PRE-SERVICE UNIVERSITY TEACHERS' PERFORMANCE EXPECTANCY AND EFFORT EXPECTANCY ON THE ADOPTION OF ARTIFICIAL INTELLIGENCE IN NIGER STATE

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ABSTRACT
Integrating Artificial Intelligence (AI) in education has transformed teaching and learning, hence, teachers' attitudes and performance expectancy play a crucial role in its adoption However, the adoption of AI among pre-service teachers be influenced by their perception. This study aims to determinine the relationship between effort expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers. The research adopted the correlational research design. The population of the study comprises (404) four hundred and four students; of final year students of pre-service university students in Niger State. (50) fifty questionnaires were distributed based on Krejce and Morgan (1970) sample size determination. The study was guided by two research questions and two research hypotheses. Data was collected using a 5-point rating scale questionnaire which was validated by 3 experts in the Department of Science Education and the instrument yielded a reliability of 0.74. The data was analysed using descriptive statistics to answer the research question, the formulated hypotheses were tested using Pearson Product Moment Correlation. The findings reveal that there is a weak positive correlation between performance expectancy and behavioural intention to adopt AI (r=0.108, p=0.458, N= 49) and a weak positive correlation between effort expectancy and behavioural intentions to adopt AI (r= 0.114, p=0.437, N=49). It was recommended that Artificial Intelligence should be integrated into teachers' preparation programs, among other.

Keywords: Artificial Intelligence, Effort Expectancy, Performance Expectancy, Pre-service Teachers, Teacher Education, UTAUT, Nigeria.

Introduction
Globally, the knowledge of science and technological growth, development and advancement are rapid. This increase of science knowledge has necessitated the integration of science in all levels of Nigeria education, that has reflected her National Policy on Education FME (Adolphus, 2019), which emphasizes the study of science in all levels of education. The field of education has continuously evolved over the years, with various modification in curriculum made to accommodate science needs of the learners. Science has been an integral instrument of human societies even during the paleolithic era when the man was assumed to be less endowed, its impact is felt in every sphere of human endeavour and therefore essential for the 21st century competitive world and intricately connected to nation's development. Ravetz, (2020) asserted that the application of scientific knowledge has improved the standard of living of humankind in its entire ramifications. In order for us to equip our students with the skills needed to face the 21st century challenges, who must align our system of education with instructional strategies and approaches that will pave way for acquisition of such competencies. This is because education is an important catalyst that speeds up national growth and development, therefore, it must be in line with basic needs of the society.

Education is also a lifelong process which enhances the individual's quality of life, build up his personality and enable him or her to contribute meaningfully and effectively to the

development of his or her society. It is also the process through which a society reproduces itself by passing on its quality and mode of life to younger generations. No matter what we do in the classroom or educational principles we adopt in the process of teaching, all efforts would be fruitless if the learners do not understand content taught effectively (Atabey *et al*, 2021).

Technology is constantly evolving, reshaping industries, societies, and human experiences. From the invention of the wheel to the rise of Artificial Intelligence (AI), technological advancements have transformed the way we live, work, communicate, and interact with the world around us. Technological advancement has transformed the social-cultural society we know, and technology landscape seems to improve and change through each decade. Dakota, (2024), noted that the innovation of technology had increased social homogenization; social homogenization is a trend that has changed the standardization of how we communicate as a culture in a global market, taking us through a stage of conformity. Hence, integration of innovative technologies in human endeavours becomes inevitable especially in this recent time. Learning is a multifaceted process that involves acquiring new knowledge, skills, attitudes, and behaviors. Reverence, or a deep respect and admiration, can significantly enhance the learning experience. Learning is a complex and dynamic process that involves acquiring knowledge, skills, and attitudes through various experiences. It encompasses cognitive, emotional, and behavioral dimensions (Hasanaov *et al*., 2021). From infancy through adulthood, humans engage in learning activities that shape their understanding of the world and their place within it.

Learning in technology encompasses the acquisition of knowledge, skills, and competencies related to the use, development, and application of technological tools and systems. It involves both formal and informal learning processes that enable individuals to adapt to technological advancements and leverage them for various purposes. Learning Environments in Technology, online learning platforms, such as learning management systems (LMS) and massive open online courses (MOOCs), provide access to educational resources, interactive modules, and collaborative tools (Tserklevych *et al.*, 2021). They offer flexibility and scalability for learners worldwide. VR and AR technologies create immersive learning environments that simulate real-world scenarios and enhance experiential learning (Rusell, 2020). They are used in fields such as medical training, engineering, and cultural heritage preservation.

