



Artificial Intelligence and Pedagogy in Science Education

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Abstract

Education is an instrument per excellence for individual and national development. Education is the process of transferring articulated and abundant knowledge by experts in education to learners in an organized manner. Furthermore, science education is the teaching of the interrelationship between science and education principles for the purpose of understanding science concepts. The quest to modernize the teaching and learning of science education has led to integration of artificial intelligence in our education system. Artificial intelligence (AI) is the application of computer and robots by teachers for successful teaching of science concepts. Artificial intelligence is concerned with the utilization of internal and digital parts of computer for teaching science while robots is the programmable machine that deals with physical tasks/activities such as teaching and loading of products in the factory. Both (AI) and robots contribute immensely in the pedagogical approaches. Pedagogy is the method of teaching adopted by teachers for teaching of science for better comprehension. This paper therefore examined factors like science education fields, the importance of science education in society. Other factors examined were pentagonal pedagogical approaches, the benefits of pedagogical approaches, artificial intelligence and importance in teaching and learning of science education, challenges of teaching science education with artificial intelligence and robots, ethical consideration in application of (AI) and robots in teaching and learning were equally examined, the difference between human and artificial intelligence. In addition, recommendations were put forward for proper teaching of science education using artificial intelligence and robots.

Keywords; Education, Science Education, Artificial Intelligence, Pedagogy

Introduction

Education is an instrument per excellence for individual and national growth and development. Education connotes training an individual in a specific field for the purposes of self-actualization. According to Asianbek (2017) education is the articulated manner in which teachers or instructors transmit their abundant knowledge from one generation to another generation. The greatest asset parents, philanthropists and government can bequeath her citizens is adequate education (Ozioko, Azubuike & Ugwu, 2024). There are three basic types of education which include formal, informal and non-formal education. Formal education is well organized form of education which is acquired in educational institutions such as Nursery, primary, secondary and tertiary institutions. Informal education is not as organized as formal education and is obtained by training individuals in entrepreneurial skills while non-formal education is acquired through peer group,

parents and personal experience (Ozioko, Ugwu & Nnamani, 2024). Essentially, education socializes students into society ([en.wikipedia.org>wiki>education](https://en.wikipedia.org/wiki/education)). An individual can also socialize and solve everyday problems by being educated through science education. Science education is the teaching of interrelationship between science and education principles for the purpose of understanding science concepts (Dienye & Gbamaja, 1990). Science education plays a key role in the development of individual and the nation as a whole. It is instrumental to entrepreneurial skill acquisition, scientific literacy and understanding of basic life processes. According to National Policy on Education (2013), the goals of science education as enshrined in the policy include:

- cultivating inquiry knowledge and rational mind for the conduct of good life and democracy

- To produce scientist for national development
- To produce service studies in technology and technological development
- To provide knowledge and understanding of the complexity of the physical world, the form

and conduct of life (FRN, 2013). These policies forms strong basis for teaching and learning of science education in Nigeria. Science education is very broad and covers this fields that is represented diagrammatically.

