*ISSN: 2992-2313 (Online)*
*ISSN: 2992-2305 (Print)*

# INTEGRATING AI: POWERFUL TOOL IN ENHANCING TEACHER EDUCATION IN VOCATIONAL EDUCATION FOR SUSTAINABLE DEVELOPMENT

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## Abstract

The integration of Artificial Intelligence (AI) in vocational education has the potential to revolutionize the teaching and learning paradigm, enhancing student outcomes, and workforce readiness. The paper explores the applications, benefits, and challenges of AI in vocational education, with focus on and development of skills relevant to emerging industries, such as data science and cyber securities, improved teacher professional development through AI-powered analytics and feedbacks, enhanced student engagement and motivation through immersive simulations and virtual reality. Studies that informed the study highlights best practices for AI adoption in vocational education, addressing concerns surrounding data privacy, equity and teacher preparedness, recommendations were made in line with benefits like intelligent tutoring and simulation – based training, derivable from the effective implementations.

**Keywords:** Artificial Intelligence, Vocational Education, Teacher Professionalism, Emerging Industries.

## Introduction

As the increasing demand for skilled workers in various industries has led to what can best be described as a surge in vocational, it then means that traditional teaching methods are often struggling to engage learners and provide adequate personalized learning experiences. Artificial Intelligence has emerged as a transformative solution, enhancing teaching and learning in vocational education, the potential of AI in the field of vocational educational reinforces the importance and motivates vocational learners to familiarize themselves with these technologies, ultimately boosting their employability and preparing them for the increasingly technology-driven industries that awaits them after studies. Artificial Intelligence has been defined as a system that has been designed to interact with the world in ways human think and exhibit intelligent behaviour (Nuhu, 2024).

Vocational education plays a vital role in preparing skilled and trained workers. In an increasingly complex and rapidly changing world, vocational education must continuously adapt to technological advancements in order to brace up for workplace requirements. As is stated in UNESCO (2019) AI has the potential to accelerate the process of achieving the global by reducing barriers to accessing learning, automating management processes, and optimizing methods in order to improve outcomes. Technology has brought significant changes to the education sector, including a shift from teacher-centred approach to a student – centred approach in learning. This is possible as it gives real-time feedback, freeing educators from the hassles of textbooks and board.

Teaching in the field of vocational education, has experienced countless setbacks due faulty methodology, and particularly ignorance in Information and Communication Technology which happens to be the bedrock of Artificial Intelligence (AI) and suffice it to say where there is no adequately equipped teacher, learning is likely to be half-hazard. Learning on the other hand, if not diversified, leaving it to be static poses a threat to real-world scenarios, hence the integration of

Artificial intelligence Generated Content(AIGC) especially for Vocational Education which can generate texts, images, visuals that can motivate intent learning experience. The transformative power of Artificial Intelligence cuts across all economic and social sectors, including education (UNESCO, 2019). This implies that the need to integrate AI into teaching and learning in all ramifications cannot be over emphasized. Vocational Education and Training programs are faced with problems like lack of available experienced industry trainers in other words, teachers and also well - equipped training facilities. Peter in (Nuhu, 2024)

The role of AI in education is an important aspect that needs to be well comprehended and approached wisely in order to provide the optimum benefits derivable by learners and the society as a whole. This is so, as pointed out in Suparyati, Widiastuti, Saputro and Pambudi(2024) that the use of AI in education also raises some concerns and challenges. One being that use of technology will replace the role humans in teaching and learning, thereby reducing important human interaction for students' social and emotional development. Another concern is regarding student data privacy and ethical issues related to the use of this technology in instruction.

Hence, the competitiveness in educational advancements call for caution in application of these technologies to the detriment of the learners, and as such technology that facilitate the work of teachers who are the disseminators of learning being leveraged, owing that they will be in a better position to handle and deliver the needed outcome without endangering or exposing the learner to the above mentioned concerns. Molenar(2021) posits that alternative use of Artificial Intelligence is to enhance human understanding and assist humans in executing effective and efficient educational programmes. As such, teachers are in position to use AI for effective and efficient programme implementation.

Artificial Intelligence is used to assist teachers in vocational education through creating and supplementing content; hence through AI platforms, teachers can curate a range of educational resources. With generative AI in particular, teachers are able create lessons, activities assessments, prompts for discussion, and presentations simply by providing a short prompt with keywords.(https://www.edutopia.org).

