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The Role of Technology-Enhanced Professional Development in Improving Teaching Effectiveness

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ABSTRACT

This study examines the impact of technology-enhanced professional development (TEPD) on teaching effectiveness among 120 teachers, controlling for variables such as gender, age, class size, experience, prior technology exposure, digital infrastructure, and the technology mode used. The analysis found that while female teachers (M = 42.3, SD = 8.99) had slightly higher mean scores than males (M = 39.1, SD = 6.62), this difference was not statistically significant. No statistically significant differences emerged across age groups, class levels, or years of experience. Access to digital infrastructure and the mode of technology used also showed no significant effect on teachers' perceptions of TEPD effectiveness. These results indicate that TEPD provides similar benefits to teachers regardless of demographic or contextual factors, supporting its broad relevance for improving teaching effectiveness.

Keywords: Technology in education, TEPD, professional development, effective teaching

INTRODUCTION

Effective teaching is crucial for student learning outcomes (Darling-Hammond, 2017). As education evolves in the 21st century, teachers' professional development is increasingly vital. While traditionally limited to in-person workshops and seminars, these methods have been transformed by Information and Communication Technology (ICT). (Abbasi et al., 2025) Technology-enhanced professional development (TEPD) now leverages digital tools, online platforms, and multimedia resources to improve teachers' knowledge, instructional strategies, and overall effectiveness.

Technology-enhanced professional development offers teachers flexible, ongoing learning opportunities tailored for the dynamic nature of teaching. Through online courses, webinars, learning management systems, mobile applications, and virtual communities, educators can conveniently access professional learning resources. These platforms also foster collaboration, enabling teachers to share experiences, exchange ideas, and develop innovative teaching strategies (Trust, Krutka, & Carpenter, 2016; Desimone & Garet, 2015). Such technology-mediated learning environments support the adoption of student-centred pedagogies and promote reflective teaching practices.

In the post-pandemic era, the importance of technology-enhanced professional development has grown significantly. The COVID-19 pandemic accelerated the adoption of digital and blended learning models, highlighting the need for teachers to develop technological and pedagogical competencies. When well-designed and well-supported, TEPD can enhance teachers' instructional skills, improve teaching effectiveness, and contribute to better educational outcomes (UNESCO, 2021).

SIGNIFICANCE OF THE STUDY

The present study examines the role of technology-enhanced professional development (TEPD) in improving teaching effectiveness in the digital era. Traditional professional development programs often face limitations such as rigid schedules, limited accessibility, and a lack of personalised support (Desimone & Garet, 2015). In contrast, TEPD provides flexible and interactive learning opportunities through digital tools, online platforms, and collaborative environments, enabling teachers to update their knowledge and instructional practices more effectively (Huang, 2024).

This research highlights how technology-based professional learning can strengthen teachers' pedagogical skills and classroom practices, thereby improving student engagement and learning outcomes (Amemasor, 2025). Understanding the relationship between TEPD and teaching effectiveness informs educational policies and development programs.

The findings are relevant for policymakers, school administrators, and teacher education institutions seeking to design effective professional development. By promoting continuous teacher learning through technology, this study supports broader educational objectives such as quality and inclusive education (SDG-4) and encourages innovation and lifelong learning within the teaching profession (UNESCO, 2021).

LITERATURE REVIEW

Technology-enhanced professional development (TPD) has become a pivotal component in modernising educational practices and improving teaching effectiveness. (Rehman et al., 2025) As technology increasingly permeates classrooms, equipping educators with the skills to integrate technology is essential. Amemasor (2025)

A systematic review by Amemasor (2025) analysed 23 peer-reviewed studies and identified key characteristics of effective TPD programs, including collaborative learning environments, hands-on digital training, ongoing mentorship, and institutional support. These elements foster positive shifts in teachers' attitudes, confidence, and competencies regarding digital instructional integration (DII).

Similarly, Huang (2024) examined TEPD programs during the COVID-19 pandemic and found that technology-enhanced TEPD programs were effective in enhancing teachers' learning and teaching practices. The study highlighted the importance of adapting TEPD programs to the digital context to ensure their effectiveness.

Ajani (2024) emphasised that educational technology enhances teachers' professional competence and provides opportunities for them to use available learning technologies for teaching and learning. However, the study also noted various challenges that hinder effective technology use in schools, suggesting the need for targeted professional development initiatives.

