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Article

Sustainable Development Goals (SDGs) in Academia: Investigating the Drivers and Barriers of Green Technology Adoption among Students

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Abstract In today's world, including Green Technology (GT) in education is crucial for tackling environmental issues. This study explores how university students adopt GT, examining how technology and sustainability are connected in higher education. We aimed to understand how different factors influence students' views on GT. This study employed a comprehensive theoretical framework, incorporating constructions such as Perceived Benefits, Perceived Barriers, Social Influence, Institutional Support, Artistic Engagement, Creative Arts Sustainability, and the ultimate adoption of green technologies. We surveyed university students using a specific questionnaire and used Structural Equation Modeling (SEM) to analyze the data carefully. The findings reveal that factors such as Social Influence, Institutional Support, and Artistic Engagement significantly influence students' attitudes and actions towards adopting green technology. However, the hypotheses related to Perceived Benefits (PBE) and Perceived Barriers (PBA) in connection to Artistic Engagement (AE) and Creative Arts Sustainability (CAS) were not statistically supported. These findings provide a distinct perspective on the factors influencing green technology adoption among university students in Saudi Arabia, resulting in a wider debate on Sustainable Development Goals (SDGs) technology integration in educational settings. This study extends theoretical models, such as the Theory of Planned Behavior, by emphasizing the role of subjective norms, attitudes, and perceived behavioral control. Additionally, the inclusion of creative arts sustainability adds a novel dimension to the understanding of technology adoption in the context of environmental sustainability. The identified drivers encompass economic, regulatory, market opportunities, social, cultural, and ethical factors, contributing to a more nuanced understanding of individual motivations.

Keywords quality education; green technology adoption; students

1. Introduction

In the contemporary era, the imperative for Sustainable Development Goals (SDGs) practices has become increasingly apparent across various sectors. Education is a crucial domain for integrating green technologies [1]. Universities, as hubs of knowledge dissemination and innovation, play a pivotal role in shaping future generations and influencing society. Green Technology (GT), a transformative force in modern innovation, offers a promising avenue to address the environmental consequences of conventional technologies. In pursuit of human convenience, prevalent products and technologies often contribute significantly to environmental degradation [2]. GT has emerged as a viable solution, envisioned to not only augment farm profitability but also curtail environmental harm and preserve natural resources [3].

The significance of green technologies lies in their commitment to sustainability, characterized by minimal environmental footprints in various processes and applications [3,4]. By aligning with natural organic resources and avoiding the production of greenhouse gases [5], GT is a testament to responsible resource consumption [6]. Its advocacy extends to resisting the increase in entropy in the universe and actively avoiding environmental degradation. The pervasive automation within green technologies further minimizes human intervention, enhancing sustainability [2,4,7]. Although the literature emphasizes the transformative potential of green technologies across sectors such as Aircraft, Automobiles, Biotechnology, Computers, Telecommunication, the Internet, Renewable Energy, Atomic & Nuclear advancements, Nanotechnology, and Space exploration [8], their adoption within academic environments remains a key area of

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exploration [9]. This study contributes to the evolving discourse on green technology adoption, shedding light on its role in fostering sustainability and shaping a greener future within the realm of academia.

Furthermore, Tushi et al. (2014) [10] reviewed the green IT literature from 2007 to 2013. They observed a predominant focus on developed nations, with limited attention paid to developing nations. The authors highlighted the environmental pressures accompanying economic growth and increased IT usage in major developing countries. Hernandez (2020) [9] challenged the perception that green IT may not be a priority in developing nations, emphasizing the importance of addressing e-waste issues. He argued that green IT presents opportunities for economic, social, and environmental benefits in these regions. Consequently, there is a pressing need to expand green IT studies in developing countries and identify emerging nations undergoing industrialization that may contribute to global environmental costs. Regrettably, the progress of green technology in Saudi Arabia is slow, indicating a concerning trend [11]. The extent of green technology awareness among Saudi university students remains unknown [12–14]. Given that these students are the future workforce, instilling knowledge of green technology is crucial for environmental sustainability [8,15].

Higher education institutions now see it as critically important to address the Sustainable Development Goals. Although SDG contributions are usually thought of as core assessment/learning content [8], the results also show that convenor-driven contributions can be important, especially for some specific SDGs. To support higher education institutions' efforts to contribute to more sustainable future societies, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) established the "Decade of Education for Sustainable Development (2005–2014)" [7]. Higher Education Institutions (HEIs) play a significant, direct, and indirect role in achieving the SDGs [11] given their capacity to engage in sustainability and promote the achievement of the goals [9].

HEIs are important for sustainable development because their work spans education, research, outreach, and management [2]. Currently, neither the national nor international levels agree upon a uniform methodology or tested process that is universally acknowledged as the most effective means of evaluating or incorporating the SDGs into education [5]. This study aimed to investigate the beliefs and behaviors of Saudi Arabian students regarding green technology at the individual level.

This study empirically explored the factors influencing the intention and action adoption of green technology by Saudi students. This study responds to the call for empirical studies on the factors influencing green technology adoption, particularly in developing countries [9,16], addressing the gap in research in this context [10,17,18].

The remainder of this paper is organized as follows: first, the Introduction sets the context and outlines the research objectives; next, the Literature Review provides a comprehensive analysis of existing research on green technology adoption; following this, the Research Methodology details the approach, design, and data analysis methods used in the study; subsequently, the Results section presents the findings of the study, including descriptive statistics and structural equation modeling analysis; finally, the Discussion and Conclusion sections interpret the results, discuss their implications, and offer concluding annotations.

2. Literature Review

The literature surrounding green technologies in education emphasizes the growing importance of integrating Sustainable Development Goals practices into academic settings. Various studies have highlighted the positive impact of adopting green technologies on reducing environmental footprints, enhancing energy efficiency, and fostering eco-conscious behaviors among students [13,14,18–20]. Green campuses equipped with energy-efficient infrastructure and digital learning resources have been shown to contribute significantly to sustainability efforts [21]. However, challenges such as financial constraints, resistance to change, and lack of awareness persist, hindering the widespread adoption of these technologies [2,22,23]. Existing research also underscores the need for comprehensive models that address the multifaceted nature of green technology adoption in educational contexts.

2.1. Green Technologies in Education

Green technologies, often referred to as clean or Sustainable Development Goals technologies, encompass a range of practices and innovations designed to minimize their impact on the environment [6,7]. These technologies aim to reduce the carbon footprint, promote energy efficiency, and mitigate the overall ecological footprint of human activities [10,24]. In the context of education, green technologies encompass a variety of solutions, including renewable energy sources, energy-efficient infrastructure, eco-friendly transportation, waste reduction strategies, and digital tools that facilitate Sustainable Development Goals learning practices [1,5,18].

Green technology, also referred to as clean or environmental technology, encompasses a broad spectrum of innovations aimed at mitigating environmental impact and fostering Sustainable Development Goals across various sectors. Research in this field has been extensive, spanning disciplines such as environmental science, engineering, economics, and education [2,18]. In environmental science, studies have investigated renewable energy sources, such as solar power [25], wind energy [26], and hydroelectric power [27], highlighting their potential to reduce greenhouse gas emissions and dependence on fossil fuels. Additionally, research has explored Sustainable Development Goals agricultural practices [28] and waste management technologies [29] to minimize environmental degradation and promote resource efficiency. Engineering research has focused on the design and optimization of green technologies to enhance energy efficiency and reduce emissions. Studies have examined advancements in energy storage systems [30], transportation technologies [31], and eco-friendly manufacturing processes [32] to mitigate environmental impacts throughout the product lifecycle. Economic analyses have assessed the costs and benefits of adopting green technology, along with policy instruments to incentivize investment. Research has explored carbon pricing mechanisms [33], renewable energy subsidies [34], and eco-labeling schemes [35], highlighting the role of market-based incentives in driving Sustainable Development Goals innovation. In education, studies have examined the integration of green technology concepts into curricula and educational programs. Research has investigated environmental education initiatives [36,37] and sustainability-focused learning experiences [38–40], aiming to cultivate awareness, knowledge, and skills related to environmental stewardship and green technology adoption among the students.

