

Awareness and Utilization of Artificial Intelligence in Teaching Computer Hardware Maintenance in Universities in Enugu State, Nigeria

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Abstract

This study investigated the awareness and utilization of artificial intelligence (AI) in teaching computer hardware maintenance in universities in Enugu State, Nigeria. The study had two specific purposes and two research questions. A descriptive survey research design was adopted for the study. A sample of 27 respondents comprised of lecturers from University of Nigeria, Nsukka, and Enugu State University of Science and Technology obtained through total population sampling given that the population was small and manageable. Instrument for data collection was a structured questionnaire entitled “Awareness and Utilization of Artificial Intelligence in Teaching Computer Hardware Maintenance Questionnaire (AUAITCHMQ)” developed by the researchers. The instrument was face validated by three experts; and the reliability was tested using Cronbach’s alpha. Data collection was done through personal contact. Data were analyzed using mean and standard deviation, with a cut-off point of 2.50 used to interpret responses. The null hypotheses were tested at 0.05 levels of significance using independent sample t-test. The results of the study revealed that lecturers were aware of artificial intelligence integration in teaching computer hardware maintenance. The findings further revealed that the extent of utilization of artificial intelligence in teaching computer hardware maintenance in the universities was low. It was recommended among others that Universities administration should collaborate with AI experts to train lecturers on the utilization of AI technologies in teaching.

Key words: Artificial Intelligence; Awareness; Utilization; Teaching; Computer Hardware Maintenance

Introduction

In recent years, the field of education has witnessed a significant transformation due to technological advancement due to Artificial Intelligence. Artificial intelligence (AI) is the ability of machines or computer to think and act as human, represents the efforts towards computerized system to imitate the human mind and actions (Wartman and Combs, 2018). It is a computer system capable of performing complex tasks that historically only human could do, such as reasoning, making decisions, or solving problems (Bostrom & Yudkowsky, 2018). AI is the simulation of human intelligence processes by machines, particularly computer systems, which include learning, reasoning, and self-correction (Russell & Norvig, 2021). It refers to the capability of a machine to imitate intelligent human

behaviour, enabling it to perform tasks that typically require human intellect, such as visual perception, speech recognition, decision-making, and language translation (Nilsson, 2020). In this context, AI is the ability of electronic devices to perform tasks that involve human intelligence. The tasks include: language understanding, pattern recognizing, problem solving, and decision making. The goal of Artificial Intelligence (AI) is to develop computer systems that can perform tasks that normally require human intelligence, such as learning, reasoning, problem-solving, understanding language, recognizing patterns, and making decisions.

Artificial Intelligence (AI) is broadly categorized into two main frameworks: by capabilities and by functionalities (Sachin, 2019). By capabilities, AI is classified

into three types: Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Artificial Superintelligence (ASI) (Venkatesh, 2025). Firstly, Artificial Narrow Intelligence (ANI) also known as "weak AI" is the only form of AI that exists today. It is highly specialized and trained to perform specific, narrowly defined tasks. Examples are voice assistants (like Apple Siri or Amazon Alexa), email spam filters, and streaming recommendation engines. Secondly, Artificial General Intelligence (AGI) often referred to as "strong AI," is a theoretical milestone. If developed, AGI would be capable of understanding, learning, and performing any intellectual task a human can across a wide variety of domains. Thirdly, Artificial Superintelligence (ASI) is a hypothetical future AI that would not only match but fundamentally surpass human intelligence and cognitive capabilities in every aspect, from creativity to problem-solving. These three frameworks classify AI based on how closely the system resembles human thinking, learning, and overall intelligence.

By functionalities, AI is divided into four groups: Reactive Machines, Limited Memory AI, Theory of Mind AI, and Self-Aware AI (Venkatesh, 2025). Firstly, Reactive Machines purely react to the present data and do not store past experiences or use prior data to inform future actions. An example is IBM Deep Blue, which is the chess-playing computer. Secondly, Limited Memory AI is the most common functional type today, these systems use past data and recent experiences to make better decisions, though they lack long-term retention. An example is self-driving cars reading traffic and chat interfaces that remember recent messages. Thirdly, Theory of Mind AI seeks to understand human emotions, beliefs, and intentions so that machines can interact in a socially responsive and emotionally intelligent manner. Fourthly, Self-Aware AI is a theoretical benchmark where the AI

possesses human-like consciousness, self-awareness, and an understanding of its own state and existence. These four frameworks categorize AI based on its ability to process information, remember past experiences, and interact with its environment.

