INFLUENCE OF DIGITAL COMPETENCY AND ATTITUDE TOWARDS ETHICAL INTEGRATION OF AI IN TEACHING ON THE TECHNO-PEDAGOGICAL COMPETENCY OF PROSPECTIVE TEACHERS

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Abstract

In the digital era, where students are deeply influenced and driven by technology and Artificial Intelligence, the education system has been undergoing drastic transformations in many aspects. Therefore, the teachers must be able to create successful learning experiences and facilitate learners in their learning process, integrating technology and Artificial Intelligence. The capability and efficiency of teacher educators to integrate the use of technology with content and subject matter properly in teaching-learning situations to enhance the performance of teaching goals and tasks is referred to as Techno-pedagogical competency. Techno-pedagogical competency and Digital Competency are not the same. Digital Competency is the ability to use digital tools in a confident, critical and creative manner. For the effective use of AI in classrooms, teachers should also have a positive attitude towards ethical integration of AI in teaching-learning process. The present study aimed to find out whether Techno-pedagogical competency of prospective teachers is correlated with Digital Competency and Attitude towards ethical integration of AI in teaching. And also, to find out whether Techno-pedagogical Competency can be predicted in terms of Digital Competency and Attitude towards Ethical Integration of AI in teaching of prospective teachers. The researcher used descriptive survey method on a sample of 388 prospective teachers across Kerala. The tools used for the data collection are Digital Competency Scale, Scale of Attitude towards Ethical Integration of AI in teaching and Techno-pedagogical Competency Scale developed by the researcher under expert validation. The data were analysed using Pearson's product-moment correlation, Multiple Linear Correlation, Simple Linear Regression, and Multiple Linear Regression. The study revealed a moderate positive correlation (r=0.427) between Techno-pedagogical Competency and combined influence of Digital Competency and Attitude towards Ethical Integration of AI in teaching of prospective teachers. Also, Techno-pedagogical Competency of prospective teachers can be predicted in terms of Digital Competency and Attitude towards Ethical Integration of AI in teaching. The findings of the study contribute to the modification and enrichment of curricular outcomes of teacher education programmes by emphasizing the systematic enhancement of the techno-pedagogical

competency of prospective teachers. This can be achieved through targeted interventions such as workshops, seminars, hands-on activities, and reflective practices that specifically focus on strengthening digital competency and fostering a positive attitude towards the ethical integration of Artificial Intelligence in teaching. Such curriculum-oriented interventions ensure that prospective teachers are not only technologically proficient but also pedagogically effective and ethically responsible in integrating AI into contemporary classroom practices.

Keywords: Digital Competency, Attitude towards ethical integration of AI in teaching, Techno-Pedagogical Competency, Prospective Teachers

Introduction

The swift transformation in the field of education driven by technological advancements and Artificial Intelligence has made significant changes in the teaching-learning process, including lesson planning, setting up of learning experiences, content transaction, evaluation, continuous assessment, feedback, etc. The present generation, known as digital natives, is evolving in an environment deeply influenced by digital technologies and Artificial Intelligence. Therefore, teachers who are expected to teach the digital natives need to possess certain competencies that could satisfy their learning needs. One of the competencies is techno-pedagogical competency which is defined as the ability of teachers to effectively integrate technology with pedagogical strategies and subject matter to create meaningful learning experiences. This is a hybrid method that incorporates information and communication technologies to facilitate effective teaching and learning activities (Sathiraj and Rajasekar, 2013). The National Education Policy 2020 highlights the importance of integrating technology into teaching and learning processes, mandating that all teacher education programs include comprehensive training in educational technology. This policy envisions a fully developed digital infrastructure, necessitating teachers possess digital literacy and technological competency in integrating technology into teaching-learning process.