The integration of green technologies in higher education extends beyond the adoption of eco-friendly practices; it encompasses the cultivation of knowledge, skills, attitudes, and values centered on environmental stewardship [2,3]. This imperative is particularly heightened in the scope of higher education due to the intricate connection between the environment and economy. Recognizing higher education's pivotal role in shaping and developing human capital, there arises a fundamental need for a holistic perspective that transcends mere economic considerations, encompassing societal dimensions [4,7]. Within this educational paradigm, faculties become instrumental in fostering learning environments conducive to addressing local, regional, and national development challenges [2]. The systems, processes, structures, and devices designed for learning must align with eco-friendly principles [8,17,41]. The scope for incorporating green practices expands exponentially in open and distance learning formats, requiring continuous research and promotion of green concepts in operations management [9,11]. An integral aspect of green education is equipping students with the knowledge to leverage green technology. Notably, computer and information technologies have already been acknowledged as green technologies because of their contributions to clean environments in various industrial processes [1,2,5,9]. Additionally, the emerging field of green nanotechnology offers avenues to minimize environmental and human health risks associated with nanotechnology products, emphasizing the importance of eco-friendly materials and life cycle considerations [10]. According to Chang et al. [3], 199 research papers published between 2007 and 2014 were analyzed to reveal the state and future of Green Information Technology (Green IT). This study segmented Green IT research into four categories: technology, process, outcome, and policy. A "TPO Matrix" further classifies studies based on their focus within the Green IT adoption cycle (technology, process, or outcome). Cost savings, environmental concerns, regulations, and competition were identified as motivations for Green IT adoption, whereas high costs, lack of awareness, technical challenges, and policy gaps were found to be barriers. Future research opportunities include exploring the social dimensions, policy effectiveness, and new outcome metrics of Green IT. Although Indian students are environmentally conscious, they lack in-depth knowledge of Green IT practices. Despite this, they expressed a strong desire to adopt it, driven by potential cost savings and environmental benefits of solar energy. However, high technology costs, lack of institutional support, and limited training hinder adoption. The study suggests that targeted education and incentive programs offered by universities could bridge the knowledge gap and empower students to champion a Sustainable Development Goals future through Green IT [42].

2.2. Green Technology Adoption

Green technologies, also known as sustainable technologies, refer to innovations that minimize environmental impact by reducing energy consumption, waste generation, and carbon emissions. These technologies span various sectors, including education, renewable energy, energy-efficient systems, eco-friendly manufacturing, sustainable agriculture, and smart infrastructure [43]. Guo et al. [44] highlighted that the adoption of green technologies is driven by global concerns about climate change, resource depletion, and the need for sustainable economic growth. Governments, industries, educational institutions, and consumers increasingly recognize the importance of adopting environmentally friendly solutions to ensure sustainability.

The adoption of green technologies is influenced by several theoretical frameworks that explain how individuals and organizations accept and integrate innovations into their operations. The Technology Acceptance Model (TAM) by Davis [45] suggests that perceived usefulness and ease of use are critical determinants of technology adoption. Lin & Ho [46] explored in the context of green technologies, individuals and organizations are more likely to adopt sustainable innovations when they perceive them as beneficial and easy to implement. The Theory of Planned Behavior (TPB) [47] posits that behavioral intention, shaped by attitudes, subjective norms, and perceived behavioral control, influences technology adoption. For instance, an institution's commitment to sustainability and social influence can drive the adoption of green educational technologies. Likewise, the Diffusion of Innovation Theory (DOI) is explained by Rogers [48] as how new ideas and technologies spread within societies, emphasizing factors such as relative advantage, compatibility, complexity, trialability, and observability. Green technologies that offer clear advantages, align with existing practices, and demonstrate tangible benefits are more likely to be adopted by farmers. Government policies, international regulations, and environmental awareness drive green technology adoption through incentives such as tax benefits and subsidies [49]. Educational institutions have integrated energy-efficient systems and sustainable curricula in response to such policies. Despite the high initial costs, long-term savings and efficiency gains encourage adoption. Infrastructure, technological readiness, and skilled personnel are crucial for successful implementation [50,51]. Social norms and public perception also influence adoption, with educational institutions fostering environmental awareness [52–54]. The challenges include high costs, lack of awareness, and resistance to change. Adoption success depends on behavioral and institutional support, such as faculty training and policy backing for sustainable initiatives [53,54].

Several models for Green IT adoption have emerged in the literature [1,2,6,7,55–58], showcasing varied perspectives. Nazari & Karim [59] integrated the Technology-Organization-Environment (TOE) framework and the Diffusion of Innovation model, emphasizing three key factors—Innovation, Organizational, and Environmental—that impact Green IT adoption at the organizational level. Schmidt et al. [60] proposed a framework suggesting that the degree of Green IT planning and implementation is positively influenced by perceived importance but negatively affected by uncertainty. Molla et al. [61] introduced the Green IT Adoption Model (GITAM), which posits that an organization's intention to adopt Green IT and the actual adoption are influenced by Green IT Readiness, Green IT Context, and Green IT Drivers. Green IT Readiness, categorized into perceived organizational, value network, and institutional readiness, assesses an organization's preparedness. Molla et al. [61] identified economic, regulatory, ethical, and eco-responsiveness as drivers influencing Green IT adoption, reflecting external pressures such as social, cultural, and political influences, industry dynamics, and new market opportunities. These models collectively provide diverse insights into the multifaceted landscape of Green IT adoption. Fu et al. (2018) [6] systematically reviewed 165 articles to identify the factors influencing the adoption of Sustainable Development Goals process technologies in businesses. They categorized these factors into five themes: economic (e.g., costs and payback periods), technological (e.g., complexity and compatibility), organizational (e.g., management commitment and knowledge), policy and regulatory (e.g., subsidies and environmental regulations), and social and cultural (e.g., public perception and stakeholder pressure) aspects. While economic and technological factors played significant roles, the study emphasized the importance of considering all themes, with organizational factors and policy incentives being particularly crucial for successful adoption. Dezdar (2017) [58] explored the factors influencing the adoption of Green Information

Technology by businesses, building on the established Theory of Planned Behavior. The study identified several key factors beyond those traditionally included in TPB, such as environmental concerns, perceived risks and benefits, and external pressures such as regulations and competitor behavior. In South African higher education institutions, Thomson & van Belle (2015) [55] identified the key drivers and readiness factors influencing the adoption of Green IT. While acknowledging low overall adoption, they found that all drivers—economic, ethical, response to pressure, and regulatory—significantly influenced HEIs' Green IT decisions. Notably, stakeholders outside the HEI value network, such as suppliers and competitors, have a limited impact on adoption. Despite encouraging results, the study suggests that universities in South Africa need to address limited Green IT awareness and skepticism towards new technologies to fully embrace Sustainable Development Goals technology solutions [55]. In their systematic literature review, Fu et al. (2018) [6] explored the diverse factors influencing the adoption of SDGs process technologies. They identified numerous influences across three levels: individual (e.g., awareness and environmental values), organizational (e.g., management support and financial resources), and institutional (e.g., regulations and market structures). Interestingly, the review revealed complex interdependencies between these levels, highlighting the need for multifaceted interventions to promote Sustainable Development Goals technology adoption. For instance, individual awareness and organizational resources interact to shape technology adoption decisions. Notably, the authors emphasize the importance of considering not only the economic but also the environmental and social aspects of sustainability when evaluating new technologies. Overall, this review provides a comprehensive framework for understanding the drivers and barriers to Sustainable Development Goals process technology adoption, informing strategies for successful implementation in various contexts. The adoption of Green IT is also driven by various factors, with economic considerations playing a pivotal role. Cost reduction, particularly in response to escalating energy prices, is a major driver for organizations embracing Green IT, especially in the South African context [62]. Regulatory drivers, such as compliance requirements for reporting carbon emissions, also shape organizations' decisions, although their impact is relatively lower due to the absence of mandatory regulations in South Africa [61,62]. Market opportunities arise from the increasing awareness of ICT's environmental impact, enabling businesses to offer and adopt green solutions [59,60,63]. Social, cultural, and political pressures are additional influential factors that prompt organizational change when societies recognize environmental degradation and industry peers adopt Sustainable Development Goals practices [64,65]. Ethical considerations, motivated by a commitment to the common good, cost benefits, employee confidence, or an enhanced brand image, also contribute to organizations' self-motivation to implement Green IT [64].