Artificial Intelligence (AI) in education is revolutionizing traditional teaching methods by introducing advanced technologies that enhance the teaching experience (Zawacki-Richter, et al., 2019). One significant type of artificial intelligence in education is Intelligent Tutoring Systems (ITS), which provide personalized instruction and feedback to students without human intervention. These systems adapt to individual learning styles and pace, making education more accessible and effective (Nkambou, et al, 2010; Holmes et al., 2019). Another type of artificial intelligence is automated grading, which uses machine learning algorithms to evaluate and grade student assignments and exams, thereby saving teachers' time and ensuring consistent and objective assessment (Balfour, 2013; Luckin et al., 2016). Additionally, artificial intelligence-powered Learning Management Systems (LMS) can track student progress, identify learning gaps, and recommend tailored resources to address those gaps, promoting a more individualized learning experience (Woolf, 2010). Artificial intelligence is also employed in the development of Virtual Reality (VR) and Augmented Reality (AR) tools, creating immersive learning environments that enhance student engagement and understanding of complex subjects (Chen, 2016). These various types of AI in education not only improve the efficiency and effectiveness of the teaching process, but also make education more inclusive and personalized especially in computer hardware maintenance.

Computer hardware maintenance refers to the process of keeping hardware components in good working condition

through regular inspections, cleanings, repairs, and updates (Classic Network & Computers, 2026). This practice ensures that the physical components of a computer, such as the hard drive, motherboard, and peripherals, operate efficiently and without interruption. Effective maintenance prevents hardware failures and extends the lifespan of the digital device. According to Moreira and Caldeira (2017), proactive maintenance helps in reducing downtime and avoiding costly repairs by addressing potential problems before they escalate.

Teaching computer hardware maintenance in universities involves a blend of theoretical instruction and hands-on sessions (Smith, 2021). Theoretical aspects cover the basics of computer architecture, components, their functions and safety measures; while practical sessions provide students with the opportunity to dismantle, assemble, and troubleshoot hardware. This dual approach ensures that students not only comprehend the underlying principles but also gain the practical skills necessary for real-world applications (Smith, 2021). Hence, teaching computer hardware maintenance prepare students to leverage advancements in technology, such as diagnostic tools and automated repair systems, which are increasingly driven by the application of AI in computer hardware maintenance.

Application of AI in computer hardware maintenance has enabled predictive and automated maintenance processes. AI algorithms analyse vast amounts of data from sensors embedded in hardware components to predict failures before they occur, reducing downtime and maintenance costs (Jackley, 2024; Massobrio, 2024). Similarly, AI-powered diagnostic tools analyse system logs, predict hardware failures before they occur, and recommend preventive measures (Brown, 2021). Machine learning models identify patterns and anomalies that human technicians might miss, ensuring more accurate diagnostics

and efficient repairs (Johnson & Lee, 2021). Furthermore, AI-driven maintenance systems schedule repairs during non-peak hours, minimizing disruption to business operations (Doe, 2019). Virtual labs and simulations offer alternatives to traditional hardware labs, allowing students to practice skills in a virtual environment (Robinson, 2021).

Furthermore, AI-powered virtual assistants and chatbots provide real-time support to students and faculty, offering instant solutions to technical queries related to hardware components and troubleshooting techniques (Jones & Brown, 2021). AI-enhanced simulation tools simulate hardware malfunctions and repair scenarios, offering students hands-on experience in a virtual environment, which complements traditional laboratory sessions (Garcia, 2022). AI algorithms analyse large datasets generated from hardware performance metrics, enabling instructors to customize learning materials and assessments based on individual student needs and learning patterns (White, 2019). Integrating AI in teaching represents a significant advancement that enhances educational outcomes by providing personalized learning experiences, optimizing maintenance processes, and preparing students for careers in technology-driven industries. Though, gender should not be a barrier to AI education. That is, gender should not determine who is taught AI or who can become an AI teacher, researcher, or professional.

Gender refers to socially constructed differences between male and female. Jaffer and Shafiq (2017) referred to gender as the culturally and socially constructed dimension of one's biological sex. The goal of gender in AI is to promote equality, fairness, inclusion, and equal opportunities for all genders in the development and use of artificial intelligence. The choice of gender is so essential because: it can

influence students' behaviour, perception, preference, need, and outcome; as well improve the students' accuracy and relevance in research findings. Basically, gender helps in understanding and addressing differences and disparities among students utilising AI.

