Article

The effectiveness of in-service teacher training programs in enhancing teaching quality and student achievement

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Abstract: In the rapidly evolving landscape of education, the continuous professional development of teachers is essential for maintaining high standards of teaching and enhancing student achievement. In-service teacher training programs, which provide ongoing education and training for currently employed teachers, are a crucial component of this professional development. This study uses a mixed-methods approach to investigate the efficacy of in-service teacher training programs in enhancing student success and teaching quality. To obtain thorough data on their experiences and perspectives, 286 in-service teachers from various schools around Kampala completed a survey. Additionally, 52 in-service teachers were interviewed, providing a comprehensive insight into their experiences. According to the quantitative results, 71% of the respondents had previously taken part in in-service training; 61% reported improvements in the quality of their instruction, and 71% noted improvements in student performance. The chi-square tests and regression analysis results showed that in-service training significantly improved student achievement and teacher quality. These findings were corroborated by the qualitative data, which highlighted themes including improved teaching strategies, increased teacher confidence, enhanced student engagement, impact on student achievement, and teacher motivation and morale. The study also highlights the value of peer cooperation and hands-on workshops in training programs and emphasizes the necessity of ongoing, customized professional development. This study offers a comprehensive knowledge of the efficacy of in-service teacher training programs by integrating quantitative and qualitative data. This understanding will be beneficial for educators and policymakers as they build more effective professional development initiatives.

Keywords: in-service; teacher training; professional development; teaching quality; student achievement

1. Introduction

Maintaining high standards of instruction and raising student achievement in quickly changing educational landscape depends on teachers' ongoing professional development [1–3]. An essential part of this professional development is in-service teacher training programs, which offer continuing education and training teachers who are currently employed. These courses are intended to assist educators in keeping up to speed on pedagogical trends and educational technologies, as well as in learning new techniques and updating their skill set [4–6]. Since these initiatives significantly raise the standard of education offered in schools, their significance has gained widespread recognition.

For several decades, researchers and enthusiasts have been interested in the

effectiveness of in-service teacher training [5]. Previous studies have emphasized the necessity for ongoing professional development by highlighting the gap between pre-service education and the real-world difficulties teachers encounter in the classroom [7,8]. Further research has demonstrated that continuous professional development can result in notable enhancements to both instructional strategies and student achievements [9].

In addition, the importance of in-service teacher training is underscored by its potential to address several critical areas in education. First, it enables teachers to refine and enhance their instructional methods [10,11], leading to more effective teaching and improved student outcomes. Second, it helps teachers stay current with emerging educational trends and technologies, ensuring that their teaching practices remain relevant and effective [12,13]. Third, professional development programs can support teachers in meeting the diverse learning needs of their students, thereby promoting inclusive education [14,15]. Despite the recognized importance of in-service training, the quality and impact of these programs can vary widely. The success of professional development programs is influenced by various elements, including the training's content, delivery style, length, and degree of follow-up assistance [2,16]. According to Iqbal and Ali [14], training that incorporates opportunities for peer collaboration and practical, hands-on workshops are generally more effective than traditional lecture-based forms. Better results have also been demonstrated to come from customized training that takes into account the unique requirements and circumstances of teachers [11].

In recent years, the integration of technology in education has added another layer of complexity and opportunity for in-service training [17,18]. In addition to knowing how to use digital technologies to improve learning, teachers are today required to be experts in both traditional teaching approaches. To guarantee that teachers are prepared to successfully integrate technology into their classrooms, this transition calls for ongoing professional development [19].

Overall, in-service programs for teacher training are essential to educators' continuous professional growth. These initiatives significantly contribute to raising educational standards by supporting educators in keeping abreast of emerging techniques and technological advancements [3,20]. Despite significant investments in these programs, there remains a gap in understanding their effectiveness and the extent to which they influence teaching practices and student outcomes. Furthermore, the context-specific nature of educational environments means that findings from one region may not be easily applicable to another, complicating efforts to develop universally effective training programs.

