

Pioneering the Application of Artificial Intelligence in OTM Programme in OTM Programme: Building the Artificial Intelligence Skills needed by OTM Educators in Polytechnics in Delta State

Ojohwoh, D. Rita

**Department of Office Technology and Management,
Delta State Polytechnic, Ogwashi-Uku**

+2318037164852

Abstract

The study sought the skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. Two research questions were raised and two null hypotheses were tested for the study. Descriptive survey research design was adopted for the study. The entire population of 26 OTM educators in two public owned polytechnics in Delta State was studied without sampling. A five point rating scale questionnaire containing 30 items was used for data collection. Cronbach Alpha co-efficient was used to establish the reliability of the instrument which yielded coefficients of 0.77 and 0.89 for different clusters with an overall coefficient of 0.83. The researcher administered the instrument with four research assistants. Mean and standard deviation were used to answer the research questions while t-test was used to test the null hypotheses at 0.05 level of significance. Findings of the study revealed that technical awareness skills were highly needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. Findings of the study revealed that technical performance skills were highly needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. Also, the study disclosed that there is no significant difference in the mean ratings of male and female OTM educators on the technical awareness skills and technical performance skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State. The study concluded that technical awareness skills and technical performance skills are needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. This study recommended among others that training courses and workshops should also be held for OTM educators to learn about what is new in the field of AI and how it can apply in OTM programme in polytechnics.

Introduction

Artificial intelligence is a set of technologies for building computer systems that can perform complex analytic tasks independently. Simple examples include everything from speech recognition and decision-making to visual perception. Artificial Intelligence has already proven to be beneficial to other industries as varied as Healthcare, Manufacturing, and Agriculture by providing greater personalization to users, automating processes and examining large data sets to suggest continuous improvements to work products (Ng, Leung, Su, Ng & Chu, 2023). Yang (2022) posited that artificial intelligence (AI) is a rapidly evolving field of technology that involves the development of intelligent machines that can perform tasks that typically require human intelligence, such as understanding natural language, recognizing patterns, and making decisions based on data. AI refers to the field of computer science that involves creating computer programs capable of imitating intelligent behavior and ideally enhancing human-like abilities (Dillenbourg, 2016). The field of AI is concerned with the theory and practice of developing systems that simulate the distinctive characteristics of human intelligence (Al-Subhy, 2020), and its main goal is to understand the principles of intelligence in human behaviour to implement them in a machine.

The development of AI began with the intention of creating intelligence similar to human intelligence and implanting it in machines, making it capable of learning and analyzing data in different situations, showing reactions and making decisions according to the situation (Chiu, 2021). There are three generations of AI. The first generation is called Artificial Narrow Intelligence (ANI), and in this generation, AI is applied to specific tasks. The second generation is called Artificial General Intelligence (AGI); in this generation, AI can think, plan, and solve problems independently. The third generation is Artificial Super-Intelligence (ASI), in which AI is considered a conscious system capable of social skills and creativity (Chen, Chen & Lin, 2020). Artificial intelligence, a swiftly expanding discipline, encompasses the development of intelligent robots capable of emulating human thought processes and actions, finding utility in diverse areas such as medical diagnosis, self-driving cars and education (Wardat et al., 2023). AI tools such as Bing and ChatGPT have been referred to as objects individuals can think with, especially in the teaching-learning situation for learners to enhance their ability to think critically and reflectively, foster creativity, acquire problem-solving skills and grasp concepts effectively (Hawes & Arya, 2023).

The integration of AI in education effectively realized learner-centered learning (Huang, 2018). AI-powered tools and applications improve educational measurement, including testing, assessment, and evaluation. These tools can provide educators with valuable insights into student performance, learning outcomes, and instructional effectiveness (Huang, 2018). For example, AI-powered assessment tools can analyze student responses to assignments and provide personalized feedback to help students identify areas of strengths and weaknesses (Huang, Lu, & Yang, 2023). These tools can also provide teachers with insights into the effectiveness of their instruction and identify areas, where they may need to adjust their teaching strategies. In addition, AI-powered tools can help automate many aspects of the assessment process, saving time and reducing the burden on teachers. For example, AI-powered grading tools can analyze students essays and provide feedback on grammar, structure, and content, reducing teachers' time grading assignments (Huang et al., 2023). AI-powered tools can also help identify students at risk of falling behind or benefit from additional assistance or remediation (Delgado et al., 2020). These tools can analyze students' data, such as test scores and attendance records, and identify patterns that may indicate a need for intervention. This can help teachers to provide targeted support to students who need it most.

