |
| | GIM6 | Becoming further engaged in the development of green ideas through product/services model is desirable. | 0.915 | | | |
| | GIM7 | Applying green ideas during the design phase of new product/services model is of personal interest. | 0.872 | | | |
| | GIM8 | Coming up with new green ideas for our new product/services design is always enjoyable. | 0.722 | | | |
| GTRS | GTRS1 | The project director/leader rewards the team with verbal appreciation for adding green environment features in the product/services model. | 0.748 | 0.891 | 0.836 | 0.673 |
| | GTRS2 | The project director/leader rewards the team by monetary appreciation for adding green environment features in the product/services model design. | 0.891 | | | |
| | GTRS3 | The team project director/leader punished the team by words of mouth for missing green environment features in the product/services model. | 0.863 | | | |
| | GTRS4 | The project director/leader punished the team through fine for missing green environment features in the product/services model. | 0.770 | | | |

Continued Table 2: Assessment result of measurement model

| Construct | | Indicator | Loading factor | Composite reliability | Cronbach alpha | AVE |
|---|---|---|---|---|---|---|
| GCT | GCR1 | The team always come up with new ways to achieve environmental goals through innovative product/services model. | 0.727 | 0.907 | 0.876 | 0.620 |
| | GCR2 | The team always propose new green ideas to improve environmental performance through innovative product/services model. | 0.761 | | | |
| | GCR3 | The team always promote and champion new green ideas to others through innovation in their product/services model. | 0.908 | | | |
| | GCR4 | The team always develop adequate plans for the implementation of new green ideas through innovative product/services model. | 0.843 | | | |
| | GCR5 | The team always rethink new green ideas through innovative product/services model | 0.708 | | | |
| | GCR6 | The team always try to find out creative solutions to environmental problems innovation in product/services model. | 0.761 | | | |

Table 3: Discriminant validity

| Variable | GCT | GIM | GTRF | GTRS |
|---|---|---|---|---|
| GCT | (0.788) | | | |
| GIM | 0.375 (0.401) | (0.842) | | |
| GTRF | 0.606 (0.661) | 0.498 (0.511) | (0.769) | |
| GTRS | 0.456 (0.521) | 0.519 (0.578) | 0.541 (0.597) | (0.820) |

values are higher than 0.50, indicating that the model is a good fit for further analysis (Hair *et al.,* 2017). In order to validate the discriminant validity between the latent variables, the Hetrotrait Monotrait (HTMT) correlation procedure and Fornell-Larcker results were presented with the square root of the AVE for each construct being higher than correlation between constructs. The findings presented in Table 3 shows that the square root of the AVE are higher than the correlation among the constructs. The Fornell-Larcker values are denoted in parentheses against each construct. On the other hand, the HTMT values are lower than 0.90 as recommended by Hair *et al.* (2021), indicating that measures are distinctive in nature.

*Structural model assessment*

In the second step, the internal model was analyzed through structural equation modeling to assess the relationship between exogenous and endogenous variables. In structural modeling, path coefficients are determined to validate the significance of relevancy of the structural model. The first step assessed collinearity through the variance inflation factor (VIF). In the current study, only one item which is GTRF10 which has a VIF value that is higher than 30 was subsequently removed, therefore ensuring that the basic assumption of the model is not violated. The direct relationships between variables are then investigated using the 500 bootstrap re-sampling procedure in SmartPLS. The empirical results detailed in Table 4 state that except for H2 (GTRS → GCT), all the hypotheses are supported as the bootstrap (t-values) are higher than (+/- 1.65). The highest significant relationship observed was for H5 (GTRF → GIM) ($f^2$=0.546) as well as H3 (GIM → GCT) creativity ($f^2$=0.128). Ghazali *et al.,* (2022) found that GTFL is a significant contributor in shaping employees' GCT in Pakistan's small and médium Enterprise sector. Similar results were corrobarated in earlier studies by Li *et al.,* (2020) for their study of electronic workers in China. Because the effect size ($f^2$) describes the value of change

