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EMERGING TECHNOLOGIES IN THE ERA OF INDUSTRY 4.0: THE DYNAMICS OF STUDENTS UNDERSTANDING OF CONCEPTS AND APPLICATION

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***Abstract*:** This research paper analyzes students' familiarity, understanding, and utilization of emerging technologies. The paper sampled tertiary institution students specifically students of computer-related courses at the Federal College of Education, Yola. The paper also dwells on six emerging technology concepts: Artificial intelligence and machine learning, cloud computing, the internet of things, cyber security, big data and blockchain technology. The findings reveal that most of the students are familiar with the technologies and have a good understanding of the concepts. The findings also indicate that most of the students are utilizing emerging technologies from different perspectives, especially in education. These findings agree with two major publications on emerging technologies.

Keywords: Emerging, Technologies, Industry 4.0, Dynamics, Concepts

INTRODUCTION

The challenges posed by the emerging technologies in solving problem continue to attract the attention of the students. The Knowledge of digital technologies, Internet of Things, real-time data gathering analysis, cloud services, and big data are among the technologies that are required to set the ball rolling for Industry 4.0. Grenčíková et al., (2021) revealed that the skills needed for work change due to increased advanced cognitive skills in critical thinking and problem-solving, while creativity and curiosity are related to socio-behavioral skills. As a result of such changes, students need to understand the concepts in emerging technologies especially when sensitive issues are at stake. The emergence of Industry 4.0 is one of the issues or realities to be addressed students to acquire the required competencies.

The research therefore seeks to find the level of students understanding of emerging technology concepts and utilization.

LITERATURE REVIEW

Emerging technology is a term referring to new technology, it may refer to the continuing development of an existing technology. The term may refer to different areas and different technologies based on those areas, how those technologies are improved and as well the new ones.

Montoro et al., (2019) are of the opinion that there is no specific definition of emerging technologies due to the divest nature of fields. They advocated that to consider what emerging technologies are one has to respect the researchers' perspectives. They when further to say that imaging technologies can be viewed as the extension of technology as other people consider it. Rotolo et al., (2015) are of the view that the understanding of emerging technologies depends on the analyst perspectives, her may consider technology emergent due to its newness and its expected socio-economic impact. While others see it as extension of an existing technology.

INDUSTRY 4.0

Industry 4.0 refers to the digitalization and transformation of production or manufacturing base industries through connected technologies, namely cyber-physical systems, the internet of things, cloud computing, and cognitive computing (Kagermann et al., 2013). As such, the uniqueness of Industry 4.0 can be categorized in four perspectives. Interconnection, information transparency, technical assistance, and decentralized decision.

The Industry 4.0 concept will change the composition of the labour market. The concept is described as a network of related systems that deliver self-regulated production where people, machines, equipment, and products will communicate with each other.

Industry 1.0 (1784) built on machinery for water and steam production.
Industry 2.0 (1870) built on mass production possible by dividing labour and electricity.
Industry 3.0 (1969) builds on electricity usage, information technology, and
Industry 4.0 (Today) using cyber-physical systems.
A cyber-physical system is a system that is controlled or monitored through computer-based procedures that include autonomous automobile systems, medical monitoring, industrial control systems, automatic pilots, etc (Muktiarni et al., 2019).
Individual Competencies based on understanding of concepts relate to a set of behaviors, abilities, skills, analysis, decision-making, and transmission of information required to claim a position in an occupation (Bermúdez and Juárez, 2017). Competencies can be categorized into three technical, behavioral, and contextual competencies (Kamaruzzaman et al. 2018). Emerging technologies when it comes to both new innovation and development on the existing technologies such technologies are Internet of things, Big data, Cyber security, Block chain, Cloud computing, and Artificial intelligence.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
Artificial intelligence (AI) are technology enables machines that perform tasks which typically require human intelligence, such as learning, decision-making, and problem-solving. It is the simulation of human intelligence in machines that are programmed to think and learn like humans. Huang, (2010) defined AI as a broad field that comprises a variety of techniques, including machine learning, natural language processing, and computer vision, to enable machines to perform tasks that typically require human intelligence. AI technologies include Machine Learning, natural language processing and computer vision (Jordan & Mitchell, 2015).