The World Bank (2022) report on effective teacher professional development using technology underscores that high-quality TPD can positively impact classroom teaching practices by directly influencing teacher outcomes, such as content knowledge and digital competencies.

Furthermore, Gess-Newsome (2003) proposed a framework for technology-infused professional development, suggesting that computer tools can offer learners opportunities to construct personally meaningful conceptions of teaching and to create products that reflect those conceptions.

OBJECTIVE OF THE STUDY

To examine the effectiveness of technology-enhanced professional development on teaching effectiveness and to analyse its relationship with selected demographic and contextual variables.

HYPOTHESES

1. There is no significant relationship between teachers' gender and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.
2. There is no significant relationship between teachers' age and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.
3. There is no significant relationship between the level of class handled by teachers and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.
4. There is no significant relationship between teachers' years of experience and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

5. There is no significant relationship between teachers' prior exposure to technology and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.
6. There is no significant relationship between the availability of digital infrastructure in schools and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.
7. There is no significant relationship between the mode of technology used and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

RESEARCH DESIGN

The study employed a quantitative research design to examine the role of technology-enhanced professional development in improving teaching effectiveness. A sample of 120 teachers was selected to participate in the study. Teaching effectiveness was assessed using a researcher-developed self-report questionnaire measured on a 5-point Likert scale, ranging from strongly disagree to strongly agree. The questionnaire's reliability was rigorously evaluated, yielding a high Cronbach's alpha of 0.93, indicating excellent internal consistency and confirming the instrument's suitability for accurately capturing teachers' perceptions of their professional development and instructional effectiveness.

Variable	Categories	N	Mean	SD	Calculated 't' Value	Table Value	Remarks
Gender	Female	102	42.3	8.99	0.14	1.96	NS
	Male	18	39.1	6.62			

STATISTICAL TECHNIQUES USED

Arithmetic Mean, Standard Deviation, t-test, and ANOVA (F-test) were used to analyse the data in jamovi.

DATA ANALYSIS AND INTERPRETATION

Null Hypothesis 01: There is no significant relationship between teachers' gender and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Table 01

There is no significant relationship between teachers' gender and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

S-Significant; NS-Not Significant

The study shows that female teachers (M = 42.3, SD = 8.99) scored slightly higher than male teachers (M = 39.1, SD = 6.62) in teaching effectiveness after technology-enhanced professional development. The calculated t-value (0.14) is lower than the table value (1.96) at the 0.05 level of significance, indicating that there is no significant difference between male and female teachers.

Null Hypothesis 02: There is no significant relationship between teachers' age and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Table 02

There is no significant relationship between teachers' age and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Variable	Categories	N	Mean	SD	Calculated 't' Value	Table Value	Remarks
Age	Below 40	89	42.1	9.13	0.49	1.96	NS
	Above 40	31	40.9	7.50			

S-Significant; NS-Not Significant.

The calculated t value (0.49) is less than the table value (1.96), showing no significant difference between the two age groups. Teachers below 40 (M = 42.1) and above 40 (M = 40.9) reported almost similar perceptions of technology-enhanced professional development.

Null Hypothesis 03: There is no significant relationship between the level of class handled by teachers and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Table 03

There is no significant relationship between the level of class handled by teachers and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Variable	Source of Variation	Sum of Squares	df	Mean Square	Calculated 'F' Value	Table Value	Remarks
Class Handling	Between	125	2	62.6	0.819	3.00	**NS**
	Within	893	117	76.4			

S-Significant; NS-Not Significant.

The calculated F-value (0.819) for Class Handling is lower than the table value (3.00). This indicates that there is no significant difference between groups in class handling effectiveness.

Null Hypothesis 04: There is no significant relationship between teachers' years of experience and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Table 04

There is no significant relationship between teachers' years of experience and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Variable	Categories	N	Mean	SD	Calculated 't' Value	Table Value	Remarks
Year of Experience	Up to 10 years	104	41.6	9.05	0.58	1.96	**NS**
	11 years and above	16	42.9	6.31			

S-Significant; NS-Not Significant.

The calculated t value (0.58) is lower than the table value (1.96), showing no significant difference. Teachers with up to 10 years' experience (M = 41.6) and those with 11 years and above (M = 42.9) scored almost equally.