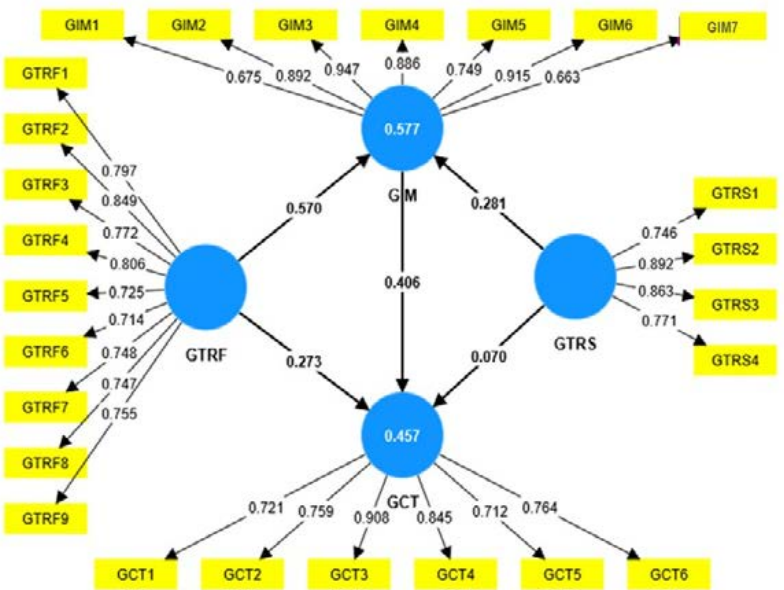


Fig. 1: Direct effect, structural model assessment and factor loading

Table 4: Structural model assessment (direct effect result and decision)

| Hypotheses | Relationship | Original sample mean (O) | Sample mean (M) | SD | T statistics (\|O/SD\|) | P-values | $f^2$ | CI [97.5%] | Decision |
|---|---|---|---|---|---|---|---|---|---|
| H1 | GTRF → GCT | 0.273 | 0.276 | 0.098 | 2.780 | 0.005 | 0.063 | (0.085 and 0.476) | Accepted |
| H2 | GTRS → GCT | 0.070 | 0.069 | 0.105 | 0.660 | 0.509 | 0.006 | (-0.132 and 0.289) | Rejected |
| H3 | GIM → GCT | 0.406 | 0.408 | 0.115 | 3.536 | 0.000 | 0.128 | (0.174 and 0.625) | Accepted |
| H4 | GTRS → GIM | 0.281 | 0.28 | 0.082 | 3.425 | 0.001 | 0.132 | (0.123 and 0.442) | Accepted |
| H5 | GTRF → GIM | 0.570 | 0.573 | 0.086 | 6.625 | 0.000 | 0.546 | (0.392 and 0.724) | Accepted |

in $R^2$ and from the findings it clearly explained that the $f^2$ value fulfills the assumption proposed by Cohen (1992). Contrary to our hypothesised relationship between green transactional leadership and green creativity, the results indicate an insignificant relationship. Table 5 shows the path coefficient relationship for the mediating variables and indirect effect. According to the findings, GIM mediates the relationship for both styles of leadership and students GCT, hence both H6 and H7 are accepted. Results from the study of Faraz *et al.,* (2021) confirm that GIM plays a contributory role in shaping pro-environmental behavior amongst employees. From the results obtained, the evidence suggests that a stronger impact can be observed for GTRF if compared to GTRS.

Table 6 presents the value of the $R^2$ to better understand how the independent variable is able to describe the dependent variable in the study. The contribution given by GTRF and GTRS on GCT was 45.7% while the contribution of GTRF, GTRS and GCT on GIM was 57.7%.

*Direct effect*

GTRF is the most important style of leadership practiced in higher education institutions to promote intrinsic motivation for clean and green environment

Table 5: Structural model assessment (indirect effect result and decision)

| Hypotheses | Relationship | Original sample mean (O) | Sample mean (M) | STDEV | T statistics (\|O/SD\|) | P-values | CI [97.5%] | Decision |
|---|---|---|---|---|---|---|---|---|
| H6 | GTRF → GIM → GCT | 0.231 | 0.233 | 0.074 | 3.129 | 0.002 | (0.095 and 0.383) | Accepted |
| H7 | GTRS → GIM → GCT | 0.114 | 0.115 | 0.049 | 2.322 | 0.020 | (0.034 and 0.226) | Accepted |

Table 6: R-square ($R^2$)

| Construct | R-square | Adjusted R-square |
|---|---|---|
| GCT | 0.457 | 0.439 |
| GIM | 0.577 | 0.566 |