AI refers to the simulation of human intelligence in machines, enabling them to perform tasks that typically require human cognition, such as problem-solving, decision-making, and natural language processing (Mondal, 2020). AI applications range from virtual assistants to autonomous vehicles. The Internet of things (IoT), refers to a network of interconnected devices embedded with sensors, software, and other technologies that enable them to collect and exchange data (Koptetz and Steiner, 2022). IoT applications include smart homes, wearable devices, and industrial automation. Blockchain is a decentralized, distributed ledger technology that enables secure and transparent transactions without the need for intermediaries (Deshpande, 2017). It has applications in cryptocurrency, supply chain management, and digital identity verification. Biotechnology involves the use of living organisms, cells, and biological systems to develop products and technologies for various purposes, such as healthcare, agriculture, and environmental conservation (Pandey and Singhal, 2022). Advances in biotechnology include gene editing, synthetic biology, and personalized medicine.

Several models and theories have provided a framework to investigate the factors that influence an individual behavioural intention to adopt a given technology. Some of these models and theories include Technology Acceptance Model (TAM), Unified Theory of Acceptance and

Use Theory (UTAUT), Diffusion of Innovation Theory. This study adopts UTAUT, the Unified Theory of Acceptance and the Use of Theory (UTAUT) and diffusion of innovation theory is concerned with the use and acceptance innovation and how innovation propagates through and education system. The theoretical model of UTAUT suggested that the actual use of technology is determined by behavioural intention. The perceived likelihood of adopting the technology is dependent on the direct effect of four key constructs, namely performance expectancy, effort expectancy, social influence, and facilitating conditions. The effect of predictors is moderated by age, gender, experience and voluntariness of use (Rhie *et al*., 2021).

Effort expectancy, a concept rooted in the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh *et al*. (2003), refers to the perceived ease of use associated with a particular system or technology. In the context of AI tools among pre-service university teachers, effort expectancy plays a crucial role in determining whether they will adopt and effectively integrate AI into their learning activities. A well-designed user interface significantly enhances effort expectancy. Pre-service teachers, who might already be juggling various responsibilities and learning new pedagogical methods, benefit from AI tools that are intuitive and straightforward. Simplified navigation, clear instructions, and a minimal learning curve can make AI tools more appealing and less intimidating. Adequate training and continuous technical support are vital. According to Davis (2019), perceived ease of use is greatly influenced by how well users are trained and supported. Workshops, tutorials, and hands-on training sessions can help pre-service teachers feel more comfortable and competent in using AI tools.

Performance expectancy, effort expectancy, and social influence. As proposed by Venkatesh et al. (2003), the UTAUT model includes four moderators: experience, voluntariness, gender, and age. (Wu *et al*., 2022; Alzahrani *et al.*, 2023). This study aims to collect data from students who are actual users of AI. For this purpose, age and voluntariness cannot provide value to the model, but this study aims to develop the UTAUT model by employing gender and experience as explanatory variables instead of moderators and including another three descriptive and behavioural variables as independent variables: education, income, and equipment used for Internet access.

An examination of gender disparities in the context of technological proficiency revealed a nuanced relationship between perceived and actual online skills. The findings suggested that although there are discernible differences in how men and women view their technological capabilities, these perceptions do not consistently correlate with tangible skill gaps in digital environments (Bain and Rice, 2006; Hargittai and Shafer, 2006). Specifically, the research highlighted that female participant tended to express higher levels of technology anxiety, lower confidence in their technology-related abilities, and generally less positive and more stereotypical views about technology compared to their male counterparts (Cai *et al*., 2017; Jackson *et al*., 2001). Despite these differences in attitude, the direct impact on actual technological proficiency was less clear, indicating that while gender may influence how students feel about technology, it does not necessarily predict their ability to use it effectively.

Statement of Research Problems

Despite the availability and potential benefits of AI tools in education, there is a noticeable reluctance among pre-service teachers to adopt these technologies. There is a lack of comprehensive understanding of the factors that influence pre-service teachers' behavioural intention and use of AI tools. While various models exist, the Unified Theory of Acceptance

and Use of Technology (UTAUT) offers a holistic framework that has not been extensively applied on AI usage. Hence research is needed to explore how UTAUT constructs—such as performance expectancy, effort expectancy, social influence, and facilitating conditions—affect AI adoption among pre-service teachers. Performance expectancy, or the degree to which pre-service teachers believe that using AI tools will enhance their learning and teaching effectiveness, is a critical factor. However, there is limited empirical evidence on how these perceived benefits influence their intention to use AI tools. Effort expectancy, which refers to the perceived ease of use of AI tools, can significantly impact their adoption. Pre-service teachers may find AI tools complex or challenging to integrate into their learning processes. Research is needed to identify specific usability concerns and how they affect AI tool usage. Social influence, including the impact of peers, mentors, and institutional culture, plays a vital role in technology adoption. Understanding how these social factors affect pre-service teachers' attitudes towards AI tools can provide insights into developing supportive environments that promote AI usage.

