

AI Education in Nigerian Schools

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Abstract: This paper examined the problems facing development of Artificial intelligence (AI) education in Nigerian Schools. Secondary data were used in the paper. The data were collected from print and online publications. The paper concluded that Artificial intelligence (AI) can be applied in preparation of students result report, school administration, aid effective learning, effective teaching implementation (intelligent tutoring), virtual learning environment and effective data management. The paper also identified funding problems, shortage of AI teachers, inadequate infrastructure facilities (laboratories), shortage of instructional materials and lack of sound AI curriculum as problems facing development of teaching and learning of AI in Nigerian schools. Based on tis problems identified, the paper hereby suggested the following: increment in funding of education; employment of AI professionals, provision of modern infrastructure facilities and development of sound AI curriculum for al level of education.

Keywords: AI, Education, Problems.

Introduction

Artificial intelligence (AI), according to Copeland (2023) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Frankenfield (2023) defined Artificial intelligence (AI) as simulation of human intelligence by software-coded heuristics. Artificial Intelligence is a branch of science producing and studying the machines aimed at the stimulation of human intelligence processes. Alagbe (2023) viewed AI as the ability of a computer or machine to mimic the capabilities of the human mind – learning from examples and experience, recognising objects, understanding and responding to language, making decisions, solving problems – and combining these and other capabilities to perform functions a human might perform, such as greeting a hotel guest or driving a car. American technology giant International Business Machines Corporation defined AI as referring to any human-like intelligence exhibited by a computer, robot, or other machines. Artificial intelligence (A.I), defined as intelligence exhibited by machines, has many applications in today’s society. Artificial intelligence according to Ogunode & Ukozor (2023) is the ability of a machine to carry out tasks usually carry out by human intelligent. Artificial intelligence is a branch of science that deals of programming machines with *a simulation of human intelligence to performance similar tasks normally carry out by human beings*. Artificial intelligence (AI) is *the intelligence of machines or software to carry out human related tasks*. Artificial intelligence (AI) is *the packaging of machines or simulation or approximation of machines with human intelligence to function and carry out task like human beings*.

AI are programs developed to perform specific tasks that are being utilized for a wide range of activities including medical diagnosis, electronic trading platforms, robot control, and remote sensing. AI has been used to develop and advance numerous fields and industries, including finance, healthcare, education, transportation, and more (Wikipedia.com). From the above, AI can be conceptualized as programs designed with human-like intelligence and structured in forms of computer, robot, or other machines to aid in provision of any kind of service or tasks to improve social economic and political development of the society. AI is an application or program constructed to carry out tasks with human like intelligence. AI are collections system, packages and application designed into digital computer or computer-controlled robot to carry out assignments and tasks with human-like intelligence.

Frankenfield (2023) maintained that the ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal. A subset of artificial intelligence is machine learning (ML), which refers to the concept that computer programs can automatically learn from and adapt to new data without being assisted by humans. Deep learning techniques enable this automatic learning through the absorption of huge amounts of unstructured data such as text, images, or video. Laskowski, & Tucci (2023) also concluded that AI programming focuses on cognitive skills that include the following:

1. **Learning.** This aspect of AI programming focuses on acquiring data and creating rules for how to turn it into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task.
2. **Reasoning.** This aspect of AI programming focuses on choosing the right algorithm to reach a desired outcome.
3. **Self-correction.** This aspect of AI programming is designed to continually fine-tune algorithms and ensure they provide the most accurate results possible.
4. **Creativity.** This aspect of AI uses neural networks, rules-based systems, statistical methods and other AI techniques to generate new images, new text, new music and new ideas.

Risks of Excluding Students from AI Education

Bojorques & Vega (2023) observed that excluding any student group – either deliberately or by neglect – from learning how to leverage artificial intelligence can lead to several negative consequences, both for individuals and society at large. Following are some of the dangers associated with excluding students from AI education.

Digital divide – Excluding students from learning about AI can contribute to the digital divide, as they may not have the knowledge and skills needed to navigate AI-driven technologies in their daily lives. This can hinder their ability to access information, participate in the digital economy and engage with online communities effectively.