Integrating technology into education involves more than merely adding digital tools; it necessitates a comprehensive redesign of teaching strategies (Zhao, 2022). Practical implementation of TPC requires familiarity with diverse digital platforms: Learning Management Systems (LMS) like Canvas, Blackboard, Moodle - structured environments for course management and student interaction, Adaptive Learning Platforms such as DreamBox, Knewton - personalizing instruction based on individual student needs, AI-Powered Tools such as Cognii, Century - to customize machine learning content and provide real-time feedback, Mobile Learning Apps like Khan Academy, Socrative, TED-Ed, Google Classroom, Duolingo, Quizlet, Photomath - enabling learning anytime, anywhere, Immersive Technologies like Google Expeditions (virtual field trips), Labster (virtual science laboratories), Digital Assessment Tools such as Kahoot, Socrative, Quizizz, Plickers, Google Forms, Padlet - gamified evaluation and instant feedback (Rubeena, 2023). These skills go beyond technical expertise to include creativity, reflective practice, and cultural adaptation (Nayak and Choudhary, 2024).

Techno-pedagogical skills empower educators to establish vibrant learning environments, tailor instruction to accommodate a variety of student needs, and promote digital citizenship along with critical thinking abilities (Sachan & Diwedi, 2023). Ertmer, Ottenbreit-Leftwich, and York (2012) examined the correlation between educators' digital competency and their utilization of technology in the classroom. The results indicated that educators possessing greater digital competency were more inclined to employ technology for teaching purposes. The research highlighted the significance of providing opportunities for educators to improve their digital competency and effectively integrate technology. Prestridge (2014) examined the elements that affect the growth of digital competence among secondary school educators. The study pinpointed factors such as teachers' previous experience with technology, availability of technological resources, and ongoing professional development as essential determinants of digital competence. The results underscored the necessity of providing educators with support and resources to cultivate and improve their digital competence. Hatlevik and Christophersen (2013) analyzed the connection between teachers' digital

competence and their utilization of digital resources in secondary education. The results revealed that educators with elevated levels of digital competence were more inclined to employ a diverse array of digital resources in their instruction. The study highlighted the importance of continuous professional development to enhance teacher's digital competence and encourage the effective application of digital resources.

As millions of new technologies emerge in seconds all over the world, technology wins over technology with its positive and negative effects. For instance, appearing for online examinations from anywhere using a computer with network connection, which was an innovation in the education system, has now limited due to rise in academic dishonesty, thereby reducing trust in the examination results. Tech-savvy students find ways to circumvent the online scrutiny of examiners. And therefore, proctored online exams are established, that employs a tech-enabled monitoring software to supervise a student from start to finish, to ensure academic integrity. This shows that the teachers in the digital era should forecast the other side of technology twice as far as students do. Therefore, teachers need to have the attitude towards ethical, responsible and critical integration of technology in their whole teaching process, such as in content transactions, delivering learning materials, assessments, feedback etc. The policies and frameworks suggest that teachers need to be techno-pedagogues. The digital innovations have replaced the traditional 'chalk and talk' method, expanding student engagement, fostering digital literacy and teacher capabilities to integrate ICT tools effectively in pedagogy (Qurashi & Jan, 2022; Ering & Ering, 2025). But in the world of Artificial Intelligence, teachers are expected to be more than just techno-pedagogues, rather, they must be ethical decision makers, critical, responsible and reflective practitioners who can integrate AI into teaching-learning processes while safeguarding human values, learner autonomy, non-maleficence, and justice.

The biggest ethical issues while integrating AI in Education relate to the privacy concerns of students and teachers (Regan & Jesse, 2019; Remian, 2019; Stahl & Wright, 2018). Another ethical issue studied is surveillance or tracking systems that collect information about the actions and preferences of users, which gives further suggestions based on the online activities. Surveillance software integrated with educational AI tools can anticipate learner choices, learning styles and preferences. Studies reveal that teachers using social networking sites for pedagogical purposes may encounter with problems like data privacy, bias and discrimination, informed consent, transparency, etc. (Asterhan & Rosenberg, 2015).