among students who are working on their final year projects. The current study's findings align with previous studies conducted in different organizational settings (Li *et al.,* 2020). Students' perception and interest to protect the nature from pollution and health hazard issues through their innovative product and process modeling is a sign of maturity and their serious concern to safeguard the environment. Transformational leadership is that kind of leadership approch which infuses motivation among followers to think deeply for a viable solution to problems. Hence, in academia it is actually the perception and motivation of supervisors to promote clean and green environmental agenda through teaching practices and innovative models to their students. In case faculty members (irrespective of their specialty) have the vision of promoting a sustainable environment, then they can motivate and engage their students for better planning to safeguard nature from future hazards. The results presented in Table 4 also depict that GTFL promotes a culture of innovation that results in the green creativity approach which provides solutions to the existing industrial development models. Previous studies also found similar results for their study conducted in the industrial sector in China. GCT is the approach to solving problems arising from water, plastic, visual pollution, soil radioactive contamination, and thermal pollution. Across the world, higher education institutions are supported through research grants for solutions to issues affecting the natural environment. Large manufacturing firms also focuses on reducing their impact in polluting the environment through investment in green research and development. Because of these efforts, sustainable production techniques are now being introduced in various spheres of life. As it is the common theme that today's students became future leaders, hence nurturing students with the caring intention for a sustainable future will play a pivotal role in promoting the cause for a greener environment for future generations. Hence, the university faculty members can mould and transform the students' intention through group goal behaviors to introduce new practices via product development and process reengineering for active participation in safeguarding the environment. The current study introduces GTRS behavior to understand the dynamic relationship between students' GIM and their creativity. In this regard, the results indicate that up to a certain extent, green intrinsic motivation is related to GTRS, however green creativity does not have any kind of relationship with GTRS. Results from previous studies (Mittal and Dhar, 2016) state that intrinsic motivation is one's feeling associated with inner satisfaction through belief, perception and recognition. Based on the findings from Faraz *et al*., (2021), transactional leadership boosts one's intrinsic motivation through reward and punishment to perform better and practice innovative behaviors at the workplace. Hence, it can be observed from the results of the current study that reward and punishment concept (by faculty members) in the form of marks allocation on completion of final year project enhances students' GIM to work on sustainable environmental approaches. In contrast, GTRS did not indicate any kind of relationship with students' GCT. The results are in contrast to the findings of Ma and Jiang, (2018) which

posit that transactional leadership promotes creativity in comparison to transformational leadership. Results from our study depict that GIM enhances the GCT level of students. Based on the theoretical underpinning of the self-determination approach (Deci and Ryan, 2012; Ryan and Deci, 2017) and the results of Kanat-Maymon *et al.,* (2020), it is evident that individuals design policies (intrinsic motivation) for their selves based on the perception of the outcomes and then act accordingly. The current study interestingly highlighted that GTRS acts as a catalyst in moulding the GIM of students to focus on green and eco-friendly solutions for their final year project problems.

*Indirect effect (Mediating effect)*

The current study also validates the mediating role of students GIM between the supervisors' (faculty members) GTRF and GCT in H6. The findings indicate that the supervisors' knowledge towards green and eco-friendly environment and their interest in promoting a culture of sustainability motivates students to work towards developing environmentally-safe solutions to the existing problem, which ultimately boosts their creativity through green product and process redesign approach of the students. Similar findings were observed in the study of Li *et al.,* (2020) in China. Their results focussed on designing a strategy by green transformational leaders at the organizational level that promotes employees green intrinsic motivation and the culture of innovation and creativity in the manufacturing sector. Furthermore, the current study moves one step forward and investigates the mediating role of GTRS between students' GIM and their creativity for green product/process development. The results indicate that the students' green product/process motivation partially mediates the relationship between GTRS and GCT level. These findings are informative in nature as GTRS is investigated for the first time from the context of environmental and green behavioral research. Until the emergence of the GTRF concept by Chen and Chang, (2013), no study had investigated the role of GTRS to understand the nature of different styles of leadership as proposed by Bass and Avolio, (1993). In short, GTRF is mostly investigated in the manufacturing sector, SMEs and hospitality industry by different researchers and the evidence from academia had not received the adequate attention that it deserves (Cao and Chen, 2019; Gonzalez *et al.,* 2022; Fawehinmi *et al.,* 2020; Fernando *et al*., 2020). Hence, the current study opens new vistas of opportunity for researchers to investigate GTRF of supervisors/faculty members as well as students' GIM for green product development in greater depth. In the future, these university students can perform their duty in various organizational setups and promote the culture of green and eco-friendly approaches to achieve sustainable development goals.

## CONCLUSION

In higher education institutions, faculty members' awareness about hazards to the natural environment must be shared with students, preparing them for future challenges and inculcating their active role for green products and process creativity. The findings indicate that GTRF has significant contribution in shaping students' GCT through GIM, which is a novel finding of this study that sheds light on the importance of the teaching faculty members' role as a catalyst in promoting green behaviors among students during their studies. In this regard, the personality of faculty members and their role of leadership while supervising students in projects play a crucial role in developing and motivating students for eco-friendly solutions to existing product/services through green creativity approach. Based on the findings of the current study that GTRF plays an important role in shaping students' GIM and GCT, it is recommended that future researchers examine this relationship at different institutional setups i.e. schools, colleges and public and private universities, which will inevitably enrich the corpus of knowledge on green approaches for students. Recent studies have indicated various managerial implications for stakeholders related to higher education authorities, behavioral scientists and environmental researchers. First of all, higher education commissions/departments should encourage students to work on green product development and process design through their educational activities. It is mandatory to foster the culture of green leadership in higher education institutions through training and development programs. The Pakistan Higher Education Commission should conduct trainings on green product development and process innovation by leading trainers at the regional and provincial levels. These experienced trainers may initiate these green concepts to nurture and grow green leadership and GCT amongst faculty and students. Students' creativity for green product can be increased through joint work of academia and industrial hubs. In this regard, groups of students under the supervision of faculty members (that has serious mindfulness attitude for sustainability of environment)

