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Personalised Learning and Teachers' Professional Development: Leveraging Technology to Support Student-Centred Learning

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ABSTRACT
This study investigates the interplay between personalised learning and teacher professional development (TPD) under the spotlight of the application of technology to build teaching practice and student engagement. Personalised learning, where student autonomy, flexibility, and relevance are emphasised, has been shown to enhance motivation, comprehension, and critical thinking. Its effective implementation is, however, dependent on the capacities of teachers, and therefore, situation-sensitive and long-term professional development becomes necessary. Drawing on more recent literature, the article highlights both the strengths and weaknesses of earlier TPD models, including being overly theoretical, detached from classroom life, and cost-frugal. More recent models, such as reverse mentoring and PLCs, are promising in fostering teamwork, reflexivity, and technical skill attainment, but scalability and teacher buy-in remain ongoing challenges. Technology is seen as a significant enabler to bridge these gaps, with the promise of virtual mentoring, AI-generated feedback, adaptive learning technologies, and collaborative web-based platforms to enhance PD accessibility, sustainability, and personalisation. With all the revolutionary powers of technology, fundamental challenges such as time constraints, limited institutional support, digital divides, and context non-relevance still limit TPD effectiveness, particularly in low- and middle-income countries. Recommendations are embracing hybrid and needs-based models of PD, leveraging digital technologies to customise learning and teacher development, and enhancing institutional and policy frameworks to provide infrastructure, technical support, and equal access. The paper concludes that technology integration in TPD is critical to making teachers capable of embracing personalized, student-centered pedagogies and thriving in evolving education settings.

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1. Introduction

Education in the 21st century is undergoing a paradigm shift towards more personalised and student-centred approaches, driven by the demands of globalisation, digital transformation, and the need for lifelong learning skills. Learning is no longer regarded as a uniform process but as a deeply personal experience shaped by individual backgrounds, cognitive dispositions, and socio-cultural contexts (Palmucci et al., 2025; Zheng et al., 2025). In this regard, *personalised learning* has emerged as an innovative instructional model that tailors content, pace, and delivery to the unique needs and interests of each learner. Research consistently shows that personalised learning enhances student engagement, motivation, and comprehension, thereby maximising individual potential (Shemshack & Spector, 2020; Falcão et al., 2018; Alamri et al., 2020).

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While personalised learning holds considerable promise, its successful implementation depends largely on the competence, adaptability, and professional growth of teachers. *Teacher Professional Development (TPD)* remains a primary mechanism for equipping educators with the knowledge, pedagogical skills, and technological fluency required to implement innovative instructional strategies (Popova et al., 2022; Korthagen, 2017). Effective TPD is not only about transferring new knowledge but also about fostering reflective practice, collaboration, and teacher agency (Darling-Hammond et al., 2017). Moreover, educational reforms across the globe highlight the necessity of technology integration within TPD to prepare teachers for increasingly complex and technology-driven classrooms (Yulisman et al., 2019; Mishra & Sahoo, 2023). Online and technology-mediated TPD of several systematic reviews of online and technology-mediated TPD range from mixed to positive reports, with the consensus being that well-designed online PD improves teachers' competencies and classroom practice if it includes supports for engagement, opportunities for reflection, and practical, discipline-relevant activities instead of being one-off lectures (Bragg et al., 2021).

Despite growing attention to personalised learning and teacher development, the literature reveals several gaps. First, studies have often examined these two domains in isolation, paying limited attention to how TPD can directly support personalised and student-centred pedagogies through technology. Second, challenges such as digital inequality, contextual irrelevance of training, and the mismatch between policy design and classroom realities continue to undermine the impact of TPD (Salifu et al., 2024; Kalyani, 2024). In particular, the need for context-sensitive, technology-enhanced professional learning frameworks that align with teachers' goals and realities remains underexplored, especially in low- and middle-income contexts (Hennessy et al., 2022; Nugroho et al., 2024).

This article seeks to address these gaps by examining the intersection of personalised learning, teacher professional development, and technology integration. Specifically, it explores how digital innovations such as artificial intelligence, online platforms, and adaptive learning systems can enhance teachers' professional growth while simultaneously fostering personalised, student-centred instruction. By synthesising recent research and highlighting both opportunities and challenges, the paper contributes to ongoing debates on educational reform and provides actionable recommendations for policymakers, teacher educators, and practitioners.

2. Methods

This study employed a qualitative, exploratory design, informed by an integrative review of recent literature. Rather than collecting primary data, the study systematically examined peer-reviewed articles, book chapters, and reports published between 2018 and 2025 that focus on personalised learning, teacher professional development (TPD), and technology integration in education.