While the potential benefits of incorporating green technologies in education are evident [1,2,5,6], challenges and barriers hinder their widespread adoption among university students. These challenges include financial constraints, lack of awareness, resistance to change, and the need for infrastructure upgrades [5]. Identifying and addressing these barriers is crucial for the successful integration of green technologies in educational settings.

2.3. Research Question and Objectives

Research Question: What factors influence university students' adoption of green technologies in education, and how can these factors be mitigated to promote widespread acceptance?

Objectives:

- To assess the current level of awareness of green technologies in education among university students.
- To identify the perceived benefits and barriers associated with the adoption of green technologies.
- To examine the impact of educational interventions and awareness campaigns on students' willingness to adopt green technologies.

2.4. Proposed Technology Adoption Model with New Constructs Related to Green Technologies

The adoption of green technologies has gained significant attention over the past few decades, as institutions and organizations have recognized the urgent need for sustainable practices. Early discussions on green technology adoption emerged in the 1970s, primarily focusing on environmental conservation efforts in response to climate change and resource depletion. Universities, as knowledge hubs, have gradually incorporated sustainability principles; however, adoption has often been hindered by high costs, lack of awareness, and technological complexity. Several models have been proposed to understand green technology adoption in organizations and educational institutions. The TAM explains adoption through perceived ease of use and perceived usefulness; however, it lacks consideration of external environmental factors. The DOI explores how innovations spread but does not explicitly address the behavioral control factors influencing adoption in structured institutions such as universities. The Unified Theory of Acceptance and Use of Technology (UTAUT) integrate social influence and facilitating conditions but does not sufficiently incorporate sustainability motivations. These gaps necessitate an inclusive framework tailored to university settings. Our study proposes a model grounded in the Theory of Planned Behavior and Perceived Benefit Theory (PBT) to explain the adoption of green technologies among students. The TPB posits that behavior is influenced by attitude, subjective norms, and perceived behavioral control, making it suitable for examining students' decision-making processes regarding sustainability. PBT highlights that individuals adopt innovations when they perceive tangible benefits, such as cost savings and reduced environmental impact.

The proposed model introduces "Perceived Benefits (PBE), Perceived Barriers (PBA), Social Influence (SI), and Institutional Support (IS) as primary factors affecting Creative Arts Sustainability (CAS) and Artistic Engagement (AE), which in turn influence the adoption of green technologies (AGT)". Unlike previous models, our framework uniquely integrates artistic engagement, recognizing that creative mediums can enhance awareness, motivation, and participation in sustainability. The integration of TPB and PBT in this study is justified by the need to understand both behavioral intent and the role of perceived advantages in green technology adoption. Social Influence and Institutional Support align with subjective norms and perceived behavioral control in the TPB, while Perceived Benefits and Perceived Barriers are supported by the PBT, explaining how cost, convenience, and environmental impact shape adoption decisions [66]. Additionally, Creative Arts Sustainability and Artistic Engagement expand the discussion on behavioral change by incorporating creative channels for sustainability awareness, which are often overlooked in traditional models.

This theoretical framework contributes to addressing the role of students' creative engagement in sustainability adoption. It provides a holistic approach that blends behavioral, institutional, and artistic perspectives, offering practical implications for policymakers, university administrators, and educators seeking to promote sustainable technology adoption and offer insights into effective strategies for promoting Sustainable Development Goals practices in educational settings. Figure 1 shows the proposed technology adoption model for green technologies.

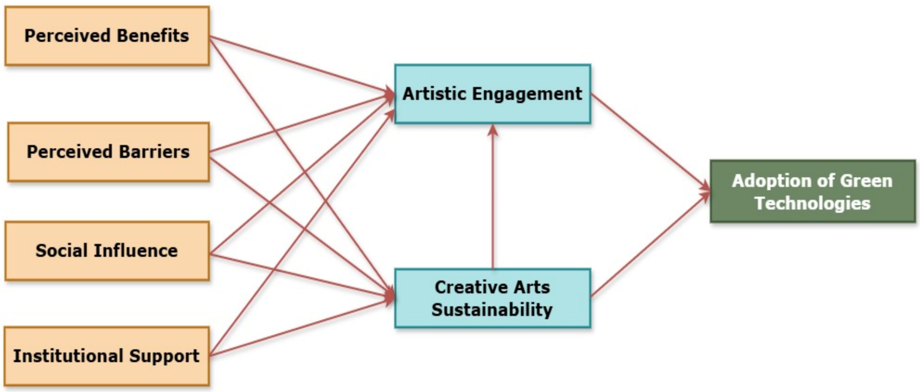

Figure 1. Green technology adoption model.

Proposed Model for Green Technology Adoption: This model incorporates several key factors influencing the adoption of green technologies in universities, summarized below:

Perceived Benefits

Perceived Benefits in the context of green technology adoption encapsulate individuals' subjective assessments of the positive outcomes and advantages associated with incorporating environmentally friendly technologies. Previous research, such as that by [67], underscores the significance of tangible benefits, including cost savings, environmental impact reduction, and enhanced operational efficiency, as crucial factors influencing individuals' willingness to embrace green technologies. Perceived Benefits hold immense power in influencing student choices. Cost savings from efficient campus infrastructure, the environmental impact of reduced waste and energy consumption, and personal satisfaction from contributing to a greener future all factor into their decision-making [68,69].

- *H1: Perceived benefits positively influence artistic engagement.*
- *H2: Perceived benefits positively influence creative art sustainability.*

Perceived Barriers

Perceived Barriers encompass individuals' perceptions of obstacles, challenges, or disadvantages hindering the adoption of green technology. Literature, as highlighted by studies such as those conducted by Lay et al. [43] and Wang et al. [70], identifies various obstacles, such as high initial costs, lack of awareness, and concerns about technology complexity, as significant impediments to the widespread adoption of green technologies. However, Perceived Barriers can present formidable challenges. The limited availability of green technologies on campus, lack of awareness about their benefits, and potential compatibility issues with existing infrastructure can all deter student engagement [71].

- *H3: Perceived barriers negatively influence artistic engagement.*
- *H4: Perceived barriers negatively influence creative arts sustainability.*

Social Influence

Social Influence explores the impact of interpersonal relationships, societal norms, and external influences on an individual's decision to adopt green technology. Studies in the field, exemplified by [58,72], emphasize the role of social factors, including peer influence, social norms, and societal expectations, in shaping individuals' attitudes and behaviors towards the adoption of green technologies. However, students are not isolated in their journeys towards greener campuses. Social Influence plays a potent role, with peer pressure, faculty guidance, and campus sustainability initiatives shaping environmental consciousness [73]. Inter-university competitions, collaborative green projects, and student-led sustainability campaigns can further amplify this influence and create a collective momentum for embracing green technologies.