Need and Significance of the Study

Artificial Intelligence (AI) offers numerous educational applications, including personalized learning platforms designed to enhance students' learning, automated assessment systems that assist educators, and facial recognition technologies that provide insights into learners' behaviours. Although AI holds significant promise for improving student's learning experiences and supporting teachers in pedagogical practices, the ethical and responsible integration of AI is seldom thoroughly examined within educational environments (Akgun & Greenhow, 2021). While reviewing related literature, it is found that digital competency, AI integration, and techno-pedagogical competencies are highly studied; however, there exists a significant research gap in studies that analyze the combined influence of digital competency and attitude towards the ethical integration of AI on techno-pedagogical competency, particularly among prospective teachers. Most research tends to concentrate on in-service teachers or prioritize technical skills, less considering the ethical aspects of AI integration in teaching. Here gains the significance of the present study, which aims to fill this gap by framing digital competency and attitude towards ethical integration of AI in teaching as predictive factors that influence techno-pedagogical competency among prospective teachers, thus providing essential insights for teacher education, curriculum development, and policy frameworks. The findings of this study are expected to have significant implications for pre-service teacher education programs. By highlighting the role of attitude towards ethical integration of AI in teaching alongside digital competency, the study emphasises the need for a balanced and holistic approach to technology integration in teacher education. It underscores the importance of embedding AI ethics, digital citizenship, and reflective practices within teacher education curricula to prepare teachers who are not only technologically competent but also ethically responsible in the integration of AI in teaching.

Objectives of the study

1.   To find out whether there exists a significant relationship between Techno-pedagogical competency and Digital Competency of prospective teachers.

2.   To find out whether there exists a significant relationship between Techno-pedagogical competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers.

3.   To find out the combined influence of Digital Competency and Attitude towards Ethical Integration of AI in Teaching on Techno-pedagogical competency of prospective teachers.

4.   To find out whether Digital Competency is a predictor of Techno-pedagogical Competency of prospective teachers.

5.   To find out whether Attitude towards Ethical Integration of AI in Teaching is a predictor of Techno-pedagogical competency of prospective teachers.

6.   To find out whether Techno-pedagogical competency of prospective teachers can be predicted in terms of the Digital Competency and Attitude towards Ethical Integration of AI in Teaching.

Methodology in Brief

In the present study investigator adopted descriptive survey method. 388 prospective teachers were selected using simple random sampling. Digital Competency scale, Scale of Attitude towards Ethical Integration of AI in Teaching and Techno-pedagogical Competency Scale were used for data collection. Data collected were analyzed using Pearson's product-moment correlation, Multiple Linear Correlation, Simple Regression and Multiple Regression.

Analysis and Discussion

Correlation of Techno-pedagogical Competency with Digital Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers

Correlation analysis has been conducted to find out the relationship between Techno-pedagogical Competency and Digital Competency, Techno-pedagogical Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers. A correlation index is a mathematical index that describes the direction and magnitude of a relationship between variables. Pearson product-moment correlation is used to determine the degree of variation in one variable that can be estimated from the knowledge about variation in the other variable.

The value of coefficient of correlation between i) Techno-pedagogical Competency and Digital Competency ii) Techno-pedagogical Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers were found, and the results are given in Table 1.

Table 1

Coefficient of correlation of Techno-pedagogical Competency with Digital Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers

Variables Correlated		N	Value of r	CI	Level of significance	Percentage variance
Techno-pedagogical Competency **X** Digital Competency		388	0.269	0.148-0.390	0.05	7.23
Techno-pedagogical Competency **X** Attitude towards Ethical Integration of AI in Teaching			0.415	0.307-0.523	0.05	17.22

** Significant at 0.05 level

Correlation between Techno-pedagogical Competency and Digital Competency of prospective teachers

The value of coefficient of correlation between Techno-pedagogical Competency and Digital Competency of prospective teachers is 0.269. The value obtained greater than the value set for 0.05 level (0.0990). Hence the obtained correlation is significant at 0.05 level. This shows that there is significant positive correlation between Techno-pedagogical Competency and Digital Competency of prospective teachers. It indicates that any increase or decrease in Techno-pedagogical Competency will be followed by a corresponding increase or decrease in Digital Competency of prospective teachers. The percentage variance shared between Techno-pedagogical Competency and Digital Competency is 7.23%. That is, 7.23% of the variance of Techno-pedagogical Competency is attributable to the variance in Digital Competency of prospective teachers.

