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Green Innovation And Ai; Leveraging AI For Sustainable Development, Clean Energy And Environmental Solution

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Abstract

The study investigates the influence of age on perceptions of emerging technologies—specifically big Data Analytics, Simulation Tools, AI for Sustainable Development, Automation, Optimization Algorithms, and Predictive Modeling—in the context of green innovation and artificial intelligence (AI). Artificial intelligence-based automation is transforming sectors in the sustainability realm since it has become more efficient, less resource-constrained, and less impactful on the environment. In addition, AI encourages ongoing enhancements by observing the actual product performance and environmental impact across a course of time. It is through this feedback loop that innovation ideas on product redesign or upgrades can be made known and this would facilitate extended product lifespan and reduced environmental costs. **Methodology**: Using the Kruskal-Wallis non-parametric test, responses from 150 participants across three age groups were analyzed to determine significant differences in opinion. The respondents were selected for the study using **convenience sampling**, a non-probability sampling technique that involves selecting participants who are easily accessible to the researcher. **Findings:** None of the Simulation Tools and AI for Sustainable Development demonstrated a big difference between age groups, but older people (more than 50) were a little bit more positive about the use of AI that sustainability. These results introduce the technological-acceptance factors in cross-generational tendency and are practical interests of technology adaptation strategies, education plans, and policies to promote the concept of sustainable innovations.

Keywords: Green innovation, artificial intelligence, Big Data Analytics, optimization algorithms, predictive modeling, sustainable development and technology perception.

1. Introduction

The XXI century has been marked by the explosive increase of digital technologies and degradation of the ecology. The climate crisis, pollution of air and water, overexploitation of resources, and climate-related disasters are some of the most topical challenges that need radical transformational frontiers. At the same time, Artificial Intelligence developed as a relatively young area to one of the essential technologies of technological development, providing versatile instruments of automatization, forecasting, and optimization. Green innovation and AI are intertwined to find a solution to greater sustainability questions. Green innovation is defined as the ability to create and put into practice a product or service, or a process, in an environmentally friendlier manner, and to improve its ecological output. With the AI propulsion, it becomes fast, larger and more efficient-with the novel ability to monitor the environment, enhance energy efficiency, cut carbon and build climate resiliency.

2. Statement of the Problem

There is a growing awareness of the Environmental issues and urgency to achieve SDGs, the currently available strategies that could be used to tackle the currently facing climate change, resource depletion, and environmental destruction are fragmented and inadequate. Green innovation refers to the creation and utilization of products, processes, or practice that minimize negative impact on the environment. Green innovation is thus very important in the making of a sustainable future. Artificial Intelligence (AI) provides revolutionary opportunities in this respect as it allows predicting analysis, efficient energy, smart environmental monitoring, and optimized resources. Nonetheless, there is less AI integration into the environmental and clean energy sectors in reality. Most governments and sectors are yet to use AI tools in a systematic way in order to green their operations because they lack know-how, there is regulatory un-certainty, and ethical issues. Moreover, the current solutions do not always show connections between technology and the sustainability of the ecology in the long-term perspective. This kind of exploration to make AI work towards sustainable development, optimized use of clean energy and scalable environmental solutions is urgent. To eliminate this challenge, it is necessary to engage in multidisciplinary work that combines technological progress with ethical regulation, the cooperation of the authorities and equalized industries, as well as environmental policies within the local and global contexts programs.

3. Research Gap

Despite the increasing body of literature on green technologies and AI applications separately, there has been a crucial research gap in determining how, in particular, AI contributes to green innovation in a comprehensive, scalable and ethical way. The current research is concentrated on individual application, like AI in climate models, energy predictions, or environmental surveillance but not on their combination as a whole, which would be a sustainable approach. In addition, only scarce empirical studies evaluate the level of such organizations, governments, and societies against adopting those AI-powered environmental solutions. There are also limited or no studies that examine the socio-economic, regulatory and ethical consequences of the use of AI in environmental applications, in particular in the context of the emerging economies. On top of that, there is also a deficiency in the provision of the open-access platforms, alignment in policies, and hypothetically inclusive practices, which will witness a broader take-up of AI tools in various sectors when global tech companies are developing sophisticated artificial intelligence tools. This disjointed knowledge is a hindrance towards the capacity of stakeholders to establish holistic AI-driven sustainable design thinking. The gap also encompasses lack of cross disciplinary practices to integrate environmental science, data science, and ethical governing of AI. There is thereby an urgent necessity of integrative studies, which aside of emphasizing the technical potentials of AI in propelling the risk-free green innovation, also touch on the institutional, ethical, and other infrastructural problems of bringing AI as a form of innovation into the ordinary and responsible practice.

4. Objectives and research methodology

To examine whether there are significant differences in the perceptions of respondents from different age groups regarding Green Innovation and Artificial Intelligence (AI) across various technological dimensions. The study has chosen 150 respondents based on convenience sampling, a non probability method of selecting participants through finding the easiest participants to recruit by the researcher. The reason as to why this method was

appropriate is because of time and resource constraint and indeed the exploratory nature of the study. In order to acquire the specified primary data, a well-formatted questionnaire was developed and implemented online via Google Forms which is a popular survey questionnaire platform. The strategy helped to collect the data conveniently, allowing the respondent to interact with the data when it is convenient and there is wider coverage of the geographical area covered. The questionnaire was geared to find out what the respondents thought of Green Innovation and Artificial Intelligence (AI) concerning many areas of technological perspectives.

