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Effect of Teachers' Competencies in AI-TPACK on Digital Creativity: A Survey of University Teachers

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ABSTRACT

This research paper examines the effect of teachers' competencies in AI-TPACK (Technological Pedagogical Content Knowledge with Artificial Intelligence integration) on their digital creativity at the university level. The primary objectives were to assess the level of AI-TPACK competencies among university teachers, evaluate their digital creativity, and analyze the relationship between the two. A descriptive survey research design was employed, with a sample of 115 teachers from Women University of AJ&K Bagh and University of Poonch Rawlakot. Data were collected through a self-designed questionnaire, analyzed using SPSS-24. The descriptive statistics Mean and Standard deviation and linear regression was used. The findings revealed that university teachers displayed a high level of AI-TPACK competencies, particularly in technological, pedagogical, and content knowledge, though ethical and troubleshooting competencies were moderately developed. Teachers also demonstrated strong digital creativity, particularly in AI-driven innovation and personalized learning. Regression analysis showed a significant predictive relationship between AI-TPACK competencies and digital creativity. These results underscore the importance of enhancing AI-TPACK competencies to foster digital creativity and innovation in teaching practices. The study recommends targeted professional development in AI ethics and troubleshooting, the integration of AI training in teacher education programs, and further research to explore best practices for AI-TPACK development in diverse educational contexts.

Key words: AI-TPACK, Competencies, Digital Creativity, University Teachers

INTRODUCTION

The fast development of the field of artificial intelligence (AI) has made a great impact on many areas, and education is not an exception. Teachers are becoming bolder to use AI in teaching as the need to incorporate AI in instruction aides them in promoting learning and achieve digital creativity in students. Technological Pedagogical Content Knowledge (TPACK) framework is a great model that can be used to grasp what it takes to be competent to integrate technologies in education. However, nowadays, there is the new term called AI-TPACK: this term proposes AI integration into the model TPACK to equip teachers with knowledge and skills to deal with the changing world of education more effectively.

In one study, Kong et al. (2024) suggested a TPACK with AI components in the fields of teaching STEM topics. The research proposed an open-to-participation course that aimed toward improving the competencies among primary school teachers as those who teach



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AI-integrated STEM activities and promote their digital imagination. The results revealed that there was a high level of improvement of the TPACK competence of the teachers and also showed that most of the participants were digitally creative in the design of the Internet of Things (IoT) systems most of which incorporated AI capabilities.

Chan and Tang (2024) evaluated the willingness of English teachers to incorporate AI tools in the teaching of languages with the help of a TPACK-grounded framework. Through their study, they pointed out the significance of professional training when acquiring and applying AI devices, in the planning of the pedagogy and in the acquisition of suitable materials in teaching the English language. The paper also reinforced the use of technological pedagogical knowledge and instructional literacy as the important predictors of the general TPACK competency highlighting the importance of specific focus on professional development to develop the AI-TPACK competencies of teachers.

A research in Education and Information Technologies considered the correlation between the competence of teachers in AI-TPACK and digital expertise. The study demonstrated that the level of AI-TPACK competencies of teachers was not high, whereas the level of digital proficiency was higher than average. Essentially, a strong correlation between AI-TPACK competencies and digital proficiency was found and digital proficiency was a good predictor of the former. This implies that the digital strengths of teachers would be an excellent way of improving their AI-TPACK skills, and hence foster digital creativity in learning institutions.

The arrival of AI in education requires a rethink of the role of a teacher and the skills they need. The AI Competency Framework of Teachers (UNESCO) responds to this need as it specifies what teachers should learn on the knowledge, skills, and values they should acquire in the era of AI. The framework describes the competencies along five dimensions namely human-centred mindset, ethics of AI, AI foundations and applications, AI pedagogy and AI for professional learning. Such competencies are divided into three levels of progression acquiring, deepening, and creating that can help the teacher develop an AI-related competence in a consistent manner.

To enable teachers to teach the uses of AI successfully, it is crucial to integrate the AI into the TPACK framework (AI-TPACK). Severe digital literacy improvement and related professional development of teachers will enable them to enhance their AI-TPACK skills (and thus promote digital creativity in learning environments) to a sufficient extent. More research is to be conducted to implement better understanding of AI-TPACK regarding different components in relation to different dimensions of digital creativity so that effective teacher improvement programs can be designed.

