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Exploring the Direct and Indirect Impact of AI on Pre-Service Teacher's Teaching Effectiveness

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Abstract

Artificial Intelligence (AI) as a core branch of computer science is seen as an attempt to get to know the importance of intelligence and to give a new trend of intelligent machines that can respond in the way human beings can with advance research in various areas of data science, data mining, data analytics, machine learning, deep learning, knowledge discovery, knowledge reasoning, speech recognition, natural language processing, language recognition, image recognition, computer vision, planning, robotics, gaming, and many more. This study explains the essence of AI in the training of pre-service teachers describes how AI will be used directly and indirectly to assist pre-service teachers to teach effectively and efficiently, spots out some challenges that AI can be used to resolve in educational processes, and transforms earlier approaches of teaching to modern and acceptable types. The study used descriptive survey design approach where teachers within Alimosho, and Ojo Local Government Areas of Lagos state formed the target population with a total of 80 teachers formed the sample for this study. Questionnaire was the major instrument used to collect information from the samples. The questionnaire items were validated and reliability index gotten confirmed that the instrument was reliable for the study. Results showed that AI has great impact either directly or indirectly on pre-teacher in preparing them for future professional development, it is capable to be used as a tutor to train pre-teachers in creating contents that are easily accessible and convenient to students regardless of their ages, distance and gender differences, and also has capacity to automate tasks to save teachers time with convenience. It is concluded that there is no doubt that artificial intelligence is the most promising technology, and the education sector will immensely benefit from it.

1. Introduction

At present, technology is an essential branch of human life because its development and use have implication on our educational system worldwide (Stahl, 2021) [10]. The quantity of data collected on daily basis about everyone in the society in the course of using internets or internet-enabled devices and social media is immense. The data collected can be applied or used in different domains of life; from tracking individual behaviours, collating data to provide raw materials for artificial intelligence (AI). In a nutshell, computers have become ubiquitous and relevant to manage and control virtually all manner of every minute item and objects that were not easily managed some years back (Feng 2019) [4]. Artificial Intelligence (AI) as a core branch of computer science is seen as an attempt to get to know the importance of intelligence and to give a new trend of intelligent machines that can respond in the way human beings can with advance research in various areas of data science, data mining, data analytics, machine learning, deep learning, knowledge discovery, knowledge reasoning, speech recognition, natural language processing, language recognition, image recognition, computer vision, planning, robotics, gaming, and many more. The advent of deep learning recently brings breakthrough into AI; the artificial intelligence now becomes a hottest field or aspect that every researcher in the field of computer which is to carry out studies on. People's expectations for AI are very high, because of a series of recent eye-catching events about AI (Suzuki, 2020) [11]. Ocaña-Fernández, (2019) [8] observed that artificial intelligence-based formats promised a very substantial improvement in education for all the different levels, with an unprecedented qualitative improvement: to provide the students with an accurate personalization of their learning according to their requirements, managing to integrate the different forms of human interaction and information and communications

technologies. The great challenge of the University of the New Millennium lies in the urgent need to plan, design, develop and implement digital skills in order to train better professionals capable of understanding and developing the technological environment according to their needs, as well as implementing the universalization of a digital language supported by programs developed under artificial intelligence formats.

Computers were originally developed for executing complex calculations fast and effectively. The intelligence of computer was based on arithmetic capabilities. This has been the mainstream in the development of computers until now. In the middle of 1950s a new application area, Artificial Intelligence (AI), was introduced by researchers. They had interest to use computers to solve problems in the way intelligent beings do. The architecture, which supported calculations, was conquered to perform tasks associated with intelligence beings, to execute inference operations and to simulate human sense. Artificial intelligence has had several reincarnation cycles; it has reappeared in different manifestations since this research area became interesting for the researchers. All the time a lot of discussion about intelligence of these systems has been going on – are the AI based systems and robots intelligent, what is the difference of human and machine intelligence, etc. Abilities related to intelligence cover ability to acquire and apply knowledge and skills, as well as ability to learn. AI provides different manifestations to the term "intelligence": the human intelligence is a wide variety of different types of intelligence, as well as the meaning of artificial intelligence has varied over time. In their paper they looked to this term, especially to provide means for comparing human and artificial intelligence and have a look to the learning capability related to it (Jaakkola *et al.*, 2021) [6].