- *H5: Social influence positively affects artistic engagement.*
- *H6: Social influence positively affects creative arts sustainability.*

Institutional Support

Institutional Support evaluates the extent to which organizational structures and support mechanisms within an institution facilitate the successful adoption of green technology. Research by Tushi et al. (2014) [10] and Molla et al. [61] underscores the crucial role of institutional backing in overcoming barriers and creating an environment conducive to the widespread adoption of green initiatives [10,66]. Beyond external pressures, Institutional Support from universities is vital. Investing in green infrastructure, providing training on using new technologies, and integrating sustainability principles into curricula all demonstrate a commitment to fostering responsible future generations [74,75]. Collaborations with green technology companies, offering scholarships for sustainability-focused research, and recognizing student initiatives can further create an environment that champions eco-friendly choices.

- *H7: Institutional support has a positive influence on artistic engagement.*
- *H8: Institutional support positively influences the sustainability of the creative arts.*

Creative Arts Sustainability

Creative Arts Sustainability encompasses Sustainable Development Goals practices within the creative arts domain, emphasizing the integration of eco-friendly approaches and technologies. While specific literature on Creative Arts Sustainability in the context of technology adoption is limited, broader discussions on sustainability in the arts, as reflected by Hall et al. [76], highlight the role of environmentally conscious practices in shaping perceptions and behaviors. Furthermore, Creative Arts Sustainability encourages students to consider the ethical implications of their artistic choices. Utilizing recycled materials, promoting Sustainable Development Goals production practices within art clubs, and incorporating messages of responsible consumption into artistic expression all empower students to contribute to a greener future through their artistic pursuits.

- *H9: Creative art sustainability positively influences artistic engagement.*

Artistic Engagement

This model introduces a novel dimension: Artistic Engagement. From murals depicting the impact of climate change to interactive installations showcasing renewable energy solutions, the arts can be a powerful tool for raising awareness, fostering empathy, and stimulating critical thinking about environmental challenges [55]. Student-led art clubs, campus greening projects incorporating artistic elements, and collaborations with local artists can all leverage creativity to ignite a passion for sustainability. Artistic Engagement involves integrating artistic and creative elements to enhance the appeal and user experience of green technology. While limited research directly associates artistic engagement with green technology adoption, the broader literature, such as KK & Maskari [77] and Fan et al. [78], suggests that incorporating aesthetics and creative design elements positively influences user perceptions and acceptance of technology adoption.

- *H10: Artistic engagement positively influences green technology adoption.*

Adopt Green Technologies

Adopt Green Technologies represents the actual adoption or usage of green technologies by individuals or institutions. Numerous studies, including those of Thomson & van Belle [55] and Gholami et al. [17], have delved into the factors influencing the adoption of green technologies, such as technological readiness, awareness, and the alignment of green technologies with organizational or individual goals. Ultimately, the success of this journey hinges on Adopting Green Technologies at the individual and collective levels [68–70]. Students equipped with knowledge, empowered by institutional support, and inspired by artistic engagement are more likely to embrace Sustainable Development Goals practices and advocate for green technology adoption within their campus communities.

The proposed model, with its focus on student-centric factors and the unique influence of the academic environment, provides a valuable framework for investigating the drivers and barriers to green technology adoption within universities. By fostering a culture of awareness, engagement, and empowerment, academia can play a pivotal role in shaping a generation of green champions, paving the way for a Sustainable Development Goals future (Figure 2).

- *H11: Sustainability of the creative arts positively influences the adoption of green technologies.*

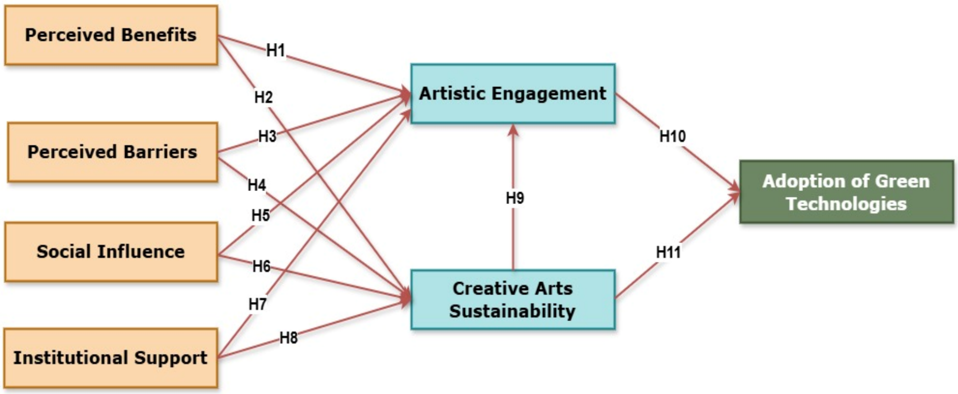

Figure 2. Green technology constructs relationships.

3. Research Methodology

The research methodology employed in this study adopts a quantitative approach to examine the factors influencing green technology adoption by university students. Following a thorough literature review, a robust research framework was developed to guide this study. The population size was determined according to the criteria outlined by Hair et al. (2019) [79], aiming for a sufficient sample size to ensure statistical validity. A total of 264 questionnaires were returned and analyzed. Kock & Hadaya (2018) [80] emphasized that the minimum sample size requirement in SEM should consider statistical power, typically aiming for 80%, which is commonly accepted in SEM studies. Using power analysis methods such as Cohen's [81] power tables or G*Power software, a sample size of 264 exceeded the threshold necessary to detect medium to large effect sizes (Cohen's $f^2 \geq 0.15$) at a 5% significance level, ensuring reliable parameter estimates and reducing the likelihood of Type II errors. Additionally, Kock & Hadaya (2018) [80] proposed alternative methods, such as the inverse square root and gamma-exponential methods, which indicate a minimum sample size of approximately 150 for models of moderate complexity to achieve 80% power at a 5% significance level. Thus, our sample size of 264 exceeds these recommendations, ensuring statistical precision and robustness for hypothesis testing and meeting the predetermined criteria [82–84].

Our study employs a model comprising seven constructs, each measured by five items, resulting in 35 indicator variables. Based on the widely accepted N:p ratio guidelines, our sample size of 264 meets the recommended thresholds discussed by Kyriazos & Theodoros [85]. The study suggests a ratio of at least 10 cases per indicator variable, which would require a minimum sample size of 350. However, Tinsley & Tinsley [86] proposed a more flexible range of 5 to 10 participants per item, indicating that for 35 items, a sample size between 175 and 350 is sufficient. Moreover, Kyriazos & Theodoros [85] highlight that for SEM, sample size recommendations can range from 100 to 500, depending on model complexity. Given that our model aligns with these recommendations and considering Monte Carlo simulation findings [87] indicating stability for models with similar construct-item ratios at $N > 200$, our sample size of 264 is deemed adequate and sufficient for a reliable SEM analysis.

The methodology comprises several key components to ensure rigor and validity. First, a comprehensive survey questionnaire (Appendix A) was meticulously crafted based on insights from the literature and existing research. The questionnaire was designed to capture insights into the factors influencing green technology adoption by university students. It consisted of two primary sections: one gathering demographic information and the other collecting quantitative data on participants' acceptance of green technologies.

Prior to the main data collection, a pilot study was conducted to assess the reliability of the questionnaire [72,88]. This involved administering the survey to a small sample of participants to identify and rectify any ambiguities or issues in the questionnaire design [82]. The collected pilot data were then subjected to statistical testing using SPSS software version 21.