Correlation between Techno-pedagogical Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers

The value of coefficient of correlation between Techno-pedagogical Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers is 0.415. The value obtained greater than the value set for 0.05 level (0.0990). Hence the obtained correlation is significant at 0.05 level. This shows that there is significant positive correlation between Techno-pedagogical Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers. It indicates that any increase or decrease in Techno-pedagogical Competency will be followed by a corresponding increase or decrease in Attitude towards Ethical Integration of AI in Teaching of prospective teachers. The percentage variance shared between Techno-pedagogical Competency and Attitude towards Ethical Integration of AI in Teaching is 17.22%. That is, 17.22% of the variance of Techno-pedagogical Competency is attributable to the variance in Attitude towards Ethical Integration of AI in Teaching of prospective teachers.

Combined influence of Digital Competency and Attitude towards Ethical Integration of AI in Teaching on Techno-Pedagogical Competency of prospective teachers

Multiple linear correlation analysis has been conducted to find out the relationship between Techno-pedagogical Competency and the combined influence of Digital Competency and Attitude towards Ethical Integration of AI in Teaching.

Table 2

Multiple Coefficient of Correlation between Techno-pedagogical Competency with Digital Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers

Variables Correlated	N	Value of r	CI	Level of significance	Percentage variance
Techno-pedagogical Competency **X** Digital Competency **&** Attitude towards Ethical Integration of AI in Teaching	388	0.427	0.346-0.508	0.05	18.23

The value of coefficient of correlation between Techno-pedagogical competency and independent variables; Digital competency and Attitude towards ethical integration of AI in teaching is found to be 0.427. The value obtained greater than the value set for 0.05 level (0.0997). Hence the obtained correlation is significant. This shows that there is a significant positive correlation between techno-pedagogical competency and digital competency and attitude towards ethical integration of AI in teaching. It indicates that any increase or decrease in Techno-pedagogical competency will be followed by a corresponding increase or decrease in combined influence of digital competency and attitude towards ethical integration of AI in teaching of prospective teachers. The percentage variance shared between techno-pedagogical competency and digital competency and attitude towards ethical integration of AI in teaching of prospective teachers is 18.23%. That is, 18.23% of the variance of Techno-pedagogical Competency is attributable to the variance in Digital competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers.

Techno-pedagogical Competency as a predictor of Digital Competency of prospective teachers

In this section, an attempt has been made to predict the Techno-pedagogical Competency of prospective teachers in terms of Digital Competency. Prediction using Simple Regression technique is based on the assumption that at least one factor will lead to the variable to be predicted is present and measurable at the time of the prediction is made. Simple regression analysis is used to make prediction about score on one variable from the knowledge of score on another variable.

Table 3

Linear Regression model for Techno-pedagogical Competency in terms of Digital Competency

Variable	Beta Coefficient	Level of Significance
Constant	17.16	0.00
Digital Competency	0.269	0.00
R square value	0.072	

The result shows that R square value of regression model is 0.072. It means that 7.2 percent of variation in Techno-pedagogical Competency is determined by the Digital Competency of prospective teachers. The beta coefficient of Digital competency is 0.269. It means that if the digital competency of prospective teachers is increased by one unit the Techno-pedagogical Competency will be increased by 0.269 units. The regression equation can be written as;

Techno-pedagogical Competency = 17.16 + 0.269 Digital Competency

Techno-pedagogical Competency as a predictor of Attitude towards Ethical Integration of AI in Teaching of prospective teachers

Table 4

Linear Regression model for Techno-pedagogical Competency in terms of Attitude towards Ethical Integration of AI in Teaching

Variable	Beta Coefficient	Level of Significance
Constant	16.02	0.00
Attitude towards Ethical Integration of AI in Teaching	0.366	0.00
R square value	0.172	