Aims and Objectives of the Study

The aim of the study is to determine pre-service university teachers' performance expectancy and effort expectancy on the adoption of artificial intelligence in Niger State. While the objectives are to identify:

11. The relationship between effort expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers.

12. The relationship between performance expectancy and behavioural intention to use artificial intelligence among pre-service university teachers.

Research questions

The following research questions will be answered in this research

1. What is the relationship between effort expectancy and behavioural intentions to use Artificial Intelligence among pre-service university teachers?

2. What is the relationship between performance expectancy and behavioural intention to use Artificial Intelligence among pre-service university teachers?

Null Hypotheses

The following are the null hypotheses of the study.

$H0_1$ There is no significant relationship between effort expectancy and behavioural intentions to use Artificial Intelligence among pre-service university teachers.

$H0_2$ There is no significant relationship between performance expectancy and behavioural intention to use artificial intelligence among pre-service university teachers.

Research Methodology

Research design

This study would employ a descriptive (correlational) research design. Descriptive survey is research which exists or uses the sampled data of an investigation to document, describe, and explain existing phenomena or the absence (Usulor, 2014). Bello and Ajayi (2020) opined that survey design is a method usually adopted when handling a large population especially on issue of the moment that involve systematic collection of data from population of study through the use of questionnaire. This study will involve the use of questionnaires to access the adoption of Unified-Theory of Acceptance and Use of

Technology to assess pre-service teachers' Artificial Intelligence usage for learning. Since the study would be considering the relationship between the constructs of UTAUT, correlational approach is most suitable.

Population of the study

The population for the study will comprises of pre-service university teachers from universities in Niger state. With the total number of 1551 pre-service university teachers studying biology education, mathematics education, physics education, chemistry education, geography education, computer education, the target population were final year students of the department of Science Education, Federal University of Technology, Niger state and Department of Science Education Ibrahim Babangida University Lapai Niger state. As at the period in which this research was carried out, the available targets are 500level students of school of Science and Technology Education.

The 500l students of the department of Science Education consist of one hundred and thirty-seven (137) students, and Ibrahim Babangida University Lapai, the targets are the 400level students of Department of Science Education. The 400l students of the department of Science Education consist of two hundred sixty-seven (267) students.

Sample and Sample Technique

From the population of the study Proportionate stratified random sampling technique will be used to select 70% of students from each department in Federal University Minna Niger state and Ibrahim Badamusi Babangida University Lapai Niger State. The number of respondents from each sub group is determined by the number of the entire population. College of Education Minna, Niger State will be used for the pilot test.

Research instrument

The instrument that was used for data collection is researchers developed questionnaire made of four sections. Questionnaire Section A- Demographic data of the respondents, Section A- Pre-service teachers Performance Expectancy on the usage of AI, Section B- Pre-service teacher Effort Expectancy on the usage of AI, Section C- Behavioural Intention to use AI.

Validity of Instrument

To ascertain the content validity of the instrument, three (3) experts in the department of Science and Technology Education FUT Minna, Niger State. The corrections and suggestions made by those experts is used to ensure the content. Validity of the research instrument, and a clean copy of the instrument was produced for data collection.

Pilot study

In order to establish the reliability of the instrument, pilot study was carried out, College of Education Minna, Niger State. The reason for choosing the school was the fact that the school is out of the study area and will not be any way used for the main study. The essence for pilot study was to test the adequacy and suitability of the instrument in measuring what it is supposed to measure and to ascertain any difficulty that the researcher may encounter. For the purpose of this, twenty (20) copies of the questionnaire were administered to pre-service teachers in the above-mentioned schools. The filled questionnaire was collected and subjected to statistical analysis using Cronbach Alpha correlational formula in order to determine the reliability of the instrument as well as the internal consistency of the items within the instrument.

Reliability of Instrument

Reliability refers to the extent to which an instrument consistently produces stable results (Moses and Yamat, 2021). The data collected from the pilot study was calculated using Cronbach Alpha and reliability index of 0.88 was obtained. Benett (2020) testified that, for a scale to be considered reliable they should have an alpha value of 0.50 to 1. With this level of reliability index, the instrument was considered reliable for use in this study.