CLOUD COMPUTING
Cloud computing technology permits access to shared computing resources on request, such resources include servers, storage, and applications, over the internet. Elebute, (2019) sees Cloud computing is a way of delivering computing services over the internet through service-based resources rather than locally managed resources.

INTERNET OF THINGS (IoT)
Internet of Things technology refers to the network of physical devices, buildings, vehicles, and other embedded with sensors, software, and connectivity, allowing the items to exchange data. (Morgan, 2019) defined internet of things as a physical object embedded with sensors, software, and other technologies for connecting and exchanging data with other devices and systems over the internet.

CYBER SECURITY
Cybersecurity technology refers to the practices, technologies, and processes designed to protect digital information, computer systems, and electronic data from unauthorized access, use, disclosure, disruption, modification, or destruction. It is the application of protecting systems, networks, and programs from digital attacks. Moore, (2024) the primary goal of cybersecurity is to ensure the confidentiality, integrity, and availability of information.

BLOCKCHAIN TECHNOLOGY
Blockchain technology is a decentralized, digital ledger that records transactions and data across a network of computers. It uses cryptography to secure and validate transactions, making it a secure and transparent way to conduct transactions and store data. Radziwill, (2018) view Blockchain as a decentralized ledger technology that enables secure, transparent, and tamper-proof transactions without the need for intermediaries.

METHODOLOGY
POPULATION AND SAMPLING THE POPULATION OF STUDY
Students from computer related courses in one of the higher institutions of learning in Nigeria who are estimated to be around 1053 students and the designated sample size is 100 students. The sample size is based on (Yamane, 1967). The sampling table stated that for the population of 1053 persons the targeted population sample size should be 100.

RESEARCH APPROACH
The research is both for descriptive and explanatory purposes as it will be used to analyze
Imaging technologies in the era of industry 4.0 the dynamics of students understanding of concepts and application in computer related departments of federal college of education, Yola.
A quantitative approach was employed in the research and a survey strategy was used to collect information about emerging technologies from the respondents using the questionnaire as the primary source of data. Questionnaires were administered to students of computer science department federal college of education, Yola. The questions reflected on each of the measuring objectives. Based on the outcome from the respondents, analysis were carried out using excel and through simple percentage method.

DATA COLLECTION
The primary and secondary data are identified as the two types of data for this study. The primary data is the data that will be collected from various respondents while the secondary data are those data that are found in the literature which provides the basis for the research. Questionnaires were administered to respondents as a method of data collection. The questionnaire has questions for each of the objectives. The weighting scale method of questions was used.

RESEARCH INSTRUMENT

The research instrument used was questionnaire. All participants were asked the same set of questions. This is to make it easier to compare data from different participants. To maintain consistency across primary data collection. The questions does not include respondent's details such as gender, age group, school, and classification.

DATA ANALYSIS

Data analysis for this study was carried out using Microsoft excel. The analysis of data was carried out to discover answers to asked questions and extract and connect information from the data that was obtained. Various descriptive statistics like the hierarchical chart, pie charts and percentages was used to test the level of significance. In this study, descriptive statistics are used to give a summary of the collected data.

DATA PRESENTATION

Table 1: Students familiarity, understanding and application of ET concepts

Students familiarity and understanding of emerging technology concepts		Students experience in applying emerging technology concepts to practice
Emerging technologies	percentage	percentage
Artificial intelligence	94%	94%
Machine learning	33%	16%
Internet of things	89%	89%
Cyber security	92%	87%
Cloud computing	97%	97%
Big data	96%	93%
Blockchain	63%	61%