5. Analysis, Findings And Results

To examine the significance of opinion difference with age as to whether more people or fewer people want to adopt advanced technologies and how cutting-edge technologies, specifically Green Innovation and Artificial Intelligence (AI), are influencing the global community, a non-parametric statistical analysis, the Kruskal-Wallis test was used. Such a test is suitable in event that there is need to compare more than two independent sets of data where the assumption of normality is not met. The hypothesis was examined by using responses on major technological fields that would have an influence on sustainable development and innovation. The differences in age were described in such dimensions as Big Data Analytics, Simulation Tools, AI Sustainable Development, Automation, Optimization Algorithms, and Predictive Modeling.

Null Hypothesis (H_0): ***There is no significant difference in the opinions of respondents from different age groups regarding Green Innovation and AI across technological dimensions.***

TABLE:1
Difference In The Opinion Based On The Age Group; Green Innovation And Ai

Factors	Age	N	Mean Rank	Test	Result
Big Data Analytics	Less than 30	70	77.91	Chi-Square	2.091
	30 to 50	37	73.01	df	2
	More than 50	43	73.72	Asymp. Sig.	.009
	Total	150			
Simulation Tools	Less than 30	70	80.27	Chi-Square	2.923
	30 to 50	37	75.41	df	2
	More than 50	43	67.81	Asymp. Sig.	.071
	Total	150			
AI for Sustainable Development	Less than 30	70	70.96	Chi-Square	3.271
	30 to 50	37	74.66	df	2
	More than 50	43	83.62	Asymp. Sig.	.083
	Total	150			
Automation	Less than 30	70	70.94	Chi-Square	4.141
	30 to 50	37	85.66	df	2
	More than 50	43	74.19	Asymp. Sig.	.016
	Total	150			
Optimization Algorithms	Less than 30	70	79.00	Chi-Square	3.267
	30 to 50	37	81.47	df	2
	More than 50	43	64.66	Asymp. Sig.	.019
	Total	150			

Predictive Modeling	Less than 30	70	81.61	Chi-Square	2.058
	30 to 50	37	82.74	df	2
	More than 50	43	59.31	Asymp. Sig.	.001
	Total	150			

In order to determine whether the divisions of the age groups are statistically relevant in terms of their attitude to different technological aspects associated with green innovation and AI, a Kruskal-Wallis test was utilized. Indeed, the findings showed that there was statistically significant difference in terms of perceptions among Big Data Analytics ($p = 0.009$), Automation ($p = 0.016$), Optimization Algorithms ($p = 0.019$), and Predictive Modeling ($p = 0.001$) which implies that age is one of the factors that determine the perception of the individual towards such technologies. Respondents under 30 years seemed to be more interested in Big Data Analytics and Predictive Modeling whereas those between 30s and 50 years were more leaning towards Automation and Optimization Algorithms. Conversely, the Simulation Tools ($p = 0.071$) and AI for Sustainable Development ($p = 0.083$) did not reveal any major variance based on age with a greater number of those aged over 50 rating AI for Sustainable Development as positive. These results indicate that different age groups may have different technological receptiveness where young and mid-aged people showed to support a technology-fueled sustainable innovation.

6. Recommendations

1. Investigations into AI Sustainability Investment: Government and business have to encourage investment in AI initiatives capable of addressing environmental concerns such as climate change, energy savings and biodiversity. Financial investments in transdisciplinary researches and inventions of secure and environmentally protecting AI uses can contribute to the establishment of viable solutions that will assist in keeping the planet ecological and resource-aware balance in the long-term.
2. Disseminate Open Data and Transparency: Making environmental data widely available will allow researchers, programmers and policy makers to develop informed AI sustainability models. Immediately, when transmitting the instruments of the open data, open innovation is activated, the development of science is promoted, and the progress made in ecological development can be monitored transparently. The concept of openness needs to be massaged with transparent data governance structures to enable integrity, data privacy, and build confidence in the minds of the citizens.
3. Champion Ethical AI Guidelines: Ethics AI frameworks must be developed and subsequently implemented in making an attempt to prevent discrimination, bias, and catastrophic outcomes. Transparency, accountability, inclusiveness and environmental justice should be features of such. Laws should be set up to educate the developers and industries on how to correlate AI AI uses with human rights, sustainable objectives and the greater good of the population as a whole.
4. Reward eco Friendly Technology Annexation: The governments should then be able to grant tax exemptions or subsidies or handing out of grants to the organizations that adopt the green technology by using AI. Public-private partnership can be used to scale up green innovation and sustainable decisions encouraged by offering incentives to consumers. Such efforts are accompanied by the popularization of green technology that reduces the amount of greenhouse emissions and allows the creation of a low-carbon economy.

Conclusion

AI stands at the forefront of the global push toward sustainability. From optimizing energy use and combating climate change to conserving biodiversity and promoting the circular economy, AI offers powerful tools to achieve green innovation. While challenges remain in data access, ethical concerns, and regulatory preparedness, the potential benefits far outweigh the risks. By fostering responsible, inclusive, and well-governed AI development, humanity can leverage this transformative technology to secure a healthier, more resilient planet for future generations. Significant age-based differences are observed for Big Data Analytics, Automation, Optimization Algorithms, and Predictive Modeling. No significant differences are observed for Simulation Tools and AI for Sustainable Development, though older respondents show a trend toward higher support in the latter. These results suggest that younger individuals are more favorable toward emerging technologies like Big Data and Predictive Modeling, while the 30–50 age groups show more support for Automation and Optimization.

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