The statement of the problem is that educators have difficulties with the integration of AI and other connected Technologies such as the Internet of Things (IoT) into STEM work because of the lack of training. In this study, impact of AI-TPACK Competencies on the teachers is going to be discussed in their capacities to promote digital creativity in the context of teachers preparation with possibilities to develop ways on how the AI knowledge can be enhanced and how the AI tools can be introduced in education in order to assure the creation of a fostering, engaging, creative and problem-solving environments. Having this in mind, the researcher seeks to undertake a study with the following title, exploring Relationship between Teachers competencies in AI-TPACK and Digital Creativity.

Objectives

The study was conducted to achieve the following objectives:

To examine the level of AI-TPACK competencies among teachers.



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To find out the level of Teachers' digital Creativity at university level.

To analyze the impact of AI-TPACK competencies on teachers' digital creativity.

METHODOLOGY

The research method in this study was the descriptive survey design. The population was a number of teachers working in two universities namely Women University of AJ&K Bagh and the University of Poonch Rawlakot. The number of teachers in both universities was 397 and 113 respectively. The total sample of 115 teachers was taken for this research. The questionnaire was developed after reviewing related literature. The researcher went to both universities personally and handed the questionnaire to the sampled teachers. The representative data thus gathered was tabulated, interpreted as well as analyzed with the help of SPSS-24 (Statistical Package for Social Sciences) and determined by Mean and standard deviation and regression.

LITERATURE REVIEW

The use of the Artificial Intelligence (AI) and digital instruments in higher education has completely changed the scope of pedagogical processes, shifting the focus towards the technological skills and digital imagination of university educators. Since the future of higher education institutions is turning into a digitally enhanced learning environment, the expertise of instructors in implementing and implementing AI in a systematic pedagogical framework such as AI-TPACK (Technological Pedagogical Content Knowledge extended to AI) is essential (Lin et al., 2023). The literature review examines concepts of teacher competency, AI-TPACK and digital creativity to establish the the overarching levels of influence on teaching and learning in the university setting.

The term competency of teachers is a multidimensional construct that accounts to the knowledge, skills, attitudes and values that teachers require to be competent in designing, implementing and assessing instruction. As the issue of teaching competency is discussed in the context of higher education, where the ever-accelerated technological progress is transforming the very principles of pedagogical landscapes, where teaching competency is no longer confined to the domain of subject knowledge and pedagogical awareness, but necessitates the emergence of a strong comprehension of the process of technological integration and digital innovation (Han et al., 2022).

The competencies in the traditional models of teaching focused mostly on delivering contents, curriculum, classroom control, and evaluation of students. The digitalization of education has, nevertheless, brought about different demands. Due to the growing number of universities applying digital platforms, AI-based services, and data-driven instructional tools, teachers are now being tasked with more than just transferring knowledge to students; they are the new facilitators of technology-driven learning (Ifinedo et al., 2021). It means that teachers require an extensive repertoire of skills and abilities, which help them to integrate content knowledge and relevant technology instruments with their pedagogical approaches, so they should embody skills represented in the Technological Pedagogical Content Knowledge (TPACK) and its extensions, such as AI-TPACK (Lin et al., 2023).

The topicality of digital and AI-integrated competency is particularly impressive given the worldwide interruptions such as the COVID-19 pandemic that required the sudden transition of the traditional face-to-face form of instruction to the online and blended/hybrid forms thereof. This change revealed that there was a substantial deficit in digital teaching preparedness among college instructors, and once again teacher digital competence as a vital aspect of quality education was in the spotlight (Liu et al., 2023). Zawacki-Richter et al. (2019) explain that instead of merely using digital tools, however,



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instructors have to make pedagogically valid decisions based on AI results when using educational technologies powered by artificial intelligence including adaptive learning systems, automated grading, virtual tutoring, and learning analytics.

Competencies of teachers in the digital age are usually perceived to incorporate a number of interdependent dimensions: Pedagogical Competency this is the capability of using instructional theories and teaching strategies to suit different learners. This involves the capacity to put into application, active learning, joint endeavors, and critical thinking techniques in the university environment (Darling-Hammond et al., 2020). The pedagogical competency is also crucial enough in its integration with AI and digital tools to make sure that the outcome is not aimed at using technology but at engaging learners.

Technology Competency: University instructors are supposed to be experts in terms of using a wide range of digital tools such as Learning Management Systems (LMS), content development software, digital examinations, and AI-based technologies such as intelligent tutoring systems and chatbots. Technological competence is also related to solving digital issues, making digital resources accessible, and usable (Guo et al., 2023).