Method of Data Collection

To collect the necessary data for the study, the researcher visited the sampled schools with an introductory letter from Science Education Department, Federal University of Technology Minna. The letter will be presented to appropriate authorities in all the sampled schools in order to seek permission to have access to the Pre-service teachers. The class representatives will serve as research assistant who will be instructed by be researcher on how to distribute and retrieve the copies of the questionnaire. The respondents will be provided with instructions on how to complete the questionnaires. The questionnaire will distribute and collected immediately.

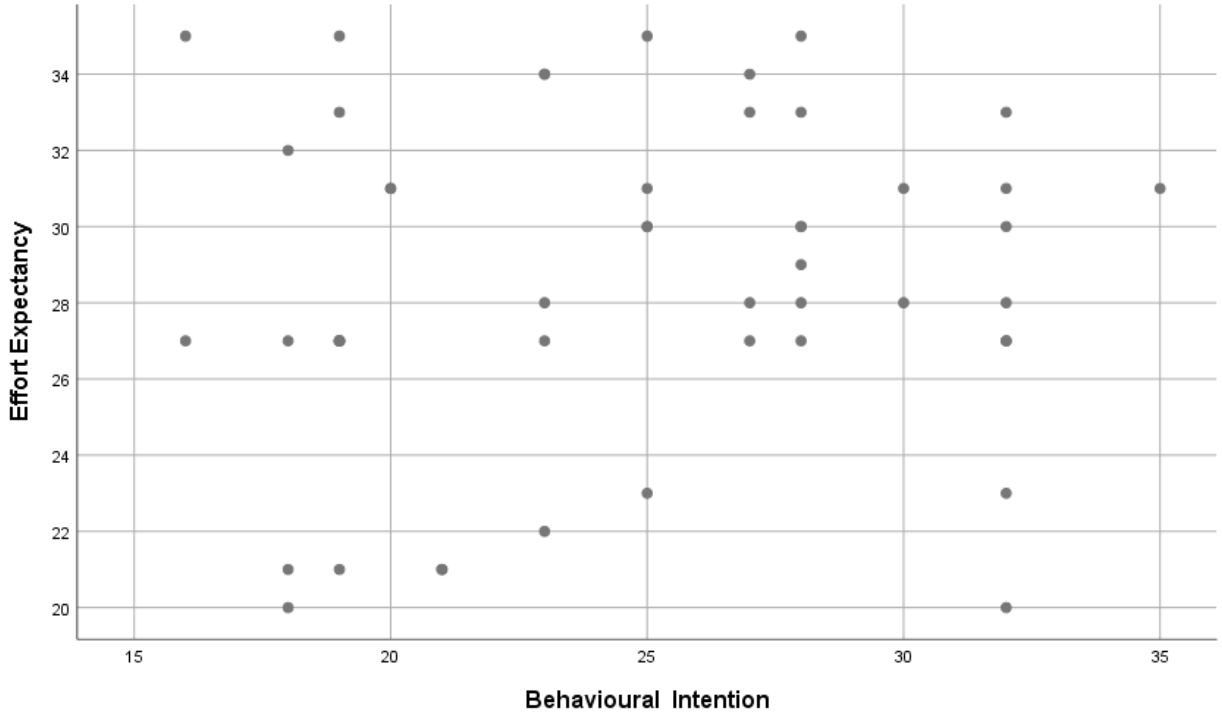
Method of Data Analysis

The data collected will be analyzed using the following statistical tools. Descriptive statistics of standard deviation, and frequencies to understand the demographic characteristics of the pre-service teachers' and the AI Usage. For the demographic data, frequency and percentage will be used to analyse, the research questions scattered plots will be used to analyse and Pearson Product Moment Correlation will be used to analyse the hypotheses of the study. The significant relationship will be ascertained at 0.05 alpha levels. The Statistical Package for Social Science (SPSS) version 23.0 will be used for the analysis.

Results and Analysis

Research Question1: What is the relationship between effort expectancy and behavioural intention to use artificial intelligence among pre-service university teachers?