According to Tuomi, (2018) [12] all human actions are based on anticipated futures. We cannot know the future because it does not exist yet, but we can use our current knowledge to imagine futures and make them happen. The better we understand the present and the history that has created it, the better we can understand the possibilities of the future. To appreciate the opportunities and challenges that artificial intelligence (AI) creates, we need both good understanding of what AI is today and what the future may bring when AI is widely used in the society. AI can enable new ways of learning, teaching and education, and it may also change the society in ways that pose new challenges for educational institutions. It may amplify skill differences and polarize jobs, or it may equalize opportunities for learning. The use of AI in education may generate insights on how learning happens, and it can change the way learning is assessed. It may re-organize classrooms or make them obsolete, it can increase the efficiency of teaching, or it may force students to adapt to the requirements of technology, depriving humans from the powers of agency and possibilities for responsible action. All this is possible. Now is a good time to start thinking about what AI could mean for learning, teaching, and education. There is a lot of hype, and the topic is not an easy one. It is, however, both important, interesting, and worth the effort.

Artificial Intelligence (AI) is currently high on the political and research agendas around the world. With the emergence of every new technology, there is always both a lot of hype and skepticism around its implications for society and the economy. Although acknowledging that the foundations for

AI have been already around for several decades, recent technological breakthroughs are accelerating what AI could do. This study looks at what this could mean for learning, teaching, and education. This study as well describes the current state of the art in artificial intelligence (AI) and its potential impact on learning, teaching, and education. It also makes contributions that are of interest for AI technology developers and researchers studying the impact of AI on the future of education and learning (Tuomi, 2018) [12]. The following research questions guide the study:

- Will direct and indirect impact of AI on pre-teachers prepare them for future professional development?
- Can AI stand as training teacher to pre-service teachers in creating contents that suits the students' need?
- Do AI have capability to automate tasks to save teachers time in order to impart knowledge to students?

2. Related literature

The origin of AI goes further back than many would suspect: the dream of automating human behaviour and reasoning can be traced back to antiquity. In Hellenistic myths it was seen that bronze automatons such as Talos, which protected Crete from pirates. In the Middle Ages, AI ideas can also be found in the stories about the Golem of Prague. Modern ideas about AI go back to the rise of the computer with key figures such as Turing, Walters and Minsky.

The term "artificial intelligence" was introduced in 1956 by scientist John McCarthy. The scientific field has since experienced a number of cycles; highs, in which AI was strongly hyped, followed by disappointment and criticism. The AI field has had three such major waves so far. The inception took place around the 1950s and 1960s, around the period that the term was created, driven by pioneers at MIT and Stanford. In the 1970s, however, the research budgets were cut considerably, because AI was unable in practice to translate (for example) texts from Russian into English - an application for which there was a demand at the time (due to the Cold War) and AI was expected to be able to fulfill. The classic example is the poor translation from "The mind is willing, but the flesh is weak" into Russian, to "the vodka is good but the meat is spoiled" into English, by an AI.

In the eighties we see Japan strongly committed to AI to help its industry move forward. The United States and the United Kingdom followed quickly. During this period, AI was dominated by expert systems. Expert systems emulate certain specific tasks/actions of people. In these systems the 'intelligence' is completely programmed by hand. Therefore, the AI could not learn new tasks without a person programming the new rules that are necessary. The systems can best be described as a pre-programmed 'decision tree' that systematically assesses if/else statements to derive a decision. Because experts' systems used hand crafted rules, it turned out that the expert systems did not work as well as was expected. It was often too difficult for the AI programmer to hand code all rules into an expert system. In the 1990s, therefore, the attention for AI once again declined sharply.