Nevertheless, there are concerns regarding user privacy is another significant matter (Hu & Min, 2023). Furthermore, concerns have been raised regarding plagiarism detection in content produced by ChatGPT, as well as the challenge of distinguishing between factual and fictional text generated (Dillenbourg, 2016). Instructors are increasingly concerned that students may utilize ChatGPT to complete their written assignments, as plagiarism detection tools can generate reports within seconds without being detected (Elliott & Soifer, 2022). More specifically, questions have been raised about the accuracy with which AI tools can discriminate between text written by humans and one written by AI tools (Khan, Ahmad, Jabeur & Mahdi, 2021). This is because there are currently no methods available to distinguish between content generated by such a tool and those written by humans (Kumar, 2019).

One would agree that the application of artificial technology is placing a sense of urgency on the educational programmes such as office technology and management to transform itself for the future. Office Technology and Management (OTM) is a 21st century educational programme designed to replace secretarial studies in order to make its recipients stay in line with current requirement of modern offices. Office technology and management programme therefore, is an educational programme meant for the acquisition of knowledge, skills office ethics and competencies needed to prepare the individuals to enter gainful employment in specific business and office occupation (Iro, 2016). In order to enable students understand the dynamics of today's fast pace business world, the components of office technology and management programme in Nigeria is structured into office technology, office application, business administration and management. It prepares recipients for office occupations such as secretaries, executive secretaries, administrative assistants, and function in other similar titles describing jobs similar or

overlapping those of the traditional secretary such as office coordinator, executive assistant, office manager and administrative professionals (Omowumi, 2014).

Udo and Bako (2014) outlined the objectives of OTM programme as following:

- a) Ability to perform general office work by relieving executives and other company officials of minor executive and clerical duties
- b) Ability to take down dictation from the boss using shorthand or stenotype machine
- c) Ability to transcribe dictation or the recorded information reproduced on a transcribing machine
- d) Ability to make appointments for the executive and reminding him or her of them.
- e) Ability to interview people coming into the office, and directing to other workers those who do not need to see the chief executive
- f) Ability to handle personal and important mails, writing routine correspondence on his/her own initiatives
- g) Ability to make and answer telephone calls
- h) Ability to supervise other clerical workers
- i) Ability to keep personnel records of events in the offices

Thus, the application of artificial intelligence in OTM programme is a global initiative. This initiative addresses the demand for AI and AI-related future workforce and equips students with lifelong skills to live and work in the AI-infused world (Fu, Gu & Yang, 2020). The need to prepare the future creators, designers and shapers of future AI technologies that currently permeate every facet of human lives is connected to the application for AI in OTM programme in educational institutions. The application of AI in OTM programme can point out places where courses need to improve. OTM educators may not always be aware of gaps in their lectures and educational materials that can leave students confused about certain concepts. AI offers a way to solve that problem. When a large number of students are found to submit the wrong answer to a homework assignment, AI alerts the educator and gives future students a customized message that offers hints to the correct answer (Chiu, 2021). The application of AI in OTM programme can shift the role of OTM educators to that of facilitators. OTM educators will supplement AI lessons, assist students who are struggling, and provide human interaction and hands-on experiences for students. In many ways, artificial technology is already driving some of these changes in the classroom, especially in schools that are online or embrace the flipped classroom model.

