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Research Article

Exploring Key Factors in Faculty Professional Development Programs for Seamless Integration of Modern Technology

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Abstract: This study investigates the relationships between faculty use of new technologies and professional development programs. Within the framework of a shifting educational landscape, this study aims to identify the specific characteristics that lead to successful technology integration in this unique setting. A qualitative technique was used in the process, which involved interviewing 86 participants, administrators and faculty members from 12 Ugandan universities. Key elements of successful integration were identified through thematic analysis. These elements included infrastructure and accessibility, incentives and recognition, customization and relevance, hands-on learning opportunities, continuous support mechanisms, flexibility and adaptability, institutional leadership and culture, and evaluation and feedback mechanisms. The results are consistent with international literature highlighting the significance of incentives, efficient assessment, sufficient infrastructure, and customized, useful, and ongoing support in professional development initiatives. The study provides insightful information about the unique requirements and difficulties experienced by faculty members, illuminating tactics for maximizing the uptake of technology. This study is significant for educators, administrators, and policymakers in education who want to improve the effectiveness of professional development programs in higher education. Through an understanding of the factors that influence faculty adoption of technology, academic institutions can design initiatives that support faculty innovation and technological competency, improving the learning environment for both teachers and students.

***Keywords*:** professional development, technology, faculty, higher education, digital skills

1. Introduction

The rapid advancement of technology in the 21st century has transformed nearly every aspect of society, including education. Modern educational institutions are increasingly integrating technology into classrooms to enhance teaching and learning processes (Haleem et al., 2022; Lachner et al., 2021; Uzorka et al., 2023). From interactive learning platforms to artificial intelligence-driven tools, the potential of technology to revolutionize education is immense. However, despite the availability of advanced tools, many faculty members face challenges in effectively utilizing these resources. Research indicates that a significant gap exists between the technological capabilities of institutions and the

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proficiency of educators in using these tools for meaningful instruction (Uzorka et al., 2023). This disparity often results in underutilized investments and missed opportunities for improving student outcomes.

Faculty professional development programs have emerged as a key strategy to address this challenge, aiming to equip educators with the necessary skills, knowledge, and confidence to integrate technology seamlessly into their teaching practices (Guggemos & Seufert, 2021; Saad & Sankaran, 2020; Uzorka & Olaniyan, 2023). While these programs are widely implemented, their effectiveness varies significantly. Studies suggest that one-size-fits-all approaches, insufficient support, and a lack of alignment with institutional goals often hinder their success (Creta & Gross, 2020; González-Pérez & Ramírez-Montoya, 2022). Furthermore, the dynamic nature of technology demands that professional development initiatives be both adaptable and sustainable to remain relevant over time.

This study explores the factors that contribute to the success of faculty professional development programs focused on technology integration through the following research question:

What are the key factors in faculty professional development programs for successful integration of modern technology?

This research aims to bridge the gap between technological innovation and practical application in educational settings by identifying the elements that foster seamless adoption of modern technological tools in teaching. Such insights are crucial for designing programs that not only enhance the technological competence of faculty members but also promote long-term educational improvements, ensuring that institutions can fully realize the benefits of their technological investments.

Addressing these issues is not just a matter of institutional efficiency but a necessity for preparing students to thrive in a technology-driven world. Therefore, understanding and enhancing faculty professional development for technology integration is an urgent priority for educational stakeholders globally.

2. Literature review

Faculty professional development programs aimed at integrating modern technology into educational practices have gained increasing prominence in the global discourse on educational reform. These programs are immensely important in providing teachers with the knowledge and abilities they need to use technology in the classroom and learning process (Fernández-Batanero et al., 2022; Sancar et al., 2021; Uzorka & Olaniyan, 2023). By analyzing various educational environments across the globe, the literature on this subject offers insightful information about the elements affecting the success of these kinds of programs. Customization and relevance are prevalent in the literature and highlight the significance of adjusting professional development programs to educators' unique needs and environments (Alamri et al., 2021; Hınız & Yavuz, 2024; Kilag et al., 2023). Educators who receive individualized learning experiences are more engaged and effective when integrating technology because they feel more equipped to handle the particular problems and objectives that they face (Hennessy et al., 2022; Pallitt et al., 2021). Kimmons et al. (2020), for example, discovered that technology integration programs that provide educators with adaptable learning pathways have a higher chance of connecting with teachers and producing favourable results.