2.1 Data Sources and Search Strategy

Relevant literature was identified using major academic databases such as Scopus, Web of Science, Google Scholar, and ERIC. The following keywords and combinations were employed: *"personalised learning," "student-centred instruction," "teacher professional development," "technology integration,"* and *"educational innovation."* Only English-language publications were considered to ensure accessibility and consistency.

2.2 Inclusion and Exclusion Criteria

Studies were included if they (a) focused on personalised or student-centred learning models, (b) examined teacher professional development frameworks, (c) discussed the role of digital tools or technology integration in education, and (d) were published within the last seven years (2018–2025). Excluded were studies that (a) did not directly relate to teaching and learning practices, (b) were purely theoretical without practical relevance, or (c) duplicated earlier works without new insights.

2.3 Data Analysis

The selected studies were analysed through thematic synthesis. Key themes were identified, including the conceptualisation of personalised learning, models of professional development, the role of technology, challenges of implementation, and recommendations for practice and policy. The findings were then organised to highlight intersections between personalised learning and TPD, with a particular emphasis on how technology can serve as a bridge between the two.

By employing this approach, the study provides a comprehensive synthesis of current knowledge, identifies gaps in existing research, and proposes strategies to strengthen both personalised learning and teacher professional development in technology-rich educational environments.

3. Results

The review of selected literature reveals several interconnected themes that explain how personalised learning, teacher professional development (TPD), and technology intersect in shaping educational practices. The findings are presented in six main themes: (1) Understanding Personalised Learning, (2) Concepts and Models of Teacher Professional Development, (3) Teachers' Professional

Development and Educational Reform, (4) Technology's Role in Personalised Learning and TPD, (5) Student-Centred Teaching Approaches, and (6) Benefits, Challenges, and Recommendations for TPD.

3.1 Understanding Personalised Learning

Personalised learning refers to an educational approach that aligns instruction with the unique needs, interests, and learning preferences of each student. It emphasises adaptability in pace, content, and method of delivery. Shemshack and Spector (2020) conceptualise personalised learning as the self-organisation of learning activities based on individual goals and experiences. Evidence suggests that such approaches increase motivation, engagement, and comprehension (Falcão et al., 2018). Similarly, Prain et al. (2018) and Alamri et al. (2020) highlight that learners benefit from autonomy and choice, progressing at their own pace while pursuing relevant and interest-driven content. However, this requires teachers to be equipped with the knowledge, skills, and resources to design customised instruction—underscoring the central role of professional development (Yadav et al., 2025).

3.2 Concepts and Models of Teacher Professional Development (TPD)

TPD encompasses structured and ongoing opportunities to strengthen teachers' pedagogical and professional competencies. These range from workshops and coursework to mentoring, lesson studies, and professional learning communities (Popova et al., 2022). Korthagen (2017) stresses that PD must account for teachers' emotional states, motivations, and contexts. Despite challenges in implementation, comprehensive models such as the 5E instructional design or constructivist frameworks have proven effective in enhancing reflective practice, collaboration, and instructional quality (Kasi et al., 2022; Nugroho et al., 2024). Case studies in Liberia and Uganda further show that locally adapted PD programs can significantly improve literacy and student-centred teaching (Piper & Korda, 2011; Kerwin & Thornton, 2021).

3.3 Teachers' Professional Development and Educational Reform

Educational reforms in the 21st century demand a reorientation of teacher roles. Teachers are expected to adopt student-centred strategies while continuously upgrading their competencies. Yulisman et al. (2019) observe that teachers increasingly value technology integration for improving learning outcomes. PD is thus not limited to training but includes graduate programs, conferences, peer collaboration, and research engagement (Samundeeswari, 2024). Daodu et al. (2024) emphasise that effective PD must be constructivist, involving reflection, interaction, and metacognition. Nevertheless, a gap persists between theory and practice: while PD frameworks are conceptually robust, their practical impact is often undermined by short duration, lack of contextualisation, and weak institutional support (Salifu, 2024). Addressing this gap requires systemic reform and long-term investment.

3.4 Technology's Role in Personalised Learning and TPD

Information and communication technology (ICT) serves as a transformative driver for both personalised learning and TPD. ICT expands access to resources, enables collaboration, and supports flexible, on-demand learning for teachers and students alike. Mishra and Sahoo (2023) argue that digital platforms enhance instructional adaptability and lifelong learning. Hall and Trespalacios (2019) demonstrate that digital PD increases teachers' confidence and ability to integrate technology, while Vanoostveen et al. (2019) note that virtual PD fosters reflective and collaborative teacher communities. At the same time, challenges remain: constant adaptation and resilience are required as teachers navigate rapid technological change (Kalyani, 2024). Scholars caution that technology should enhance rather than replace human interaction in professional learning (Kalyani, 2024).