Reviews on this paper focused on integration of AI into teacher education in vocational education for sustainable development, the contributions, concerns and possible appropriate application are outlined. If AI is to change the world in the near future, there is need for us to educate the educators who will be in best position to give to the learners the required assistance on the use of AI. This is so, as the impact of AI is far-reaching and extends into various industries, presenting both tremendous possibilities and notable obstacles. In the realm of education, AI can transform teaching approaches, enrich learning encounters, and fundamentally alter the dynamic between technology and people. With intelligent tutoring systems and automated assessment resources, AI is redefining how educators connect with students and how students engage with educational material. (Isa and Eduina, 2024).

One may likely buy the discussions about whether it should be prohibited or whether teachers and students should receive adequate training to use it effectively and ethically. The purpose of AI in education should be to embrace the opportunities it presents while maintaining high academic standards such it is expedient for thorough investigation into best way to harness the benefits that AI offer to teaching and learning. Education is the process of teaching, training and learning especially in schools, colleges or any organised setting to improve knowledge and develop skills. Effective service delivery in educational training depends on the technique or method used by the teacher in teaching concepts, means of communication, material or media used during the process and the nature of learners

*ISSN: 2992-2313 (Online)*
*ISSN: 2992-2305 (Print)*

in the instructional setting. In Nigeria, teachers believe that Artificial Intelligence will be a new driving force for the development of intelligent library and better ideas on information in order to meet up with the current global trends.(Abimbola and Idakwoji,2023)

**Major Artificial Intelligence Technologies**

The major Artificial Intelligence technologies as outlined by Thomas and Gambari in Abimbola and Idakwoji (2023) include: machine vision, expert systems, machine learning, natural language processing, deep learning, and robotics.

**1. Machine Vision (MV)**

Machine Vision, also known as computer vision, is a major technology of Artificial Intelligence that enables software to recognise patterns, make predictions, and apply newly discovered patterns to situations that were not included or covered by their initial design (Richter et al., 2019). It enables visual perception like human recognition of image characteristics with high speed, high precision, and high accuracy, it uses a camera and computer to perform the functions of recognition, tracking, measurement of objects and image processing. Machine vision technology has been widely adopted in video surveillance, automated facial recognition, and biometric face-scanning surveillance, autonomous driving, medical image analysis, and archaeology (Chen, 2019). It can be utilised in education for taking attendance records, monitoring facial expressions of students and facial detection of a confused learner. Automated Facial Recognition (FR) integrated with machine vision has been used for attendance marking in class. The use of the FR system for attendance marking allows teachers and students to use class time more effectively and saves lecturers' time by eliminating the need to cross-check the attendance.

**2. Expert System (ES)**

Knowledge-based expert system is the ability of computer software to imitate a human expert on a particular subject area to solve a problem using a well-organised body of knowledge. Nwigbo and Mahdu (2016) note that an expert system uses a knowledge base of human expertise for problem-solving and making decisions exactly as a human expert would have done. In education, expert system's applications are embedded into the Intelligent Tutoring System (ITS) which act as professional tutors to provide personalised learning to students considering the students' prior knowledge and ability. Artificial Intelligence career coaches are embedded with expert system to provide individualised advice to students based on their history, experience, skills, combined with career requirements to satisfy students' need to further their study (Khare et al., 2018).

**3. Natural Language Processing (NLP)**

Natural language processing is a technology of Artificial Intelligence mainly concerned with the imitation of human natural language and communication methods. The Natural language processing offers ways of communicating with an intelligent system using natural languages such as English, French, Swahili, and Chinese in either written or spoken form. It is integrated into machines to enable the machines to perform useful activities that require natural human language, and is integrated into talking calculators to provide oral dictation of punched numbers or signs. It also allows more users in different countries to have access to either spoken or written information in different languages; and persons with visual impairments, hearing difficulties, dexterity and motor difficulties can initiate and manage conversations with others independently. Natural language processing is integrated into commonly used services such as Google Translate and chatbots (Kolodny, 2017). It helps learners with spelling and grammatical corrections and also offers automatic online translation for works with multiple languages.