Despite the transformative potential of AI in educational settings, integration of AI in teaching computer hardware maintenance remains underexplored (Oluwaseun & Adedayo, 2023). Hence, this study addressed this gap by investigating the awareness and utilization of AI in teaching computer hardware maintenance in universities in Enugu State Nigeria.

Statement of the Problem

In ideal educational environment, artificial intelligence (AI) is seamlessly integrated into teaching processes, enhancing the educational experience through personalized learning, adaptive assessments, and automated administrative support. In fields like computer hardware maintenance, AI can offer sophisticated tools for practical training and simulations, equipping students with the skills necessary to thrive in a rapidly evolving technological landscape. This integration not only supports educators in delivering more effective instruction but also prepares students for the demands of modern workplaces where technology plays a critical role.

Despite global advancements in AI and its successful implementation in various educational settings, the current state of AI awareness and utilization in Nigerian universities, particularly in Enugu State, reveals a significant gap. There is limited understanding of how AI could be applied specifically to teach computer hardware maintenance. As a result, teaching experiences in computer hardware maintenance remain suboptimal, necessitating a comprehensive investigation into the current landscape of AI awareness and utilization within this academic context

to identify opportunities for enhancement and development. Hence, this study aims to bridge this gap by thoroughly investigating the awareness and utilization of artificial intelligence in teaching computer hardware maintenance in universities in Enugu state, Nigeria.

Purpose of the Study

The main purpose of this study is to determine the awareness and utilization of artificial intelligence in teaching of computer hardware maintenance in universities in Enugu state Nigeria. Specifically, the study sought to determine the:

1. awareness level of artificial intelligence in teaching of computer hardware maintenance in universities in Enugu State, Nigeria.
2. extent of utilization of artificial intelligence in teaching of computer hardware maintenance in universities in Enugu State, Nigeria.

Research Questions

The following research questions were formulated to guide the research study:

1. What is the awareness level of artificial intelligence in teaching of computer hardware maintenance in universities in Enugu State Nigeria?
2. To what extent are artificial intelligence utilized in teaching of computer hardware maintenance in universities in Enugu State, Nigeria?

Hypotheses

The formulated null hypotheses guided the study and were tested at 0.05 levels of significance.

- H₀₁: Gender has no significant difference on awareness level of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria.
- H₀₂: University has no significant difference on the extent of utilization of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria

Methodology

This study adopted descriptive survey research design. The study was carried out in public universities that teach computer hardware maintenance in Enugu State during the 2024/2025 academic session. The population for the study was 27 respondents comprised of 19 lecturers from Department of Computer and Robotics Education, University of Nigeria Nsukka, and 8 lecturers from Department of Computer Science Education, Enugu State University of Science and Technology, respectively. There was total population sampling due to the fact that the target group was small and of manageable size by the researchers. The instrument for data collection was a structured questionnaire titled “awareness and utilization of artificial intelligence in teaching computer hardware maintenance Questionnaire (AUAITCHMQ)” developed by the researchers. AUAITCHMQ is a 16-item questionnaire. Research question one has a 4-point rating scale (Very High Level, VHL = 4; High Level, HL = 3; Low Level, LL = 2; and Very Low Level, VLL = 1); and research question two also has a 4-point rating scale (Very High Extent, VHE = 4; High Extent, HE = 3; Low Extent, LE = 2; and Very Low Extent, VLE = 1). AUAITCHMQ was subjected to face validity by three experts from the Department of Computer and Robotics Education, Universities of Nigeria, Nsukka. The experts were requested to use their expertise to determine the suitability of the items in the instrument to elicit the needed data for the study. The experts’ suggestions

and corrections were affected before the final copy of the instrument was produced and used for the study. The reliability of the instrument was established using Cronbach Alpha reliability method. A total of 10 lecturers from Nnamdi Azikiwe University (NAU) Awka, Anambra State, which was outside the study area, though shared similar geographical characteristics with the zone under the study, was used for the trial testing. The reliability test yielded an Alpha value (reliability index) of 0.78, indicating high reliability. The instrument was administered by the researchers through personal contacts; and the consent of the respondents was voluntarily given. The data collected for the study were analysed using mean to answer each of the research questions, and standard deviation to determine the closeness or otherwise of the opinions of the respondents from group mean. Any item with a mean value of 2.50 and above was high level for research question one, and high extent for research question two respectively; while items with mean values less than 2.50 were low level for research question one, and low extent for research question two respectively. Moreover, null hypotheses formulated for the study were tested using independent sample t-test at 0.05 levels of significance. If the significance is less than 0.05, then, the null hypothesis should be rejected otherwise the null hypothesis should be accepted.