3. 5 Student-Centred Teaching Approaches

Aligned with personalised learning principles, student-centred pedagogies such as inquiry-based, project-based, and cooperative learning shift the focus from teacher delivery to student engagement and critical thinking (Goodwin, 2024; Levitt & Grubaugh, 2023). These methods promote deeper understanding but often demand greater preparation, resources, and cultural adaptation. Studies by Slunt and Giancarlo (2004) and Maloy and LaRoche (2010) reveal that transitioning to such methods requires significant pedagogical shifts, which many teachers find challenging. Willingness to adopt these approaches depends on the availability of supportive PD, collaborative opportunities, and institutional backing (Appova & Arbaugh, 2018).

3.6 Benefits, Challenges, and Recommendations for TPD

TPD offers extensive benefits: improved instructional skills, enhanced teacher efficacy, and higher student achievement (Monica & Kuswandono, 2019; Juma, 2024). Collaborative PD, instructional coaching, and professional learning communities are shown to foster reflective practice, teacher leadership, and shared responsibility (Prenger et al., 2021; Oppi et al., 2023). Digital tools such as Google Classroom, Kahoot, and Schoology further enrich professional learning (Akudo, 2022; Bonina et al., 2021).

However, challenges persist. Teachers often struggle with time constraints, heavy workloads, and a lack of follow-up support (Avillanova & Kuswandono, 2019;

Panthee, 2022). PD content frequently lacks contextual relevance, leading to limited teacher engagement (Kuncahya & Basikin, 2019). Geographic barriers also restrict access in rural settings. Moreover, many government-led programs remain top-down and prioritise technical training over holistic growth (Owston, 2007; Newman, 2018).

4. Discussion

The literature reviewed highlights that personalised learning, teacher professional development (TPD), and the use of technology are three mutually reinforcing elements in advancing the quality of education. However, their integration is far from automatic and often fraught with challenges. Adaptive technologies and digital platforms hold great promise for enabling differentiated instruction while simultaneously expanding access to flexible TPD opportunities (Mishra & Sahoo, 2023; Hall & Trespalacios, 2019). Yet, persistent barriers such as digital inequities, misaligned PD design, and limited institutional support frequently undermine their potential (Salifu, 2024; Kalyani, 2024). These findings underscore the need for a systemic approach to educational reform, one that balances teacher capacity, supportive policies, and sufficient technological infrastructure to realise the vision of personalised learning.

Within this framework, TPD emerges as a critical pillar that determines the success of pedagogical innovation. The literature points out the limitations of one-off, decontextualised training workshops, which rarely produce lasting change in teaching practice. Instead, effective professional learning is characterised by its continuity, contextual relevance, and strong ties to teachers' everyday classroom challenges. Models such as lesson study, professional learning communities (PLCs), and coaching have proven more effective in strengthening instructional practice (Korthagen, 2017). Digital technologies can enhance these models by enabling micro-learning, cross-school virtual mentoring, and data-informed reflection. Recommended design principles include beginning with a rigorous needs assessment, co-designing PD content with teachers, combining short, actionable modules with long-term coaching, and embedding follow-up mechanisms to sustain change (Salifu, 2024).

The realisation of personalised learning through technology, however, is deeply shaped by structural constraints, particularly issues of equity and teacher readiness. In many developing and rural contexts, inadequate access to devices, internet connectivity, and technical support remains a critical barrier (Panthee, 2022; Avillanova & Kuswandono, 2019). Even when such infrastructure is available, teachers often face limited time, heavy workloads, and insufficient incentives to innovate (Monica & Kuswandono, 2019). This suggests that investments in digital infrastructure must be accompanied by systemic reforms that address teacher well-being, motivation, and professional agency. In other words, technology alone is insufficient; it must be embedded within broader institutional and policy frameworks that enable and sustain teacher growth.

From a practical standpoint, the findings imply the need for integrated and context-sensitive implementation strategies. Schools and education authorities should begin with careful needs assessments before adopting specific PD models or technologies. Training content must be co-designed with teachers to ensure alignment with their classroom realities. Blended PD models that combine short online modules with ongoing coaching and collaborative PLCs are especially promising. In resource-constrained settings, low-bandwidth and mobile-first solutions may offer more feasible alternatives. Additionally, continuous evaluation mechanisms—such as indicators of teaching practice, formative student outcomes, and technology usage data—should be embedded into PD programs to facilitate ongoing improvement.