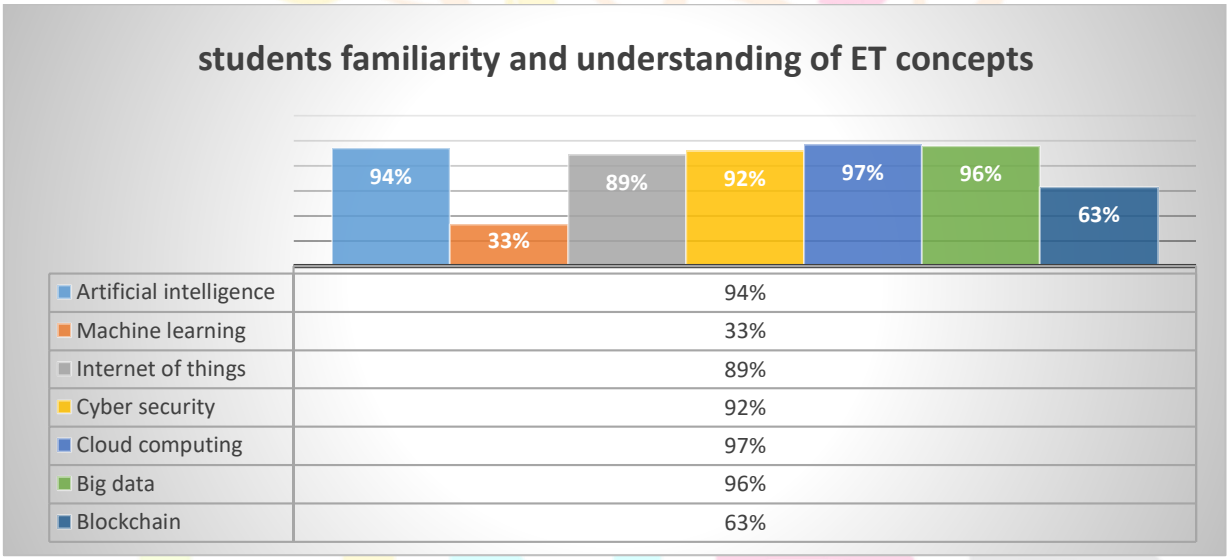

Figure 1: Students familiarity and understanding of ET concepts

Figure 1 indicates that must of the students studying computer related courses are familiar and understands of what those emerging technologies stand for (Artificial intelligence AI, Internet of things, Cyber security, Cloud Computing, Big Data, Block chain Technologies), only few that do not have idea on those emerging technology concepts with the exception of block chain technology which have over 30% that claim not to have idea and do not understand the concept.