Content knowledge: It is important that an educator is knowledgeable in a certain field. Nevertheless, content knowledge, when applied to the technology-involved arena, has to engage in a dynamic connection with the digital pedagogical tools. To consider one example, a university biology instructor should be capable of delivering molecular processes more efficiently with the help of AI simulations and virtual labs (Han et al., 2022).

Assessment Competency: Quality teachers must be in a position to come up with such assessments in the form of the design of interesting, authentic, formative, and summative studies that take advantage of digital technologies. The example of AI-enabled analytics is that an educator can monitor progress and learning patterns and give feedback in real-time now, and a teacher has to understand and convert this information to take necessary actions (Roll & Wylie, 2021).

Legal and ethical consciousness: Along with the spread of the digital tools usage, the teacher should also acquire the awareness of privacy laws, ethical aspects of the use of AI, copyrights regulations and digital citizenship. This attribute of competency has gained more relevance through the ever-increasing involvement of AI in decision-making in the field of education (Zawacki-Richter et al., 2019).

Developing Higher Education Teachers Skill: These competencies do not develop automatically and need a guided approach in terms of professional development programs, institutional support and reflection in teaching. According to a study conducted by Ifinedo et al. (2021), ongoing professional learning has a much more noticeable impact on the digital instructional competence of the faculty. Equally, according to Spante et al. (2021), institutions need to establish digital competence culture wherein peer-to-peer learning, experimentation, and innovations are promoted.

Professional growth should no longer take a form of workshops but rather to form into purpose-oriented engagements that are longitudinal in nature and provide the faculty with a space to explore, reflect, and innovate. Guo et al. (2023) argue that such AI-integrated models of professional development that not only demonstrate how a tool can be operated but also contain cases of a demonstration of pedagogy in the real world are valuable.

In addition to this, institutional infrastructural facilities and policy guidelines are an important aspect of empowering teachers. The level of investment in facilities, incentives, and leadership by a university in achieving digital transformation is an indicator of how much teachers can adapt and master digital and AI-supported teaching (Liu et al., 2023).

Effect of Competency of Teachers on the Student Results: Quality teaching and learning



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is anchored on the presence of competent teachers in a technology rich environment. The research experiments show that competency among the teachers is always associated with higher levels of engagement, achievement, and satisfaction of students (Darling-Hammond et al., 2020). According to the study by Guo et al. (2023), students at the university who were taught by instructors with high AI-TPACK competence performed much better and showed their advanced critical thinking skills. On the same note, digital innovation and creativity in teaching have been evidenced to improve the motivation of learners, improve their comprehension as well as digital literacy among the learners. Koh and Chai (2022) stressed that, when there are original digital tools in the assessment and interactive modules, the students will have greater likelihoods to absorb 21 st -century skills including communication, collaboration, and creativity.

Results:

In this section, the author shows the description and analysis of the data collected using a structured questionnaire among the university teachers.

Table 1: Descriptive Statistics of AI-TPACK Competencies

Competency Dimension	N	Mean	Std. Deviation	Interpretation
Technological Knowledge (TK)	115	3.84	0.61	High
Pedagogical Knowledge (PK)	115	3.76	0.67	High
Content Knowledge (CK)	115	3.70	0.72	High
Ethical & Troubleshooting (ET)	115	3.59	0.66	Moderate to High
Overall AI-TPACK	115	3.72	0.68	High

The table 1 contains the mean values as well as the standard deviations of various AI-TPACK competencies dimensions of university teacher. Through the analysis, it is shown that teachers indicated the high level of technological knowledge ($M = 3.84$, $SD = 0.61$) indicating that they are assured in their capacity to apply the AI tools and technologies in classrooms. In the same manner, there was also a greater degree of pedagogical knowledge among the teachers ($M = 3.76$, $SD = 0.67$), which is a confirmation that they will be able to implement AI tools in their teaching strategies to facilitate students learning. The content knowledge aspect also had a very high mean ($M = 3.70$; $SD = 0.72$) and depicts the ability of the teachers to equate AI tools and subject content in order to achieve better comprehension. As far as ethical and troubleshooting dimension is concerned, the mean can be said to be slightly lower at 3.59 ($SD = 0.66$) which indicates a moderately high competence level. It implies the idea that educators on the whole know about ethical concerns and fundamental problems-solving strategies of AI tools, still, they might need further professional growth regarding them. The general AI-TPACK competency level was high ($M = 3.72$, $SD = 0.68$), which means that mostly the teachers of the university feel themselves competent and have the balanced and harmonious command of the AI-related pedagogical, technological, and content knowledge. The results are an indication of high willingness of the teachers to adopt the use of AI in higher education instructions.