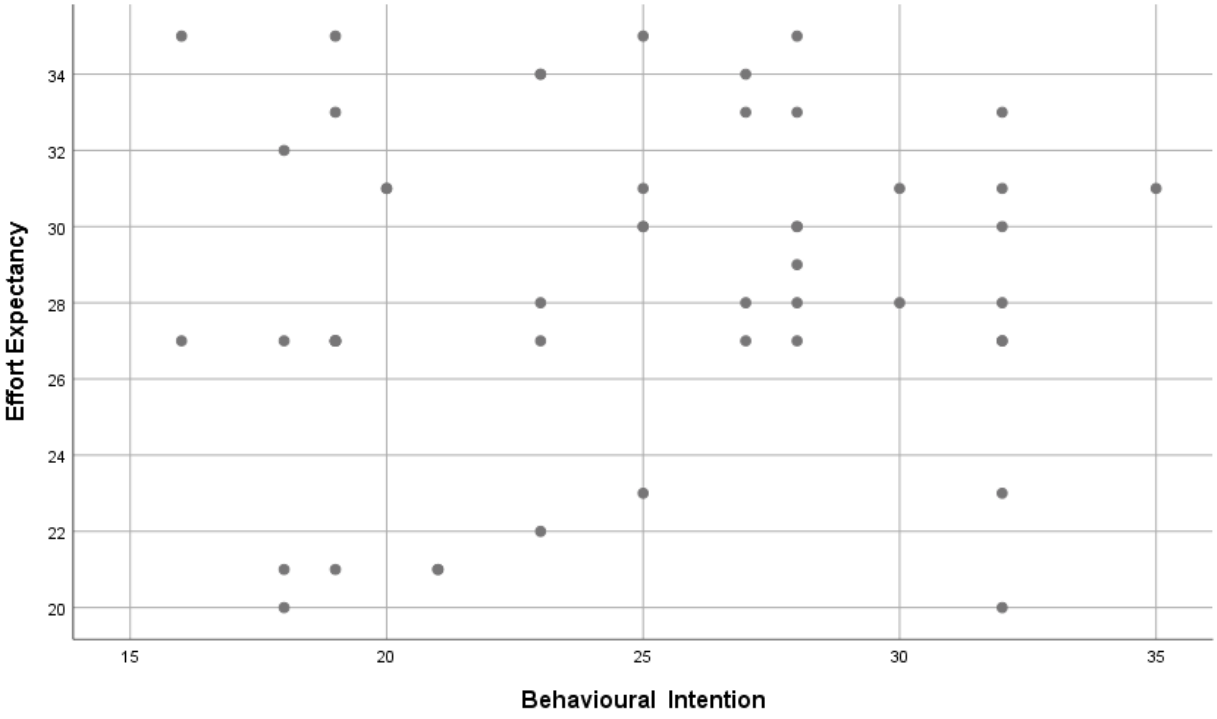
Graph1: Showing the scatter plot of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.



The scatterplot above shows the effort expectancy and behavioural intentions with almost no correction. The correction coefficient is actually -0.05. This indicates a very weak negative correlation.

Research Question2: What is the relationship between performance expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers?

Graph 2: Showing the scatter plot of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.



The scatterplot above shows the performance expectancy and behavioural intentions with a correlation of -0.69. This indicates strong negative correlation

Testing of Hypotheses

Hypothesis 1: $H0_1$. There is no significant relationship between effort expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers.

Table1: Showing the Pearson correlational coefficient of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.

Items	Correlation Coefficient (r)	N	Sig 2 tail P value
Performance Expectancy	0.108	49	0.458
Behavioural Intentions			

Table 1 shows the correlation between performance expectancy and behavioural intention, correlation coefficient (r) is 0.108, the N is 49, P value is 0.458, this indicate that the correlation is not statistically significant at the 0.05 level ($p>0.05$). The hypothesis is thereby accepted.

Hypothesis 2: Showing the scatter plot of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.

Table 2: Showing the Pearson correlational coefficient of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.

Items	Correlation Coefficient **(r)**	**N**	Sig 2 tail P value
Effort Expectancy	0.114	49	0.437
Behavioural Intention			

Table2 shows the correlation between performance expectancy and behavioural intention, correlation coefficient (r) is 0.114, the N is 49, P value is 0.437, this indicate that the correlation is not statistically significant at the 0.05 level ($p>0.05$). The hypothesis is thereby accepted.

Discussion of Findings

The study investigated the relationship between pre-service university teachers' performance expectancy, effort expectancy and intention to adopt Artificial Intelligence in teaching and learning. The findings weak positive correlation between performance expectancy and behavioural intention to adopt AI ($r=0.108$, $p=0.458$, $N= 49$) and weak positive correlation between effort expectancy and behavioural intentions to adopt AI ($r= 0.114$, $p=0.437$, $N=49$).

Conclusion

This study underscores the importance of addressing pre-service teachers' performance expectancy and effort expectancy to facilitate AI adoption in education. By doing so, we can harness the potential of AI to enhance teaching and improve students' outcomes.

Recommendation

Artificial Intelligence education and training should be integrated into teachers preparation programs, there should be development and promotion of user-friendly AI tools and foster a supportive environment for AI adoption.

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