In Uganda, where this study is situated, educational systems face unique challenges such as resource constraints, varied educational policies, and diverse teacher competencies [21,22]. There is a pressing need to assess whether the in-service training programs currently offered align with teachers' needs and result in measurable enhancements in teaching quality and student learning outcomes. To evaluate the effects of these programs on student accomplishment and teaching quality, this study provides information that will help future in-service teacher training program initiatives be designed and implemented more successfully.

This study is significant for several reasons. First, it provides empirical evidence

on the effectiveness of in-service teacher training programs, contributing to the existing body of knowledge in the field of educational research. Second, the findings offer practical insights for policymakers and educational leaders seeking to design and implement effective professional development programs. Finally, the study highlights the voices and experiences of teachers, providing valuable feedback that can inform the continuous improvement of in-service training initiatives.

1.1. Research question

The research question was:

How effective are in-service teacher training programs in improving teaching quality and enhancing student achievement?

1.2. Theoretical framework

The theoretical framework for this study on the effectiveness of in-service teacher training programs is built upon social cognitive theory and diffusion of innovations theory. These frameworks help understand how teacher training impacts teaching practices and student achievement.

1.2.1. Social cognitive theory

Albert Bandura social cognitive theory emphasizes the importance of observational learning, self-efficacy, and social interactions in acquiring new skills and behaviors, making it a vital framework for understanding how in-service teacher training can improve teaching quality and student achievement [23,24], Key components of this theory include [25–27]:

Observational Learning: Teachers learn new teaching strategies by observing and modeling the practices demonstrated during training sessions. When teachers see effective teaching methods in action, they are more likely to adopt and implement these strategies in their classrooms, enhancing their teaching quality.

Self-Efficacy: A teacher's belief in their ability to successfully implement new teaching strategies significantly influences their willingness to adopt these methods. Training programs that build self-efficacy through positive reinforcement and opportunities for mastery experiences empower teachers to try new approaches and improve their instructional practices.

Reciprocal Determinism: The interaction between personal factors (e.g., beliefs, attitudes), environmental influences (e.g., school culture, resources), and behavior (e.g., teaching practices) is critical in shaping teaching quality. In-service training programs that address these factors can create a supportive environment for teachers to enhance their skills and positively impact student achievement.

Social Cognitive Theory supports the idea that in-service teacher training programs should provide opportunities for teachers to observe best practices, build confidence in their abilities, and create supportive environments for change. By focusing on these elements, training programs can lead to improved teaching quality and higher student achievement, as teachers become more confident and skilled in their instructional practices.

1.2.2. Diffusion of innovations theory

Everett Rogers diffusion of innovations theory explains how new ideas and

practices spread within a community or organization [28,29]. Key elements include [28,30,31]:

Innovation: The new idea, practice, or technology being introduced (e.g., new teaching strategies).

Communication Channels: The means through which information about the innovation is shared.

Social System: The community or organization where the innovation is being implemented.

Adoption Process: The stages individuals go through when adopting an innovation, including awareness, interest, evaluation, trial, and adoption.

This theory provides insights into how in-service teacher training programs can effectively disseminate new teaching practices among teachers. Understanding the adoption process helps identify factors that facilitate or hinder the implementation of training insights in classrooms.

The integration of these theoretical frameworks provides a comprehensive basis for examining the effectiveness of in-service teacher training programs.

2. Literature review

In-service teacher training programs are an essential part of professional development that offers continuing education and training to teachers who are currently employed. In-service training improves teaching quality [32–34]. According to Qaisra and Haider [8], Professional development is essential for teachers to refine their instructional practices, adapt to new curricular demands, and meet diverse student needs. Similarly, Richter et al. [35] emphasize that effective professional development should be content-focused, incorporate active learning, and provide opportunities for collaboration and feedback. Several studies have demonstrated that in-service training can lead to significant improvements in teaching quality [36–38]. However, the effectiveness of these programs varies based on their design and implementation. Quilapio and Callo [39] argue that professional development must be sustained and intensive to be effective, with a strong emphasis on practical application and ongoing support.