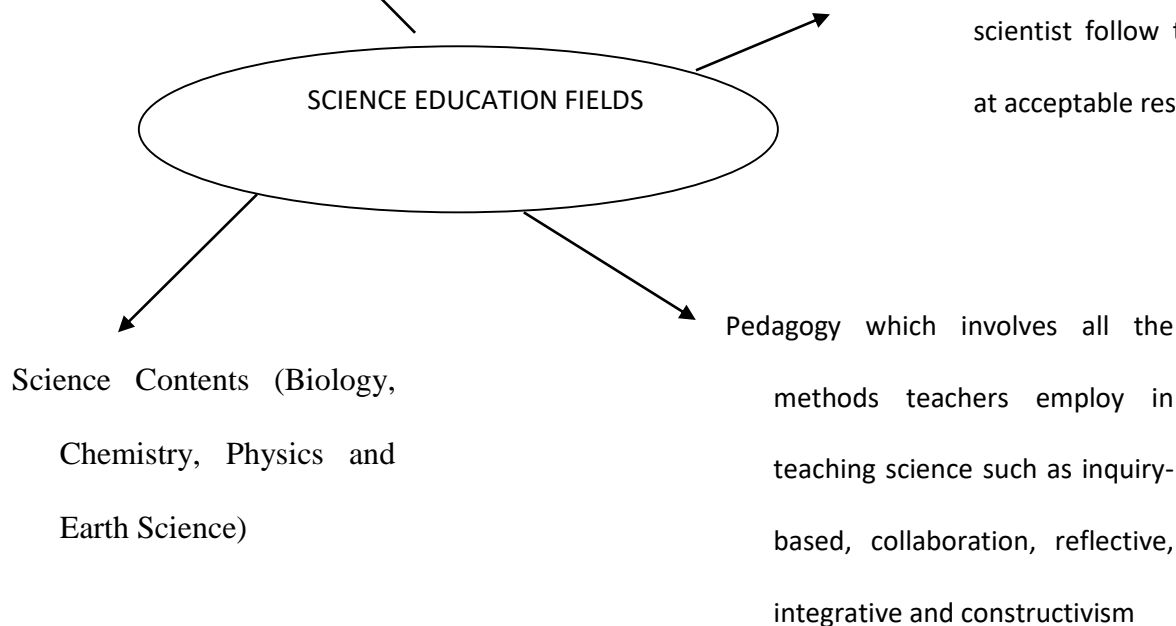
Science Education Fields

Social science covers areas like

economics, psychology,

anthropology and archeology

Scientific Processes which
portrays all the processes
scientist follow to arrive
at acceptable result



Source: Wikipedia, the free encyclopedia

Importance of Science Education

Science education is very crucial in all aspects of our life activities hence it embraces the followings:

- Achieving better health for all citizens. The knowledge of science education helps to foster personal hygiene such as the use of hand sanitizer as solvent for protection against dreaded diseases.
- Promoting scientific literacy for all: The primary purpose of science education is to train-out adequate scientist who can take care of themselves and the entire society through the production of valuable goods such as agricultural products, communication gadgets and the ability to teach the younger generation.
- Promoting National growth and development: Science education contribute much in the area of food security by training out agricultural extension officers who train famers in rural areas. This process contributes significantly in the production adequate food for the population (food security).
- Achieving food security: food security implies the production of adequate food for all citizens using scientific knowledge.
- Sustaining environmental friendliness and stability: Environmental sustainability is all about planting of trees, avoiding different forms of pollution and maintaining proper hygiene in our environment.
- Transmission of entrepreneurial skills: To educate means to transmit abundant knowledge from one generation to another. Science education has been considered as a vital tool for the transmission of entrepreneurial skill such as bakery, Tailoring, production of various types of soap chemicals and Agro-chemical (NOUN, 2024). These goals can be achieved through appropriate teaching methods. The global quest for the improvement of teaching science education led to adoption of various pedagogical approaches. Pentagonal pedagogical approaches include integrative, inquiry-based, reflective, and collaborative and constructivists approaches.

INTEGRATIVE PEDAGOGICAL APPROACH:

An integrative pedagogical approach which is one of the pentagonal approach involves the articulation of teacher's and student's experience and disciplines like chemistry, physics and biology to achieve holistic teaching and learning. This

pedagogical approach requires critical thinking, innovative ideas and problem-solving ability to achieve (<https://intranet.ecu.edu.au>).

REFLECTIVE PEDAGOGICAL APPROACH:

Another vital pedagogical approach is the reflective approach. It involves teachers continuously re-assessing their teaching efficiency. This manifests when teachers record their teaching, accepting feedback from students and professional colleagues. Another instance is embarking on a conversation in his area for justifiable critique (<https://study.com>).

INQUIRY- BASED PEDAGOGICAL APPROACH.

The basis of this pedagogical approach is to develop and apply critical thinking in teaching, solving problems and investigation. It allows students to play a major role hence it is students-centered pedagogical approach which is based on skill development flexibility in teaching and rapport. The types of inquiry-based pedagogical approaches are guided, controlled and open inquiry based approaches (<https://www.nysed.gov>).

COLLABORATIVE PEDAGOGICAL APPROACH.