It is well known that providing educators with opportunities for hands-on learning will help them become more proficient and confident in using technology-enhanced pedagogies (Kilag et al., 2024; Torralba & Doo, 2020; Yannier et al., 2021). Research has indicated that experiential learning methods, like workshops, role-playing, and group projects, help teachers learn more deeply and develop their skills (Aithal & Mishra, 2024; Kanapathy & Azhari, 2024; Wang, 2020). Professional development programs can enable educators to experiment with novel teaching techniques and modify them to fit their instructional contexts by offering chances for hands-on learning. Throughout their professional development journey, educators need to be able to access ongoing support mechanisms to maintain their motivation and overcome implementation issues (Biswas et al., 2022; Boice et al., 2021; Fairman et al., 2022). Educators' perceptions of competence and resilience in managing the challenges of technology integration are influenced by peer cooperation, coaching, and mentorship (Jacobson et al., 2020). Organizations that place a high priority on ongoing support and resources encourage a culture of innovation and learning, which promotes long-term success in efforts to integrate technology.

According to Ramírez-Montoya et al. (2021), professional development programs must be flexible and adaptable

to accommodate the varied learning styles and preferences of educators. Research indicates that educators with diverse schedules and responsibilities find success with self-paced modules, alternate delivery formats, and blended learning techniques (Evmenova et al., 2021; Keigher & Pharr, 2022; Uzorka & Olaniyan, 2023). Organizations can ensure the relevance and sustainability of their programs by embracing technology advancements and changing needs through the adoption of agile approaches to professional development.

According to Matiba (2024), incentives and recognition systems are important factors in encouraging educators to take an active part in professional development activities. Instructors are encouraged to devote time and energy to technology integration initiatives through extrinsic benefits including certificates, stipends, and prospects for advancement (Chadha, 2021; ГОЙ & ЖУК, 2020). On the other hand, intrinsic motivators like chances for professional development and influence over student learning outcomes are just as important for maintaining teachers' dedication and engagement (Bukhari et al., 2023).

Effective systems for evaluation and feedback are crucial for determining the effectiveness of professional development programs and improving their design (Ahmadi et al., 2021). Institutions can track the development of educators, pinpoint areas for growth, and implement data-driven modifications by utilizing formative assessments, feedback loops, and reflective practices (Uzorka & Olaniyan, 2023). Institutions may guarantee that their technology integration activities are continuously improved by cultivating a culture of review and responsibility.

The success of faculty professional development programs is largely dependent on the availability of sufficient technology infrastructure and assistance (Hennessy et al., 2022). Hardware, software, and dependable internet access are critical for enabling teachers to experiment with and adopt technology-enhanced teaching methods (Asgari et al., 2021; Bragg et al., 2021; Haleem et al., 2022). Schools that make equal investments in technology access and infrastructure development enable their teachers to make good use of digital resources. Resolving issues and spotting emerging patterns are critical to the long-term viability and applicability of faculty professional development initiatives (Uzorka & Olaniyan, 2023). Teachers encounter several obstacles, such as resource limitations, technological difficulties, and opposition to change (Núñez-Canal et al., 2022). These obstacles call for proactive measures and teamwork. Organizations that cultivate a resilient and innovative culture will be more adept at managing challenges and seizing opportunities in the rapidly changing digital environment.

3. Theoretical framework

The theoretical framework for this study is grounded in three interconnected theories and models that provide a comprehensive understanding of professional development and technology integration in education: the Technology Acceptance Model (TAM), the Diffusion of Innovations Theory, and Andragogy (Adult Learning Theory). Each theory offers unique insights into the factors influencing the faculty's adoption and application of modern technology. However, when considered independently, each framework has limitations, necessitating an integrated approach to comprehensively address the multifaceted nature of this issue.

The Technology Acceptance Model (TAM), developed by Davis (1989), is one of the most widely used frameworks to explain how individuals come to accept and use new technologies. The Technology Acceptance Model (TAM) posits that the acceptance and use of technology are primarily influenced by two factors: perceived ease of use and perceived usefulness (Mohd Amir et al., 2020; Tırpan & Bakırtaş, 2024). According to TAM, users are more likely to adopt and effectively integrate technology if they believe it will improve their performance and is easy to use. This model provides a foundation for understanding how faculty members' perceptions of new technologies impact their willingness to engage with and utilize these tools in their professional practice. TAM, while effective in predicting initial acceptance of technology, is limited in addressing the social, cultural, and organizational factors influencing sustained technology use, such as leadership support and institutional culture.

