Application and Sustainability Factors in the use of Artificial Intelligence in Electrical/Electronic Engineering Telecommunication Instructional Delivery in North-Central Nigeria

by

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Abstract

This study investigated the application and sustainability factors in the use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery in North- Central Nigeria. Three research questions guided the study while three hypotheses formulated were tested at 0.05 level of significance. The study employed a correlational research design. The study sampled all 123 teachers teaching telecommunication in the study area. The study made use of a structured questionnaire as instrument for data collection. The instrument was validated by three experts in the University of Nigeria, Nsukka. The instrument was trial tested, Cronbach alpha reliability method was used to determine the reliability coefficient of the questionnaire items and 0.89 was obtained. The study found out that: (i) relationship exists between AI application and sustainability factor in electrical/electronic engineering telecommunication instructional delivery, (ii) relationship exists between application and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery, and (iii) relationship exists between sustainability factor and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery. It was recommended among others that, teachers should adopt sustainability factor in the use of Artificial Intelligence; Government should promote the use of artificial intelligence application and use of artificial intelligence tools for teaching electrical/electronic engineering telecommunication in tertiary institutions..

Keywords: Sustainability Factor; Artificial Intelligence; Telecommunication; Instructional Delivery

Introduction

Artificial Intelligence (AI) plays a significant role in promoting sustainability across various sectors, but it also presents challenges that need careful consideration. The sustainability factor of AI can be analyzed through its potential benefits and risks in achieving the Sustainable Development Goals (SDGs). Gwon, Keum & Choi (2019,) stated that AI technologies optimizes resource use and improve efficiency in sectors such as energy, agriculture, and transportation. El Kafhali, El Mir & Hanini (2022) state that AI has the potential to facilitate the achievement of productivity, promoting equality, and enhancing environmental outcomes. AI address barriers created by human biases and emotional decision-making, providing data-driven insights that support sustainable practices. Bindra, & Sood (2019) states AI enables progress towards sustainability, duality highlights the need for a balanced approach to AI development and deployment (Chris, 2022). Chris, (2017) express the rapid advancement of AI technologies raises concerns about transparency, safety, and ethical standards. Without proper regulatory frameworks, AI could exacerbate issues such as automated bias and ethical conflicts AI has the potential to significantly contribute to

sustainability efforts by enhancing efficiency, addressing environmental challenges (Reuven, 2022), Thus, Balancing the benefits and challenges of AI will be key to leveraging its capabilities for sustainable development.

Artificial intelligence (AI) has made significant strides in transforming the field of electrical and electronic engineering. Holmes, Hui, Miao&Ronghuai (2021) stated that applications of AI in this domain through AI algorithms can analyze vast amounts of data to predict power demand accurately, enabling engineers to optimize energy generation, distribution, and consumption. AI is integral to the development of smart grids, which use sensors, data analytics, and machine learning algorithms to optimize energy delivery and consumption (NITI 2021). AI can predict energy demand and adjust the production of renewable energy sources accordingly, promoting efficient and sustainable energy usage. Kshirsagar & Kumar (2021) stated that by combining AI with electrical and electronic engineering principles, engineers have developed intelligent robots capable of performing complex tasks autonomously (Novak, 2010). These robots can adapt to changing environments, learn from their experiences, and interact with humans effectively. AI is also used in the development of autonomous systems like drones and robots for applications such as power line inspection. (Sadiku, Ashaolu, Ajayi-Majebi & Musa 2021). AI-based algorithms can optimize circuit layouts for better performance while reducing costs. Machine learning techniques enable accurate predictions of circuit behavior before physical implementation, streamlining the design process. AI systems analyze equipment performance data to identify patterns and anomalies that could indicate potential problems. By detecting these issues early on, engineers can take preventative measures and avoid costly downtime or equipment failures (Cope, Kalantzis&Searsmith 2020)

The adoption of machine learning in electrical engineering has been especially valuable for expanding the horizons of signal processing. AI systems can increase the accuracy and efficiency of signal processing tasks, such as speech and image recognition, natural language processing, and more (Kengam, 2020). AI-powered simulations enable engineers to model complex behaviors of electrical components and increase simulation speed by creating AI-based reduced order models (ROMs). This allows for the creation of AI-based virtual sensors and control strategies for various electrical systems (Panigrahi, 2020). As AI technology continues to advance, its integration into electrical and electronic engineering will only grow, offering new solutions to complex challenges and driving innovation in sustainability field.

