

Technology-Enhanced Professional Development: Basis for Improving Teaching Practices and Learning Outcomes in Dupax Del Norte I District, Nueva Vizcaya

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ABSTRACT

This study examined technology-enhanced professional development as a basis for improving teaching practices and learning outcomes in Dupax del Norte I District, Nueva Vizcaya. It investigated the effects of technology integration in teacher professional development on instructional practices, teacher self-efficacy, professional beliefs, and learner performance. A mixed methods approach employing a quasi-experimental design was utilized, involving 60 public elementary school teachers who were assigned to experimental and control groups. Quantitative data were collected through validated survey questionnaires, teacher performance assessments, learner achievement records, and technology usage indicators. Qualitative data were gathered through semi-structured interviews, focus group discussions, classroom observations, and document analysis. Data were analyzed using descriptive and inferential statistical techniques for quantitative data and thematic analysis for qualitative data, with triangulation employed to ensure validity and reliability. Findings indicated that teachers who participated in technology-enhanced professional development demonstrated improved instructional practices, higher self-efficacy in integrating digital tools, and increased collaboration. Moreover, their learners showed improved engagement and better learning outcomes compared to those exposed to traditional professional development programs. The study concluded that technology-enhanced professional development served as an effective basis for strengthening instructional practices and improving learning outcomes. The results provided empirical evidence supporting the enhancement of professional development programs and informing policy directions on technology integration in education.

Keywords: collaboration, instructional practices, self-efficacy, learning outcomes, technology-enhanced professional development

INTRODUCTION

The integration of digital technologies into education has reshaped teaching and learning practices across the globe. As educational systems continue to adapt to the demands of the digital age, teachers are expected to develop new competencies that enable them to deliver effective, learner-centered instruction. Consequently, professional development has become an essential component of educational improvement, serving to strengthen teacher capacity and promote better learner achievement. Despite its recognized importance, conventional professional development initiatives have often been criticized for their limited effectiveness due to their one-time, lecture-oriented nature and weak connection to actual classroom practices (Darling-Hammond et al., 2017). To address these concerns, technology-enhanced professional development has gained increasing attention as a more flexible and responsive approach to teacher learning. By utilizing digital technologies, online learning platforms, and virtual collaborative spaces, it provides teachers with continuous opportunities to expand their knowledge and refine their instructional practices. Previous studies have indicated that technology-supported professional learning can contribute to stronger pedagogical competencies, increased collaboration among educators, and more reflective teaching practices, particularly when learning experiences are sustained, relevant, and directly connected to classroom implementation (Desimone & Garet, 2015).

At the international level, the importance of technology integration in teacher development is reflected in the UNESCO ICT Competency Framework for Teachers (2018). The framework emphasizes that educators must go beyond acquiring technical skills and instead use technology to facilitate innovative, learner-centered learning experiences. It highlights the need for teachers to develop competencies that promote critical thinking, creativity, collaboration, and digital literacy among learners. Such perspectives underscore the growing expectation that teachers continuously adapt their instructional approaches to meet contemporary educational challenges. Within the Philippine educational landscape, continuous professional development is reinforced through policies and standards established by the Department of Education. The Results-Based Performance Management System (RPMS) encourages ongoing professional growth linked to teacher effectiveness and learner achievement. Likewise, the Philippine Professional Standards for Teachers (PPST) identifies technology integration as an important component of effective teaching, emphasizing its role in curriculum implementation, assessment, and instructional delivery (Department of Education, 2017). These policy frameworks reflect the country's commitment to preparing teachers who can effectively respond to the demands of technology-driven education.

However, the implementation of technology-focused professional development remains uneven. Teachers continue to encounter challenges such as inadequate access to digital resources, insufficient training opportunities, and varying levels of technological competence. These factors may limit the extent to which professional development initiatives translate into meaningful improvements in classroom instruction and learner performance. These concerns are likewise evident in Dupax del Norte I District, Nueva Vizcaya, where teachers are increasingly expected to integrate technology into their daily instructional practices. While efforts have been made to support digital learning initiatives, the effectiveness of technology-enhanced professional development in improving teaching practices and student learning outcomes has not been thoroughly examined within the district. Understanding its influence is essential for designing professional development programs that are responsive to teachers' needs and aligned with educational goals.

In view of these considerations, this study investigates technology-enhanced professional development as a basis for improving teaching practices, teacher self-efficacy, and learning outcomes in Dupax del Norte I District, Nueva Vizcaya. The findings are expected to provide evidence that may guide the enhancement of professional development initiatives and contribute to the effective implementation of technology integration policies in basic education.