Results

Research Question 1: What are the awareness levels of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State Nigeria?

Table 1: Mean Distribution of the awareness level of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State Nigeria

S/N	Statements	N	$\bar{x}$	SD	Decision
1	I am aware of artificial intelligence technology used in teaching of computer hardware maintenance.	27	2.64	0.76	High Level
2	I am familiar with artificial intelligence applications relevant to computer hardware maintenance.	27	2.52	0.82	High Level
3	I am aware of artificial intelligence role in teaching computer hardware maintenance.	27	2.87	0.94	High Level
4	I discuss artificial intelligence applications in hardware maintenance regularly.	27	2.73	0.82	High Level

5	I am aware of artificial intelligence application in personalized learning.	27	2.90	0.73	High Level
6	I am aware of the impact of artificial intelligence on the future of education.	27	2.76	0.78	High Level
7	I am aware of ethical considerations in the use of artificial intelligence in education.	27	2.38	0.96	Low Level
8	I am aware of artificial intelligence role in enhancing teaching engagement.	27	2.66	0.78	High Level
9	I am aware that integration of artificial intelligence can improve the efficiency of teaching computer hardware maintenance.	27	2.89	0.84	High Level
10	I am aware of institutional policies supporting artificial intelligence in education.	27	2.94	0.98	High Level
11	I am aware of faculty trainings on artificial intelligence integration in teaching.	27	2.67	0.84	High Level
Cluster Details		27	2.72	0.84	High Level

Key: N= Number of Respondents, $\bar{X}$ = Mean, SD = Standard Deviation.

Table 1 showed that all the items except item 7 have their mean ratings above 2.50. This implied that the majority of the respondents responded that the items had high level of awareness of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria. However, item 7 had a mean rating of 2.38 which implied that the respondents had lower level of awareness of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria. The lower level of AI awareness suggested that there was still a gap in the consciousness of ethical implications or rather considerations in the use of artificial

intelligence in education. This suggested for further awareness programmes on the ethical aspects of artificial intelligence to ensure a more comprehensive understanding of its role in education. The standard deviation of all the items ranged from 0.73-0.98 showed that the respondents were close to each other in their responses to the items. The cluster mean of 2.72 proven that the responses of the respondents were of high level of awareness of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria.

Research Question 2: To what extent are artificial intelligence utilized for teaching in universities in Enugu State, Nigeria?

Table 2: Mean and Standard Deviation Distribution of the extent artificial intelligence are utilized for teaching in universities in Enugu State, Nigeria

S/N	Statements	N	$\bar{x}$	SD	Decision
12	Artificial intelligence is actively used in practical labs for hardware maintenance courses.	27	2.18	0.36	Low Extent
13	Artificial intelligence is used to assess student performance in hardware maintenance tasks.	27	2.07	0.91	Low Extent
14	Faculty members incorporate artificial intelligence-based projects in hardware maintenance curriculum.	27	2.41	0.64	Low Extent
15	Artificial intelligence is extensively used in teaching computer hardware maintenance in my university.	27	2.22	0.76	Low Extent
16	Artificial intelligence is utilized in customizing learning experiences for students.	27	2.34	0.91	Low Extent
Cluster Details		27	2.24	0.72	Low Extent

Key: N= Number of Respondents, $\bar{x}$ = Mean, SD = Standard Deviation.

Table 2 showed that all the items have mean ratings below 2.50. This implied that the respondents responded that all the items have low extent of artificial intelligence utilization in teaching computer hardware maintenance in universities in Enugu State, Nigeria. The standard deviation of all the items ranged from 0.36-0.91 showed that the

respondents were close to each other in their responses to the items. The cluster mean of 2.24 confirmed the response of the respondents that all the items were low extent of utilization of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria.

Null Hypothesis 1

Table 3: Gender has no significant difference on awareness level of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria.

Gender	N	$\bar{X}$	SD	F	Sig.	T	Df	Sig. (2-tailed)	Decision
Male	15	2.73	0.82	18.21	0.23	1.01	25	0.34	Not Significant
Female	12	2.90	0.73						

Key: N=Number of Respondents, $\bar{X}$ =Mean, SD=Standard Deviation

The result of the analysis in table 3 showed that Levene's of $F(25) = 18.21$, $P = 0.23$, $t(25) = 1.01$, $P = 0.34$ was greater than 0.05 alpha level. This indicated that gender was not statistically significant on awareness

level of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria. Hence, the null hypothesis was accepted.