Teachers now need to engage in ongoing professional development due to the inclusion of technology in the classroom. According to Yurtseven Avci [40], for teachers to effectively employ digital resources to improve learning, they must receive professional development in technology integration. According to research by Ali et al. [41] and Lai and Jin [42], teachers' pedagogical approaches and technological proficiency are both enhanced by professional development that emphasizes technology integration. In-service training programs are also vital for preparing teachers to address diverse learning needs in the classroom. Kivirand et al. [43] found that professional development that includes strategies for differentiation and inclusive education helps teachers better support students with varied abilities and backgrounds. Similarly, Rodríguez-Oramas et al. [44] highlight the importance of professional development in equipping teachers to create inclusive learning environments.

High-quality in-service training can result in increased student achievement. Didion et al. [45] carried out a metadata analysis and concluded that student learning

outcomes can be markedly improved by professional development programs that are well-designed and implemented. Smith and Gillespie [2], who named teacher professional development as one of the major variables impacting student outcomes, lends credence to this.

Despite the extensive body of research on the benefits of professional development, there is still a need for empirical evidence to understand the specific impacts of in-service teacher training programs on teaching quality and student achievement in the context of developing country like Uganda. This study seek to address this gap by evaluating these impacts using a mixed-methods approach, combining quantitative and qualitative data to provide a comprehensive understanding of the effectiveness of these programs.

3. Methodology

3.1. Research design

This study employed a mixed-method research design to investigate the effectiveness of in-service teacher training programs in enhancing teaching quality and student achievement. The combination of quantitative and qualitative approaches allowed for a comprehensive analysis of the data, capturing both numerical trends and in-depth personal experiences of the participants.

3.2. Quantitative data collection

A questionnaire was developed based on an extensive literature review of existing studies on teacher training programs and their impact on teaching quality and student performance. The review highlighted key factors influencing the effectiveness of such programs, which informed the creation of the questionnaire items. A new questionnaire (Appendix A) was specifically created for this study to ensure relevance and applicability to the context being investigated.

The questionnaire included closed-ended questions designed to measure various aspects of teaching quality and student achievement, such as:

- In-Service Training Experience
- Impact on Teaching Quality
- Impact on Student Achievement
- Suggestions for Improvement

All in-service teachers who have recently taken part in professional development training programs within Kampala were the study's target population. A random sampling technique was used to choose a representative sample of 286 teachers from different schools around Kampala. The chosen sample of teachers received the questionnaires over email. To boost response rates, teachers were emailed follow-up reminders after the first two-week period. To promote truthful and precise responses, anonymity and confidentiality were guaranteed. The collected data was then analyzed using statistical methods to identify trends and correlations.

3.3. Qualitative data collection

Semi-structured interviews were conducted to collect qualitative data. An

interview guide (Appendix B) was developed with open-ended questions to explore the in-service teachers' detailed experiences and perceptions of the training programs. Key areas of focus included:

- Personal experiences and reflections on the training
- Specific examples of how the training influenced teaching practices
- Perceived impact on student engagement and achievement
- Suggestions for improving future training programs

A purposive sampling method was used to select 52 in-service teachers for the interviews, ensuring a diverse representation of subjects and teaching experiences. Interviews were scheduled over three months to minimize changes in data and maximize participant availability. The interview took place for fourteen days in September 2023, October 2023, and December 2023. Before the interview, each participant signed a consent form. Individual interviews took place at the participants' offices and meeting spaces. They lasted an average of 40–60 minutes, with only twelve lasting less than 35 minutes. Interviews were conducted until data saturation was reached, meaning no new information or themes were emerging from the interviews. This point was reached at the 52nd interview. Each interview was audio-recorded and transcribed for analysis.

3.4. Pilot study

A pilot study was conducted prior to the main data collection to assess the reliability and validity of the newly developed questionnaire. The pilot involved 20 teachers who were not part of the main study sample. The questionnaire demonstrated high internal consistency, with a Cronbach's alpha of 0.87 across all subscales, indicating that the items were reliably measuring the intended constructs.

Feedback from the pilot participants was used to refine the wording of several items for clarity. Construct validity was supported by factor analysis, which confirmed that items grouped under their respective subscales as intended. Participants found the questionnaire to be straightforward and the length manageable, completing it within approximately 20 minutes on average.