Biased AI systems – AI systems often are trained on data collected from human behavior, which can contain biases. For example, facial recognition originally was designed exclusively with white faces because the developers were not diverse. Excluding diverse perspectives from the development and design of AI systems can perpetuate or amplify existing biases, leading to unfair or discriminatory outcomes for certain groups of people.

Wider skills gap – As AI becomes increasingly important in various industries, the demand for professional skills in using AI will grow dramatically. Excluding students from AI education can exacerbate the skills gap,

making it more difficult for businesses and organizations to find the diverse talent they need to thrive in the AI-driven economy.

Economic inequality – Students who lack AI education may find it more challenging to secure well-paying jobs as many traditional roles may be automated or significantly transformed by AI. This can lead to increased economic inequality and limit social mobility for those who are not adequately prepared for the AI-driven job market.

Loss of creativity and innovation – A diverse workforce in AI and related fields leads to more creative problem-solving and innovative solutions. By excluding certain students from AI education, we risk losing the valuable insights and ideas that they could bring to the development of AI technologies.

Ethical concerns – As AI becomes more integrated into our lives, it is essential to have a diverse group of professionals involved in the development and regulation of AI systems to ensure ethical considerations are taken into account. Excluding students from learning about AI may result in a lack of diverse perspectives, leading to potential ethical issues and unintended consequences. It also leaves students unprepared to navigate ethical dilemmas (Bojorques & Vega 2023).

Review of Literature

Application of Artificial Intelligence in Education

Artificial Intelligence can be applied in almost every aspect of educational administration and management. AI can be applied in preparation of students result report, school administration, aid effective learning, effective teaching implementation (intelligent tutoring), virtual learning environment and effective data management.

Preparation of Students Result Report

AI can assist teachers and lecturers especially exam officers prepare students result very fast and reliable. Westagilelabs (2022) observed that AI-powered grading software combines Machine Learning to create calculating systems after it collects important data on metrics for grading assignments from papers that have been graded by teachers/professors. The tools are designed to understand and replicate the teachers' human grading process earlier. Teachers' inputs + AI combination can grade essays, papers and tests in seconds, even in different languages. They can easily integrate them into an existing virtual environment or cloud-based platform. They are handy when the number of papers is significant so that the teachers can be occupied by more value-based work instead of wasting hours in grading.

School administration

AI has the capacity to aid effective school administration. School administration is the internal arrangement of school resources to the implementation of school programme. School administration look at education from the specific educational institutions. School administration is the internal activities that deal with coordinating of school programme for optimum performance (Ogunode, 2021). Sang, Valcke, Van Braak, & Tondeur (2010) and Ogunode, Ahaotu and Obi- (2021) stated that one of the major objectives of school administration is to integrate and coordinate all the physical and human resources efficiently towards a common goal. The physical resources mainly contribute to building equipment and instructional materials. The human resources that school administration deals with include; students, teachers, supervisors, administrators and parents. School administration according to Ogunode & Ahaotu (2021) covers the following; school planning, organizing, controlling, coordinating and evaluating performance, decision making, curriculum development and planning, school plant management, students activities, teachers' programme, human capacity

development, school-community relationship, academic calendar planning, extra-curriculum programme, school discipline programme, school sport, school examination and school security. School administration involves practical organization and arrangement of school work schedules in effective ways using administrative structures to implement school programme and realize the school objectives whereby posts are created and assigned for the optimal performance of the school. AI can aid school administration in areas of decisions making, forecasting, school objectives, programming school activities planning, budgeting, establishing and interpreting policies, examination, sporting activities and prize-giving/ graduation. Westagilelabs (2022) noted that to eliminate manual administration work in n schools, colleges and universities such as scheduling, rescheduling classes, marking attendance, grading papers, finance, and accounting and record keeping. This streamlines the regular, mundane tasks that no longer need to be done by the staff. AI tools can perform various functions like ending truancy alerts, report cards and other correspondence to the parents automatically, Plan and schedule meetings, Automate routine, student forms, enrollments, and other paperwork to the correct department, Shorten the time spent on progress reports AI, Streamline any other record-keeping tasks. It can enable teachers and professors to focus primarily on improving educational quality instead of manual paperwork and reducing work pressure.