Table 2: Descriptive Statistics of Teachers' Digital Creativity

Creativity Aspect	N	Mean	Std. Deviation	Interpretation
Digital Content Design	115	3.89	0.59	High
Personalized Learning	115	3.74	0.62	High
Use of AI for Innovation	115	3.91	0.57	High



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Overall Digital Creativity 115 3.85 0.60 High

Table 2 gives a presentation of the descriptive statistics of the digital creativity levels of the university teachers in different aspects. The findings revealed that the digit content design creativity of teachers is high as observed on the mean score of 3.89 (SD = 0.59). This is an indication of the teachers getting actively and resoundingly involved in delivery of fascinating and interactive digital educational contents in the making. The extent of use of AI in innovation was also the highest with a mean score of 3.91 (SD = 0.57) implying that teachers are very innovative in their teaching activities using AI. It denotes a high desire to apply innovation and explore new techniques and find ways to use AI to improve the course of teaching and learning. Personalized learning as another significant factor of digital creativity was rated high, as well (M = 3.74, SD = 0.62). This proves that educators are successfully applying AI to adjust the learning experience to specific needs and preferences of individual students. On average, the digital creativity levels were also high (M = 3.85, SD = 0.60), indicating that university teachers have significant creative skills in planning, customising and creating their delivery work with AI. The findings are a positive and proactive indication on digital transformation at the higher education level.

Table 3: Regression Analysis Results

Model	R	R ²	F	Sig.	β (Beta)	T	p- value
AI-TPACK → Digital Creativity	0.688	0.473	101.27	0.000	0.687	10.06	0.000

Table 3 provided the findings of a straight forward linear regressions analysis undertaken to check how the level of AI-TPACK competencies influences the digital creativity of teachers. The results show that there is a very positive relationship between AI-TPACK and digital creativity whose correlation coefficient (R) is 0.688. Coefficient of determination (R² = 0.473) indicates that about 47.3 percent of the digital creativity variance can be attributed to the AI-TPACK skills of college instructors. To check on the significance of the regression model, the F-statistic (F = 101.27, p <.001) shows that the regression model is significant, and AI-TPACK is a significant predictor of digital creativity. The standardized coefficient of regression (bf = 0.687) also achieves the p < .001 level of significance (t = 10.06), indicating that an increment in the ability towards AI-TPACK is linked to a tremendous boost in digital creativity. This great effect size implies that the increase in teachers skills regarding AI-TPACK is significant already to their capability of creating and innovating inside the digital teaching space.

Conclusions

The findings of the research article under consideration emphasize that university educators have a large proportion of AI-TPACK competencies, as they are characterized by confidence and the ability to incorporate the tools of artificial intelligence into all directions related to technology, pedagogy and subject matter. Technological knowledge was identified as the most powerful area of all the attributes proving that teachers can be especially skillful in implementing the AI tools into their educative activities. Likewise, a high score of pedagogical and content knowledge implies that teachers are highly ready



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to integrate AI tools with successful teaching practices and subject-based academic information. Although the overall competencies were high, the marginally lower scores in ethical and troubleshooting dimension is an indication of moderate preparedness in dealing with AI-related ethical challenge and technical problems. That implies that the teaching staff still requires specialized training to be more competent in handling ethical matters and diagnosing the AI-based learning aids when it comes to digital education. The performance of the teachers, in terms of digital creativity, was admittedly high always, in their inventive application of AI with regard to the improvement of teaching practices. The maximum of the scale of using AI to innovate indicates a high tendency of educators to play around and imaginatively connect AI-related technologies to the classroom. Moreover, high achievement in the digital content design and personalized learning suggests that teachers are real partners in the creation of appealing digital contents and individualized learning with the help of AI.

Recommendations

It is recommended to university administrators that they may organize targeted professional development programs focused on enhancing teachers' AI-TPACK competencies, particularly in ethical use and troubleshooting of AI tools.

It is recommended to teacher training institutions that they may provide hands-on training sessions on digital content design and the use of AI for personalized learning to foster innovation and creativity among university teachers.

It is recommended to technology integration teams that they may support teachers by providing access to advanced AI tools and technical support, enabling educators to apply these tools effectively in their teaching practices.

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