The Diffusion of Innovations Theory, developed by Everett Rogers in 1962, explains how, why, and at what rate new ideas and technology spread among individuals and groups (Rogers et al., 2014). This theory highlights the process of innovation adoption and the roles of different categories of adopters: innovators, early adopters, early majority, late majority, and laggards. It also identifies key factors influencing the diffusion process, including the perceived attributes of innovations, communication channels, and the social system (Mbatha, 2024). In this study, the

diffusion of innovations theory is relevant in understanding the role of professional development programs as a means of accelerating the adoption of technology among faculty members. The theory suggests that faculty members are more likely to adopt new technologies when they perceive them as advantageous, compatible with existing practices, and relatively easy to implement. While this theory effectively addresses social and systemic factors, it does not adequately account for individual psychological factors, such as self-efficacy, or the practicalities of adult learning. Additionally, it assumes uniform access to resources and opportunities, which does not always reflect real-world conditions, such as time constraints or infrastructure disparities.

Andragogy, or Adult Learning Theory, developed by Malcolm Knowles, focuses on the specific needs and characteristics of adult learners (Fogelberg, 2023). Knowles proposed that adult learning is self-directed and problem-centered, and that adults bring prior experience, motivation, and readiness to learn that must be acknowledged and leveraged in educational programs (Fogelberg, 2023). This theory implies that professional development programs need to be flexible, relevant, and tailored to the specific needs of faculty members. While andragogy addresses the "how" of learning, it does not provide a framework for understanding the specific barriers to technology adoption or the systemic factors influencing faculty attitudes toward innovation. It also lacks a focus on the social dynamics of adoption, such as the role of peer networks or institutional leadership.

By integrating TAM, Diffusion of Innovations Theory, and Andragogy, this study aims to provide a multifaceted understanding of how faculty professional development programs can be designed and implemented to facilitate the effective integration of modern technology. The TAM helps explain how faculty views influence technology acceptance, whereas Diffusion of Innovations Theory provides insights into the adoption process and factors driving the spread of new technologies. By ensuring that professional development programs are in line with the principles of adult learning, andragogy can improve their effectiveness and relevance to the needs of faculty members. When combined, these theories offer a strong framework for exploring key factors in faculty professional development programs for seamless integration of modern technology.

4. Methodology

To investigate the critical elements determining the effective integration of contemporary technology in faculty professional development programs, this study uses a qualitative research methodology. The goal is to obtain rich insights into the viewpoints and experiences of administrators and educators through in-depth interviews.

Participant Selection: 86 administrators and educators from 12 educational institutions in Uganda were chosen through the use of a purposive sampling technique. The selection criteria made sure that a range of experiences and backgrounds were represented, which made it easier to comprehend the subject matter completely.

Demographic: The demographic characteristics of the participants are presented in Table 1. 86 invitees participated in the study. There were 55 (63.95%) males and 31 (36.05%) females with ages ranging from 20 and above years. The majority of the participants 40 (46.51%) are PhD degree holders. There were 15 (17.44%) administrators and 71 (82.56%) faculty members.

Data Collection: The chosen individuals were interviewed in a semi-structured manner, which provided room for the exploration of pertinent issues without sacrificing coherence among interviews. The purpose of the interview questions was to extract comprehensive answers about the elements that make faculty professional development programs that integrate contemporary technology successful. With the participants› permission, every interview was audio recorded to guarantee accuracy in data collection. Participants were encouraged to expound on their answers and offer nuanced perspectives by using probing approaches.

Data Analysis: Data analysis was done using NVivo 12. To find patterns, themes, and trends in the interview data, thematic analysis was used. Iterative coding of the transcripts was used in the analysis procedure to systematically arrange and classify the emergent themes. Important elements affecting the effective incorporation of contemporary technology within faculty professional development programs were discovered through ongoing comparison and reflection.

Trustworthiness: Various techniques, including peer debriefing and member checking, were used to improve the reliability and trustworthiness of the results. To verify the accuracy and interpretation of the participant's responses,

member checking entailed distributing the condensed findings to the participants. Peer debriefing meetings were also held to interact with other researchers and get input on the analysis procedure.

Ethical Considerations: To guarantee the privacy and rights of participants, this study complied with ethical standards. Before they participated in the trial, all subjects provided informed consent. Throughout the research procedure, participants were guaranteed anonymity and safeguards were put in place to protect the privacy of their answers.