The sustainability factor of artificial intelligence (AI) presents several challenges that need to be addressed to ensure its responsible and effective implementation. Here are some key challenges associated with the sustainability of AI. Rodrigues, (2020) stated that AI systems, particularly those involving deep learning and large-scale data processing, require significant computational power, leading to high energy consumption. The rapid advancement of AI technologies can lead to increased electronic waste (e-waste) as older hardware becomes obsolete (Singh & Jain, 2018). Transitioning to renewable energy sources and improving energy efficiency in data centers are essential steps to mitigate this impact. Lack of transparency leads to ethical concerns and hinder efforts to assess the sustainability of AI systems effectively. In industries with limited environmental data sources, ensuring access to relevant data for analysis can be a significant challenge, impacting the ability to implement sustainable AI solutions (Luckin, 2017). Therefore, addressing these challenges requires collaborative efforts from stakeholders, including policymakers, researchers, and

industry leaders, to develop guidelines and practices that promote sustainable AI development and deployment.

Artificial intelligence (AI) offers numerous benefits in promoting sustainability across various sectors. Makuvaza, Jat .&Gamundani (2021) AI analyzes energy consumption patterns in buildings and industries, identifying areas for improvement and reducing waste. According to Tambekar (2019) AI contributes to the effective management of renewable resources. AI optimizes waste management systems by analyzing data on waste production and disposal. AI provides insights that help in developing effective climate adaptation and mitigation strategies (Holmes, Bialik & Fadel 2019). therefore, AI's potential to drive sustainability is vast, impacting various sectors from agriculture to energy management. By optimizing resource use, enhancing efficiency, and supporting conservation efforts, AI emerges as a pivotal tool in addressing environmental challenges and fostering a sustainable future (UNESCO 2019). However, it is essential to implement these technologies responsibly to maximize their benefits while minimizing potential risks.

The risks and challenges associated with artificial intelligence (AI) are multifaceted and require a comprehensive approach to address them effectively. Some of the key risks and challenges. Ghanem, Aparicio-Navarro, Kyriakopoulos, Lambotharan, &Chambers, (2017)) stated that AI systems often rely on vast amounts of personal data for training and decision-making. Improper handling or unauthorized access to this data can result in privacy breaches and violations of individuals' rights to privacy US National Cyber Incident Response Plan (NCIRP). (2017) open that AI algorithms inadvertently perpetuate bias and discrimination, leading to unfair or discriminatory outcomes, particularly in sensitive areas such as hiring, lending, and law enforcement. Biased data sets, flawed algorithms, and inadequate testing exacerbate existing inequalities and undermine privacy rights but in the opinion of European Police (Europol). (2022) AI systems operate as black boxes, making it challenging to understand how decisions are made or to hold them accountable for their actions. Lack of transparency and explain ability in AI algorithms can undermine trust and confidence in their outcomes, particularly in contexts where privacy and fairness are paramount. Instilling moral and ethical values in AI systems, especially in decision-making contexts with significant consequences, presents a considerable challenge. Alkahtani&Aldhyani (2022) express AI systems, due to their complexity and lack of human oversight, might exhibit unexpected behaviors or make decisions with unforeseen consequences, which can negatively impact individuals, businesses, or society as a whole to overcome these challenges and mitigate the risks associated with AI, a multifaceted approach is required (Bhingarkar& Shah 2015). This includes adopting a privacy-by-design approach, establishing clear policies for ethical data use and governance, fostering transparency and explain ability in AI systems, and promoting international collaboration to develop global norms and regulations that protect against AI-related risks.