Artificial intelligence is the most promising among these technologies. The developments in this field go back to when Alan Turing proposed the Turing machine, which indicated that if we cannot differentiate a human response or a machine response, it is artificial intelligence. This deals with the human cognitive process and decision-making

capabilities. Artificial intelligence applications are comprised of expert systems, natural language processing, speech recognition and machine vision/ computer vision. Computer vision allows a machine to interpret and understand the visual world as it sees it. We have different models: Deep Learning, Machine learning and neural networks, which constitute artificial intelligence.

According to Verma, (2018) [13] artificial intelligence is the combination of two words artificial + intelligence. Where artificial means 'not real' or 'natural' and by intelligence means 'the ability to reason, to trigger new thoughts, to perceive and learn'. Artificial intelligence can be defined that area of computer science that mainly focus on the making on such kind of intelligent machines that work and give reactions same like human beings. It is combination of many activities which includes for designing the artificial in computers that are like-recognizing the speech, learning, planning and solving the problem. When any system adapts itself according to situation in any environment is called intelligent. In other words, it can be defined as programming such machines which can think and act with some level of human intelligence is known as artificial intelligence. Artificial intelligence can be defined as efficiently use of limited resources. So artificial intelligence can be defined as making computer programs to solve complex problems same like as human solve the problems. So, it is also divided into two parts one is to solving complex problems by the machine and second is same like human beings. The term artificial intelligence is also used to describe a property of machines or programs: the intelligence that the system demonstrates. Artificial intelligence is combination of science and engineering for making the machines which behaves in intelligent manner. In it many fields are combined like philosophy, psychology and computer science

Artificial Intelligence has many different definitions. From the most past articles, AI is a machine that thinks, understands languages, solves problems, diagnoses medical conditions, keeps cars on the highways, plays chess, and paints impressionistic imitations of van Gogh paintings. AI is often defined as a computer system with the ability to perform tasks commonly associated with intelligent beings. As this definition somewhat problematically requires us to define intelligence and is inconveniently tautological, artificial intelligence is now commonly defined as a scientific discipline; as the activity that creates machines that can function appropriately and with foresight in their environment. The first explicit definition of artificial intelligence was suggested in a funding proposal to the Rockefeller Foundation in 1955. It was based on the "conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it." This early definition rapidly led to deep controversies. In practice, the early developers of AI interpreted intelligence and thinking as mechanical processing of logical statements, thus, in effect, defining human intelligence as computation of truth values. This interpretation was historically aligned with logical positivism and attempts to formalize mathematics using purely syntactic means, but it also raised important questions about the philosophical foundations of AI (Tuomi, 2018) [12]. To Bundy, (1986) [1] AI methods used to elicit knowledge of teaching and learning processes and to represent such knowledge computationally, offer the tools

needed by teachers to gather evidence in a systematic, detailed and incremental manner that can be also shared with and inspected by others. Viewing the contribution of AI to Education as a methodological one opens up an important perspective on the possible role of AI in Education than has been adopted to date.

Huang, Saleh & Liu, (2021) [5] were of opinion that at present, with the development of global science and technology, AI technology has also been improved by leaps and bounds. AI technology is continuously updated and widely used in various fields (Pannu, 2015). It is an indisputable fact that AI has increasingly penetrated into the educational environment and teaching process of schools. In the process of development, more and more people pay attention to the importance of this technology in the field of education. AI has been widely used in the education field and has shown substantial application advantages, which has a profound impact on the teaching process and classroom management (Chassignol, Khoroshavin, Klimova, & Bilyatdinova, 2018; Roll & Wylie, 2016) [2, 9]. AI can continuously optimize and improve the learning environment, stimulate the enthusiasm, initiative and creativity of students (Colchester, Hagras, Alghazzawi, & Aldabbagh, 2017; Yang & Bai, 2020) [3, 15]. At the same time, it can significantly improve the classroom management level of teachers and ensure that classroom management is more reasonable and efficient (Tuomi, 2018; Wang, 2020) [12, 14]. With the rapid development of modern science and technology, AI technology is also advancing. The research results in related fields have enabled AI to be further applied to the education field, and it has shown sound application effects, contributing to teaching reform. The application of AI in the field of education has realized the full integration of teaching and learning, and also provided an opportunity for the reform of teaching and learning. This article comprehensively summarizes and analyzes the application of AI in education