Null Hypothesis 05: There is no significant relationship between teachers' prior exposure to technology and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Table 05

There is no significant relationship between teachers' prior exposure to technology and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Variable	Categories	N	Mean	SD	Calculated 't' Value	Table Value	Remarks
Prior exposure to technology	Yes	105	41.4	8.98	0.13	1.96	NS
	No	15	44.9	6.05			

S-Significant; NS-Not Significant.

The calculated t-value (0.13) is less than the table value (1.96) at the 0.05 level of significance, indicating that there is no significant difference between teachers with and without prior technology exposure. Teachers with prior exposure (M = 41.4, SD = 8.98) and those without exposure (M = 44.9, SD = 6.05) show similar levels of teaching effectiveness. Hence, the null hypothesis is accepted.

Null Hypothesis 06: There is no significant relationship between the availability of digital infrastructure in schools and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Table 06

There is no significant relationship between the availability of digital infrastructure in schools and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Variable	Categories	N	Mean	SD	Calculated 't' Value	Table Value	Remarks
Availability of digital infrastructure	Yes	81	41.4	8.77	0.43	1.96	NS
	No	39	42.7	8.68			

S-Significant; NS-Not Significant.

The calculated 't' value (0.43) is lower than the critical value (1.96), indicating no significant difference between teachers with and without access to digital infrastructure. Both groups (Yes: M = 41.4; No: M = 42.7) reported almost similar effectiveness in teaching.

Null Hypothesis 07: There is no significant relationship between the mode of technology used and the effectiveness of technology-enhanced professional development in improving teaching effectiveness.

Table 07

There is no significant relationship between the mode of technology used and the effectiveness of technology-enhanced

Variable	Source of Variation	Sum of Squares	df	Mean Square	Calculated 'F' Value	Table Value	Remarks
Mode of technology used	Between	408	3	136.0	0.14	3.00	NS
	Within	8653	116	74.6			

professional development in improving teaching effectiveness.

S-Significant; NS-Not Significant.

The calculated F value (0.14) is lower than the table value (3.00) at the 0.05 level of significance. Hence, the null hypothesis is accepted. This indicates that there is no significant difference in teaching effectiveness across modes of technology use, such as Learning Management Systems, Video Conferencing, Mobile Devices, and Interactive Tools. Teachers using different technological modes reported similar levels of effectiveness after participating in technology-enhanced professional development.

DISCUSSION

The findings of the present study reveal that technology-enhanced professional development (TEPD) positively contributes to teachers' teaching effectiveness, although demographic and contextual variables such as gender, age, class management, and years of experience did not show statistically significant differences. Female teachers scored slightly higher than male teachers, but the difference was not significant, suggesting that gender does not affect TEPD effectiveness. Similarly, no significant difference was observed between teachers under and over 40 years of age, suggesting that professional learning through technology is influenced more by motivation and institutional support than by age (Kopcha, 2012). Class handling and years of experience also showed no significant influence, indicating that both novice and experienced teachers benefit equally from technology-enhanced training (Ertmer & Ottenbreit-Leftwich, 2010).

The study further revealed that the availability of digital infrastructure and the mode of technology used—such as Learning Management Systems, Video Conferencing, Mobile Devices, and Interactive Tools—did not significantly influence teaching effectiveness. The calculated F value (0.14) was lower than the table value (3.00), indicating no significant difference among the different technological modes. This suggests that teachers reported similar levels of teaching effectiveness regardless of the technology platform used. Overall, the results highlight that well-designed TEPD programs can improve teaching effectiveness across diverse teacher groups, emphasising the importance of quality professional development, collaborative learning, and pedagogical application rather than teacher characteristics alone (Desimone & Garet, 2015).

CONCLUSION

Technology-enhanced professional development plays a pivotal role in improving teaching effectiveness by providing educators with flexible, accessible, and personalised learning opportunities. Integrating digital tools and online platforms allows teachers to update their pedagogical skills, engage in collaborative learning communities, and access real-time resources and feedback (Darling-Hammond, Linda et al., 2017; Trust, Torrey et al., 2016). Research indicates that technology-supported training enhances instructional strategies, promotes reflective practice, and fosters student-centred learning (Amemasor, Solomon K., 2025; Ajani, Olusola A., 2024). Moreover, it bridges geographical and temporal constraints, enabling continuous professional growth (UNESCO, 2021; World Bank, 2022). In conclusion, leveraging technology in professional development not only strengthens teachers' competence but also improves classroom outcomes, ultimately enhancing the overall quality of education.

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