AI is revolutionizing instructional delivery in education by enabling personalized learning experiences and enhancing teaching effectiveness. Singh, Manickam & Rehman (2014) stated that the ways AI is transforming instructional delivery: AI-powered adaptive learning platforms analyze student performance data to provide personalized content and activities tailored to each student's needs and learning style. Intelligent tutoring systems and natural language processing enable AI to deliver interactive learning experiences and provide real-time feedback and guidance to students. Manimurugan, Al-

Mutairi, Aborokbah, Chilamkurti, Ganesan & Patan 2020) AI tools can assist teachers in aligning instruction to standards, assessing student mastery, delivering content effectively, and adjusting cognitive demand. Dehkordi, Soltanaghaei&Boroujeni (2021) stated that AI can provide teachers with insights into student understanding, recommend differentiated instructional strategies, and automate grading and administrative tasks (The CTU-13 Dataset 2022). AI is being integrated into the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) instructional design model. AI can analyze learner data to inform the analysis and design phases, generate personalized content in the development phase, and provide real-time insights during implementation and evaluation. (Kushwah, & Ranga 2012). The concept of Classroom Robotic Assistants (CRAs) has emerged as an AI-powered expert system that can help deliver lessons and instructional content. CRAs can assist teachers in diagnosing learner needs, delivering content, and assessing learning difficulties, especially when the teacher is unavailable. (Zhong, Xu, Rodriguez, Xu, &Buyya 2021). AI can enhance the delivery of instructional materials by making content readily available, easily updatable, and accessible to students. AI-powered systems can deliver content in engaging formats, provide supplementary resources, and track student progress (Shawahna, Abu-Amara, Mahmoud &Osais 2020). While AI holds great promise for transforming instructional delivery, it is important to consider the ethical implications and ensure that AI is used to augment and empower teachers, not replace them entirely. Integrating AI thoughtfully and responsibly can lead to more effective and equitable learning experiences for all Telecommunication students.

Telecommunication has transformed the world. It is the wheel that is moving technological development in the world today. According to Rodrigues (2020) telecommunication involves the exchange of information between two communication entities using technology. It is the transmission of signs, signals, sounds, words, writing, and messages via signals, wire, radio and optics. According to Tumba& Michika (2014), it is the science of communicating over a long-distance using telephone or radio technology. This means that telecommunication has to do with exchange of information over a long distance. It makes use of other media like radio, optics and wires. To achieve communication through these media demands a great deal of skill, knowledge and attitude. These media are communication systems and such have input, process and output signals with complex circuitry. These acts are made up of fragile sensitive components or devices as such are of developing fault. Reading facts in element of communication system demands adequate skills and proven attitude of polytechnic students.

The polytechnic as one of these institutions is primarily saddled with the responsibility of producing technicians. A Polytechnic according to Tumba& Michika (2014) is a tertiary educational institution whose statutory function is primarily to train middle level manpower for the nation. Polytechnics are established to continue with and expand and pursue the objectives of in specific terms, the primary purpose of polytechnic education in Nigeria is to provide technical learning that will certainly assist the nation in meeting her needs for industrial growth. A major difference between the polytechnic education and other forms of tertiary education in Nigeria is the serious emphasis it placed on practical based learning, with work-attachment as part of its curriculum (Tayo, 2014). The curriculum design and instructional delivery are tailored in such a way to enable students have on-the-job work experience. The focus is on students' future

career. So there is serious attention to the attachment of needed skills acquisition in parts of the course content and how they are delivered. The aim here is to ensure that students develop self-belief and critical reasoning and thinking which are significant to the growth and development of the society (Addison, 2012). Hence of the teaching methods that can guarantee this type of learning that involves hand on deck is artificial intelligence -based learning in North Central Nigeria.