In education, AI can eliminate the need for standardized tests. One criticism of standardized tests is that it is a snapshot, and is not always a good representation of a student's performance. With AI the performance of a learner can be monitored throughout the learning process. This eliminates the need for testing at specific moments and creates a better picture of a student's abilities. It can be categorized as a digital learning resource. In order for AI to be used successfully, similar prerequisites must be met. At the lowest level there must be a good digital infrastructure. The digital infrastructure consists at least of a broadband internet connection and devices for students and teachers. Data must also be available to train AI models. This can be data from administrative systems, (meta) data about educational resources, and data generated by the use of (digital) educational resources.

The prerequisites for successful AI applications are not only technical in nature. Teachers, school leaders and administrators must also be able to see the added value of AI applications and use them responsibly. For this, it is necessary that staff in the education sector have sufficient digital skills. Next, subject-specific AI applications can be used in the teaching process. Finally, when users have sufficient experience with responsible application of AI, an institution can move towards integration of different AI systems.

In the Nigeria education system, the teacher plays a central role. The teacher is free to decide how he or she organizes the lesson. The design of an AI must therefore be approached from a design thinking perspective. In design thinking, the needs of the user are central in the development (Student-centred) of a technology. In order to successfully implement AI in education, the AI must be flexible in its use and must fit with the different learning styles of teachers. The greatest impact of AI, in addition to the users of the applications (pupils and students), will be experienced by instructors. Some teaching tasks can be automated by AI, some of the existing tasks will become more important, and there will also be new tasks introduced by applying AI in education. Among the tasks that can be taken over, we mainly see the selection of course material and assessment/grading. The provision of feedback to the student can also be taken over by an AI. Because some of the tasks can be automated by an AI, this leaves room for the teacher to pay more attention to tasks that are difficult or impossible to automate with AI (e.g., social tasks such as guidance and coaching). The application of AI will also result in new tasks. In order to be able to apply an AI responsibly, a teacher must be able to interpret the output of an AI and translate it into concrete actions.

Schools are complex organizations and there is little doubt that AI will play an increasing role in what might be termed the non-teaching aspects of education. Some of these have little or nothing to do with the classroom teacher – for example, the allocation of students to schools in places where such decisions are still made outside individual schools, improved recruitment procedures for teachers and other staff, better procurement systems for materials used in schools and more accurate registration of students. Other aspects do involve the teacher – for example, improved design and marking of terminal assessments, more valid provision of information about students to their parents/guardians (reports) and so on. The importance of these for the lives of teachers should not be underestimated. Many teachers would be delighted if AI could reduce what they often characterize as bureaucracy that wears them down. A range of software tools to help with some of these aspects of school life already exists – for example, for timetabling (FET, Lantiv Timetable, among others) – and there is a burgeoning market for the development of AI for assessment purposes by Pearson and other commercial organizations. Obviously, automated systems can be used (and have been for many years) in 'objective marking' (as in a multiple-choice test). The deeper question is about the efficacy and occurrence of any unintended consequences when automated systems are used for more open-ended assignments.