3.5. Data analysis

For quantitative analysis, the Statistical Package for the Social Sciences (SPSS) program was used to analyze the data. The demographic details of the respondents and their answers to the questionnaire items were compiled using descriptive statistics. Regression analysis and Chi-square tests were done to look at the relationship between in-service teacher training and the extent of perceived improvements in teaching quality and corresponding changes in student achievement.

For qualitative analysis, the transcribed interviews were analyzed using thematic analysis. The process involved several steps:
1) Familiarization with the data by reading and re-reading the transcripts
2) Coding the data to identify significant statements and recurring themes
3) Grouping the codes into broader themes that captured the essence of the participants' experiences
4) Reviewing and refining the themes to ensure they accurately represented the data

Both qualitative and quantitative findings were then integrated to provide a comprehensive understanding of the effectiveness of the in-service teacher training programs.

3.6. Ethical considerations

Informed consent was obtained from all participants, and they were assured of confidentiality and anonymity of their responses. Participants were informed of their right to withdraw from the study at any time without any consequences.

3.7. Limitations

1) Sample Size Limitation

The study was conducted with a limited sample size, which may affect the generalizability of the findings to a broader population. The sample was carefully stratified to include teachers from diverse educational backgrounds, teaching different subjects, and with varying years of experience. This stratification helped ensure that the sample was representative of the wider teaching population.

2) Self-Reported Data Bias

The use of self-reported questionnaires may introduce bias, as participants may provide socially desirable responses rather than accurate reflections of their experiences. Participants were assured of the anonymity and confidentiality of their responses. This assurance was provided to encourage honest and accurate reporting of their experiences and perceptions.

3) Context-Specific Findings

The study was conducted in a specific educational context, which may limit the applicability of the results to different regions or educational settings. The study included a comparative analysis with existing literature from different contexts. This comparison helped identify similarities and differences, offering insights into how findings might be applicable or need adaptation in other settings.

4) Potential Interviewer Bias

Interviews may be subject to interviewer bias, where the interviewer's presence or questioning style influences participants' responses. Interviewers received thorough training in conducting interviews, emphasizing neutrality, consistency, and non-leading questioning techniques to minimize bias. In addition, a standardized interview protocol was developed and strictly adhered to, ensuring that each interview was conducted in a uniform manner across all participants.

4 Results

4.1. Quantitative results

The quantitative data collected from the 286 in-service teachers through the structured questionnaire were analyzed using descriptive and inferential statistics.

4.1.1. Demographic

Table 1 shows the demographic characteristics of the participants. 286 invitees participated in the study. The majority of respondents were female (63.99%) and fell into the age group of 35–44 (43.71%). Regarding teaching experience, 24.13% of

respondents had less than 5 years of experience, 25.52% had 5–10 years of experience, 26.22% had 11–15 years of experience, and 24.13% had more than 20 years of experience. The most commonly taught subjects were Mathematics (36.71%) and Language Arts (32.87%).

Table 1. Demographic.

Variables	Male Frequency (%)	Female Frequency (%)	Total Frequency (%)
Gender	103 (36.01)	183 (63.99)	286 (100.00)
Age (Years)			
25–34	51 (44.35)	64 (55.65)	115 (40.21)
35–44	26 (20.80)	99 (79.20)	125 (43.71)
45–above	26 (56.52)	20 (43.48)	46 (16.08)
Educational Qualification			
Certificate	20 (35.71)	36 (64.29)	56 (19.58)
Diploma	44 (45.83)	52 (54.17)	96 (33.57)
Bachelor	15 (16.48)	76 (83.52)	91 (31.82)
Master	24 (55.81)	19 (44.19)	43 (15.03)
Teaching Experience (Years)			
Under 5 years	23(33.33)	46 (66.67)	69 (24.13)
5–10 years	24 (32.88)	49 (67.12)	73 (25.52)
11–15 years	22 (29.33)	53 (70.67)	75 (26.22)
16 years and above	34 (49.28)	35 (50.72)	69 (24.13)
Taught Subject			
Mathematics	58 (55.24)	47 (44.76)	105 (36.71)
Language Art	15 (15.96)	79 (84.04)	94 (32.87)
Others	30 (34.48)	57 (65.52)	87 (30.42)

4.1.2. In-service training experience

71% of respondents said they had previously taken part in in-service teacher training programs. Of those who had, 51% said they had gone occasionally and 29% said they had gone often. The average assessment for the overall quality of training programs was 4.2 on a 5-point scale.