RESEARCH DESIGN & METHODS

This study utilized a mixed methods approach employing a quasi-experimental design to examine the effectiveness of technology-enhanced professional development in improving teaching practices and learning outcomes among public elementary school teachers in Dupax del Norte I District, Nueva Vizcaya. The integration of quantitative and qualitative methods provided a more comprehensive understanding of how participation in technology-enhanced professional development influences teachers' instructional practices, self-efficacy, professional beliefs, and learners' academic performance. Specifically, the quantitative component employed a pretest-posttest nonequivalent control group design, which enabled the comparison of outcomes between teachers who participated in a technology-enhanced professional development program and those who continued with conventional professional development activities.

The study was conducted in selected public elementary schools in Dupax del Norte I District under the Schools Division of Nueva Vizcaya. The district was selected because of its ongoing efforts to integrate digital technologies into teaching and learning, as well as the increasing demand for professional development initiatives that strengthen teachers' digital and pedagogical competencies. The participants consisted of sixty (60) public elementary school teachers selected through purposive sampling. Consistent with the nature of a quasi-experimental design, existing school-based groups were designated as either the experimental group ($n = 30$) or the control group ($n = 30$). Teachers included in the study were actively engaged in classroom instruction, willing to participate in the research process, and had access to basic technological resources necessary for involvement in technology-enhanced learning activities. For the qualitative component, selected participants from both groups took part in interviews and focus group discussions to provide deeper insights into their experiences with technology integration and professional learning.

Multiple instruments were employed to gather data on the variables under investigation. A validated survey questionnaire was used to assess teachers' perceptions of technology-enhanced professional development, instructional practices, professional beliefs, and self-efficacy in integrating digital tools into classroom instruction. Classroom observations guided by indicators aligned with the Philippine Professional Standards for Teachers (PPST) were conducted to evaluate actual teaching practices, learner engagement strategies, assessment methods, and technology integration competencies. Student learning outcomes were measured through achievement records, classroom assessment results, and performance task scores obtained from participating teachers. Qualitative data were collected through semi-structured interviews, focus group discussions, classroom observations, and document analysis to capture participants' experiences, challenges, and perceived benefits associated with technology-enhanced professional development.

Prior to the conduct of the study, approval was obtained from the Schools District Office, school heads, and participating teachers. Baseline data were gathered through surveys, classroom observations, and learner achievement records before the implementation of the intervention. The experimental group then participated in an four-week technology-enhanced professional development program consisting of synchronous and asynchronous learning activities, technology integration workshops, collaborative lesson planning, virtual mentoring sessions, and reflective practice activities designed to strengthen digital pedagogical competencies. During the same period, the control group continued to participate in the regular professional development activities implemented within the district. Following the intervention, post-assessments were conducted to determine changes in teaching practices, teacher self-efficacy, professional beliefs, and student learning outcomes. Interviews and focus group discussions were subsequently conducted to gain a deeper understanding of participants' experiences and perspectives regarding the implementation of the program.

Quantitative data were analyzed using descriptive and inferential statistical techniques. Frequency counts, percentages, weighted means, and standard deviations were computed to describe respondents' characteristics and determine the levels of teaching practices, professional beliefs, and teacher self-efficacy. Paired-sample t-tests and independent-sample t-tests were employed to determine significant differences in pretest and posttest scores within and between groups. Analysis of covariance (ANCOVA) was likewise utilized, where appropriate, to control for pre-existing differences between groups and provide a more accurate estimate of the intervention's effects. Pearson product-moment correlation analysis was used to examine the relationships among technology-enhanced professional development, teaching practices, teacher self-efficacy, professional beliefs, and learning outcomes. Qualitative data were analyzed using thematic analysis, which involved transcription, coding, categorization, and interpretation of recurring themes. To enhance the credibility and trustworthiness of the findings, triangulation was employed by comparing information obtained from surveys, interviews, focus group discussions, observations, and documentary sources.

Ethical principles were observed throughout the study. Participation was voluntary, and informed consent was secured from all participants prior to data collection. Confidentiality and anonymity were maintained through the use of identification codes instead of participants' names. Participants were informed of their right to withdraw from the study at any stage without penalty. All data collected were treated with strict confidentiality and used solely for academic and research purposes.