Null Hypothesis 2

Table 4: University has no significant difference on the extent of utilization of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria

University	N	$\bar{X}$	SD	F	Sig.	T	Df	Sig. (2-tailed)	Decision
UNN	19	2.41	0.64	2.67	0.60	0.25	25	0.46	Not Significant
ESUT	8	2.22	0.76						

Key: N=Number of Respondents, $\bar{X}$ =Mean, SD=Standard Deviation

The result of the analysis in table 4 showed that Levene's of $F(25) = 2.67$, $P = 0.60$, $t(25) = 0.25$, $P = 0.46$ was not significant at 0.05 alpha level. This indicated that university was not statistically significant on the extent of utilization of artificial intelligence in teaching computer hardware maintenance in universities in Enugu State, Nigeria. Hence, the null hypothesis was accepted.

Discussion of the Findings

The data presented revealed that lecturers had high level of artificial intelligence awareness in the context of teaching computer hardware maintenance. But it is only "awareness of ethical considerations in the use of artificial intelligence in education" had low level. In support of the

findings, Habib (2018) found out that 78% of respondents were aware of artificial intelligence use in computer hardware maintenance education. Similarly, Dergunova, et al. (2022) reported that the artificial intelligence awareness level of the respondents in their study was also high.

The data presented revealed that the extent of utilization of artificial intelligence in teaching in the universities was low. Corroborating the above findings, Abdulganiy, Aliyu and Ahmed (2023) reported that the extent of utilization of artificial intelligence technology among library and information science educators in teaching in Ebonyi State was low.

Implications of the Findings

The findings of the study have significant implications for several stakeholders in the education sector.

1. Universities in Enugu State should prioritize enhancing the awareness of ethical considerations regarding artificial intelligence to foster responsible use among students and faculty.
2. Unawareness and underutilization of artificial intelligence resources in computer hardware maintenance underscores the need for educational institutions to invest in updated technologies and training tools that facilitate effective artificial intelligence integration into the curriculum.
3. Faculty members should be encouraged to develop and incorporate artificial intelligence -based projects and assessments in their teaching methodologies to improve student engagement and learning outcomes.
4. The active use of artificial intelligence in practical labs indicates a successful application of technology, suggesting that universities can leverage this strength to expand artificial intelligence utilization across other academic areas.

Conclusions

Indeed, adoption of Artificial Intelligence in education is gaining much recognition globally, especially in the developing nations due to its massive potentials. The main goal of AI is to use intelligent computer systems to assist humans, solve problems, automate tasks, and improve the way humans live and work. Unfortunately, the pace of utilization of AI in the developing countries including sub-Saharan Africa is not commendable. The findings of the results revealed that majority of the lecturers have high level of awareness of artificial intelligence in teaching computer hardware maintenance. However, it was discovered from the findings that the extent of utilization of artificial intelligence in teaching in the universities was low. This

therefore calls for government and other stakeholders in education to increase campaign that fosters AI adoption in the educational system.

Recommendations

The following recommendations were made based on the findings of the study:

1. Universities administration should collaborate with AI experts to organize workshops, seminars, and training sessions for lecturers to deepen their understanding and application of AI technologies in teaching.
2. Universities administration should also invest in acquiring up-to-date AI software, tools, and infrastructure that support teaching computer hardware maintenance.
3. Universities should implement policies that will enforce the implementation of artificial intelligence in instructional delivery.
4. Educational policymakers and curriculum planners should review and update the curriculum to include more AI-related courses and modules.

References

- Abdulganiy, O. A., Aliyu, M. B. & Ahmed, A. A. (2023). Awareness, availability, and utilisation of artificial intelligence technology among library and information science educators in Ebonyi State. Retrieved on 1st August, 2025, from, https://www.researchgate.net/publication/383201813_Awareness_Availability_and_Utilisation_of_Artificial_Intelligence_Technology_among_LIS_Educators_in_Ebonyi_State.
- Balfour, S. P. (2013). Assessing writing in MOOCs: Automated essay scoring and calibrated peer review. *Research & Practice in Assessment*, 8, 40-48.