Table 1. Demographic characteristics of the participants

Variables	Male frequency (%)	Female frequency (%)	Total frequency (%)
Gender	55 (63.95)	31 (36.05)	86 (100.00)
Age (Years)			
20-29	06 (50.00)	06 (50.00)	12 (13.95)
30-39	10 (45.45)	12 (54.55)	22 (25.58)
40-49	21 (72.41)	08 (27.59)	29 (33.72)
50-above	18 (78.26)	05 (21.74)	23 (26.75)
Educational qualification			
Bachelor	05 (55.56)	04 (44.44)	09 (10.47)
Master	25 (62.16)	12 (37.84)	37 (43.02)
Ph.D.	25 (62.50)	15 (37.50)	40 (46.51)
Designation			
Administrator	07 (46.67)	08 (53.33)	15 (17.44)
Faculty	48 (67.61)	23 (32.39)	71 (82.56)
Work experience (Years)			
Under 5 years	08 (57.14)	06 (42.86)	14 (16.28)
5-10 years	10 (47.62)	11 (52.38)	21 (24.42)
11-15 years	21 (75.00)	07 (25.00)	28 (32.55)
16 years and above	16 (69.57)	07 (30.45)	23 (26.75)

5. Results

To maintain the confidentiality of names each participant in the study was assigned a database number referred to as respondents 1 to 86 (R1 to R86). When the findings reference a participant's comments, the database number (R1 to R86) is recorded in parentheses.

5.1 *Customization and relevance*

Customization and relevance emerged as critical factors in the effectiveness of professional development programs for technology integration. Respondents emphasized how crucial it is to customize training to each faculty member's

needs as well as institutional interests. One participant highlighted that "training materials feel more relevant and applicable to our daily teaching practices when they are customized to address our specific needs" (R8). Another responder supported this perspective, saying, "When the content aligns with our institution's strategic initiatives, it's easier to see the value of what we're learning" (R32).

Tailoring content to specific subject areas was also seen as vital for ensuring the applicability of new technologies. A respondent pointed out, "Receiving training that directly relates to my field makes it much more engaging and useful" (R51). The inclusion of real-world examples and case studies in the training materials further enhanced relevance and engagement, as one participant shared, "When we see how these technologies work in actual educational settings, it becomes much more relatable and easier to implement" (R65).

5.2 *Hands-on learning opportunities*

Experiential learning opportunities were identified as essential for effective technology integration in higher education. Respondents stressed the importance of hands-on experiences that allow faculty members to explore and practice using new tools in a supportive environment. As one participant stated, "Workshops that let us experiment with new technologies in a safe space are incredibly helpful for building both competence and confidence" (R2). This practical approach was seen as crucial in bridging the gap between theory and application, with another respondent noting, "Actually using the tools helps me understand how to apply them in my specific teaching context" (R7).

Workshops, seminars, and cooperative projects were frequently mentioned as valuable formats for these hands-on experiences. One participant commented, "Engaging with new technologies through workshops and group projects not only builds my skills but also gives me the confidence to integrate them into my teaching" (R35). This practical engagement was seen as key to developing real-world expertise, as another respondent shared, "These experiential learning opportunities are what equip us with the knowledge we need to effectively incorporate technology into our courses" (R28).

5.3 *Ongoing support mechanisms*

Participants emphasized that successful technology integration requires continuous assistance beyond initial training sessions. One respondent observed, "It's not just about learning the technology; we need ongoing support to tackle challenges and keep up the momentum" (R6). The importance of mentorship and peer collaboration was highlighted, with another participant stating, "Having a mentor to turn to for advice and support makes a huge difference when trying to integrate new tools into my teaching" (R18).

Communities of practice and online platforms were also mentioned as valuable resources for sustained learning and problem-solving. A respondent noted, "Online forums and discussion boards are great for exchanging ideas and getting quick answers to questions about technology integration" (R25). The availability of updated training resources and technical support was seen as crucial for maintaining technological proficiency, as one faculty member shared, "Regular access to updated materials and quick technical support ensures we can stay current and address any issues that arise" (R47).

5.4 *Flexibility and adaptability*

Flexibility in scheduling, content formats, and delivery methods was identified as a key factor in the success of professional development programs. Respondents emphasized the importance of accommodating individual learning needs and preferences to enhance accessibility and engagement. One participant highlighted, "The ability to choose training formats that fit my schedule and learning style makes the whole process much more manageable" (R25). This flexibility was seen as essential for creating an inclusive learning environment, with another respondent noting, "Offering a variety of learning modalities ensures that everyone's needs are met, regardless of their preferred way of learning" (R55).