The result shows that R square value of regression model is 0.172. It means that 17.2 percent of variation in Techno-pedagogical Competency is determined by the Attitude towards Ethical Integration of AI in Teaching of prospective teachers. The beta coefficient of Attitude towards Ethical Integration of AI in Teaching is 0.366. It means that if the Attitude towards Ethical Integration of AI in Teaching of prospective teachers is increased by one unit the Techno-pedagogical Competency will be increased by 0.366 units. The regression equation can be written as;

Techno-pedagogical Competency = 16.02 + 0.366 Attitude towards Ethical Integration of AI in Teaching

Combined Prediction ability of Digital Competency and Attitude towards Ethical Integration of AI in Teaching on Techno-pedagogical competency

In this section, an attempt has been made to predict the Techno-pedagogical competency of prospective teachers based on the independent variables; Digital Competency and Attitude towards Ethical Integration of AI in Teaching. Prediction through the use of correlational technique is based on the assumption that at least some of the factors that will lead to the behaviour to be predicted are present and measurable at the time the prediction is made. A related technique, known as regression is used to make predictions about the scores on one variable from knowledge of scores on another variable. These predictions are obtained from the regression equation. Multiple regression generally explains relationship between multiple independent or predictor variables and one dependent or criterion variable.

Predictors of Techno-pedagogical competency in terms of Digital Competency and Attitude towards Ethical Integration of AI in Teaching of prospective teachers

Multiple regression was fitted to the techno-pedagogical competency of prospective teachers in terms of Digital Competency and Attitude towards Ethical Integration of AI in Teaching. The beta coefficient along with significant levels of the independent variables; Digital Competency and Attitude towards Ethical Integration of AI in Teaching, are given in Table 5.

Table 5

Linear regression model for Techno-pedagogical competency of prospective teachers in terms of Digital Competency and Attitude towards Ethical Integration of AI in Teaching

Variables	Beta Coefficient	Level of significance
Constant	13.27	0.00
Digital Competency	0.112	0.00
Attitude towards Ethical Integration of AI in Teaching	0.367	0.028
R square value	0.182	

The result shows that R square value of regression model is 0.182. It means that 18.2 percent of variation in Techno-pedagogical Competency is determined by the Digital Competency and Attitude towards Ethical Integration of AI in Teaching. The beta coefficient of the two independent variables is found to be significant at 0.05 level. The beta coefficient of Digital Competency is 0.112. It indicates that if the digital competency is increased by one unit, the Techno-pedagogical Competency of prospective teachers will increase by 0.112 units. The beta coefficient of Attitude towards Ethical Integration of AI in Teaching is 0.367. It indicates that if the Attitude towards Ethical Integration of AI in Teaching is increased by one unit, the Techno-pedagogical Competency of prospective teachers will increase by 0.367 units. The regression equation can be written as;

Techno-pedagogical Competency = 13.27 + 0.112 Digital Competency + 0.367 Attitude towards Ethical Integration of AI in Teaching

Conclusion

In the contemporary education system driven by digital technology and Artificial Intelligence, the responsibilities of teachers have evolved beyond conventional teaching methods to encompass technological expertise and ethical accountability. This research emphasizes the importance of techno-pedagogical competency among prospective teachers, asserting that successful teaching in the digital era necessitates not only digital proficiency but also the capacity to integrate technology in a meaningful and ethical manner into pedagogical practices. The results highlight that digital competency and attitude towards the ethical integration of AI in education are key indicators of techno-pedagogical competency. This illustrates the interrelation of technological knowledge, pedagogical insight, and ethical consciousness in developing capable educators for the future.

Future Recommendations

The study may extend to adopt experimental or quasi-experimental designs to evaluate the effectiveness of specific interventions such as AI-focused workshops, ethics-based training modules, digital pedagogy courses, and hands-on technology integration activities to foster techno-pedagogical competency of prospective teachers. As AI technologies continue to evolve, future studies may explore the role of emerging tools such as generative AI, learning analytics, virtual reality, and adaptive learning systems in enhancing techno-pedagogical competency.

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