**4. Machine Learning**

Machine learning (ML) is the most advanced area of Artificial Intelligence, it refers to the designing, training, and deploying of models to applications, processes, and other machines

by providing algorithms, Application Programming Interfaces (APIs), development and training toolkits, data, and computing power. Goksel and Bozkurt (2019) add that Machine Learning is a system in which existing data is used for future predictions. Content providers use Machine Learning to determine what course material works best in each study area. With Machine Learning, lecturers make use of feedback and scoring systems to help grade assignments, guard against plagiarism, and assess students' progress. Machine Learning is integrated into Natural Language Processing to provide text-to-speech applications, language-to-language translation applications. Machine Learning has changed the way information is searched for by automating related suggestions to users and making recommendations for information to search with just a click.

**5. Deep Learning (DL)**

Deep Learning, also known as deep neural network, is a technology for implementing Machine Learning. It is primarily used in pattern recognition and classification applications supported by large data sets (Chen, 2019). It allows virtual assistants to detect and understand speech, images, sound and videos. Deep learning has increased the efficiency of online learning, as adapted educational software are used in online platforms which makes it easy to meet individual needs of students; thus fostering personalised learning and offer an opportunity for learners to get extra assistance from tutors.

**6. Robotics**

Robotics entails the science and technology of designing, constructing, operating, manufacturing and application of robots. The Robot Institute of America in 1979 defines a robot as a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialised devices through various programmed motions for the performance of a variety of tasks. Robots are built with the ability to sense their environment in ways that are similar to the way that humans sense their surroundings (Odoh, 2018). They can be used to provide a synchronous lesson to students who are absent from school. For example, Avatarion, a Swiss company that builds robots connected to the Microsoft Azure IoT Hub to provide lessons to physically absent students in a class, with full video and audio connections in their hospital or home, to enable them to participate in the learning process. The student uses a tablet to control the robot's movements, and answer questions by raising the robot's hand and speaking through a connected microphone and speaker (Mamudu & Lamido, 2017).

AI has the potential to address some of the biggest challenges in education today, innovate teaching and learning practices, and accelerate progress towards SDG 4 (UNESCO, 2023). With the ability to analyse data on students' performance and preferences, AI can help educators to create customised lesson plans and assessments that align with each student's unique strengths and weaknesses. This can improve students' engagement and motivation, and ultimately lead to better academic outcomes.

Personalized training of AI is also a platform that analyse each learner's strength and weaknesses, and this will enable lesson to be taught in these analyses, thereby enabling the teacher to harness the full potential of the learner.

**Benefits of AI for Teacher Education in Vocational Education**

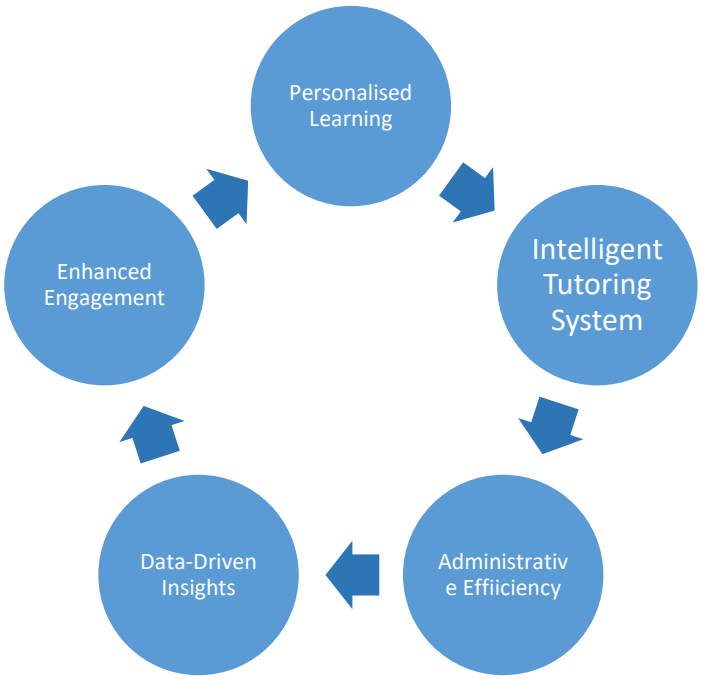
There are numerous dimensions where AI can be beneficial to vocational education and training.