Structural Equation Modeling was employed as the core analytical method for this study, with Partial Least Squares SEM (PLS-SEM) chosen over Covariance-Based SEM (CB-SEM) because of its suitability for predictive research and exploratory studies. CB-SEM, commonly implemented using AMOS or LISREL, is primarily used for theory testing and model validation, requiring large sample sizes and multivariate normality to produce robust model fit indices [89,90]. In contrast, PLS-SEM, implemented via SmartPLS, is a variance-based approach that does not impose strict assumptions on sample size or data normality, making it more appropriate for studies with small to medium sample sizes and non-normal data distributions [91,92]. PLS-SEM is particularly useful for complex models that incorporate both reflective and formative constructs and prioritize maximizing explained variance (R^2) over goodness-of-fit measures [93]. Given that our study explores the adoption of AI-driven systems and focuses on predictive relationships, PLS-SEM is the most appropriate method. Additionally, Monte Carlo simulations and empirical studies [94] have demonstrated that PLS-SEM yields result comparable to CB-SEM when applied correctly, further supporting its use. Following Hair et al. [92], our analysis followed a two-step approach: first, assessing the measurement model for convergent and discriminant validity, and then evaluating the structural model using SmartPLS 4 to estimate path coefficients and explained variance (R^2). To address the reviewer's concern, we have now included a dedicated section in the revised manuscript that explicitly justifies the use of PLS-SEM with references to relevant methodological literature, ensuring transparency in our analytical approach.

3.1. Measurement Items

The primary aim of this study was to empirically examine the adoption of green technology by art education students in Saudi Arabia. The research objectives focused on identifying the factors that influence these students. The targeted respondents for the questionnaire were university students in Saudi Arabia, chosen because of their daily engagement with information technology, making their actions towards green technologies particularly significant. This study employed a comprehensive set of constructs to gauge various dimensions pertinent to the adoption of green technology, as detailed in Table 1. Perceived Benefits encompassed a set of five items drawn from a reputable source [28]. Similarly, Perceived Barriers utilized five items sourced from a recognized study [23]. Social Influence was measured using five items, with references from established sources [44] and [45]. Institutional Support consisted of five items, relying on a well-regarded source [28]. Artistic Engagement and Creative Arts Sustainability each comprised five items, drawn from sources [28] and [37]. Lastly, the construct of Adopt Green Technologies included five items, with sources referenced from [28] and [45]. This meticulous selection of constructs and items from credible sources enhances the robustness and reliability of the study's measurement tools, ensuring a thorough exploration of the factors influencing green technology adoption among university students. All items were measured on a five-point Likert-type scale with response anchors ranging from "strongly agree" to "strongly disagree".

Table 1. Construct information.

Construct	Num of Items	Adopted From
Perceived Benefits (PBE)	5	[55]
Perceived Barriers (PBA)	5	[23]
Social Influence (SI)	5	[95,96]
Institutional Support (IS)	5	[55]
Artistic Engagement (AE)	5	[55,66]
Creative Arts Sustainability (CAS)	5	[55,66]
Adopt Green Technologies	5	[55,96]

3.2. Ethical Approval

This study was approved by the heads of the departments at the university. All participants provided informed consent, and measures were taken to ensure their confidentiality and privacy. This study adhered to ethical guidelines, including the principles of beneficence and autonomy.

4. Results

4.1. Pilot Study

To assess the feasibility of the survey instruments, a pilot study was conducted by distributing online survey forms to a prominent university student email group. A total of 60 students responded to the survey, and subsequent analysis using SPSS 21.0 indicated that the Cronbach's alpha values for all variables exceeded 0.7. This outcome, which aligns with the recommendations of Hair et al. (2010) [79], affirms the reliability of the questionnaire. The survey instruments were deemed reliable and suitable for use in the main study. This preliminary investigation ensured the practicality of the survey materials and validated their internal consistency. The use of a five-point Likert-type scale facilitated a nuanced understanding of students' perceptions and attitudes towards green technology adoption in art education.

4.2. Data Collection and Descriptive Statistics

Owing to constraints in time and resources, a convenience sampling method was employed for data collection. The questionnaires were distributed among university students. The self-administered questionnaires were personally handed to the respondents within their classes, following the necessary permission obtained from their lecturers to maximize the response rate. A total of 300 questionnaires were distributed, and 264 valid responses were used for subsequent analyses. Table 2 presents the participants' demographic information. Regarding gender distribution, 106 respondents were female and 158 were male. In terms of age, the majority fell within the 23–26 age range (146 participants), followed by 18–22 (55 participants). The academic-level distribution indicated that 195 participants were undergraduates and 69 were postgraduates.

4.3. Convergent Validity Analysis

The evaluation of convergent validity focused on three key metrics: factor loading, composite construct reliability, and average variance extracted (AVE) [88,97]. Specifically, factor loading

Table 2. Demographic data.

Items	Characteristic	Count	%
Gender	Female	106	40.2
	Male	158	59.8
Age (Years)	18–22	55	20.8
	23–26	146	55.3
	27–30	34	12.9
	31–34	19	7.2
	More than 35	10	3.8
Academic Level	Undergraduate	195	73.9
	Postgraduate	69	26.1

analysis provides insights into the strength and significance of the relationships between each item and its respective construct. The factor loadings presented in Table 3 indicate the strength of the associations, with all items demonstrating substantial factor loadings exceeding the recommended threshold of 0.70 [88,97]. This observation underscores the robustness of the measurement model, as each item significantly contributed to the measurement of its underlying construct ($p < 0.01$ in all cases). High factor loadings suggest that the items effectively capture the intended concepts and contribute meaningfully to the overall construct.

Table 3. Convergent validity analysis.

Construct	Item	Factor Loading
Artistic Engagement (AE)	AE1	0.82
	AE2	0.84
	AE3	0.72
	AE4	0.85
	AE5	0.83
Adopt Green Technologies (AGT)	AGT1	0.77
	AGT2	0.80
	AGT3	0.81
	AGT4	0.80
	AGT5	0.77
Creative Arts Sustainability (CAS)	CAS1	0.76
	CAS2	0.76
	CAS3	0.90
	CAS4	0.89
	CAS5	0.88
Institutional Support (IS)	IS1	0.82
	IS2	0.86
	IS3	0.89
	IS4	0.89
	IS5	0.79
Perceived Barriers (PBA)	PBA1	0.72
	PBA2	0.73
	PBA3	0.80
	PBA4	0.79
	PBA5	0.78
Perceived Benefits (PBE)	PBE1	0.81
	PBE2	0.86
	PBE3	0.81
	PBE4	0.78
	PBE5	0.80

Table 3. (*Continued*)

Social Influence (SI)	SI1	0.81
	SI2	0.79
	SI3	0.83
	SI4	0.79
	SI5	0.77

The reliability and convergent validity of the constructs were rigorously assessed by examining Cronbach's alpha, composite reliability (CR), and average variance extracted, as presented in Table 4. Reliability, as measured by Cronbach's alpha, surpassed the widely accepted threshold of 0.70 for all constructs, ranging from 0.81 to 0.90 [88,97]. These alpha values indicate a high level of internal consistency within each construct, signifying that the items within each construct reliably measured the same underlying concept.

The composite reliability values were consistently high, ranging from 0.81 to 0.91. These values exceeded the recommended threshold of 0.70, further substantiating the internal consistency and reliability of each construct [97]. The CR results confirmed the dependability of the measurement model. Convergent validity was further supported by the AVE values, all of which surpassed the recommended level of 0.50 [97,98]. Specifically, the AVE values ranged from 0.57 to 0.73, exceeding the suggested threshold. These outcomes affirm that a substantial proportion of the variance in each construct was captured by its associated items. The Cronbach's alpha reliability coefficients, composite reliability values, and AVE results collectively indicate that the measurement model demonstrates high internal consistency, reliability, and convergent validity. The study's constructs reliably measured the intended concepts, meeting the criteria recommended by Hair et al. (2010) [79] for robustness in construct measurement.

Table 4. Reliability and convergent validity.