The main feature of collaborative pedagogical approach is the ability to exhibit group work which imbibes sharing ideas in solving critical problems and active participation. The tenets associated with the pedagogical approach are being active in learning from each other, being responsible for group success or failure. Typical examples are writing school-based project in group and brainstorming for the purpose of examination and writing school based project. It promotes fast learning, foster deeper understanding and communication (<https://www.wimi>)

CONSTRUCTIVISM PEDAGOGICAL APPROACH

The constructivist pedagogical approach is the type of teaching method where teachers or instructors give students the freedom to work on the current problem based on previously acquired knowledge, experience and activities. This pedagogical approach discourages traditional teaching method (chalk and talk method) which is associated with root- learning. Furthermore, it foster skill acquisition and better comprehension through hands-on activities and self directed learning (<https://tophat.com>) The tenets behind this approach include:

- The utilization of previous knowledge to comprehend new concept/knowledge.
- Ability to work in group

- It is purely on students' leadership
- Students are actively involved in the education processes
- In-depth critical assessment is involved
- There is linkage between the new and existing knowledge.
- This approach can be witnessed in project-based learning, experiment, collaborative and inquiry-based activities

The development of education system in any nation hinges on perfect pedagogical approach applied in science education. Consequently, to achieve success in teaching science education, the following guideline becomes imperative:

- ❖ Employment of trained teachers in the field of science education
- ❖ Ensure adherence to science education policies by all the stakeholders.
- ❖ Adequate provision of instructional resources to both teachers and students.
- ❖ Integration of modern education equipment such as projector, computers robots and internet facilities
- ❖ Proper co-ordination and supervision of science education programme
- ❖ Proper recognition of teachers through awards and financial remuneration
- ❖ Introduction of basic scientific attitude in teaching (Akpan,2015)

In recent time, there has been great achievement towards modernizing teaching and learning of science education globally due to integration of artificial intelligence. Artificial intelligence is an advance technological outfit involving computer which execute different functions such translation of language, ability to recommend things and perform data analysis

(<https://cloud.google.com>) .In addition, robots are programmed machines which perform complex task/function independently as guided by external control (Wikipedia) The importance of artificial intelligence and robot in education cannot be overemphasized

- they can create a wonderful group and peer group for learning and discussion. The process helps to breakdown complex and abstract information into meaningful and understandable ideas.
- they also creates opportunities for students to participate meaningfully in hands-on activities which enhance active learning.
- Personalized instruction can also achieved with assistance of robot and artificial intelligence.
- they helps to solve students' needs and equally promote individual learning ability.
- They assist students to acquire skills for individual's life sustainability.
- they promotes innovative ideas, critical thinking and problem opportunities.
- they can assist to develop students interest and motivation in education
(<https://www.ijopr.com>)
- **Differences between Human Intelligent and Artificial Intelligent (AI) System**

At this juncture it is wise to x-ray the differences between human intelligence (HI) and artificial intelligent (AI) in teaching and learning integrated science. Although, human beings and artificial intelligence perform similar functions, there are some notable differences between them.

	Human intelligent (HI)	Artificial intelligent(AI)
1	Human intelligent has high rate of error in pedagogical activities.	AI error rate is minimal
2	Human beings can be stressed up due to excessive workload in teaching.	AI works for a very long period without stress
3	Human beings reason out creative and innovative ideas without data installation during teaching.	AI work is based on garbage in data
4	Human beings expresses empathy, feels emotion and personalized understanding such touching and sympathizing with students	AI lacks the moral capabilities. to feel such emotion understanding and empathy
6	The instructions of human beings are relatively sluggish	AI performs it's work at very fast rate
7	Human beings initiates new instructional methods by means of cognitive process.	AI is automated and cannot develop cognitive process

Source; online.hull.ac.uk>blog>what-is-artificial intelligence

Importance of Artificial Intelligence (AI) for teaching and learning

The contributions of artificial intelligence in teaching and learning of science education

- Artificial intelligence (AI) has contributed immensely in the distance learning programme. This pattern of education allows students to participate in online teaching, solving of assignment and taking of examination and assignment at home.
- Teachers can teach comfortably at home and in the offices without classroom contact.
- AI also enable teachers and students to conduct their researches
- AI is also used to assign projects and assignment to students (Okwelogu & Ola
- AI has also enhance universal asses to science education educate
- The use of Braille machine teaching device has improved the learning of special Risk and Dangers of using Artificial Intelligence in teaching and learning (Moyegin(2024).