AI can be used to shape the learning and teaching process, through for example, digital assistants which support the teacher in teaching in the classroom. AI can undertake administrative tasks, freeing teachers for more time supporting learners. In the school context, there could also be AI-based learning data analysis (Learning Analytics), AI-based sindividualised learning offers (Adaptive Learning) or AI-based assessment systems (Artwell, Deitmer, Tutlys, Roppert, & Perrini, 2020).

*ISSN: 2992-2313 (Online)*
*ISSN: 2992-2305 (Print)*

Regardless of their specific design, these applications would change learning and teaching. Another impact for vocational education and training is that the transformative power of AI promises profound changes in employment and work tasks. For VET the greatest implications of AI lies in the changing tasks and roles within jobs, which require changes in initial and continuing training for those in work as well as those seeking employment. AI can be used in vocational education to give learners access to innovative resources and tools, such as design software or creative virtual assistants. These technologies can stimulate creativity and critical thinking, giving students opportunities to explore new ideas, develop their imaginations, and find innovative solutions to complex problems.

**Figure 1**
**Potential benefit is AI in teacher education in Vocational Education**




Artificial intelligence can, therefore, enter vocational education and training in various fundamental ways (Figure 1).

Firstly, **AI-based tools for teaching and learning** can be used in the Classroom. On the other hand, AI can be addressed as a consequence of the increased use of technology in business and industry in the classroom. Again, occupations that will see increasing demand for work include teachers, nursing aides, and technical and other professionals. AI technologies are discussed in schools in a practical or theoretical way to prepare young people for an AI-based working environment.

Furthermore, the innovative, evolutionary and revolutionary growth and development of digital technology and ICT in education have instigated the fourth education revolution (Education 4.0). Education 4.0 has a significant effect on learning opportunities, educational policies, and instructional procedures (Eleyyan, 2021). Education 4.0 is evolutionary in nature since newer technologies and education approaches have been replaced by previous technologies and education approaches, AI is a major player of Education 4.0. (Abimbola and Idakwoji, 2023).

Here's a more detailed look at AI's role in education:

- **Personalized Learning**

AI algorithms can analyze student data to tailor educational content and pacing to individual needs and learning styles, leading to more effective learning experiences.

- **Intelligent Tutoring Systems**

AI-powered systems can provide immediate feedback, explanations, and practice problems, simulating one-on-one tutoring and offering personalized support.

- **Administrative Efficiency**

AI can automate tasks like grading, scheduling, and enrollment management, freeing up educators' time for more meaningful interactions with students. AI does not impact only the learning and teaching process but also the assessing and grading process. For instance, AI checks assignments and research projects through software such as Turnitin against billions of resources in no time. Consequently, similarities are easily generated to judge whether the learner plagiarised. Similarly, online rubrics and grading forms are added to assignments with criteria and scales, and final grades are automatically added to the submitted work without any hassle( Zouhaier,2023).

- **Data-Driven Insights**

AI can analyze large datasets to identify trends in student performance, teaching effectiveness, and curriculum efficacy, enabling data-driven decision-making.

- **Enhanced Engagement**

AI can create interactive and engaging educational content, such as simulations, virtual reality experiences, and gamified learning activities, these help learners with slowness in comprehension of concepts to be in the picture.

- **Improved Accessibility and Inclusivity**

AI technologies like speech-to-text and text-to-speech can improve accessibility for students with disabilities. It is a tool handy for educators who so find themselves in an inclusive classroom

- **AI-Driven Instruction and Tutoring**

These systems can provide real-time, automated instructions and explanations, adapting to individual student learning and providing immediate feedback and support. The use of Artificial Intelligence (AI) within assessment tools supports assessment and evaluation through automated grading and feedback, including a range of student-facing tools, such as intelligent agents that provide students with prompts or guidance when they are confused or stalled in their work.

Suffice to state that AI assists the learner to be independent which is a vital tool for achieving one of the aims of vocational training or education as it encourages self-reliance even from the training point. Intelligent tutoring system is imbibed too by the teacher who is exposed to vast knowledge, better equipped to contribute towards sustainable development. AI enables for teacher improvement by administrative efficiency role it plays, assisting the teacher to develop skills that help in everyday job demands of a teacher, the circle is vicious as is illustrated above in figure 1.

**Challenges and Considerations**

- **Privacy and Security**

  Concerns about data privacy and security are paramount when using AI in education, requiring careful consideration of data collection and storage practices.