The inclusion of multimodal training materials, such as video content, interactive simulations, and practical exercises, was also valued for catering to diverse learning styles. As one faculty member explained, "Having access to different types of materials such as videos, hands-on exercises, written guides, helps me grasp the content in a way that

suits my learning preferences" (R21). Flexible scheduling options, such as weekend sessions or shortened seminars, were also appreciated for accommodating the time constraints of faculty members, with one respondent stating, "Being able to attend training outside of regular working hours is a big help for balancing my professional development with my other responsibilities" (R16).

5.5 *Institutional leadership and culture*

Institutional leadership and culture play a crucial role in shaping the success of professional development programs for technology integration. Respondents emphasized the importance of a clear vision from leadership that guides faculty members in their adoption of new technologies. One participant noted, "When leaders articulate a clear vision for technology use, it provides us with the direction and motivation we need to integrate it into our teaching" (R57). Adequate financial and technological resources were also seen as critical for the effective implementation of professional development initiatives, with another respondent emphasizing, "Without sufficient resources, it's challenging to carry out these initiatives successfully" (R60).

The promotion of technology adoption was shown to be contingent upon an institutional culture that is both friendly and rewards innovation and experimentation. One respondent shared, "Our institution encourages us to explore new technologies, which makes it easier to try out new tools and integrate them into our teaching practices" (R68). Another participant stated "When leaders regularly communicate about the positive impact of technology and upcoming training opportunities, it creates a culture where we're all more aware and eager to participate" (R62). Leadership's role in communicating the benefits of technology integration and promoting success stories was also noted.

5.6 *Incentives and recognition*

Incentives and recognition were identified as powerful motivators for faculty participation in professional development programs. Respondents highlighted the significance of acknowledging and rewarding faculty efforts in technology integration. One participant observed, "Receiving recognition for my work in integrating technology is a great incentive to continue developing my skills" (R4). The impact of formal incentives, such as promotions or recognition in tenure decisions, was also emphasized, with another respondent noting, "Incentives like promotions or tenure considerations encourage us to invest in continuous professional development" (R12).

Financial incentives, such as funding for attending conferences or advanced training sessions, were also valued as tangible rewards for faculty members who actively engage in technology integration. One respondent shared, "Having access to funding for conferences or specialized training motivates me to keep advancing my technology skills" (R54). Opportunities for faculty members to present their work or publish their experiences were also seen as important forms of recognition, as one participant explained, "Being given the chance to present at conferences or publish my work is a great way to gain recognition in my field" (R57).

5.7 *Evaluation and feedback mechanisms*

Effective evaluation and feedback mechanisms were deemed essential for continuously improving professional development programs. Respondents emphasized the importance of systematic assessment processes and constructive feedback loops. One participant noted, "Regular feedback helps ensure that our professional development programs stay relevant and up-to-date with the latest technological advancements" (R8). The use of surveys, informal evaluations, and frequent check-ins was highlighted as a way to gather valuable insights into faculty progress, with another respondent stating, "Frequent check-ins and evaluations provide us with important feedback on how we're progressing with technology integration" (R15).

Post-implementation reviews were also seen as crucial for assessing the impact of technology integration on teaching practices. As one faculty member explained, "After we've implemented new technologies, it's important to review the outcomes to understand what worked well and what could be improved" (R30). The ability to make prompt adjustments based on feedback was also valued, with another respondent noting, "Feedback loops allow us to quickly adapt our strategies as we learn more about what works and what doesn't" (R43).

5.8 *Infrastructure and accessibility*

Infrastructure and accessibility were identified as foundational elements for the success of professional development programs in technology integration. Respondents highlighted the need for robust technology infrastructure and easy access to resources. One participant remarked, "Having reliable hardware, software, and network capabilities is essential for successful technology integration" (R7). The importance of sustained funding and administrative support was also emphasized, with another respondent stating, "For these initiatives to be successful, there needs to be ongoing financial and administrative backing" (R24).

Access to modern hardware and intuitive learning management systems (LMS) was also seen as critical for effective technology use in teaching. As one faculty member explained, "Having access to up-to-date hardware and a user-friendly LMS makes it much easier to manage course content and incorporate new technologies into my teaching" (R59). The availability of specialized tools, such as graphic design software and recording studios, was also valued for enhancing the quality of multimedia content, with another respondent noting, "Access to advanced tools allows us to create high-quality multimedia materials that enhance the learning experience for students" (R61).