must work for industrial setup and in case of providing solutions, the team may be rewarded in the form of patent registration with specific proportion of equity for that group. Once such an environment is nurtured, students' intrinsic motivation for eco-friendly production will be increased, therefore fostering a culture of new eco-friendly startups and creating green entrepreneurship that may ready to play their role in achieving sustainable development goals. It would be possible to promote the culture of GTRF and GTRS in higher education through governmental policy and initiatives. The current research has several limitations, so suggestions for future researchers are put forth. The current study is focused on selected universities in the Khyber Paktoonkhwa region of Pakistan, hence its results cannot be generalized to other regions and locations. Future researchers may investigate the current model in their own higher education setup and then compare the results with the current study. Secondly, the current study investigates only GIM as a possible mediator, however future researchers may validate the model by comparing the meditational part of both intrinsic and extrinsic motivation to understand students' intentions better while working towards GCT. Thirdly, future studies may also investigate the moderating role of green mindfulness, students' demographic attributes and their efficacy beliefs in HEIs to understand the dynamic relationship between leaders and followers in promoting green and eco-friendly environment for future generations.

## AUTHOR CONTRIBUTIONS

N. Saif conducted the conception and design, acquisition, analysis and interpretation of data, drafting and critical revision of the manuscript and statistical analysis. G.G.G. Goh conducted the conception and design, drafting and critical revision of the manuscript, support and supervision of the study. J.W. Ong conducted the drafting and critical revision of the manuscript, support and supervision of the study. I.U. Khan performed the analysis and interpretation of data and statistical analysis

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## CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

## OPEN ACCESS



## PUBLISHER'S NOTE



## ABBREVIATIONS

| | |
|---|---|
| *%* | Percent |
| *AVE* | Average variance extracted |
| *CI* | Confidence interval |
| *CR* | Composite reliability |
| *et al.* | Et alia |
| *f2* | Effect size |
| *Fig.* | Figure |
| *GCT* | Green creativity |
| *GIM* | Green intrinsic motivation |
| *GTRF* | Green transactional leadership |
| *GTRS* | Green transformational leadership |
| *HTMT* | Hetrotrait monotrait |
| *H1* | Hypothesis 1 |
| *H2* | Hypothesis 2 |

| | |
|---|---|
| *H3* | Hypothesis 3 |
| *H4* | Hypothesis 4 |
| *H5* | Hypothesis 5 |
| *H6* | Hypothesis 6 |
| *H7* | Hypothesis 7 |
| *O* | Original sample mean |
| *PLS* | Partial least square |
| *p-value* | Probability value |
| *R2* | Determination coefficient |
| *SD* | Standard deviation |
| *SMART PLS* | Measurement model assessment |
| *STDEV* | Standard deviation of the estimated parameter over all subsamples |
| *t-test* | Hypothesis test statistic |
| *VIF* | Variance inflation factor |

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**AUTHOR (S) BIOSKETCHES**

**Saif, N.,** Ph.D., Assistant Professor, Department of Management Sciences, University of Science and Technology Bannu, Pakistan.
- Email: *n.saif@utsb.edu.pk*
- ORCID: 0000-0001-9577-1489
- Web of Science ResearcherID: AAK-8338-2020
- Scopus Author ID: 57210801366
- Homepage: https://www.ustb.edu.pk

**Goh, G.G.G.,** Ph.D., Associate Professor, Knowledge Management, Economics and Quantitative Analysis Department, Multimedia University, Melaka, Malaysia.
- Email: *gggoh@mmu.edu.my*
- ORCID: 0000-0001-7718-4686
- Web of Science ResearcherID: G-7818-2016
- Scopus Author ID: 36835785700
- Homepage: https://mmuexpert.mmu.edu.my/gggoh

**Ong, J.W.,** Ph.D., Senior Lecturer, Management Department, Faculty of Management, Multimedia University, Cyberjaya, Malaysia.
- Email: *jwong@mmu.edu.my*
- ORCID: 0000-0002-0333-495X
- Web of Science ResearcherID: AGX-6659-2022
- Scopus Author ID: 46461640600
- Homepage: https://mmuexpert.mmu.edu.my/jwong

**Khan, I.U.,** Ph.D., Assistant Professor, Department of Public Administration, Gomal University, Dera Ismail Khan, Pakistan.
- Email: *irfanullah@gu.edu.pk*
- ORCID: 0000-0001-5672-2326
- Web of Science ResearcherID: AFH-1065-2022
- Scopus Author ID: 57219515125
- Homepage: http://www.gu.edu.pk

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