- **Algorithmic Bias**

  AI algorithms can reflect and amplify existing biases in data, potentially leading to unfair or discriminatory outcomes for certain student groups.

- **Equitable Access**

  Ensuring equitable access to AI technologies and the necessary infrastructure is crucial to avoid widening the digital divide and ensuring that all students benefit from AI in education.

*ISSN: 2992-2313 (Online)*
*ISSN: 2992-2305 (Print)*

- **Ethical Considerations**
  Ethical considerations surrounding AI in education, such as the potential for job displacement of educators and the need for human oversight, must be addressed.
- **Trust and Transparency**
  Building trust in AI systems and ensuring transparency in their decision-making processes is essential for educators and students to effectively use and benefit from AI in education.
- **Cost**
  The cost of implementing and maintaining AI technologies in education can be a significant barrier, requiring careful planning and resource allocation.
- **Teacher Training and Support**
  Educators need adequate training and support to effectively integrate AI tools into their teaching practices and address any challenges that may arise.
- **Collaboration and Partnership**
  Effective implementation of AI in education requires collaboration and partnership among educators, policymakers, technologists, and other stakeholders.

**Teacher Education in Vocational Education for sustainable development**

Today, technological trends suggest an increasing pressure for educational systems to visualize the types of work that will soon emerge, prepare learners for technologies that are not yet invented and equip them with the knowledge and skills that would help prosper them(Majumdar,2011)- we in our time are witnessing the emergence of Artificial Intelligence

Hence, teachers are expected to create a new flexible and open learning environment in ICT era, however, he stressed that the teacher should always keep learning at the center of all activities, pedagogy should be at the heart and integration of pedagogy-technology should be the central focus. Teacher education refers to programs, policies, procedures and provision towards attainment of knowledge, attitudes, approaches, methodologies and skills they require to perform their tasks effectively in the classroom, school or wider community.(www. Researchgate.net, 22/10/2024).

Vocational Education as a type of education that is given to an individual to prepare him/her to be gainfully employed or self-employed with requisite skill. It generally connotes a training that prepares a person for a skilled craft. It implies that whoever undergoes a vocational education or training is aiming at betterment of oneself and contributing their quota for developmental goal.

By incorporating artificial intelligence (AI) technologies into teacher education in vocational education, educational institutions can provide customized learning experiences that cater to the varied requirements and inclinations of individual students, while also being in line with the cultural and socio-economic environment of the region.

The use of adaptive learning algorithms and intelligent tutoring systems allows instructors to improve teaching methods, offer instant feedback, and create a collaborative learning environment that promotes skill development. (Vallejo & uevara, 2019). In addition, the incorporation of virtual simulations for Teacher education programme, provides practical training opportunities, enabling students to acquire practical experience in a controlled environment and develop crucial skills pertinent to their selected disciplines. The interdependent connection between AI-supported learning and Teacher educational and Vocational Education not only improves educational results but also promotes empowerment and innovation, placing the local workforce in a favorable position to succeed in a progressively digital and competitive global economy.

Simulation –based training which increases learner engagement and retention is another powerful benefit of integrating AI in teacher education in vocational education as this makes it easy to envisage learning with ease by the learner instead of making it teacher-centred affair.

**Teaching prospects**

In teacher education too, AI will be of immense benefit to teachers in Nigerian educational institutions. Depending on the specific technology, using AI could reduce the burden of attending classrooms, marking papers and other tasks, enhancing the overall teaching experience and quality. The use of AI could assist teachers in identifying the learning needs and abilities of individual learners and developing appropriate measures to respond to such needs. Also, teacher-facing AI systems are used to support the teacher and reduce workload by automating tasks such as administration, assessment, feedback, and plagiarism detection. AI could also provide additional support for teachers in analysing students' data, predicting their academic achievements, and proffering solutions to address their learning challenges. Importantly, AI helps educators gain greater insight into how students are progressing. That means they could adjust their approach, supporting students' individual needs. Furthermore, AI could foster the development of smart content and platforms for the professional development of teachers. Peers and mentors may emerge from such communities, invariably boosting teaching experience and quality, including AI mentors for learners and further development educators through virtual global conferences.