At the policy level, TPD must be treated as a long-term investment rather than a short-term intervention. Governments and education stakeholders should prioritise reliable infrastructure, provide technical support, and establish incentive structures that reward teacher participation in professional learning. Policies that focus narrowly on technical training without fostering reflective and contextualised practice are unlikely to produce meaningful change. National standards for TPD, micro-credentialing systems, and partnerships with higher education institutions and private sectors represent important levers to ensure that PD is relevant, sustained, and equitable (Owston, 2007; Newman, 2018).

Despite the breadth of literature reviewed, limitations remain. Much of the evidence is descriptive or context-specific, restricting the ability to draw causal conclusions about the effectiveness of particular models. The literature is also skewed toward studies published in English between 2018 and 2025, which may underrepresent innovative practices documented in other contexts or languages. Future research should therefore prioritise longitudinal, mixed-method studies that trace the long-term impact of tech-enabled TPD on classroom practice and student learning. Comparative effectiveness studies, including randomised controlled trials where feasible, are needed to examine blended PD against traditional models. Furthermore, questions of cost-effectiveness, scalability, and digital equity remain underexplored, as do the ethical and pedagogical implications of AI-driven tools for teacher learning and personalised

instruction (Yadav et al., 2025; Mishra & Sahoo, 2023).

Generally, this discussion reinforces that the success of tech-enhanced personalised learning and TPD depends on the alignment of three central pillars: teacher capacity, technological affordances, and institutional policy support. Technology serves as a powerful enabler, but only when teachers are equipped with the necessary pedagogical and reflective competencies and when institutional conditions are conducive to change. By committing to need-based design, collaborative professional learning, and long-term systemic investment, stakeholders can unlock the potential of personalised learning and TPD to enhance both instructional practice and student outcomes sustainably.

5. Conclusion

This study highlights the interdependence of personalised learning, teacher professional development (TPD), and technology in shaping the future of education. The literature consistently shows that personalised learning has the potential to improve student engagement and achievement. Still, its success depends heavily on the capacity of teachers and the support systems available to them. High-quality TPD, especially when sustained, context-sensitive, and collaborative, equips teachers with the pedagogical, reflective, and technological skills needed to implement student-centred approaches effectively.

Technology, while often presented as a transformative force, functions primarily as an enabler rather than a solution in itself. Its integration into TPD and personalised learning requires careful planning, adequate infrastructure, and continuous institutional support. Without these conditions, digital innovations risk exacerbating inequities rather than closing learning gaps. The evidence suggests that meaningful reform can only be achieved through systemic alignment: teacher readiness, robust policy frameworks, and equitable technological access must advance in tandem.

The implications are clear for practice and policy. Professional learning should move beyond fragmented workshops toward blended, job-embedded models that foster collaboration and sustained growth. Policy makers must treat TPD as a long-term investment by ensuring reliable infrastructure, supporting teacher well-being, and creating incentive structures that value ongoing professional learning. At the same time, researchers are called to provide stronger evidence through longitudinal and comparative studies, particularly in underrepresented contexts, to guide more effective and equitable implementations.

In conclusion, the combined agenda of personalised learning, technology integration, and teacher professional development offers significant promise for improving instructional quality and student outcomes. Realising this potential requires not only innovative tools and models but also a commitment to equity, contextual relevance, and sustained professional growth. When these conditions are met, education systems can move closer to delivering meaningful, adaptive, and future-ready learning experiences for all students.

Article Information Form

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Authors' Contribution

Ismail Abiodun ABDULMUMIN: involved in the concept, design and definition of intellectual content, literature search.

Mariam Bola SULYMAN, PhD: Involved in literature search, data acquisition, and manuscript preparation.

Fahdilat Talatu AHMED, PhD: Involved in manuscript editing and review.

Declaration of Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Artificial Intelligence Statement

The authors declare that no artificial intelligence (AI) tools were used in the writing or analysis of this manuscript.

Ethical Approval

This study received ethical clearance from the affiliated institutions. All procedures performed were in accordance with the ethical standards of the researchers' universities.

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Dr. Mariam Bola Sulyman holds a Ph.D. in Educational Technology (2025), building on a strong academic foundation that includes an MPA in Public Administration (2022) and a B.Ed. in Educational Technology (2010). Her research expertise lies in leveraging emerging technologies to enhance teaching and learning across diverse educational settings, with a specific focus on integrating Artificial Intelligence. Through her publications, Dr. Sulyman demonstrates a dedication to pioneering innovative educational practices.

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