3. Methodology
The research design used for this study was descriptive survey design type. The use of descriptive survey design is considered appropriate for the study because it suits the nature of the study. In order to capture the exploring the direct and indirect impact of AI on Pre-Service teacher's teaching effectiveness, the target population involved all teachers within Alimosho, and Ojo Local Government Areas of Lagos state. A total of 80 teachers formed the sample for this study. Eight secondary schools were sampled within the local government areas chosen. Ten teachers were randomly selected in each school; totaling 80 teachers altogether. Equal numbers of male and female were picked from each school (male: 5 and female: 5 for). The selection of the schools involved in the study was based on proximity. The sample used was a through representative of the population for the study

Questionnaire was the major instrument used to collect information from the samples. The items/statements used were coined out from already formulated research questions earlier in the study. The instrument was validated and also subjected to reliability and internal consistence using Chronbach's alpha analyses that yielded 0.78 index. The data collected were collated and subjected to statistical tools for proper analysis. The analysis was done using tables, charts, and other descriptive statistics with the aid of SPSS statistical package.

4. Results
RQ1: Will direct and indirect impact of AI on pre-teachers prepare them for future professional development?
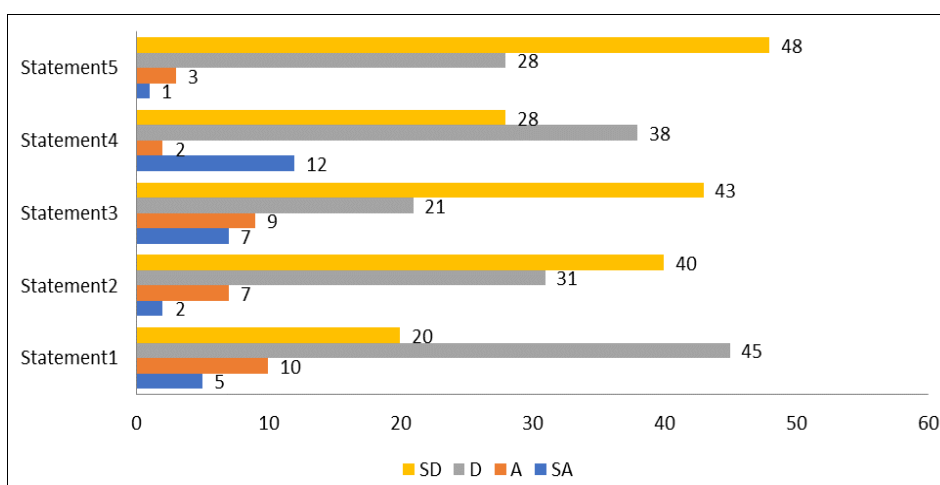
Fig 1: Response of Teachers on Direct and indirect impact of AI on pre-teachers

As shown in figure 1, teachers were asked about their views to how AI can be used directly and indirectly to help pre-teachers preparing them for future professional development. Five statements were relevant to the formulated hypotheses. The results showed that 45 and 20 teachers disagreed and strongly disagreed to statement 1, 40

and 31 teachers strongly agreed and disagreed to statement 2, 43 and 21 teachers strongly disagreed and disagreed to statement 3, 38 and 28 disagreed and strongly disagreed to statement 4, while 48 and 28 strongly disagreed and disagreed to statement 5. This result implies that more than 60 respondents out of 80 collectively disagreed or rejected the null hypothesis that says 'Direct and indirect impact of AI on pre-teachers will not likely to prepare them for future professional development' to consider an alternative

hypothesis that says 'Direct and indirect impact of AI on pre-teachers will likely to prepare them for future professional development'. Hence, AI has an enormous impact in preparing pre-teachers for future professional development.