Artificial Intelligence is beneficial for teaching and learning in the schools, but has some pitfalls. The challenges, dangers and risk of artificial intelligence embraced the followings:

- a) One of the dangers of artificial intelligence (AI) is the ability of teachers to use deep takers to commit fraud, such as impersonation, alteration of scores

and harass students using their photos and audio of the students.

- b) Job losses due to Artificial Intelligence: if computer and robots can perform the work of teachers, many teachers will automatically loses their job.
 - c) Transparency: it is one of the attitudes of good scientist. Artificial Intelligence (AI) transparency irriges on the ability of the AI to explain how it arrive at manipulating data to yield results like in examination, data analysis and assignment. The inability to explain the results gotten is the major setback or bias.
 - d) Explain ability: the decision made by AI must be clear and understandable to the students or researchers. The teachers, students and researchers must understand the data analyze.
 - e) Teachers and students' dependence on Artificial Intelligence (AI).
- Over dependence of AI can be very dangerous. The damage and malfunctioning of AI leads to failure in learning process.
- f) The use of AI encourages technological addiction to the facilities such as android phones.

Conclusion

The summary of this paper is that for Nigeria to catch up with global competitiveness in science and technological development, artificial intelligence and good pedagogical approaches, must be proper integrated into teaching and learning of science education in Nigeria.

Recommendations

- One of the importance points to consider in the use of AI in teaching and learning is that teachers and students should be adequately trained in the use of computer and Android phones for teaching and learning. The stakeholders in education should organize regular workshop and seminars for serving teachers on the use of artificial intelligence.
- Additionally, solar panel and adequate electricity should be provided to empower computer used for teaching and learning.
- Government should equip the ICT centers with modern facilities such as computers and projects.
- Another important consideration is the employment of well- trained staff of AI equipment in our schools.

References

- Akpan, B.B.(2015). The Place of Science Education in Nigeria for Global Competitiveness. *Journal of the Science Teacher association of Nigeria*,(50)1 Abuja 652-635, www.stanonlie.org.
- Asianbek, N.(2017). *What is Education?*.International Conference on the Future of Education.7th ed. Florence, Italy.
- Dienye, N.& Gbamaja,S.P.(1990) In Ozioko, S.U., Ugwu,D.U.& Nnamani, H.U.(2024). *Workshop Practice and Safety Measures in Science Education*, pp 3-4
- Federal Republic of Nigeria (FRN, 2013). *National Policy on Education, 4 Year Strategic Plan for the Development of Education Sector*, ERDC Press, Lagos, pp 1-3.
- Integrative Pedagogical Approach(2025), Retrieved April 22 from <https://intranet.ecu.edu.au>
- National Open University of Nigeria (2014). *Foundation of Science Education*, pp34-36
- Okwelogu, I.O &Olamoyegin, S.O.(2024).Artificial Intelligence on teaching and Learning of Science Education Programme in Tertiary Institution in Nigeria. *Lieduieh* 1(1) 40
- Ozioko, S.U., Azubuike, E.N. & Ugwu, D.U.(2024).Artificial Intelligence as a Factor of Interest for Enhancing Academic Achievement in Integrated Science Education in the New Era. *Alvan Journal of sciences* (15) B.5-6
- Ozioko, S.U., Ugwu, D.U. & Nnamani, H.U.(2024). *Workshop Practice and Safety Measure in Science Education*. pp 1-2
- Reflective Pedagogical Approach (2025) Retrieved April 22, from <https://intranet.ecu.edu.au>
- Risk and Danger of Artificial Intelligence (2025).Retrieved April 24, 2025 from <https://builtin.com>
- Wikipedia, Free Encyclopedia (2025). Definition of Education. Retrieve April 16, 2025 from [en.wikipedia.org/wiki>Education](https://en.wikipedia.org/wiki/Education)
- Wikipedia, Free Encyclopedia (2011).Pentagonal Pedagogical Approach, Retrieved April 20, 2025 from [https://education on foundation.org.uk](https://education.foundation.org.uk)