- Bostrom, N., and Yudkowsky, E. (2018). The ethics of artificial intelligence. In K. Frankish & W. M. Ramsey (Eds.), *The Cambridge Handbook of Artificial Intelligence* (pp. 316-334).
- Brown, A. (2021). Artificial Intelligence in Hardware Maintenance: Innovations and Challenges. *Journal of Technology Management*, 15(2), 45-58.
- Chen, C. J. (2016). The use of virtual reality in education: A tool for learning in the experience age. *Journal of Educational Technology Development and Exchange*, 9(1), 1-15.
- Classic Network & Computers (2026). The Importance of Regular Computer Hardware Maintenance for System Longevity. Retrieved on 3rd June, 2026, from, <https://www.cnc-system.com/blog/the-importance-of-regular-computer-hardware-maintenance-for-system-longevity/>.
- Dergunova, Y., Aubakirova, R., Yelmuratova, B., Gulmira, T., Yuzikovna, P., & Antikeyeva, S. (2022). Artificial intelligence awareness levels of students. *International Journal of Emerging Technologies in Learning*, 17(18), 26-37.
- Doe, J. (2019). AI in predictive maintenance. *Tech Journal*, 34(2), 45-52.
- Garcia, A. (2022). "Enhancing Hands-On Learning in Computer Hardware Maintenance Through AI-Enhanced Simulations." *Journal of Educational Technology*, 12(3), 45-58.
- Holmes, W., Bialik, M, and Fadel, C. (2019). *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. (1st ed.)*. Center for Curriculum Redesign: Boston, MA, USA.
- Jackley, M. (2024). *Using AI in Predictive Maintenance*. Retrieved on 3rd June, 2025, from, <https://www.oracle.com/africa/scm/ai-predictive-maintenance/>.
- Jaffer, U. and Shafiq, M. (2017). Relationship between age, gender and conflict management styles and its effect on employee performance in the major universities of Quetta City. *Balochistan Review*, 2(2), 163-172.
- Johnson, A., and Lee, M. (2021). Machine learning applications in hardware diagnostics. *Journal of Computing*, 57(3), 112-125.
- Jones, B., and Brown, C. (2021). "AI-Powered Virtual Assistants in Higher Education: Improving Support for Computer Hardware Maintenance Students." *Educational Technology Review*.
- Luckin, R., Holmes, W., Griffiths, M., and Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. London: Pearson.
- Massobrio, A. (2024). Predictive Maintenance Machine Learning: A Practical Guide. Retrieved on 3rd June, 2025, from, <https://www.neuralconcept.com/post/how-ai-is-used-in-predictive-maintenance>.
- Moreira, M. M., and Caldeira, M. M. (2017). *Computer Maintenance: Concepts and Applications*. Springer.
- Nilsson, N. J. (2020). The Quest for Artificial Intelligence. *Cambridge University Press*.
- Nkambou, R., Mizoguchi, R., & Bourdeau, J. (2010). Advances in Intelligent Tutoring Systems. *Springer Science & Business Media*.

- Oluwaseun, A., and Adedayo, I. (2023). Artificial Intelligence in Higher Education: Current Trends and Challenges. *Educational Technology & Society*, 26(2), 45-60.
- Robinson, D. (2021). Virtual Labs and Simulations in Computer Hardware Maintenance Education. *Journal of Computing Sciences in Higher Education*, 12(1), 78-92.
- Russell, S. J., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson Education, Inc., London.
- Sachin, R. (2019). Artificial Intelligence: Understanding the Different Types. Retrieved on 23rd March, 2026, from, <https://www.fingent.com/uk/artificial-intelligence-understanding-the-different-types/>.
- Smith, J. (2021). *Computer Hardware Maintenance: Theory and Practice*. Routledge
- [Venkatesh, R. \(2025\)](#). What Are the Main Types of Artificial Intelligence? Retrieved on 23rd March, 2026, from, <https://trybusinessagility.com/articles/ai/types/>.
- Wartman, S. A., & Combs, D. (2018). Medical Education Must Move from the Information Age to the Age of Artificial Intelligence. *Academic Medicine*, 93, 1107-1109. <https://doi.org/10.1097/ACM.00000000000002044>
- White, R. (2019). "Personalized Learning Using AI in Computer Hardware Maintenance Education." *Journal of Artificial Intelligence in Education*.
- Woolf, B. P., Lane, H. C., Chaudhri, V., & Kolodner, J. (2013). AI grand challenges for education. *AI Magazine*, 34(4), 66-84.
- Zawacki-Richter, O.; Marín, V. I.; Bond, M. and Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators??. *International Journal of Educational Technology in Higher Education*, 16, (39) 1-27. <https://doi.org/10.1186/s41239-019-0171-0>