AI aid Effective Learning

AI can aid effective learning to take place. AI can help students with prepared learning instructions such as voice assistants. Westagilelabs (2022) asserted voice assistants that are an engaging and convenient way to bring learning at home while also helping users schedule study calendars, listen to coaching instructions while on the go, and give instant answers to students' basic questions in class. The benefits of voice assistants in education include: efficient saving of time for students and teachers, providing community learning opportunities, and providing personalized education within seconds. These AI-powered voice assistants can be used in apps on smartphone even if they don't have smart speakers. Also, in area of personalized learning, AI tools can assist learning through tailor-made study schedules and customize learning based on the specific needs of individual learners. They identify the gaps in knowledge, creating instructions, testing and feedback systems for learners from preschool to college. AI-powered software, games and tools can set a strategy for students to learn at their speed, time and requirements for repeated practice. This machine-assisted classroom environment can help teachers customize individual lesson plans based on students' individual needs and go a long way in differentiated and adaptive learning that can build a solid foundation for all kinds of learners. For example, a personalized learning system might identify that a student struggles with a particular concept in mathematics. The system would then provide the student with additional resources and support, such as targeted practice problems or videos, to help them master the concept. As the student progresses, the system would continue to adjust the instruction to meet their changing needs (Westagilelabs 2022). Also, AI can help to improve learning through AI-powered gamification can make learning more engaging and enjoyable by using game elements such as points, badges, and leaderboards. Gamification can motivate students to learn and help them to develop important skills such as problem-solving and critical thinking. Gamification can be used in a variety of educational contexts, from K-12 classrooms to higher education and professional training programs. For example, a gamified math program might award points to students for completing practice problems correctly and allow students to progress through levels as they demonstrate mastery of different concepts.

Instructional Resources (Smart Content)

AI can help teachers or lecturers prepare instructional resources that will aids delivery of teaching or lectures at anywhere such as smart content. Westagilelabs 2022) concluded that smart content can range from digital textbooks, guides, instructional snippets, and videos to AI tools that create customized environments for the

educational organization based on strategies and goals. Personalization in education is the future global trend that can be accomplished by identifying the areas in which AI tools can play a role. For instance, schools can create AR/VR-based learning environments as well as web-based lessons to accompany them. AI Monitoring and Evaluation tools can streamline content for different learning styles and match pace with diverse learning curves. When many students submit an incorrect answer, AI and ML-powered algorithms can identify the areas that can be improved in the curriculum to fill in the gaps in defective or ineffective content and help teachers correct it.

Effective Teaching Implementation (intelligent tutoring)

AI can be applied to aid delivery of lecture or implementation of teaching programme in educational institutions. Westagilelabs (2022) observed that tutoring programs or intelligent tutoring systems (ITS) based on artificial intelligence are equipped to handle personalized feedback and instructions for one-on-one teaching. However, they cannot replace teachers since they are not advanced enough to teach how a human can. They can help in scenarios where human tutors are not available for small lessons that can be taught and evaluated online. It can be an effective tool in e-learning platforms to teach languages, geography, circuits, medical diagnosis, computer programming, mathematics, physics, genetics, chemistry, etc. They are designed to factor in engagement, metrics for grading and comprehension.

Virtual Learning Environment

AI has the capacity to aid virtual learning in Nigerian educational system. AI can help to improve accessibility to educational services in rural areas and in communities far from cities. Westagilelabs (2022) maintained that using VR technologies, students can directly connect to their mobile devices or laptops and access content interactively. Virtual learning environments can offer group educational experiences, provide student counseling services, and facilitate an immersive learning experience. VR headsets can help students with ADD/ADHD by blocking out distractions and increasing attention spans. Additionally, learners can also aid learners in soft skill coaching, life skills, and self-development with interactive virtual simulations.

Effective Data Management

AI has the capacity to improve data generation, distribution, storage and computation in school for effective decision and planning. (Ogunode (2021) asserted that one of the major function of education administration is planning of educational programme and projects. Planning is very vital to the realization of the objectives of secondary school education. Educational institutions must be planned to be able to achieve its objectives and education must be planned too to be able to realize its goals. Data is what is needed to plan and take decisions. Data is very important for planning educational programme. Without current educational data, planning is impossible. AI can give school management insights into their operations they might not have been aware of. The rapidly expanding population of generative AI can play these roles in schools data management: classification of data by obtaining, extracting, and structuring data from documents, photos, handwriting, and other media. Cataloging by helping to locate schools data. Improve quality of data collected by reducing errors in the data management process. Data security in school by keeping data safe from bad actors and making sure it's used in accordance with relevant laws, policies, and customs and ensuring data integration by helping to build "Management databank of schools.