North Central Nigeria is one of the six geopolitical zones in the country, known for its diverse culture, geography, and significant agricultural contributions. Here are some key aspects of the region: Geographic Composition six states and the Federal Capital Territory (FCT), which includes: Benue Kogi, Kwara, Nasarawa, Niger and Plateau the North Central zone is home to various ethnic groups, each with its unique traditions and languages. This diversity contributes to a rich cultural landscape, with numerous festivals and cultural practices celebrated throughout the region. North Central Nigeria plays a crucial role in the country's geography, economy, and cultural identity. Its combination of urban centers, agricultural productivity, and diverse communities makes it a vital area within Nigeria. Thus, the need to determine application and sustainability factor in the use of artificial intelligence in Electrical/Electronic Engineering Telecommunication instructional delivery in North central Nigeria

Statement of the Problem

AI systems are expected to analyze equipment performance data to identify patterns and anomalies that could indicate potential problems. By detecting these issues early on, engineers can take preventative measures and avoid costly downtime or equipment failures. So that can be adoption of machine learning in Electrical Engineering has been especially valuable for expanding the horizons of signal processing. AI systems been accuracy and efficiency of signal processing tasks, such as speech and image recognition, natural language processing, and more. AI-powered simulations enable engineers to model complex behaviors of electrical components and increase simulation speed by creating AI-based reduced order models (ROMs). This allows for the creation of AI-based virtual sensors and control strategies for various electrical systems. As AI technology continues to advance, its integration into electrical and electronic engineering will only grow, offering new solutions to complex challenges and driving innovation in this field.

Unfortunately, the sustainability factor of artificial intelligence (AI) presents several challenges that need to be addressed to ensure its responsible and effective implementation. AI systems, particularly those involving deep learning and large-scale data processing, require significant computational power, leading to high energy consumption. This demand can strain energy resources and contribute to increased carbon emissions if powered by fossil fuels. The carbon footprint of AI technologies is a major concern, as data centers and AI training processes can generate substantial greenhouse gas emissions. The environmental impact of maintaining and cooling these facilities further exacerbates the issue, necessitating the development of greener technologies and practices. School data centers play a critical role in AI operations, but their energy-intensive nature contributes to significant emissions. AI's effectiveness relies heavily on the availability of high-quality data. In schools with limited environmental data sources, ensuring access to relevant data for analysis can be a significant challenge, impacting the ability to implement sustainable AI solutions. Addressing these challenges requires collaborative efforts from stakeholders, including policymakers, researchers, and industry leaders, to develop guidelines and practices that promote

sustainable AI development and deploymentto innovate and solve complex problems across various contributing to advancements in technology and sustainability the need to determine application and sustainability factor in the use of artificial intelligence in Electrical/Electronic Engineering Telecommunication instructional delivery in North central Nigeria

Purposes of the Study

1. Relationship between AI application and sustainability factor in electrical/electronic engineering telecommunication instructional delivery
2. Relationship between application and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery
3. Relationship between sustainability factor and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery

Research Questions

1. What is the relationship between AI application and sustainability factor in electrical/electronic engineering telecommunication instructional delivery?
2. What is the relationship of AI application and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery?
3. What is the relationship of sustainability factor and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery?

Hypotheses

1. There are no significant differences between the relationship of application and sustainability factor in electrical/electronic engineering telecommunication instructional delivery
2. There are no significant differences between the relationship of application and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery
3. There are no significant differences between the relationship of sustainability factor and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery

Methodology

This study aims to explore the application and sustainability factor of Artificial Intelligence in instructional delivery. The research method employed is a correlational design.The questionnaire instrumentwas developedby the researcher based on related existing literature. The study samples all 123 teachers teaching telecommunication in the study area. The questionnaire with five-point scale 23 items for research question one and 17 items for research question two. Instrument was validated by three experts from university of Nigeria Nsukka. The instrument was trail tested, Cronbach's alpha reliability statistics for the items was 0.89. Hypothesis was tested at 0.05 level of significance.