RESULTS

Teaching Practices of Teachers Before and After the Technology-Enhanced Professional Development Program

Table 1 Pretest and Posttest Mean Scores of Teaching Practices

Group	Pretest Mean	Description	Posttest Mean	Description	Mean Gain
Experimental (n=30)	3.21	Moderate	4.35	Very High	1.14
Control (n=30)	3.18	Moderate	3.41	High	0.23

Teacher Self-Efficacy in Technology Integration

Table 2 Teacher Self-Efficacy Scores Before and After the Intervention

Group	Pretest Mean	Posttest Mean	Mean Gain
Experimental (n=30)	3.08	4.42	1.34
Control (n=30)	3.11	3.38	0.27

Significant Difference in Teaching Practices

Table 3 Paired-Sample t-Test on Teaching Practices of the Experimental Group

Variable	Mean Difference	t-value	p-value	Decision
Teaching Practices	1.14	9.87	.000	Significant

Comparison of Experimental and Control Groups

Table 4 Difference Between Experimental and Control Groups in Posttest Teaching Practices

Group	Mean	SD	t-value	p-value
Experimental	4.35	0.41	5.62	.000
Control	3.41	0.48		

Learning Outcomes

Table 5 Learning Outcomes by Group

Group	Pretest Mean	Posttest Mean	Mean Gain
Experimental	78.46	87.53	9.07
Control	77.92	81.34	3.42

Relationship Between Technology-Enhanced Professional Development and Selected Variables

Table 6 Correlation Between Technology-Enhanced Professional Development and Selected Variables

Variable	r-value	Interpretation	p-value
Teaching Practices	.78	Strong Positive	.000
Teacher Self-Efficacy	.82	Very Strong Positive	.000
Professional Beliefs	.69	Strong Positive	.000
Learning Outcomes	.74	Strong Positive	.000

Thematic Analysis of Teachers' Experiences in Implementing Technology-Enhanced Professional Development

Table 7 Emergent Themes on Teachers' Experiences with Technology-Enhanced Professional Development

Theme	Description	Representative Statement
Increased Confidence in Technology Integration	Teachers reported greater confidence in using digital tools for lesson delivery, assessment, and classroom management.	"Before the training, I was hesitant to use digital applications in my lessons. After the workshops, I became more confident in integrating technology into my daily teaching." (Participant 8)
Enhanced Collaboration and Professional Learning	Teachers highlighted the value of online collaboration, mentoring, and sharing of instructional resources with colleagues.	"The online sessions allowed us to exchange ideas and learn effective teaching strategies from one another." (Participant 15)
Improved Learner Engagement and Participation	Teachers observed greater learner interest, participation, and motivation during technology-supported lessons.	"My learners became more active and interested when I incorporated interactive digital activities into the lessons." (Participant 22)

DISCUSSION

Teaching Practices of Teachers Before and After the Technology-Enhanced Professional Development Program

Table 1 shows the pretest and posttest mean scores of teaching practices among teachers in the experimental and control groups. Prior to the intervention, both groups demonstrated moderate levels of teaching practices, with mean scores of 3.21 and 3.18, respectively. Following the implementation of the technology-enhanced professional development program, the experimental group attained a posttest mean of 4.35, described as very high, while the control group obtained a posttest mean of 3.41, interpreted as high.

The experimental group recorded a substantially higher mean gain (1.14) compared with the control group (0.23), suggesting that participation in technology-enhanced professional development contributed to significant improvements in instructional delivery, classroom engagement, assessment practices, and technology integration. This finding supports the assertion of Darling-Hammond et al. (2017) that effective professional development is sustained, collaborative, and directly connected to classroom practice, thereby improving teacher effectiveness and instructional quality. Similarly, Desimone and Garet (2015) emphasized that professional development initiatives that are content-focused and practice-based are more likely to produce meaningful changes in classroom instruction.

Teacher Self-Efficacy in Technology Integration

Table 2 presents the pretest and posttest scores of teachers' self-efficacy in technology integration. Before the intervention, both groups exhibited relatively similar levels of self-efficacy. However, after participation in the technology-enhanced professional development program, the experimental group achieved a posttest mean score of 4.42, with a mean gain of 1.34, whereas the control group showed only a slight increase with a mean gain of 0.27.

The findings indicate that the intervention significantly enhanced teachers' confidence in integrating digital tools into classroom instruction. According to Bandura (1997), self-efficacy develops through mastery experiences, social modeling, and positive reinforcement. The professional development activities provided opportunities for teachers to practice technology integration and receive support from mentors and colleagues, thereby strengthening their confidence in using educational technologies. Likewise, Tondeur et al. (2017) found that

technology-related professional development positively influences teachers' self-efficacy and willingness to adopt innovative instructional practices.

Significant Difference in Teaching Practices

Table 3 shows the results of the paired-sample t-test conducted to determine whether a significant difference existed between the pretest and posttest scores of the experimental group. The computed t-value of 9.87 and p-value of .000 indicate a statistically significant improvement in teaching practices after participation in the technology-enhanced professional development program.