RQ2: Can AI stand as training teacher to pre-service teachers in creating contents that suits the students' need?
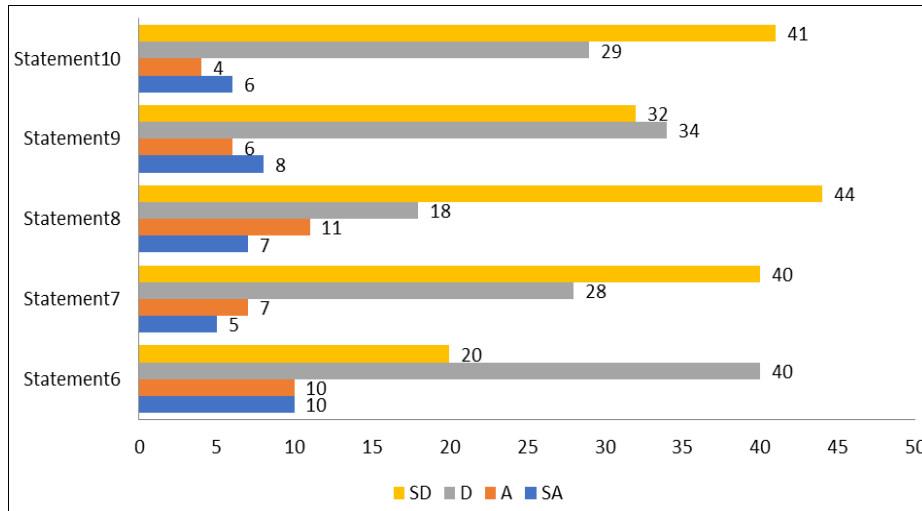

Fig 2: Response on how AI can stand as training teacher approach to pre-service teachers in creating contents

In the same manner, figure 2 showed the responses of teachers regarding how AI can be used to train pre-teachers in creating teaching contents. Five statements relevant to the formulated hypothesis were asked. The results showed that 40 and 20 teachers disagreed and strongly disagreed to statement 6, 40 and 28 teachers strongly agreed and disagreed to statement 7, 44 and 18 teachers strongly disagreed and disagreed to statement 8, 34 and 32 disagreed and strongly disagreed to statement 9, while 41 and 29 strongly disagreed and disagreed to statement 10. This result implies that more than 60 respondents out of 80 collectively disagreed or rejected the null hypothesis that says 'AI

cannot stand as training teacher approach to pre-service teachers in creating contents that suits the students' needs' to consider an alternative hypothesis that says 'AI can stand as training teacher approach to pre-service teachers in creating contents that suits the students' needs. Hence, AI can stand independently as a tutor to train pre-teachers in creating effective contents that suits learners' needs at any time.

RQ3: Do AI have capability to automate tasks to save teachers time in order to impart knowledge to students?
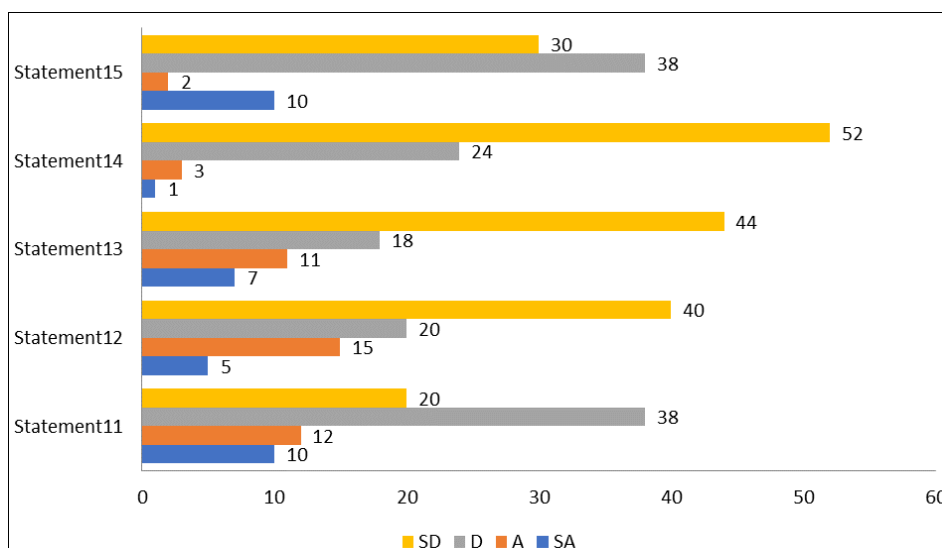

Fig 3: Response on how AI can save teachers' time in imparting knowledge to students