5.9 *Addressing challenges and future considerations*

Respondents identified several challenges and areas for improvement in enhancing the effectiveness of professional development programs. Time constraints, resistance to change, and resource limitations were frequently mentioned as obstacles to successful technology integration. One participant noted, "Finding the time to engage in professional development is a significant challenge, especially with our already demanding schedules" (R12). Resistance to change was also highlighted, with another respondent explaining, "Some faculty members are hesitant to adopt new technologies, either because they're unsure of their effectiveness or because they're comfortable with their current methods" (R14). To address these challenges, respondents suggested targeted interventions that focus on building positive attitudes toward change and enhancing technological skills.

6. Discussion

The study provides insight into the critical elements affecting the effectiveness of professional development initiatives for faculty members integrating contemporary technology into educational establishments. Effective professional development initiatives in this context are multifaceted, as evidenced by the emergent themes of customization and relevance, hands-on learning opportunities, ongoing support mechanisms, flexibility and adaptability, incentives and recognition, evaluation and feedback mechanisms, infrastructure and accessibility, and addressing challenges and future considerations.

The relevance and customization theme emphasizes how crucial it is to design professional development programs that are tailored to the requirements and preferences of faculty members. This result is consistent with other research that highlights the value of tailored learning experiences in raising teachers' efficacy and engagement levels (Alamri et al., 2021; Hınız &Yavuz, 2024). This study contributes to this understanding by demonstrating that when professional development content is tailored to the strategic initiatives and subject areas of the institution, faculty members are more likely to perceive the training as relevant and valuable. Moreover, the integration of real-world examples and case studies further enhances the relevance of the training, making it more relatable and applicable to the challenges faced in everyday educational settings.

The emphasis on relevance aligns with Andragogy, which highlights the importance of adult learners engaging in experiences closely tied to their real-world challenges (Fogelberg, 2023). Respondents emphasized the value of programs that integrate discipline-specific technology and directly address their pedagogical goals. In comparison, studies by Bragg et al. (2021) and Fairman et al. (2022) found that programs lacking relevance result in low engagement and adoption rates. To strengthen this area, institutions should conduct needs assessments to ensure training content aligns with faculty priorities and offer modular, discipline-specific resources.

The importance of experiential learning approaches in faculty development initiatives is shown by the emphasis on hands-on learning experiences. Faculty can become more competent and self-assured in their use of technology and

instructional techniques by participating in hands-on, interactive experiences. This result is consistent with previous research that shows how effective active learning strategies are in helping faculty members become more proficient with integrating technology into their teaching (Aithal & Mishra, 2024; Torralba & Doo, 2020; Wang, 2020). This study adds to this body of knowledge by highlighting the importance of providing a supportive environment where faculty members can explore, experiment, and practice using new tools. Workshops, seminars, and collaborative projects are particularly effective in bridging the gap between theory and practice, enabling educators to develop both competence and confidence in using technology. This hands-on approach is essential for fostering a deep understanding of how technology can be integrated into unique educational situations.

The finding on hands-on learning experiences aligns with TAM, particularly the dimension of perceived ease of use, as practical application reduces the perceived complexity of adopting new tools (Mohd Amir et al., 2020; Tırpan & Bakırtaş, 2024). Similarly, Diffusion of Innovations Theory supports the value of trialability, where hands-on exposure helps users build confidence and competence (Mbatha, 2024). Consistent with Kanapathy and Azhari (2024), providing hands-on experiences fosters a sense of mastery, increasing both adoption and retention of skills. Future programs should prioritize interactive workshops and provide access to test environments where faculty can safely explore new technologies without the pressure of immediate classroom implementation.

This research emphasizes how important it is for educational institutions to have a thorough support system to enable the easy incorporation of contemporary technology into teaching and learning procedures. The idea of continuing support systems emphasizes how crucial it is to give educators continual support and resources as they progress through their professional development. Maintaining educators' enthusiasm and resolving implementation issues have been found to require consistent assistance, which includes coaching, mentorship, and access to online communities (Jacobson et al., 2020; Uzorka & Olaniyan, 2023). This study extends this understanding by identifying specific forms of ongoing support that are particularly effective, such as mentorship, peer collaboration, and online platforms for discussion and problem-solving. The findings suggest that these support systems not only help faculty members overcome challenges during the technology integration process but also promote a culture of continuous learning and development. The study's unique contribution lies in its detailed exploration of how different support mechanisms can be integrated into professional development programs to ensure that faculty members remain proficient in using technology to enhance their instruction.