Methodology

This examined the problems facing development of Artificial intelligence (AI) education in Nigerian Schools. Secondary data from different sources were used for the paper. Content analysis was used to analyze all literatures collected. Only those relevant to the topic were systematically selected. Exploratory method was

adopted in the analysis. To ensure the reliability and validity of the study, multiple secondary sources were used to minimize the risk of error. The secondary data were collected directly from textbooks, journals, articles, newspapers and other local and international publications on sexual harassment in tertiary institutions.

Discussion on Problems Militating against Development of AI education in Nigeria Schools

Funding problems, shortage of AI teachers, inadequate laboratories, and shortage of instructional materials and lack of sound AI curriculum

Funding

Funding may hinder development and effective teaching and learning of AI in Nigerian schools. AI education required huge investment in areas of infrastructure and human capital development. The funds may not be provided for because education funding in Nigeria is poor and below UNESCO recommendation for education. Ogunode, Attah, & Ebute, (2023), reported that Nigerian education spending for in percentage for 2021, 2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011 and 2010 the education spending in GDP percentage had 5.14%, 5.13%, 5.86%, 5.94%, 6.12%, 6.65%, 9.26%, 9.04%, 8.68%, 8.55%, 7.88% and 6.17%. In 2022 and 2023 the education spending in GDP percentage are 7.21% and 5.11% respectively. The major issue in educational development is the shortage of funds (Ogunode & Madu 2021). Ogunode, Attah, & Ebute (2023) identified the poor implementation of national policy on funding of education, subsidy payment, debt servicing, corruption, insecurity problems, fall in national revenue and revenue loss as barriers to investment in education in Nigeria.

AI Teachers and Professionals

One of the major problem that may affects the teaching and learning of AI in schools in Nigeria is shortage of professional teachers. The implementation of AI curriculum required the services of professional teachers in AI. Professional teachers with specialization in AI are few in the country. Many of the professionals with specialization in AI are engaged in other sector of the economy. Peter (2020) submitted that there are shortage of professional AI in Nigeria which Ogunode Abdulrazak, & Abubakar (2023) noted that the shortage of digital professionals in the various educational institutions have affected the development of digital education. Expertise are needed to fix and help in the maintenance of the facilities in the schools. Also, digitization is a complex process which requires specialized skills. However, a good number of staff who may be involved in the digitization process in Nigerian academic institutions may not skilled as they do not possess adequate knowledge or competence in the handling of digitization equipment. The absent of these expertise in many of the schools today in Nigeria have affected the rate of usage of digital technological facilities for teaching and learning. Ogunode & Paul (2021) identified poor funding, poor manpower planning, corruption and poor motivation as factors responsible for inadequate science teachers in Nigerians schools.

Infrastructure Facilities (Laboratories)

Infrastructure facilities like laboratories and electricity are very important in the implementation of teaching and learning of AI in schools. Laboratories are also needed for effective teaching and learning of AI in schools in Nigeria. Presently most public schools are in shortage of laboratories for Mathematics, Physic, Biology and Chemistry. This problem of inadequate laboratories may also affects effective implementation of teaching and learning of AI in schools in Nigeria. Also, Jegede & Abashi (2019); Jegede, Diaka & Ogunode, (2021) and Ogunode, Ayoko, & Orifah, (2023) observed that Nigeria as a developing country is facing the challenge of providing adequate power for its citizens. The inability of the government to provide constant electricity and to ensure every nook and cranny especially the rural areas have electricity had affected the application of

digital resources in the classrooms. Mungai (2011); Ogunode, Okwelogu & Olatunde-Aiyedun (2021) and Ogunode & Dahir (2021) noted that many schools are not yet connected to electricity, especially in developing countries, Nigeria inclusive. Mohammed (2015) and Ogunode, Okwelogu & Yahaya (2021) submitted that inadequate power supply is one of the major problems confronting the teaching and learning process in Nigeria with particular reference to the deployment of digital resources. Alagbe, Awodele & Ayorinde (2021) concluded that infrastructure facilities to support effective implementation of AI in schools are not available.