Figure 3 revealed the teachers responses concerning how AI can save teachers time of knowledge presentation. Using the same trend, five statements relevant to the formulated hypothesis were asked (Statement11 – Statement15). The results showed that 38 and 20 teachers disagreed and strongly disagreed to statement 11, 40 and 20 teachers strongly agreed and disagreed to statement 12, 44 and 18 teachers strongly disagreed and disagreed to statement 13, 52 and 24 strongly disagreed and disagreed to statement 14, while 38 and 30 disagreed and strongly disagreed to statement 15. This result implies that more than 57 respondents out of 80 collectively disagreed or rejected the null hypothesis that says 'AI does not have capability to automate tasks to save teachers' time in imparting knowledge to students' to consider an alternative hypothesis that says 'AI has capability to automate tasks to save teachers' time in imparting knowledge to students. Hence, AI can automate teaching to the extent of reducing time spent on conventional teaching environment.

5. Discussion of findings
The discussion was done by answering the formulated research questions in chapter one. The results from fig. 1 help to answer the first research question that says 'Will direct and indirect impact of AI on pre-teachers prepare them for future professional development? The outcome of the analysis showed that AI has great impact either directly or indirectly on pre-teacher in preparing them for future professional development. This finding was supported by Chassignol, Khoroshavin, Klimova, & Bilyatdinova, (2018) [2]; Roll & Wylie, (2016) [9] when they said that AI has been widely used in the education field and has shown substantial application advantages, which has a profound impact on the teaching process and classroom management. At the same time, it can significantly improve the classroom management level of teachers and ensure that classroom management is more reasonable and efficient (Tuomi, 2018; Wang, 2020) [12, 14].

Therefore, it was clearly showed that fig. 2 analysis answered the second research question that says 'Can AI stand as training teacher to pre-service teachers in creating contents that suits the students' need?' the results explained that AI is capable to be used as a tutor to train pre-teachers in creating contents that are easily accessible and convenient to students regardless of their ages, distance and gender differences. Colchester, Hagras, Alghazzawi, & Aldabbagh, (2017) [3]; Yang & Bai, (2020) [15] agreed to this in their observations that AI can continuously optimize and improve the learning environment, stimulate the enthusiasm, initiative and creativity of students. Also, Verma, (2018) [13] listed various areas in the field of education where AI applications are useful such as automating basic activities in education, like grading, adaptation of educational software to student needs, pointing out places where courses need to improve, Students getting additional support from AI tutors, and AI-driven programs that can give students and educators helpful feedback

The third research question that says 'Do AI have capability to automate tasks to save teachers time in order to impart knowledge to students?' The result proved that truly AI has capacity to automate tasks to save teachers time with convenience. This was buttressed with what Verma, (2018) [13] said that AI applications are useful such as automating basic activities in education, like grading.

6. Conclusion
There is no doubt that artificial intelligence is the most promising technology, and the education sector will immensely benefit from it. Self-learning is one of the best advantages for students. By offering personalized education, working as a teaching assistant, enabling inclusive and accessible education, proctored online examinations; AI is the way to go forward for the Nigerian educational system. National Education Policy has emphasized the use of technology, and it is hoped that our students and teachers would reap the benefits to maximum potential. It has been established that AI is here to stay in education. It is possible that in the short- to medium-term (roughly, the next decade) it will have only modest effects – whereas its effects in many other areas of our lives will almost certainly be very substantial. At some point, however, AI is likely to have profound effects on education. Integrating AI into education brings new quality to both learning and teaching. The AI-powered tools help create sophisticated educational environment where learning may be more personalized, teaching more flexible, and management more inclusive. They can help learners develop the knowledge and skills that modern technology-enhanced society looks for and requires. So, this study has explained the essence of AI in the training of pre-service teachers, describe how AI will be used directly and indirectly to assist pre-service teachers to teach effectively and efficiently, it has well spot out some challenges that AI can be used to resolve in educational processes, and finally how AI can be used to transform earlier approaches of teaching to a modern and acceptable types

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