The rejection of the null hypothesis implies that the intervention effectively enhanced teachers' instructional competencies. This finding is consistent with Dede et al. (2009), who argued that professional development programs characterized by active learning, collaboration, and continuous support are more likely to result in sustained improvements in classroom practice.

Comparison of Experimental and Control Groups

As presented in Table 4, the experimental group obtained a higher posttest mean score ($M=4.35$, $SD=0.41$) than the control group ($M=3.41$, $SD=0.48$). The computed t-value of 5.62 and p-value of .000 indicate a statistically significant difference between the two groups.

The results suggest that technology-enhanced professional development is more effective than conventional professional development activities in improving teaching practices. This finding corroborates the work of Darling-Hammond et al. (2017), who noted that traditional one-shot professional development activities often produce limited effects because they are disconnected from teachers' classroom experiences and provide insufficient opportunities for sustained learning and collaboration.

Learning Outcomes

Table 5 reveals that learners taught by teachers who participated in the technology-enhanced professional development program achieved higher posttest scores and greater learning gains than learners in the control group. The experimental group recorded a mean gain of 9.07, whereas the control group obtained a mean gain of only 3.42.

The findings suggest that improvements in teachers' instructional practices and technology integration competencies contributed to better learner performance. Hattie (2009) emphasized that teacher quality is among the most influential school-related factors affecting learner achievement. Likewise, Yoon et al. (2007) concluded that professional development positively affects student learning when it leads to meaningful changes in teachers' classroom practices.

Relationship Between Technology-Enhanced Professional Development and Selected Variables

Table 6 presents the correlation between technology-enhanced professional development and the selected variables. The results reveal significant positive relationships between technology-enhanced professional development and teaching practices ($r = .78$), teacher self-efficacy ($r = .82$), professional beliefs ($r = .69$), and learning outcomes ($r = .74$).

The strongest relationship was observed between technology-enhanced professional development and teacher self-efficacy, indicating that teachers who actively participated in the intervention developed greater confidence in integrating digital tools into instruction. These findings are consistent with the UNESCO ICT Competency Framework for Teachers (2018), which emphasizes that strengthening teachers' technological and pedagogical competencies contributes to improved teaching effectiveness and learner achievement.

Thematic Analysis of Teachers' Experiences in Implementing Technology-Enhanced Professional Development

Table 7 shows the emergent themes derived from interviews and focus group discussions conducted with teacher participants. Three major themes emerged from the analysis: increased confidence in technology integration, enhanced collaboration and professional learning, and improved learner engagement and participation.

Teachers reported becoming more confident in using digital technologies for lesson delivery, assessment, and classroom management following their participation in the program. They also highlighted the value of collaboration and mentoring opportunities that allowed them to exchange instructional ideas and resources with colleagues. Furthermore, participants observed increased learner participation and motivation during technology-supported lessons. These findings support the study of Trust et al. (2016), which found that technology-mediated professional learning communities foster collaboration, knowledge sharing, and instructional innovation among teachers.

CONCLUSION

The findings demonstrated that teachers who participated in the technology-enhanced professional development program exhibited substantial improvements in their instructional practices, self-efficacy in technology integration, and professional beliefs compared with those who participated in conventional professional development activities. The statistically significant differences observed between the experimental and control groups indicate that technology-enhanced professional development is an effective approach for strengthening teachers' instructional competencies and promoting meaningful instructional change. The study further revealed that learners taught by teachers who participated in the intervention achieved higher learning gains than those whose teachers underwent traditional professional development. This finding suggests that improvements in teachers' pedagogical practices and technology integration competencies positively influenced learner engagement and academic performance.

Moreover, the significant positive relationships between technology-enhanced professional development and teaching practices, teacher self-efficacy, professional beliefs, and learning outcomes underscore the important role of continuous, technology-supported professional learning in improving educational outcomes. The qualitative findings further reinforced these results by highlighting teachers' increased confidence in technology integration, enhanced collaboration and professional learning, and improved learner engagement and participation.

Based on these findings, it can be concluded that technology-enhanced professional development serves as an effective and sustainable approach to improving teaching practices and learner outcomes in basic education. The integration of digital technologies into professional development initiatives provides teachers with meaningful opportunities for continuous learning, collaboration, and reflective practice, thereby enhancing instructional effectiveness and supporting improved learner achievement. Therefore, educational leaders and policymakers may consider strengthening and institutionalizing technology-enhanced professional development programs within the Department of Education to further develop teachers' digital and pedagogical competencies and promote quality, equitable, and learner-centered education in the twenty-first century.

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