Results

Research Question 1

what is relationship of artificial intelligence application and sustainability factor in Electrical/Electronic Engineering Telecommunication instructional delivery?

Correlations

		Application	Sustainability Factor
Application	Pearson Correlation	1	.738**
	Sig. (2-tailed)		.000
	N	123	123
Sustainability Factor	Pearson Correlation	.738**	1
	Sig. (2-tailed)	.000	
	N	123	123

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis between artificial intelligence application and sustainability factor shows that there is a negative and not significant relationship (r = 0. 738**; P>0.05) between the artificial intelligence application and sustainability factor. This relationship infers that the negative artificial intelligence application and sustainability factor there is less application and sustainability factor in Electrical/Electronic Engineering Telecommunication instructional delivery

Hypothesis 1

There are no significant differences between application and sustainability factor in electrical/electronicengineering telecommunication instructional delivery

ANOVA

Sustainability Factor

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14273.951	32	446.061	5.965	.000
Within Groups	6730.114	90	74.779		
Total	21004.065	122			

This is shown that the Sig. column. The value of 0.000 indicates the statistical not significance Here, P < 0.0005 which is less than 0.05 and indicates that, overall, the model applied is not significantly good enough for predicting the outcome variable. In the behavioral sciences, the acceptable level of significance is 0.05 and any p value that is not greater than 0.05 indicates that the model is not significant between sustainability Factor and use of artificial intelligence in Electrical/Electronic Engineering Telecommunication instructional delivery

Research Question 2

what is relationship of artificial intelligence application and use of artificial intelligence tools in Electrical/Electronic engineering Telecommunication instructional delivery?

Correlations

		Application	Use of AI tools
Application	Pearson Correlation	1	.012
	Sig. (2-tailed)		.898
	N	123	123
Use of AI tools	Pearson Correlation	.012	1
	Sig. (2-tailed)	.898	
	N	123	123

The correlation analysis between artificial intelligence application and use of artificial intelligence tools shows that there is a positive and significant relationship (r = 0. .012; P<0.05) between the artificial intelligence application and use of artificial intelligence tools. This relationship infers that the more artificial intelligence application and use of artificial intelligence tools in Electrical/Electronic engineering Telecommunication instructional delivery

Hypothesis 2

There are no significant differences between application and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery

ANOVA

Use of AI

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1130.652	32	35.333	.765	.802
Within Groups	4156.048	90	46.178		
Total	5286.699	122			

This is shown that the Sig. column. The value of 0.802 indicates the statistical significance Here, P > 0.0005 which is more than 0.05 and indicates that, overall, the model applied is significantly good enough for predicting the outcome variable. In the behavioral sciences, the acceptable level of significance is 0.05 and any p value that is greater than 0.05 indicates that the model is significant in between application and use of artificial intelligence in Electrical/Electronic Engineering Telecommunication instructional delivery

Research Question 3

what is relationship of sustainability factor and use of artificial intelligence in Electrical/Electronic Engineering telecommunication instructional delivery?

Correlations

		Sustainability Factor	Use of AI
Sustainability Factor	Pearson Correlation	1	-.079
	Sig. (2-tailed)		.384
	N	123	123
Use of AI	Pearson Correlation	-.079	1
	Sig. (2-tailed)	.384	
	N	123	123

The correlation analysis between Sustainability Factor and Use of Artificial Intelligence shows that there is a positive and significant relationship (r = 0. .384; P<0.05) between the Sustainability Factor and Use of Artificial Intelligence. This relationship infers that the more Sustainability Factor and Use of Artificial Intelligence the more Use of Artificial Intelligence in Electrical/Electronic Engineering Telecommunication instructional delivery

Hypothesis 3

There are no significant differences between sustainability factor and use of artificial intelligence in electrical/electronic engineering telecommunication instructional delivery

ANOVA

Sustainability Factor

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5746.381	23	249.843	1.621	.054
Within Groups	15257.684	99	154.118		
Total	21004.065	122			