4.1.3. Perceived impact on teaching quality

61% thought that their teaching abilities had improved somewhat to significantly as a result of in-service training programs.

83% said the programs made it easier for them to introduce new technologies or teaching strategies into their classrooms.

74% of participants reported feeling more comfortable handling a variety of learning needs.

4.1.4. Perceived impact on student achievement

71% thought that in-service training programs had improved student performance in their classrooms, either somewhat or significantly.

Following their involvement in training sessions, 58% of students reported

measurable increases in motivation and engagement.

4.1.5. Suggestions for improvement

It was shown that practical workshops (45%) and peer collaboration sessions (28%), among other program elements, were the most advantageous for professional growth.

Increased follow-up support following training (35%) and more individualized training sessions catered to individual requirements (50%) were among the suggestions made for improving effectiveness. In addition, several participants (48%) underscored the significance of continuous professional development to stay abreast of the rapidly changing trends and technologies in education.

4.1.6. Regression analysis results

Table 2 shows the regression analysis. A *p*-value < 0.05 suggests statistical significance. Participation in in-service training programs, Teaching experience, and subject taught (Mathematics) has a statistically significant positive effect on perceived improvements in teaching quality.

The constant term represents the baseline perceived improvement in teaching quality when all other independent variables are zero.

Table 2. Regression analysis results.

Variable	Coefficient	Standard Error	*t*-value	*p*-value
Participation in Training Programs	0.493	0.098	4.194	<0.001
Teaching Experience	0.296	0.104	3.285	0.003
Subject Taught (Mathematics)	0.203	0.059	2.965	0.005
Subject Taught (Language Arts)	0.103	0.062	1.902	0.083
Constant	1.197	0.403	4.197	0.004

4.1.7. Chi-square test results

The chi-square test reveals a significant association between participation in in-service training programs and perceived improvements in teaching quality ($\chi^2 = 22.39$, $df = 2$, $p < 0.001$).

Similarly, the chi-square test indicates a significant association between participation in in-service training programs and perceived improvements in student achievement ($\chi^2 = 17.86$, $df = 2$, $p < 0.001$).

4.2. Qualitative results

The qualitative data from the 52 semi-structured interviews were analyzed using thematic analysis, and several key themes emerged.

4.2.1. Improved teaching strategies

Participants illustrated different ways they have applied new teaching strategies learned from in-service training programs to enhance their classroom practices and student learning experiences. "The training introduced me to differentiated instruction techniques which have significantly helped me cater to the diverse needs of my students" (P1). "My approach to teaching has changed as a result of the training's introduction to project-based learning" (P6). "The workshops on using technology in

the classroom opened our eyes" (P12). "I now employ educational applications to enhance the dynamic and relevant nature of learning" (P18). "It was not until the training stressed the significance of formative evaluation that I became aware of its impact" (P22). "My classroom has become a more collaborative environment as a result of the training's introduction to cooperative learning techniques" (P27). "I am now more aware of the need to modify my teaching to accommodate children with special needs as a result of the seminars on inclusive education practices" (P31). "My students' ability to arrange their ideas and communicate themselves clearly has improved since they started using visual organizers, as advised in the training" (P35). "After the training, I began implementing flipped classroom techniques" (P40). "After the training, I now incorporate themes related to cultural diversity into my courses, which has improved the relevance and inclusivity of learning for all students" (P49).