The application of AI in OTM programme requires a set of new skills for OTM educators to enable them adapt to AI in the future. For OTM educators to succeed in the application of AI in OTM programme, they must understand the technical knowledge and technical skills behind the technology. With AI skills, educators can critically evaluate AI technologies, communicate and collaborate effectively with AI, and use AI as a tool online, at home and in the workplace (Lin, Yang, Jiang & Li, 2022). AI skills include the ability to use AI technologies safely, critically, and judiciously in work, learning, social engagement and human interactions to achieve various goals (Ng, Leung, Chu & Qiao, 2021). In the field of education, AI skills include the technical skills that educators use to obtain information, formulate it in the form of digital images, store it in files, and publish it on the information network (Voogt, Fisser, Pareja-Roblin, Tondeur & van-Braak, 2013). AI skills can help provide educators with the appropriate amount of knowledge and skills to use AI technologies in their field of work (Sanusi, Olaleye, Oyelere & Dixon, 2022) and keep pace with the development taking place in the field of education.

In general, AI skills can raise the quality of education and learning. To this end, sets of skills that have been proposed in previous studies mainly fall into two categories: (1) technical awareness and (2) technical performance skills (Sun, Ma, Zeng, Han & Jin, 2022). Technical awareness skills entail understanding the ideas and principles of AI. Technical awareness skills describe OTM educators' knowledge of artificial intelligence. Technical awareness skills-set helps to update the skills for successful integration of the AI

curriculum, for instance, knowledge of AI concepts and principles or how to use AI-based tools to develop students' competencies (Ng, Leung, Su, Ng & Chu, 2023).

On the other hand, technical performance skills entail using AI-based tools as a hands-on activity (Al-Ghamdi, 2019). Technical performance skills describe OTM educators' ability to utilize AI technology, and integrate it into teaching practice. It is important that OTM educators are aware of and appreciate the skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State. Identifying the current technical awareness skills and technical performance skills needed by OTM educators for the application of AI in OTM programme is the crux of this study. Also, gender divide could influence the opinions of OTM educators on the skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State. However, this assumption needs to be supported by empirical evidence. Against this backdrop, the study sought to determine the skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State.

Purpose of the study

The study is designed to determine the skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. Specifically, the study sought to determine:

1. Technical awareness skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State.
2. Technical performance skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State.

Research Questions

The following research questions guided the study:

1. What are the technical awareness skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State?
2. What are the technical performance skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference in the mean ratings of male and female OTM educators on the technical awareness skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State
2. There is no significant difference in the mean ratings of male and female OTM educators on the technical performance skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State.

Method

This study adopted descriptive survey research design. The entire population of 26 OTM educators in the two public owned polytechnics in Delta State was studied without sampling. A structured and validated questionnaire was used for data collection. The questionnaire contained 19 items on a five point rating scale of Very Highly Needed (VHN), Highly Needed (HN), Moderately Needed (MN), Slightly Needed (SN) and Not Needed (NN). Face validity of the instrument was determined by three experts; one expert in OTM unit of Department of Vocational and Technical Education, one expert in the Department of

Computer Science and another in Measurement And Evaluation unit of Department of Educational Foundations all from Delta State University, Abraka. A pilot test was conducted to establish the internal consistency of the instrument by administering it to 15 OTM educators in polytechnics in Edo State which were not part of the study and the data collected were analyzed using Cronbach Alpha method which yielded reliability coefficients of 0.77 and 0.89 for the different clusters with an overall coefficient of 0.83.

The researcher administered the instrument to the subjects in their offices with the help of four research assistants. This procedure facilitated the collection of all the administered questionnaire and this exercise lasted for two weeks. Mean and standard deviation were used to analyse data collected in relations to the research questions while mean was used to answer the research questions, standard deviation was used to determine the homogeneity of the respondents' views. Decision on the questionnaire items was based on the real number relative to the real limits of numbers as:

Response	Rating Scale	Real Limit of Numbers
Very Highly Needed(VHN)	5	4.50 – 5.00
Highly Needed (NN)	4	3.50 – 4.49
Moderately Needed(MN)	3	2.50 – 3.49
Slightly Needed(SN)	2	1.50 – 2.49
Not Needed (NN)	1	1.00 – 1.49

T-test was used for testing the null hypotheses at 0.05 level of significance. Hypothesis was accepted where the p-value is greater than the alpha level of 0.05 ($p > 0.05$), at a degree of freedom; otherwise, the null hypothesis was rejected. The analysis was carried out using Statistical Package for Social Science (SPSS).