The theme of ongoing support mechanisms aligns with the Diffusion of Innovations Theory, which emphasizes the role of social systems and peer influence in driving adoption (Mbatha, 2024). Additionally, Andragogy supports the need for sustained support structures, as adult learners benefit from collaborative learning and ongoing feedback. Findings echo the work of Uzorka et al. (2023), who noted that lack of support post-training is a significant barrier to sustained technology integration. Institutions should establish mentoring programs, online communities of practice, and responsive IT support teams to reinforce learning and address emerging challenges.

This research emphasizes how crucial it is to implement flexible professional development strategies that can adapt to changing demands and technology developments in learning environments. The emphasis on adaptability and flexibility draws attention to the need to take into account the different learning preferences and styles of faculty members. Teachers' varied schedules and responsibilities can be accommodated by flexible professional development structures, such as self-paced courses and alternate delivery formats (Evmenova et al., 2021; Keigher & Pharr, 2022; Uzorka & Olaniyan, 2023). The study adds to the literature by demonstrating that when programs offer a variety of learning modalities, such as online resources, live seminars, and peer collaboration, faculty members are more likely to engage with the content and integrate new technologies into their teaching. The provision of on-demand resources and expert support also ensures that the training is practically applicable and responsive to the immediate needs of educators.

The emphasis on adaptability and flexibility strongly correlates with Andragogy, which advocates for self-directed learning and flexible, learner-centered approaches (Fogelberg, 2023). This finding is consistent with Pallitt et al. (2021), who emphasized that rigid, one-size-fits-all training models fail to meet the diverse needs of faculty. To address this, institutions should offer hybrid delivery formats, allowing participants to choose between online, in-person, and asynchronous options, thereby maximizing accessibility and participation.

Institutional leadership and a supportive culture were seen as crucial for fostering an environment conducive to technology integration. This aligns with Diffusion of Innovations Theory, particularly the influence of organizational structures and leadership in promoting adoption (Fogelberg, 2023). Findings mirror recent studies, such as those by

Uzorka and Olaniyan (2023), which demonstrate that leadership plays a pivotal role in normalizing technology use. Clear communication of institutional priorities, recognition of faculty efforts, and visible support from administrators can cultivate a culture that values innovation and reduces resistance to change.

The focus on rewards and recognition highlights how important extrinsic motivators are for encouraging faculty involvement in and dedication to technology integration initiatives. This aligns with the Technology Acceptance Model's principle that perceived usefulness such as career advancement opportunities, can drive adoption (Mohd Amir et al., 2020). Additionally, incentives align with Andragogy, as adult learners often value programs that offer extrinsic rewards and align with their professional goals. Similar findings were noted in Chadha's (2021) study, which revealed that financial rewards, certificates, or acknowledgment of efforts increase faculty engagement. Teachers can be encouraged to actively participate in professional development activities through incentive mechanisms like promotions, certifications, and awards (Chadha, 2021; ГОЙ & ЖУК, 2020). Institutions must, however, balance extrinsic rewards with internal motivators, such as chances for career advancement and influence on student learning outcomes. The findings suggest that these incentives not only encourage faculty participation in professional development but also contribute to a culture of continuous improvement and innovation. Institutions should consider offering stipends, teaching release time, or public recognition to incentivize participation.

The evaluation and feedback mechanisms theme emphasizes how crucial it is to conduct ongoing reflection and assessment to guide the development of professional development programs. This aligns with Andragogy, which emphasizes iterative learning processes informed by regular feedback (Fogelberg, 2023). Evaluation also resonates with Diffusion of Innovations Theory, as data-driven insights can inform strategies for scaling and sustaining innovations. Consistent with Ahmadi et al. (2021), integrating formative and summative evaluation methods helps identify gaps in program design and implementation. Recommendations include using post-training surveys, peer reviews, and impact assessments to refine offerings and ensure alignment with faculty needs. Institutions can analyze the success of their programs and make data-driven adjustments with the use of robust evaluation mechanisms, such as formative assessments and feedback loops (Ahmadi et al., 2021; Uzorka & Olaniyan, 2023). This study expands on this by highlighting the need for systematic assessment procedures and feedback loops that allow for timely adjustments to the training content and delivery methods. By incorporating diverse perspectives and data-driven strategies, institutions can create a dynamic framework for continuous development that enhances the overall impact of technology integration efforts.

The infrastructure and accessibility theme emphasizes how important it is to have sufficient technology resources and support infrastructure to enable faculty professional growth.