4.2.2. Increased teacher confidence

Participants highlighted how in-service training programs have contributed to increased confidence in their teaching abilities across various aspects of classroom management, instructional strategies, technology integration, and student engagement. "Before the training, I was always second-guessing my methods. Now, I feel much more assured in my teaching practices" (P15). "I gained practical skills from the training that increased my confidence in my ability to properly handle problems with classroom management" (P17). "I am more confident in my ability to create a more creative learning environment because of the training". "During the training, I gained knowledge about the most recent education research, which has enabled me to make well-informed decisions on teaching strategies and curricula" (P20). "After completing the training courses on educational technology, I feel more comfortable utilizing technology to improve learning outcomes" (P21). "I now have a better understanding of various learning styles thanks to the training, and I feel more comfortable modifying my instruction to suit the needs of a wide range of students" (P27). "I feel more comfortable now creating and carrying out interesting projects that increase students' comprehension" (P33). "I'm more comfortable using formative assessment techniques to direct lessons now" (P36). "After learning useful tactics in the training that accommodate a range of learning capacities, I feel more confident in my capacity to differentiate instruction" (P39). "My confidence in cultivating strong teacher-student connections and classroom dynamics has increased as a result of the training workshops on effective communication skills" (P42). "I used to be hesitant to use inclusive methods. I'm more comfortable now fostering a diverse and inclusive learning environment in the classroom" (P43).

4.2.3. Enhanced student engagement

Participants demonstrated how they have successfully enhanced student engagement by applying diverse instructional strategies learned from in-service training programs, ultimately fostering more interactive and participatory learning environments. "Since incorporating the interactive activities from the workshop, my students seem more interested and active in class discussions" (P2). "I learned about gamification strategies from the course, and they have made my lessons more interesting for the students" (P4). "Following the training, I observed a notable rise in student involvement when I used peer-to-peer learning practices" (P11). "My students

are now more interested in learning and keen to go deeper into subjects thanks to the use of inquiry-based learning activities which I learnt from the training" (P16). "The significance of using real-world examples were underlined during the training. My students are now more interested in connecting what they are learning in class to real-world situations" (P18). "Following the training, I began implementing collaborative projects, and it's incredible to watch students take responsibility for their education and cooperate" (P25). "As recommended in the training, including multimedia presentations have drawn students in and made difficult subjects more approachable" (P34). "After the training, I feel more comfortable utilizing narrative skills, which has improved my ability to engage students in my classes" (P37).

4.2.4. Impact on student achievement

Participants illustrated how in-service training programs have positively impacted student achievement by equipping them with effective instructional strategies and tools to enhance learning outcomes across various subjects and skills. "I've seen a marked improvement in my students' performance, particularly in critical thinking and problem-solving skills" (P23). "I've seen a noticeable improvement in my students' reading comprehension skills after implementing the new literacy tactics from the training" (P26)." Better academic results have resulted from my ability to customize lessons to each student's needs thanks to the training on differentiated instruction" (P28). "By putting the formative assessment strategies, I learned in the course into practice, I've been able to provide students feedback on time, which has improved their learning" (P31)." Since implementing the problem-solving techniques I acquired during the course, I've noticed a discernible improvement in my students' arithmetic proficiency" (P34). "It has been easier for me to recognize and close learning gaps by utilizing the data-driven instructional tactics I learned at the training" (P35). "Since using the training's writing process tactics, I've seen an improvement in my students' writing abilities" (P38). "I was inspired to incorporate additional practical exercises by the training. This has made it easier for students to understand difficult subjects" (P41). "I've been using peer assessment strategies that I learned from the training, and it's encouraging to watch how students help each other grow and learn" (P44). "My students' attitudes toward learning have improved since I've started using the research-based techniques from the training" (P45).

4.2.5. Teacher motivation and morale

Participants emphasized how participation in in-service teacher training programs not only enhances teaching skills but also revitalizes teachers' passion for their profession, fostering a more motivated and committed teaching staff. "These training programs rejuvenate my passion for teaching. They remind me why I chose this profession in the first place" (P3). "My passion for teaching has been rekindled by attending these training courses'' (P7). "I'm feeling more motivated to experiment and enhance my methods of instruction after the training" (P14). "I value how these training courses contribute to our professional development as teachers. It encourages me to aim for teaching excellence" (P27)." Gaining new skills through professional growth keeps me inspired to keep getting better and adapting" (P36)." I've been able to regain my love for teaching because to these sessions. I now approach every day with a fresh sense of purpose and enthusiasm" (P38). "When I take part in these

training programs, I experience an increase in support and value as a teacher. It greatly raises my spirits" (P44). "These training sessions' collaborative format has improved my feeling of community among committed educators" (P46). "My ability to take charge of my own professional development has increased as a result of the professional development possibilities" (P50).