Constructs	Cronbach's alpha	CR	AVE
AE	0.83	0.84	0.60
AGT	0.83	0.83	0.59
CAS	0.90	0.91	0.71
IS	0.90	0.91	0.73
PBA	0.82	0.83	0.58
PBE	0.84	0.85	0.62
SI	0.81	0.81	0.57

4.4. Discriminant Validity Analysis

Discriminant validity is a crucial aspect of assessing the distinctiveness of constructs in a measurement model. This ensures that each latent variable measures a unique concept and that there is limited overlap with other constructs. In this study, two types of discriminant validity analyses were conducted: the heterotrait-monotrait (HTMT) ratio and the Fornell-Larcker Criterion [99,100].

The HTMT ratios presented in Table 5 offer insights into the discriminant validity of the constructs. The HTMT values ranged from 0.63 to 0.82, all below the recommended threshold of 0.85 [101]. These results suggest that the constructs (AE, AGT, CAS, IS, PBA, PBE, and SI) are distinct from each other, with minimal shared variance. This finding supports the conclusion that each latent variable captures a unique aspect of the overall model, emphasizing the discriminant validity of the measurement.

The Fornell-Larcker criterion, presented in Table 6, provides another perspective on discriminant validity. The criterion compares the square root of the AVE for each construct with the correlations between that construct and the other constructs. In this analysis, all diagonal elements (square roots of the AVE) were greater than the off-diagonal elements (correlations with other constructs), reaffirming discriminant validity [100]. Both analyses consistently demonstrated strong evidence of discriminant validity in the measurement model. The HTMT ratios and Fornell-Larcker Criterion values consistently fell below the established thresholds, signifying that the latent variables in the study were distinct and measured unique concepts. This outcome is crucial for ensuring that the constructs effectively capture the different aspects of green technology adoption among university students in Saudi Arabia.

Table 5. Discriminant validity (HTMT ratio).

	AE	AGT	CAS	IS	PBA	PBE	SI
AE							
AGT	0.78						
CAS	0.77	0.79					
IS	0.84	0.73	0.66				
PBA	0.65	0.72	0.65	0.73			
PBE	0.65	0.75	0.63	0.69	0.82		
SI	0.74	0.69	0.74	0.73	0.64	0.65	

Table 6. Discriminant validity (Furnell-Larker Criterion).

	AE	**AGT**	**CAS**	**IS**	**PBA**	**PBE**	**SI**
AE	0.77						
AGT	0.65	0.77					
CAS	0.66	0.68	0.84				
IS	0.74	0.63	0.60	0.85			
PBA	0.55	0.60	0.56	0.64	0.76		
PBE	0.55	0.63	0.55	0.60	0.68	0.79	
SI	0.61	0.57	0.63	0.62	0.53	0.54	0.76

4.5. Analysis of R-Square of Constructs

Table 7 provides insight into the explanatory power of the endogenous latent variables in the structural model, as indicated by the R-squared (R^2) and adjusted R-squared values [88,97].

Artistic Engagement: The R-squared value for Artistic Engagement is 0.62, indicating that approximately 62% of the variance in AE is explained by the exogenous variables in the model. The adjusted R-squared, which accounts for the number of predictors in the model, was 0.58. This suggests that the model effectively captures a significant portion of the variability in AE, highlighting the relevance and importance of the chosen exogenous variables in explaining observed variance. Adopt Green Technologies: For Adopt Green Technologies, the R-squared value is 0.53, suggesting that 53% of the variability in AGT is accounted for by the predictors in the model. The adjusted R-squared was consistent at 0.53. These values indicate a substantial level of explanation for the variance in AGT, underscoring the model's efficacy in elucidating the factors influencing the adoption of green technologies among university students. Creative Arts Sustainability: The R-squared value for Creative Arts Sustainability is 0.50, with an adjusted R-squared of 0.50. This indicates that 50% of the variability in the CAS was explained by the model. Despite being slightly lower than the R-squared values for AE and AGT, the explanatory power for CAS remains considerable, implying that the chosen predictors effectively contribute to understanding the sustainability aspects of the creative arts.

Table 7. Analysis of R-Square of constructs.

Constructs	**R-square**	**R-square Adjusted**
AE	0.62	0.58
AGT	0.53	0.53
CAS	0.50	0.50

The hypothesis testing results, outlined in Table 8, provide a statistically rigorous examination of the relationships among the key constructs in the structural model, considering effect sizes, T-statistics, and P-values. These constructs encompass Perceived Benefits, Perceived Barriers, Social Influence, Institutional Support, Artistic Engagement, Creative Arts Sustainability, and the outcome of adopting green technologies.

The analysis of the hypothesis results revealed insightful patterns in the relationships between the constructs. The hypothesis regarding the influence of Perceived Benefits on Artistic Engagement was rejected ($T = 0.65$, $p = 0.510$). Similarly, the hypothesis concerning the impact of PBE on Creative Arts Sustainability was rejected ($T = 1.720$, $p = 0.080$). The relationship between Perceived Barriers and AE was also rejected ($T = 0.01$, $p = 0.990$). However, the hypothesis that

PBA positively influenced CAS was accepted (T = 2.170, p = 0.030), indicating a significant connection. Social Influence exhibited a positive impact on AE (T = 2.07, p = 0.040) and a substantial Influence on CAS (T = 5.560, p = 0.000), reinforcing its role in shaping artistic engagement and sustainability. Institutional Support had a significant effect on both AE (T = 7.450, p = 0.000) and CAS (T = 2.330, p = 0.020), highlighting its pivotal role. Creative Arts Sustainability (CAS) significantly affected Artistic Engagement (T = 4.78, p = 0.000), emphasizing the intertwined nature of these constructs. Moreover, both AE → AGT (T = 4.760, p = 0.000) and CAS → AGT (T = 6.34, p = 0.000) hypotheses were accepted, underscoring the positive influence of artistic engagement and creative arts sustainability on the adoption of Green Technologies. The consistent acceptance of these hypotheses reflects the robust associations between the specified constructs in the structural model. The hypothesis testing outcomes, grounded in statistically significant details, offer a nuanced understanding of the relationships shaping green technology adoption among university students in Saudi Arabia. The results contribute to the growing body of statistically robust evidence guiding Sustainable Development Goals practices and technological advancements in academic settings.

Table 8. Hypothesis testing (Path, T-Value, and P-value).

Hypothesis	Original Sample (O)	T statistics	P values	Decision
PBE → AE	0.050	0.650	0.510	Rejected
PBE → CAS	0.130	1.720	0.080	Rejected
PBA → AE	-0.000	0.010	0.990	Rejected
PBA → CAS	0.160	2.170	0.030	Accepted
SI → AE	0.110	2.070	0.040	Accepted
SI → CAS	0.350	5.560	0.000	Accepted
IS → AE	0.460	7.450	0.000	Accepted
IS → CAS	0.200	2.330	0.020	Accepted
CAS → AE	0.300	4.780	0.000	Accepted
AE → AGT	0.350	4.760	0.000	Accepted
CAS → AGT	0.450	6.340	0.000	Accepted

As shown in Figure 3, the connections between Social Influence, Institutional Support, Artistic Engagement, Creative Arts Sustainability, and the adoption of Green Technologies were all supported by robust statistical evidence. In contrast, hypotheses pertaining to Perceived Benefits and Perceived Barriers in relation to Artistic Engagement and Creative Arts Sustainability were rejected due to insufficient statistical support.