Instructional Materials of AI

The teaching and learning of AI in schools demands instructional materials. Ogunode & Josiah (2023) noted that the school system is designed to function with the application and deployment of instructional materials. Instructional materials are very essential to the development of education. Instructional materials are one of the critical components of the educational system. Ogunode (2021) pointed out that instructional materials are used in all forms of educational institutions. The resources are influencing the implementation of teaching, research and community service in the various tertiary institutions. In schools, instructional materials are supporting teaching and learning. Teachers in educational institutions teach well with the deployment of instructional materials. Instructional materials serve as a channel between the teacher and the students in delivering instructions. They may also serve as the motivation for the teaching-learning process. It is used to get the attention of the students and eliminate boredom. Some of instructional materials available for teaching and learning of AI in schools includes;

1. Knewton: An adaptive learning platform that can provide personalized course materials to students.
2. Dialogflow: A Google-powered chatbot development platform that can help educators create their own chatbots for various educational purposes.
3. Carnegie Learning: An AI-powered math education platform that can adapt to individual student needs and provide personalized instruction.
4. Open edX Insights: A free, open-source learning analytics platform that can help educators track student progress and engagement.
5. Google Cloud Speech to Text: A speech recognition API that can be used to develop voice-controlled educational applications.
6. Classcraft: A gamified learning management system that can help educators engage students and promote positive behavior.
7. OpenCV: An open-source computer vision library that can be used for a variety of educational purposes, such as robotics and digital art.
8. Kahoot!: A game-based learning platform that can be used to create quizzes and other educational games (Westagilelabs 2022). Most of these AI instructional materials are not available in schools across the country due to poor funding as Ogunode & Josiah (2023) that poor funding of basic schools, poor improvisation, high cost of instructional resources, poor storage, poor planning, lack of maintenance, poor capacity building in instructional materials management and corrupt practices as factors that have militated against the deployment of instructional materials in the Nigerian schools.

Lack of Sound AI Curriculum

Another problem that may affects development and implementation of teaching and learning of AI in Nigerian schools AI curriculum development. Presently most schools do not have a special curriculum (scheme of work

and syllable) on the teaching and learning of AI in schools. The various institutions established by federal government for schools curriculum planning and development may still be working on how to assemble such curriculum.

Findings

The paper revealed that AI has the potential to transform education by aiding in preparation of students report card, school administration, aid effective learning, effective teaching implementation (intelligent tutoring), virtual learning environment and effective data management. The paper discovered that problems facing development of AI education in Nigerian Schools include funding problems, shortage of AI teachers, inadequate laboratories, and shortage of instructional materials and lack of sound AI curriculum as problems facing development of teaching and learning of AI in Nigerian schools.

Conclusion and Recommendations

In conclusion, this paper examined the problems facing development of AI education in Nigerian Schools. The paper concluded that AI has the potential to transform education by aiding in preparation of students report card, school administration, aid effective learning, effective teaching implementation (intelligent tutoring), virtual learning environment and effective data management. The paper also identified funding problems, shortage of AI teachers, inadequate laboratories, and shortage of instructional materials and lack of sound AI curriculum as problems facing development of teaching and learning of AI in Nigerian schools.

Based on tis problems identified, the paper hereby suggested the following: increment in funding of education; employment of AI professionals, provision of modern infrastructure facilities and development of sound AI curriculum for al level of education.