4.2.6. Suggestions for improvement

Participants made suggestions, reflecting their diverse perspectives and desires regarding how in-service training programs can be improved to better support their professional development and enhance their teaching practices effectively. "Although the theory is excellent, I would like to see more practical workshops where we may try applying new techniques in authentic classroom settings" (P7). "After the initial training, follow-up sessions would be helpful. It aids in reinforcing knowledge and resolving implementation difficulties" (P12)." If the training material could be more closely matched to the unique requirements and difficulties we encounter in our subject areas that would be beneficial" (P26). "Although I value expert knowledge, I also think that peer collaboration is important" (P33). "Different learning preferences and schedules could be accommodated by offering a range of formats, such as workshops, seminars, and online modules" (P51).

5. Integration of quantitative and qualitative findings

The integration of quantitative and qualitative findings from this research provides a comprehensive understanding of the effectiveness of in-service teacher training programs in enhancing teaching quality and student achievement. The convergence of data from both methods underscore the multifaceted impact of these programs, highlighting areas of strength and opportunities for improvement.

According to quantitative results, the majority of respondents (61%) thought that in-service training had enhanced their teaching abilities moderately to significantly. Regression analysis revealed that participation in in-service training programs had a statistically significant positive effect on reported increases in teaching quality ($p <$ 0.05), which validated this perspective. A significant correlation was also found by the chi-square test between taking part in these programs and improvements in perceived teaching quality ($\chi^2 = 22.39$, $df = 2$, $p < 0.001$). These findings were supported by qualitative data, as interviewees often mentioned that the training had given them new and useful teaching techniques. This theme of enhanced teaching quality was continuously emphasized as a key advantage, supporting the numerical outcomes.

A notable 83% of questionnaire respondents stated that the implementation of new teaching techniques or technology in their classrooms was made easier by in-service training. The information from qualitative interviews supplemented this, showing that teachers felt more competent and self-assured in incorporating these novel approaches into their lesson plans after in-service training. A recurring element was the rise in teacher confidence, implying that training not only gives teachers new resources but also increases their confidence in their ability to use them.

According to quantitative data, 74% of participants felt more capable of managing a range of learning demands after in-service training. This is consistent with qualitative findings that participants reported having a positive influence on their

capacity to successfully engage and meet the needs of a diverse student body.

According to a quantitative analysis, 71% of respondents believed that student performance had improved somewhat to significantly as a result of in-service training sessions. A significant chi-square connection between training participation and perceived improvements in student achievement (χ^2 = 17.86, *df* = 2, *p*< 0.001) supported this. Furthermore, following training, 58% of students showed discernible gains in motivation and engagement. These findings were corroborated by the interview data, which revealed clear themes of increased student engagement and beneficial effects on academic attainment. Instructors reported that better academic results and increased student participation were significantly impacted by the tactics they had acquired in training sessions.

According to the quantitative response, peer collaboration sessions (28%) and practical workshops (45%) were especially helpful for professional development. To address particular needs, participants also recommended more customized training sessions (50%) and more follow-up support (35%). The need for continued professional development was also emphasized in qualitative interviews, where participants emphasized the necessity of constant training to stay up to date with educational trends and innovations. This theme is consistent with the quantitative recommendation for opportunities for professional growth that are more individualized and ongoing.

The beneficial effect of in-service training on teacher morale and motivation was a prominent qualitative theme. Teachers who took part in in-services training said they felt more driven and devoted to their work. This morale boost is essential to creating a supportive learning environment for teachers and, eventually, improving the educational experiences of students

6. Discussion

The findings from this study demonstrate the significant positive impact of in-service teacher training programs on teaching quality and student achievement. Our quantitative data showed that 61% of teachers perceived improvements in their teaching abilities due to in-service training programs, a finding corroborated by the regression analysis and chi-square test results. These findings align with previous research which has consistently shown that professional development can enhance teaching skills and instructional practices [41,42,46]. Specifically, the provision of practical workshops and peer collaboration sessions were highlighted as particularly beneficial. This supports the idea that active, collaborative learning experiences are more effective than passive forms of professional development [47].