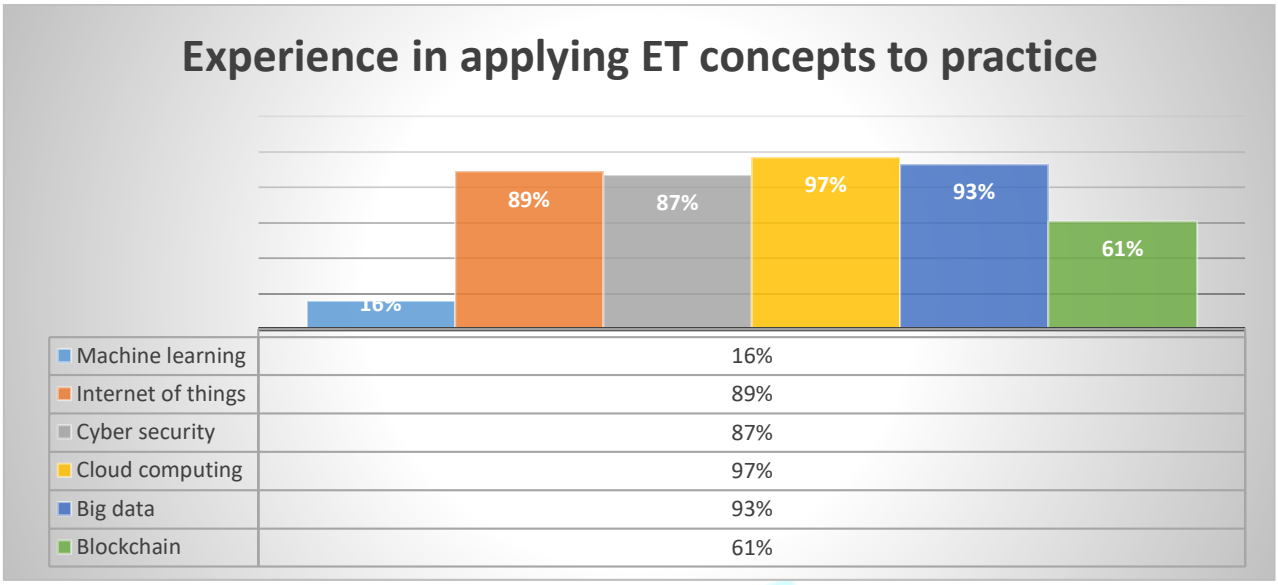

Figure 2: Students experience in applying ET concepts to practice

Figure 2 indicates that must of the students have experience in using those technologies in different ways and for different purposes with only few students claiming not to have experience in using those technologies. Though the number of students claiming to have experience using machine learning technology is only 16% of the sample population.

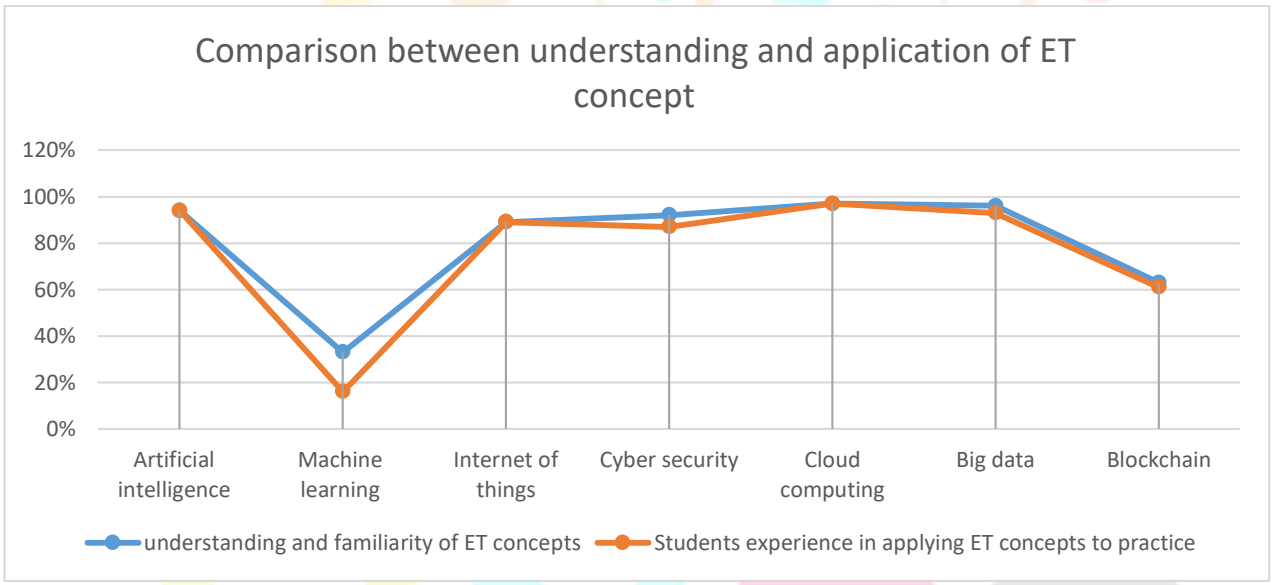

Figure 3: Comparison between understanding and application of ET concept

DISCUSSION OF RESULTS AND CONCLUSION

The importance of students having good understanding and the ability to use those emerging technologies will enhance productivity and self-reliance as the application of emerging technologies cut across all sectors of human endeavor in this research a survey study was carried out to discover the student level of familiarization, understanding and utilization of emerging technologies. The result was very encouraging as majority of the sample students have familiarity, understanding and are utilizing the emerging technologies in different ways especially in education. This tally with the findings of Junaid et al., (2022) which claimed that in recent years emerging technologies have been wide deployed in many areas. The paper is also in agreement with Ujah-ogbuagu, (2023) who claimed that there are some notable achievements emerging technology utilization in Nigeria.

The paper though concentrated only on six emerging technologies named Artificial Intelligent, Internet of things, Cloud Computing, Cyber security, Big Data, and Block Chain Technologies. The paper also concentrated only on higher institutions of learning and specifically Federal College of Education, Yola (FCEY) with students of computer related courses as a priority.

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