References

1. Alagbe, J, Awodele, O & Ayorinde, I. (2021). Is Nigeria ready for Artificial Intelligence in schools? <https://punchng.com/is-nigeria-ready-for-artificial-intelligence-in-schools/>
2. Bojorquez, H & Vega, M., M. (2023).The Importance of Artificial Intelligence in Education for All Students. <https://www.idra.org/resource-center/the-importance-of-artificial-intelligence-in-education-for-all-students/>
3. Copeland, B.J (2022). Artificial Intelligence. <https://www.britannica.com/technology/artificial-intelligence>
4. Frankenfield, J, (2023). Artificial Intelligence: What It Is and How It Is Used <https://www.investopedia.com/terms/a/artificial-intelligence-ai.asp>
5. Jegede, D. & Diaka, P. E. & Ogunode, N. J. (2021) Challenges Preventing the Use of Information and Communication Technology(s) for the Teaching and Learning of Christian Religious Studies in F.C.T, Abuja, Nigeria. *Central Asian Journal of Literature, Philosophy and Culture*, 2(8), 10-21.
6. Language magazine (2023). The Importance of Artificial Intelligence in Education for All Students. <https://www.languagemagazine.com/2023/05/31/the-importance-of-artificial-intelligence-in-education-for-all-students/#:~:text=AI%20can%20also%20help%20teachers,to%20reach%20their%20full%20potential.>
7. Laskowski, N.,B. & Tucci, L. (2023) artificial intelligence (AI) <https://www.techtarget.com/searchenterpriseai/definition/AI-Artificial-Intelligence>
8. Ogunode, N., J. & Ukozor, C., U. (2023). Curriculum Revolution in Higher Education: The Mighty Role of Artificial Intelligence. *Indonesian Journal of Innovation Studies* Vol. 25 (2023), 6-11

9. Ogunode, N., J. & Ahaotu, G. N. (2021). The effects of incessant closure of schools on school administration in Northern Nigeria. *International Journal of Innovative Analyses and Emerging Technology* 1(4), 98-103
10. Ogunode, N., J. Ahaotu G. N. & Obi-E., U. (2021) Effects of insecurity on school administration in Nigeria. *Middle European Scientific Bulletin*, 13. 94-102
11. Ogunode N., J., Ayoko, V., O & Orifah, V. (2023). Digitalization of Post-Basic Education and Career Development (PBECD) in Nigeria: Problems and Way Forward. *European Multidisciplinary Journal Of Modern Science* (19), 30-42
12. Ogunode, N., J. Abdulrazak, A. Abubakar, J., A. (2023). Digitalization of Educational Institutions in Nigeria: Benefits, Problems and Solutions. *World of Semantics: Journal of Philosophy and Linguistics*. 13-24
13. Ogunode N., J, Okwelogu, I. S., & Yahaya, D, (2021) Inadequacy of Information Communication Technology (S) in Public Universities in Nigeria: Causes, Effects and Way Forward. *Middle European Scientific Bulletin*, Vol, (17) 334-354.
14. Ogunode N. J, Attah, G., E. & Ebute, J. (2023) Investment in Education in Nigeria: Barriers and Way Forward. *European Journal of Higher Education and Academic dvancement* 1 (2), 61-71
15. Ogunode N.J. & Jegede D. (2020). Challenges of using ICT for the administration of secondary schools in Nigeria and the Ways Forward. Unpublished Article
16. Ogunode. N, J, Okwelogu, I. S, & Olatunde-Aiyedun, T.G (2021) Challenges and Problems of Deployment of ICT Facilities by Public Higher Institutions During Covid- 19 in Nigeria. *International Journal of Development and Public Policy*, 1(5), 162-174
17. Ogunode N.J, Somadina, O, I & Yahaya D., M (2021) Inadequacy of Information Communication Technology (S) in Public Universities in Nigeria: Causes, Effects and Way Forward, *Middle European Scientific Bulletin* (17), 344-354
18. Ogunode, N., J & Josiah, H., F. (2023). Deployment of Instructional Materials in Basic Schools in Nigeria: Impact, Challenges and Implications for Decision Making By School Administrators. *International Journal of Inclusive and Sustainable Education* 2(1)
19. Ogunode, N.J. & Paul, S.A. (2021). Shortage of professional teachers in Nigerian educational institutions and the way forward. *Journal of Ethics and Diversity in International Communication* 1(4).8-15
20. Ogunode, N.J. & Madu, C.O. (2021). Education financing in Nigeria: problems and the way forward. *International Journal of Development and Public Policy*. 1(5), 162-172
21. Plitnichenko, L (2020). 5 Main roles of artificial intelligence in education. <https://elearningindustry.com/5-main-roles-artificial-intelligence-in-education>
22. Sang, G., Valcke, M., Van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, 54(1), 103-112.
23. Westagilelabs (2022). How Artificial Intelligence (AI) is transforming education: 8 cutting-edge applications. <https://www.westagilelabs.com/blog/8-applications-of-artificial-intelligence-in-education/>