This is shown that the Sig. column. The value of 0.054 indicates the statistical significance Here, P > 0.0005 which is more than 0.05 and indicates that, overall, the model applied is significantly good enough for predicting the outcome variable. In the behavioral sciences, the acceptable level of significance is 0.05 and any p value that is greater than 0.05 indicates that the model is significant in between sustainability factor and use of artificial intelligence in Electrical/Electronic Engineering Telecommunication instructional delivery

Recommendations

1. Teachers to adopt sustainability factor in the use of Artificial Intelligence
2. Government to make promotion for intelligence application and use of artificial intelligence tools

REFERENCES

Addison, C. (2012). Polytechnic education and nation building in Nigeria. *Retrieved from http://sunnewsonline.com*

Alkahtani, H. &Aldhyani, T.H.H. (2022). Developing Cybersecurity Systems Based on Machine Learning and Deep Learning Algorithms for Protecting Food Security Systems: Industrial Control Systems. Electronics 2022, 11, 1717. [CrossRef]

Bhingarkar, A.S. & Shah, B.D. (2015). A survey: Securing cloud infrastructure against edos attack. *In Proceedings of the International Conference on Grid Computing and Applications* (GCA), Athens, Greece, 27–30 July 2015; pp. 16–22.

Bindra, N. &Sood, M. (2019). Detecting DDoS attacks using machine learning techniques and contemporary intrusion detection dataset. Autom. Control. Comput. Sci. 2019, 53, 419–428. [CrossRef]

Chris, H. (2022) Cloud Computing Security: From DDoS (Distributed Denial of Service) to EDoS (Economic Denial of Sustainability). 2008. Available online: http://rationalsecurity.typepad.com/blog/2008/11/cloudcomputing-security-from-ddos-distributeddenial-of-service-to-edos-economic-denial-of-sustaina.html.

Chris, H. A (2017) Couple of Follow-Ups on the EDoS (Economic Denial of Sustainability) Concept. 2009. Available online: http://rationalsecurity.typepad.com/blog/edos.

Cope, B., Kalantzis, M., & Searsmith, D. (2020). Artificial Intelligence for Education: Knowledge and its assessment in AI-enabled learning ecologies. Educational Philosophy and Theory, 1-17.

Dehkordi, A.B.; Soltanaghaei, M.&Boroujeni, F.Z. (2021). The DDoS attacks detection through machine learning and statistical methods in SDN. J. Supercomputer. 2021, 77, 2383–2415.

El Kafhali, S.; El Mir, I. &Hanini, M. (2022) Security threats, defense mechanisms, challenges, and future directions in cloud computing. Arch. Compute. Methods Eng. 2022, 29, 223–246.

European Police (Europol). (2022). The Internet Organized Crime Threat Assessment (IOCTA). 2017. Available online: https://www.europol.europa.eu/activities-services/main-reports/internet-organisedcrime-threat-assessment-iocta-2017 (accessed on 22 March 2022).

Ghanem, K.; Aparicio-Navarro, F.J.; Kyriakopoulos, K.G.; Lambotharan, S. & Chambers, J.A. (2017) Support vector machine for network intrusion and cyber-attack detection. In Proceedings of the 2017 Sensor Signal Processing for Defense Conference (SSPD), London, UK, 6–7 December 2017; pp. 1–5.

Gwon, H.; Lee, C.; Keum, R.; Choi, H. (2019,) Network intrusion detection based on LSTM and feature embedding. arXiv

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education. Boston: Center for Curriculum Redesign.

Holmes, W., Hui, Z., Miao, F., &Ronghuai, H. (2021). AI and education: A guidance for policymakers. UNESCO Publishing.

Kengam, J. (2020). Artificial intelligence in education. Https://www.researchgate.net/publication/347448363_artificial_intelligence_in_education

Kolias, C.; Kambourakis, G.; Stavrou, A.; Voas, J. (2022). DDoS in the IoT: Mirai and other botnets. Computer 2017, 50, 80–84.