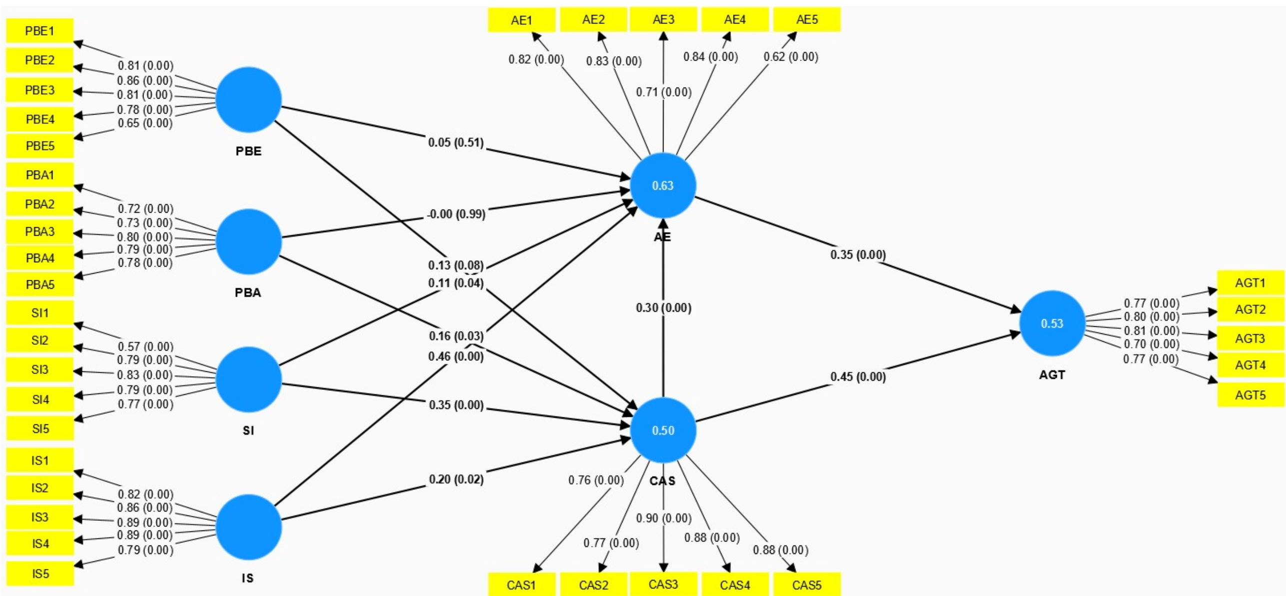

Figure 3. Structural model (path coefficients).

5. Discussion

Green Technology: Green technology, encompassing environmentally friendly innovations and Sustainable Development Goals practices, has gained prominence in addressing contemporary global challenges. The application of green technology spans various sectors, including aviation, automotive, biotechnology, computer science, telecommunications, renewable energy, and space exploration. The overarching goal is to mitigate environmental degradation, reduce carbon footprints, and promote Sustainable Development Goals development. This study aligns with the growing recognition of the importance of green technology in addressing societal challenges and contributes valuable insights into its adoption among university students.

The study's focus on green technology adoption among university students addresses a significant gap in the literature, as evidenced by its research questions and objectives. By investigating the factors influencing green technology adoption and strategies for promoting its acceptance, this study contributes valuable insights to the field. Specifically, it assessed the current awareness levels among students, identified perceived benefits and barriers, and examined the impact of educational interventions on the willingness to adopt green technologies. The findings underscore the importance of integrating green technology into higher education to foster environmental awareness and Sustainable Development Goals practices. Social influence, institutional support, artistic engagement, and creative arts sustainability emerged as key drivers of green technology adoption, aligning with the existing literature. Education plays a pivotal role in shaping attitudes and behaviors towards green technology. The integration of green technology in higher education is crucial for fostering environmental awareness and promoting Sustainable Development Goals practices. This study underscores the need for green technology in academic settings, emphasizing its role in creating knowledge, skills, attitudes, and values related to the environment. The adoption of green technology in education extends beyond the theoretical realm, with practical implications for various disciplines, such as agriculture, organic farming, climate science, and healthcare. These findings align with the broader literature, highlighting the transformative potential of green technology in education.

The impact of green technology in education extends beyond the classroom, influencing students' perceptions, behaviors, and career choices. This study identifies the demand for green jobs, emphasizing the role of higher education institutions in preparing students for careers that align with Sustainable Development Goals practices. Incorporating green technologies into the curriculum, facilities, and institutional culture contributes to a holistic educational experience. Moreover, this study recognizes the potential of open and distance learning in promoting green education, making it accessible to a wider audience. Understanding the drivers and barriers to green technology adoption among university students is crucial for shaping future environmental leaders. The study revealed that factors such as Social Influence, Institutional Support, Artistic Engagement, and Creative Arts Sustainability positively influenced the adoption of Green Technologies. These findings corroborate the existing literature, emphasizing the role of social factors, institutional backing, and the integration of sustainability principles in fostering green technology adoption. The identified drivers provide valuable insights for educational institutions seeking to promote eco-friendly practices among their students [102].

The study's findings revealed that various factors significantly influenced the adoption of green technology among university students. Social Influence, Institutional Support Artistic Engagement, and Creative Arts Sustainability emerged as key drivers of fostering a positive attitude towards adopting green technologies. This aligns with the broader literature emphasizing the impact of social networks, institutional backing, and artistic engagement on promoting sustainability initiatives [103,104]. The literature suggests that social influence plays a crucial role in shaping individuals' attitudes and behaviors, especially in adopting environmentally friendly practices. The study results support this perspective, indicating that students are more likely to embrace green technology when influenced by their peers, faculty, and societal norms that prioritize sustainability [105–107]. Institutional support has been recognized as a pivotal factor in the successful implementation of sustainability initiatives in educational settings [108–110]. The study's identification of institutional support as a significant driver echoes the existing literature, highlighting the role of universities in providing resources, policies, and infrastructure that promote green technology adoption [111,112]. Artistic Engagement and Creative Arts Sustainability have emerged as influential factors driving the adoption of green technology. This finding is supported by the literature on the intersection of art and sustainability, which suggests that artistic expression can inspire environmental consciousness and encourage Sustainable Development Goals practices [113–115].

Contrary to expectations, hypotheses linking Perceived Benefits to Green Technology Adoption and Sustainable Practices and Perceived Barriers to GTA were not supported. This contradicts traditional views based on the direct role of cost savings and environmental issues in green technology adoption [116]. The non-support for PBE → GTA and PBE → SP suggests that in our study context, the adoption of green technologies is driven by more general organizational and strategic factors than by perceived benefits. Therefore, the irrelevance of PBA → GTA indicates that perceived barriers such as high initial costs or technological limitations are not necessarily the primary hindrances. Institutional rules, regulatory frameworks, and organizational readiness may affect the adoption process [117–120]. The evidence above shows a picture of green technology adoption as a complex phenomenon where external facilitators, such as government incentives and infrastructure investment, may override personal beliefs in benefits and barriers. Future research should follow such underlying forces to enhance sustainable technology integration. The findings indicate that interventions in the creative industry to encourage green technologies must be driven by intrinsic drivers, such as artistic innovation and environmental stewardship, as opposed to just tangible rewards or decreased barriers. Learning programs should link sustainable actions with artistic values to maximize their uptake. Future studies should investigate further cultural values, individual beliefs, and institutional support as drivers of artistic participation and sustainability. Educational interventions and promotional activities also play an important role in shaping students' attitudes towards adopting green technologies. Studies have shown that incorporating sustainability into the curriculum and engaging students in projects focused on renewable energy, waste management, and sustainable practices significantly increases their willingness to adopt green technologies [121–123]. Promotional activities, such as awareness campaigns and workshops, also enhance students' interest by providing practical knowledge and opportunities to engage with experts [124,125]. Furthermore, institutional support, such as offering incentives and fostering eco-friendly initiatives, boosts students' confidence in adopting green technologies [126]. By integrating these strategies, educational institutions can promote the development of environmentally conscious individuals who are ready to make a positive impact.