This aligns with the TAM's dimension of perceived ease of use, as technological barriers directly hinder adoption (Tırpan & Bakırtaş, 2024). This finding echoes Lachner et al. (2021) Technological Pedagogical Content Knowledge (TPACK) framework, which highlights the interplay between infrastructure and teaching effectiveness. Institutions should prioritize investments in user-friendly platforms, accessible resources, and equitable access to technology across departments. For educators to investigate and apply cutting-edge teaching approaches, they must have access to dependable internet connectivity, technology, and software (Asgari et al., 2021; Haleem et al., 2022). The findings suggest that by ensuring faculty members have access to up-to-date technology and necessary tools, institutions can lay a strong foundation for successful technology integration into teaching practices.

Despite the numerous benefits of professional development programs, challenges such as resistance to change, limited time, and resource constraints remain significant obstacles. Resistance to change, in particular, aligns with Diffusion of Innovations Theory, as late adopters and laggards require targeted strategies to shift perceptions and encourage participation (Mbatha, 2024). The study's findings resonate with previous research which identifies several difficulties, including resource limitations, technological obstacles, and opposition to change that educators encounter to technology adoption (Núñez-Canal et al., 2022; Uzorka & Olaniyan, 2023). However, this study goes further by offering practical recommendations for addressing these challenges, such as targeted interventions to foster a positive attitude toward change offering time management resources, addressing faculty concerns through dialogue, gradually introducing changes to reduce resistance and the exploration of creative funding structures to support professional development initiatives. The study also suggests that future programs should focus on customizing training materials to meet the diverse needs and preferences of faculty members, thereby enhancing their relevance and impact.

This study makes several unique contributions to the existing body of research on faculty professional development

and technology integration. Firstly, it provides a comprehensive analysis of the factors that contribute to the success of professional development programs, offering a nuanced understanding of how these elements interact to support technology integration. Secondly, the study highlights the importance of ongoing support, flexibility, and institutional leadership in sustaining the impact of professional development, offering practical recommendations for how institutions can enhance their programs.

The results of this study have significant implications for the field of higher education and professional development. By identifying the key factors that contribute to the successful integration of technology, this study provides a roadmap for institutions seeking to enhance their professional development programs. The emphasis on customization, hands-on learning, ongoing support, and institutional leadership underscores the need for a holistic approach to professional development that goes beyond one-time training sessions.

7. Limitations of the study

Sample Diversity: The study sample may not fully represent all faculty members, as it primarily reflects the perspectives of participants from specific institutions or disciplines, limiting the generalizability of findings.

Self-Reported Data: The reliance on self-reported data introduces potential biases, such as social desirability bias or inaccuracies in participants' recollections, which may affect the validity of the results.

Context-Specific Factors: The study's findings are influenced by the specific institutional and cultural contexts in which the research was conducted, which may not be applicable to other settings with different leadership, infrastructure, or resources.

Limited Longitudinal Perspective: The study captures faculty experiences and attitudes at a single point in time, without tracking changes in technology adoption or program effectiveness over an extended period.

Technology-Specific Focus: The study does not extensively explore differences in adoption challenges across various types of technologies, which may require different training and support approaches.

Exclusion of Student Outcomes: While the study focuses on faculty professional development, it does not examine the impact of faculty technology adoption on student learning outcomes, leaving a critical dimension of effectiveness unaddressed.

8. Conclusion

This study offers insightful information about the critical elements impacting the effectiveness of professional development initiatives for educators that aim to seamlessly integrate contemporary technology into educational settings. Effective professional development initiatives in this context are multifaceted, as evidenced by the emergent themes of customization and relevance, hands-on learning opportunities, ongoing support mechanisms, flexibility and adaptability, incentives and recognition, evaluation and feedback mechanisms, infrastructure and accessibility, and addressing challenges and future considerations.

The implications of these findings are significant. They highlight the need for universities to adopt a strategic and holistic approach to professional development that goes beyond traditional training methods. By focusing on creating personalized, engaging, and supportive learning environments, institutions can significantly enhance the effectiveness of technology integration efforts, leading to improved teaching practices and, ultimately, better educational outcomes for students.

Investing in comprehensive professional development frameworks that prioritize customization, experiential learning, continuous support, flexibility, incentives, evaluation, infrastructure, and proactive problem-solving is essential for educational institutions, legislators, and stakeholders. Educational institutions can take the lead in promoting innovation and continuous learning by giving teachers the tools, resources, and know-how they need to help them navigate the challenges of the digital age and inspire the next generation of students. Future research should continue to explore the evolving needs of faculty and the dynamic nature of educational technology to ensure that professional development remains relevant, effective, and impactful.

Conflict of interest

The authors declare there is no conflict of interest.

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