Results

Research Question 1

What are the technical awareness skills needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State?

Data relating to this research question were analysed and presented in Table 1

Table 1

Respondents' mean ratings on technical awareness skills needed for pioneering the application of AI in OTM programme in polytechnics

S/N	Technical awareness skills	X	SD	Remarks
1	Ability to understand the meaning of computer vision that make up AI	4.28	.73	Highly Needed
2	Ability to understand the meaning of machine learning that make up AI	4.17	.41	Highly Needed
3	Ability to understand the meaning of natural language processing that make up AI	3.89	.82	Highly Needed
4	Ability to understand the meaning of computational			

thinking that make up AI	3.91	.59	Highly Needed
5Ability to understand the meaning of algorithm composition that make up AI	4.03	.48	Highly Needed
6Ability to understand the meaning of digital literacy that make up AI	3.96	.63	Highly Needed
7Ability to understand the meaning of digital privacy that make up AI	4.10	.80	Highly Needed
8Ability to understand the meaning of digital integrity that make up AI	4.03	.46	Highly Needed
9Ability to understand the meaning of digital etiquette that make up AI	3.94	.74	Highly Needed

Data in Table 1 show that the nine items listed on technical awareness skills were highly needed by respondents with mean ratings of 3.89 and 4.28. The cluster mean score of 4.03 indicates that technical awareness skills were highly needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. The standard deviations for all the items are within 0.41 to 0.82. This shows that the respondents are not wide apart in their ratings.

Research Question 2

What are the technical performance skills needed by OTM educators for pioneering application of AI in OTM programme in polytechnics in Delta State?

Table 2

Respondents' mean ratings on technical performance skills needed for pioneering application of AI in OTM programme in polytechnics

S/N	Technical performance skills	X	SD	Remarks
11	Ability to use AI-Computer-Assisted Technologies in OTM programme	4.64	.56	Very Highly Needed
12	Ability to use Augmented Reality (AR) Technologies in OTM programme	4.02	.68	Highly Needed
13	Ability to use AI-Powered Gamification Technologies in OTM programme	3.91	.40	Highly Needed
14	Ability to use Predictive Analytics Technologies in OTM programme	3.86	.78	Highly Needed

15	Ability to use Learning Analytics Technologies			Very
16	in OTM programme			Highly Needed
17	Ability to use Virtual Reality (VR) Technologies	4.76	.43	Highly Needed
18	in OTM programme	4.00	.62	Highly Needed
19	Ability to use AI-Powered Virtual Assistants	3.95	.59	Very
20	in OTM programme	4.86	.73	Highly Needed
	Ability to use Intelligent Tutoring System (ITS)			
	in OTM programme	3.90	.49	Highly Needed
	Ability to use AI-powered Natural Language Processing	4.15	.64	
	in OTM programme			
	Ability to use Automated essay scoring (AES) software			
	in OTM programme			

Data in Table 2 show that three out of the 10 items listed on technical performance skills were very highly needed by respondents with mean ratings of 4.64 to 4.86 while the remaining seven items were highly needed with mean ratings ranging from 3.86 to 4.15. The cluster mean score of 4.21 indicates that technical performance skills were highly needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. The standard deviations for all the items are within 0.40 to 0.78. This shows that the respondents are not wide apart in their ratings

Hypothesis 1

There is no significant difference in the mean ratings of male and female OTM educators on the technical awareness skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State

Table 3

t-test analysis of mean ratings of male and female business educators on technical awareness skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State

Variable	N	X	SD	df	t-value	p-value	Decision
Male	15	72.856.08	24	1.03	0.74	Not Significant	
Female	11	68.915.77					

Table 3 shows that there is no significant difference in the mean ratings of male and female OTM educators on the technical awareness skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State. This is shown by the p-value of 0.74, which is greater than the significance level of 0.05. The null hypothesis of no significant difference between the two groups is therefore accepted.