Kshirsagar, D. & Kumar, S. (2021). An efficient feature reduction method for the detection of DoS attack. ICT Express 2021, 7, 371–375.

Kushwah, G.S. & Ranga, V. (2012) Optimized extreme learning machine for detecting DDoS attacks in cloud computing. Compute. Secure 2021, 105, 102260.

Luckin, R. (2017). Towards artificial intelligence-based assessment systems. Nature Human Behavior, 1(3), 1-3.

Makuvaza, A.; Jat, D.S. &Gamundani, A.M. (2021). Deep neural network (DNN) solution for real-time detection of distributed denial of service (DDoS) attacks in software defined networks (SDNs). SN Comput. Sci. 2021, 2, 107.

Manimurugan, S.; Al-Mutairi, S.; Aborokbah, M.M.; Chilamkurti, N.; Ganesan, S. & Patan, R. (2020). Effective attack detection in internet of medical things smart environment using a deep belief neural network. IEEE Access 2020, 8, 77396–77404.

NITI Ayog (2021). Responsible AI, AI for All, Approach Documents for India, Part-1 Principles for Responsible AI.

Novak, J. D. (2010). Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations. Routledge.

Panigrahi, C. M. A. (2020). Use of Artificial Intelligence in education. Management Accountant, 55, 64-67.

Reuven, C. (2022) Cloud Attack: Economic Denial of Sustainability (EDoS). Available online: http://www.elasticvapor.com/2009/01/cloud-attack-economic-denial-of.html (accessed on 20 March 2022).

Rodrigues, R. (2020). Legal and human rights issues of AI: gaps, challenges and vulnerabilities. Journal of Responsible Technology, 4, 100005.

Sadiku, M. N., Ashaolu, T. J., Ajayi-Majebi, A., & Musa, S. M. (2021). Artificial Intelligence in Education. International Journal of Scientific Advances, 2(1), 5-11.

Shawahna, A.; Abu-Amara, M.; Mahmoud, A.S.H. &Osais, Y. (2020) EDoS-ADS: An enhanced mitigation technique against economicdenial of sustainability (EDoS) attacks. IEEE Trans. Cloud Comput. 2020, 8, 790–804.

Singh N. C. and Jain R... (2018). Personalizing 'Learning' - Can AI Promise Customised Education for 'Humanity'. It is cited by (UNESCO MGIEP, 2018).

Singh, P.; Manickam, S.; & Rehman, S.U. (2014). A survey of mitigation techniques against Economic Denial of Sustainability (EDoS) attack on cloud computing architecture. In Proceedings of the IEEE 3rd International Conference on Reliability, Infocom Technologies and Optimization (ICRITO), Noida, India, 8–10 October 2014; pp. 1–4.

Tambekar, A. (2019). How Artificial Intelligence AI can Help the Physically Challenged. https://www.mygreatlearning.com/blog/how-artificial-intelligence-ai-can-help-thephysically-challenged/

Tayo, O. (2014). The odds against polytechnic education. Retrieved from www.pmnewsnigeria.com

The CTU-13 Dataset. (2022). A Labeled Dataset with Botnet, Normal and Background traffic. Available online: https://www.stratosphereips.org/datasets.

Tumba I. & Michika, M.U. (2014). Assessing technical teachers' professional development in information and communication technology for teaching in polytechnics in the north eastern states of Nigeria. *European Scientific Journal September, 10(25)*

UNESCO (2019). Challenges of beginning teachers and prerequisite support to retain and sustain them in the Profession. Working Papers on Education Policy no.07.

US National Cyber Incident Response Plan (NCIRP). (2017). Available online: https://www.us-cert.gov/ncirp Sensors 2022, 22, 4685 22 of 24

Zhong, Z.; Xu, M.; Rodriguez, M.A.; Xu, C. &Buyya, R. (2021) Machine learning-based orchestration of containers: A taxonomy and future directions. ACM Comput. Surv. (CSUR) 2021.