5.1. Theoretical Implications

These findings have policy and academic implications. Organizations should target social networks to promote environmental stewardship. Comprehensive sustainability programs, green infrastructure, and eco-friendly incentives can foster institutional support. Artistic engagement and creative arts sustainability are also stressed in the study, suggesting STEM collaboration. Green technology adoption, sustainability, and behavioral theories are also affected by this study. First, adding creative arts sustainability to the model helps explain how creative and artistic qualities interact with environmental factors. Previous research has shown that merging creative expressions with sustainability initiatives can transform [58]. Integrating sustainability concepts into creative practices promotes ecological knowledge and a sense of responsibility [83]. CAS positively affects creative engagement.

The study's structural model expands the Theory of Planned Behavior to green technology adoption by including dimensions such as Perceived Benefits, Perceived Barriers, Social Influence, and Institutional Support. These factors strongly influence behavioral intentions, supporting the TPB's claim that attitudes, subjective standards, and perceived behavioral control shape behavior [83,127,128]. This shows that the TPB can explain people's intentions to adopt green technologies in a unique context, integrating behavioral theories and environmental sustainability.

The extended Unified Theory of Acceptance and Use of Technology correspond with the discovery of specific drivers, including eco-responsiveness [129]. The study's recognition of the multiple causes of green technology adoption beyond economic and regulatory issues improves the theoretical landscape [8,9,41,43,55–57]. This incorporates sociocultural and ethical components into technology adoption theories, matching current sustainability viewpoints [130,131]. Policymakers should offer incentives and recognition to encourage universities to embrace sustainability. These suggestions help graduates become environmentally conscious and promote Sustainable Development Goals activities in society. The results of this study are important for education and environmental policy because they show what helps or prevents students from using green technology. These insights advocate for the integration of sustainability education and green innovation approaches into higher education institutions, consequently advancing the objectives of Saudi Vision 2030 and the Saudi Green Initiative. Colleges can assist the nation in attaining sustainability objectives and Sustainable Development Goals by educating students about the environment, fostering innovative technology, and promoting responsible conduct. Schools should improve lessons that educate students about sustainability, promote green activities on campus, and engage students in initiatives that are healthy for the environment. This will assist in integrating learning with Saudi Arabia's fundamental objective of developing a society that lasts, cares about the environment, and is founded on knowledge systems.

5.2. Practical Implications

This study has major implications for academia and politics. Institutions must design focused social network interventions to encourage environmental stewardship among students. Comprehensive sustainability initiatives, green infrastructure, and eco-friendly incentives can foster a Sustainable Development Goals institutional environment. Science, technology, arts, engineering, and mathematics collaborations should stress artistic engagement and creative arts sustainability in developing ecological understanding and responsibility. Interdisciplinary approaches can enhance sustainability efforts and inspire novel ideas. Policymakers should offer incentives and recognition to encourage universities to embrace sustainability. Institutions can help graduates become environmentally conscious and promote Sustainable Development Goals behaviors by following these guidelines.

6. Conclusion

The growing awareness of environmental issues has spurred the need for Sustainable Development Goals solutions, leading to Green Technology. GT's devotion to environmental sustainability may mitigate the ecological effects of conventional technologies. GT is used in many domains, and its integration is essential for balancing technological progress with environmental protection. GT integration in education promotes environmental awareness, Sustainable Development Goals actions, and prepares future leaders for unprecedented ecological concerns. Higher education institutions shape student attitudes and actions; therefore, it is important to understand the drivers and hurdles of GT adoption. This study examined the motivations and constraints of GT adoption among university students, emphasizing technology and sustainability in education. The goals were to determine how social influence, institutional support, artistic involvement, and creative arts sustainability affect students' GT views. Social impact, institutional support, artistic engagement, and creative arts sustainability were used to understand students' GT uptake in the research model. Structural Equation Modeling was used to examine the survey responses of university students. The study found that social impact, institutional support, artistic involvement, and creative arts sustainability strongly influence students' GT adoption. The inclusion of artistic components showed how creative expression may shape Sustainable Development Goals mindsets. These findings add to the literature by illuminating the complex factors that affect GT adoption in education.

6.1. Limitations and Future Work

The limitations of this study should be considered. While the study employed a convenience sampling method to collect data from university students, we acknowledge that this approach may affect the representativeness of the sample. Data were collected from students at a single university, which may limit the generalizability of the findings to broader student populations. Future studies should employ more rigorous sampling methods, such as stratified random sampling or multi-stage sampling, to ensure a more diverse and representative sample. Additionally, expanding the scope to include participants from multiple universities and regions can improve the generalizability of the results of this study. Moreover, the cross-sectional methodology provides a snapshot rather than a long-term perspective, and self-reported data may introduce response bias. Cross-cultural research is needed because cultural biases may affect the results. These constraints should be addressed by using more diverse samples, combining qualitative and quantitative methodologies, and studying cross-cultural differences. An increase in longitudinal research may reveal the long-term effects of Green Technology education. Further research should examine how sustainability programs and activities affect students' long-term environmental awareness. Our understanding of GT adoption dynamics and Sustainable Development Goals education tactics improves with these efforts.

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Data Availability

No new data was created or analyzed in this work. Data sharing is not applicable to this article.

Conflicts of Interest

The author has no conflict of interest to declare.

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Appendix A. Main Survey Tool

Please rate your agreement with the following statements on a scale of 1 to 5, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree".

Constructs	Items	SD	D	N	A	SA
Perceived Benefits (PB)	Integrating green technologies enhances my artistic creativity.					
	Green technologies contribute to a more sustainable art environment.					
	Using green technologies positively impacts the quality of my artistic projects.					
	Adopting green technologies aligns with my personal values and beliefs.					
	Green technology adoption prepares students for future environmentally conscious art practices.					
Perceived Barriers (PB)	Financial constraints hinder the integration of green technologies.					
	Lack of awareness about green technologies is a barrier to adoption.					
	Resistance to change among faculty/students impedes green technology integration.					
	Inadequate institutional support hinders the adoption of green technologies.					
	Perceiving green technologies as complex is a barrier in art education.					
Social Influence (SI)	Peers' opinions influence my willingness to adopt green technologies.					
	Educators' encouragement positively influences my adoption of green technologies.					
	Societal norms regarding environmental sustainability impact my choices.					
	Discussions about green technologies with peers/educators affect my views.					
	Environmental consciousness within the broader community influences my artistic choices.					
Institutional Support (IS)	My university provides sufficient resources for green technology integration.					
	Well-defined policies at my university promote the adoption of green technologies.					
	Faculty members at my university actively support green technology integration.					
	The university administration encourages sustainability initiatives.					
	There are adequate facilities for the use of green technologies.					
Artistic Engagement	I use sustainable/recycled materials in my artistic projects.					
	I incorporate environmental themes in my artistic work.					
	I collaborate with peers on environmentally conscious art projects.					
	I seek information on sustainable art practices.					
	I participate in environmentally focused art exhibitions or events.					
Creative Arts Sustainability	Art education should prioritize sustainability principles					
	Integrating green technologies enhances the overall sustainability of artistic practices.					
	Sustainable artistic practices should be integral to the curriculum in art education.					
	Environmental responsibility is a key consideration in artistic decision-making.					
	Sustainable practices in art contribute to societal awareness of environmental issues.					
Adopt Green Technologies	I am willing to adopt green technologies in my artistic projects.					
	Integrating green technologies is essential for the future of art.					
	I actively seek opportunities to incorporate green technologies in my artistic practices.					
	Using green technologies enhances the relevance of my artistic work.					
	Adopting green technologies positively impacts the environment.					
Green Technology Use and Learning Performance	Using green tech in my art projects boosts my learning in art education.					
	Green tech significantly improves my understanding and application of artistic concepts.					
	Green tech in art education enhances my creative and critical thinking.					
	Green tech positively influences my artistic skills and techniques.					
	Adopting green tech positively impacts my overall learning in art education.					