Hypothesis 2

There is no significant difference in the mean ratings of male and female OTM educators on the technical performance skills needed for pioneering application of AI in OTM programme in polytechnics in Delta State

Table 4

t-test analysis of mean ratings of male and female business educators on technical performance skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State

Variable	N	X	SD	df	t-value	p-value	Decision
Male	15	80.917.53		24	1.32	0.29	Not Significant
Female	11	74.606.38					

Table 4 shows that there is no significant difference in the mean ratings of male and female OTM educators on the technical performance skills needed for pioneering application of AI in OTM programme in polytechnics in Delta State. This is shown by the p-value of 0.29, which is less than table value at significance level of 0.05. The null hypothesis of no significant difference between the two groups is therefore accepted.

Discussion of Findings

Findings of the study revealed that technical awareness skills were highly needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. This means that the ability of OTM educators to understand the basic foundations and core concepts of artificial intelligence are highly needed for pioneering the application of AI in OTM programme in polytechnics. The finding of this study agree with Xia, Chiu, Lee, Sanusi, Dai and Chai (2022) and Yang (2022) which reported that understanding the concepts behind AI algorithms are important especially for educators in educational institutions. Applying AI in OTM programme has become necessary since its application in daily situations has become unavoidable since computers and other intelligent devices influence how things are done in today's world.

Findings of the study revealed that technical performance skills were highly needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State. This means that the ability of OTM educators to use Learning Analytics Technologies, AI-Computer-Assisted Technologies, Augmented Reality (AR) Technologies and Intelligent Tutoring System (ITS) among others to facilitate and manage project-based learning or inquiry-based learning in OTM programme in polytechnics. This finding corresponds with Chen, Chen and Lin (2020) who reported that educators need technical performance skills to manage educational programme via online and in-person classroom. The possession of technical performance skills by OTM educators will help them use available AI technologies to carry out practical learning activities in OTM programme

Also, the study showed that there is no significant difference in the mean ratings of male and female OTM educators on the technical awareness skills and technical performance skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State. This means that gender of OTM educators do not influence their mean ratings on technical awareness skills and technical performance skills needed for pioneering the application of AI in OTM programme in polytechnics in Delta State. This findings tally with Al-Subhy (2020) who reported that there is no statistically significant different between gender of educators on technical awareness skills and technical performance skills needed for educational purposes on the premise that they must understand and utilize the full value of AI in education. This finding supports, Chaudhry and Kazim (2022) which reported that educators need AI skills due to their enablement of learning support, content delivery and real-time assessment.

Conclusion

Artificial intelligence is increasingly important in academic institutions as educators and students need adequate information for research. AI is utilized in many disciplines, including computer science, biology, psychology, linguistics, mathematics, and engineering, to develop computer functions related to human intelligence, such as thinking, learning, and problem-solving. The study concluded that technical awareness skills and technical performance skills are needed by OTM educators for pioneering the application of AI in OTM programme in polytechnics in Delta State.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Training courses and workshops should also be held for OTM educators to learn about what is new in the field of AI and how it can apply in OTM programme in polytechnics.
2. Teacher training should be arranged for OTM educators to enable them acquire technical awareness skills and technical performance skills needed for implementing AI lessons in OTM programme in polytechnics.

References

- Al-Ghamdi, A. (2019). Technical competencies of teachers of Islamic education in schools of the future from the viewpoint of specialists. *Pedagogical Pedagogy*, 8(4), 113 -136
- Al-Subhy, A. (2020). The reality of artificial intelligence applications use in education by faculty members at Najran University. *Journal of the Faculty of Education, Ain Shams University*, 4(44), 319-368
- Chaudhry, M. A., &Kazim, E. (2022). Artificial Intelligence in Education (AIEd): A high-level academic and industry note 2021. *AI and Ethics*, 2(1), 157–165
- Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, 8, 75264–75278.
- Chiu, T. K. (2021). A holistic approach to the design of artificial intelligence (AI) education for K-12 schools. *TechTrends*, 65(5), 796–807.
- Dillenbourg, P. (2016). The evolution of research on digital education. *International Journal of Artificial Intelligence in Education*, 26(2), 544-560.
- Elliott, D., & Soifer, E. (2022). AI technologies, privacy, and security. *Frontiers in Artificial Intelligence*, 5, 826737.
- Fu, S., Gu, H., & Yang, B. (2020). The affordances of AI-enabled automatic scoring applications on learners' continuous learning intention: An empirical study in China. *British Journal of Educational Technology*, 51(5), 1674–1692.
- awes, D., &Arya, A. (2023). Technology solutions to reduce anxiety and increase cognitive availability in students. *IEEE Transactions on Learning Technologies*, 16(2), 278-291.
- Huang, A.Y., Lu, O.H., & Yang, S.J. (2023). Effects of artificial intelligence-enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom. *Computers & Education*, 194, 104684