AI in education, encompassing technologies like machine learning and natural language processing, aims to personalize learning, enhance efficiency, and improve student outcomes, with potential benefits like personalized tutoring and automated assessment, but also raises concerns about privacy, bias, and equitable access. In whichever way it is viewed, it will benefit the teacher and the learner. As such, teacher training requirement should be made available for teachers to benefit and be equipped to further enhance classroom learning for sustainable development.

**Conclusion**

The paper focused on integration of Artificial Intelligence in teacher education in vocational education for sustainable development. it captured the impact of AI when integrated into teacher education which includes; improvement in personalized learning, intelligent tutoring system, administrative efficiency, data-driven system, improved accessibility inclusiveness. These were discussed in line with what role they will play in improving the quality of teacher education in vocational education for sustainable development, this is important as online education has revolutionized the education industry, distant learning is now a reality and education is no more limited to classroom. The challenges and concerns on Artificial Intelligence like over reliance on AI as well as fear of job loss were also discussed. The concerns raised include the future job security of the teacher in vocational education should AI be integrated, data security of the users, cost of procuring AI related teaching materials as well as accessibility to both teacher and learners

**Recommendations**

Based on the discussion above, the study will recommend the following as a measure to support the integration of artificial Intelligence in teacher education in vocational education for sustainable development.

1. A legal framework backing the training and retraining of teachers to embrace technological trends for effective teaching.
2. A coherent mechanism that will ensure proper adherence to the ethical concerns raised in the course of the study.
3. Adequate provision of facilities like computer and internet access that will enable the teacher to harness the numerous potentials of Artificial Intelligence for effective classroom performance.
4. Continuous research interventions to enable the teacher embrace the growing technological upgrade in other not to go obsolete in knowledge.

*ISSN: 2992-2313 (Online)*
*ISSN: 2992-2305 (Print)*

5. Stakeholders in education which include the Government agencies, Teacher association and Schools should push for inclusion of Artificial Intelligence related courses/subjects in the curriculum to give it a place in learning environs.
6. Emphasis on moderate use of AI for learning purposes should be made to avoid over dependence on AI even on things human resources would have been harnessed.

**References**

Abimbola, M., & Idakwoji, S. (2023). An analysis of role of artificial intelligence in Nigerian educational system. *African Journal of Theory and Educational Research, 11*.

Attwell, G., Deitnell, L., Tutlys, V., Roppertz, S., & Perini, M. (2020). Digitalization, artificial intelligence and vocational occupations and skills: What are the needs for training teachers and trainers? In *Proceedings of the European Conference on Educational Research* (Vol. 111, pp. 30–42). Vocational Education and Training Network (VETNET). https://doi.org/10.5281/zenodo.4005713

Eleyyan, S. (2021). The future of education according to the fourth industrial revolution. *Journal of Educational Technology & Online Learning, 4*(1), 23–30. https://doi.org/10.31681/jetol.737193

Goksel, N., & Bozkurt, A. (2019). Artificial intelligence in education: Current insights and future perspectives. Retrieved March 21, 2025, from https://www.edutopia.org

Isah, E., & Eduina, M. (2024). Impact of artificial intelligence on education. *International Journal of Innovative Research in Multidisciplinary Education, 3*(4), 463–471. https://doi.org/10.58806/ijirme.2024.v3i4n01

Majumdar, S. (2011). *New paradigm in technology education in TVET*. Keynote paper presented at the conference organized by UNESCO-UNIVOC International Centre, titled *Preparing TVET Educator for the Next Generations*.

Mamudu, F., & Lamido, A. A. (2017). A comparative analysis of the effect of robots on Nigerian economy. *IOSR Journal of Computer Engineering (IOSR-JCE), 19*(5), 36–40.

Muhammad, T., Farha, H., & Mudasir, S. (2024). Role of artificial intelligence in education: A conceptual review. *World Journal of Advanced Research and Reviews.*

Muhammad, Y., Rahmad, M., & Mochammad, A. (n.d.). *Vocational education development strategy in the use of artificial intelligence in the digital era*.

Nwigbo, S., & Madhu, B. K. (2016). Expert system: A catalyst in educational development in Nigeria. *Journal of Mobile Computing & Application, 3*(2), 8–11. https://doi.org/10.9790/0050-03020811

Zouhaier, S. (2023). The impact of artificial intelligence on higher education: An empirical study. *European Journal of Educational Sciences*. https://doi.org/10.19044/ejes.v10no1a17