- Huang, S.P. (2018). Effects of using artificial intelligence teaching system for environmental education on environmental knowledge and attitude. *EURASIA Journal of Mathematics, Science and Technology Education*, 14(7), 3277-3284.
- Hu, Y., & Min, H. K. (2023). The dark side of artificial intelligence in service: The “watching-eye” effect and privacy concerns. *International Journal of Hospitality Management*, 110, 103437.
- Iro, D.M. (2016). *Assessment of the adequacy of office technology and management programme curriculum relative to employers’ requirement in North West Nigeria*. Unpublished Ph.D Dissertation, Department of Technology and Vocational Education, NnamdiA zikiwe University, Awka
- Khan, I., Ahmad, A. R., Jabeur, N., & Mahdi, M. N. (2021).An artificial intelligence approach to monitor student performance and devise preventive measures. *Smart Learning Environments*, 8(1), 1-18.
- Kumar, N. S. (2019). Implementation of artificial intelligence in imparting education and evaluating student performance. *Journal of Artificial Intelligence*, 1(01), 1-9.
- Lin, R., Yang, J., Jiang, F., &Li, J. (2022).Does teacher's data literacy and digital teaching competence influence empowering students in the classroom? Evidence from China. *Education and Information Technologies*, 28, 2845-2867
- Ng, D., Leung, J., Su, J., Ng, R., & Chu, S. (2023). Teachers’ AI digital competencies and twenty-first century skills in the post-pandemic world. *Educational technology research and development*, 71, 137-161
- Ng, D.T.K., Leung, J.K.L., Chu, S.K.W., &Qiao, M.S. (2021).Conceptualizing AI literacy an exploratory review. *Computers in Education: Artificial Intelligence*, 2 (2021), Article 100041
- Omowumi, O. (2014). Relevance of shorthand skills to secretaries’ job performance in modern office in North West geo-political zone, Nigeria.*Unpublished Masters’ Thesis*, Department of Vocational and Technical Education, Ahmadu Bello University, Zaria
- Sun, J., Ma, H.,Zeng, Y., Han, D & Jin, Y. (2022).Promoting the AI teaching competency of K–12 computer science teachers: A TPACK-based professional development approach. *Education and Information Technologies*, 28, 1509-1533
- Sanusi, I.T., Olaleye, S.A., Oyelere, S.S., &Dixon, R.A. (2022).Investigating learners' competencies for artificial intelligence education in an African K–12 setting.*Computers and Education Open*, 3 (2022), Article 100083
- Udo, M.P., & Bako, D.H. (2014).Acquiring maximum vocational business education skills and competencies for sustainable development in Nigeria. *Journal of Educational and Social Research*, 4(7), 53-60
- Voogt, J.,Fisser, P., Pareja-Roblin, N., Tondeur, J., &van Braak, J. (2013). Technological pedagogical content knowledge—a review of the literature. *Journal of Computer Assisted Learning*, 29(2), 109-12
- Xia, Q., Chiu, T.K., Lee, M., Sanusi, I.T., Dai, Y., & Chai, C.S. (2022).A self-determination theory (SDT) design approach for inclusive and diverse artificial intelligence (AI) education. *Computers & Education*, 189 (2022), Article 104582

Yang, W. (2022). Artificial intelligence education for young children: Why, what, and how in curriculum design and implementation. *Computers in Education: Artificial Intelligence*, 3 (2022), Article 100061