The study found that 83% of teachers reported that in-service training made it easier for them to incorporate new teaching methods and technology into their lessons. This result is in line with earlier studies' findings that suggest that efficient professional development enables educators to adopt cutting-edge teaching strategies and technological tools, improving student performance [3,12,13]. The qualitative data indicates that teachers are more confident in utilizing these new tools, which emphasizes the value of professional development in enhancing teachers' pedagogical and technological proficiency.

Our data showed that 74% of participants felt more prepared to manage a variety of learning demands after training. This result is consistent with the body of research that highlights the value of professional development in equipping educators to adapt their instruction to the diverse needs of their students and advancing inclusive education [14,15]. Fostering an equitable learning environment requires the ability to meet a variety of learning requirements, and our findings demonstrate the beneficial role that in-service training plays in this area.

The study revealed that 71% of teachers said that in-service training programs improved student performance, and 58% said that students were more engaged and motivated. Previous research has demonstrated that professional development can result in increased student engagement and achievement, which is consistent with these findings [9,45]. The qualitative data added further context and revealed that the degree to which these gains are realized depending critically on how new techniques are implemented faithfully. This result emphasizes how crucial it is to provide teachers with continuous support and monitoring in order to guarantee the successful implementation of new techniques.

Participants demanded more specialized training and ongoing professional development, expressing a significant preference for hands-on workshops and peer cooperation sessions. This is consistent with the body of research that shows that context-specific, intensive, and ongoing professional development is the most beneficial [35,48]. The emphasis on lifelong learning is especially pertinent in the quickly changing educational environment of today, when upholding good teaching standards requires staying current with new advancements.

The qualitative findings, which emphasize the beneficial effects of in-service training on teacher motivation and morale, are in line with earlier studies. It has been demonstrated that professional development increases teachers' commitment to their profession, sense of efficacy, and job satisfaction [49]. This morale boost is essential for fostering a culture of continual development and a healthy school climate.

7. Conclusion

This study investigated the effectiveness of in-service teacher training programs in enhancing teaching quality and student achievement using a mixed-methods approach. The findings provide compelling evidence of the positive impacts these programs have on both teachers and students. The majority of participants reported improvements in their teaching abilities. Quantitative data showed significant associations between in-service training and perceived improvements in teaching quality. Qualitative insights highlighted the acquisition of new and effective teaching strategies. In-service training was found to be instrumental in helping teachers integrate new technologies and teaching methods into their classrooms. This was reflected in both the high percentage of teachers who felt more comfortable using these tools and the qualitative reports of increased teacher confidence. In addition, a substantial proportion of teachers felt better prepared to address a variety of learning needs, emphasizing the role of professional development in fostering inclusive education.

Teachers observed improvements in student performance and engagement, which

were significantly associated with participation in in-service training programs. Qualitative data supported these findings, highlighting the practical benefits of implementing new strategies learned during training. Practical workshops and peer collaboration sessions were identified as particularly beneficial, and there was a strong call for more individualized and continuous professional development. This underscores the need for ongoing, context-specific training to maintain high teaching standards. The study also found that in-service training positively impacted teacher motivation and morale, leading to a more enthusiastic and committed teaching staff. This boost in morale is critical for creating a positive educational environment and promoting continuous improvement.

The findings of this study have several implications for practice. First, they underscore the importance of providing high-quality, practical, and collaborative professional development opportunities for teachers. Second, they highlight the need for ongoing support and follow-up to ensure the effective implementation of new strategies and technologies. Finally, they suggest that professional development should be tailored to the specific needs of teachers and should be an ongoing process to keep pace with the changing educational environment.

Future research should explore the long-term impact of in-service training programs on teaching quality and student achievement, considering factors such as the sustainability of improvements and the role of continuous professional development. Additionally, more research is needed to understand the specific elements of professional development that are most effective in different educational contexts.

Author contributions: Conceptualization, AU and OAO; methodology, AU and OAO; software, AU, KK and OAO; validation, AU, KK and OAO; formal analysis, AU, KK and OAO; investigation, AU and KK; resources, AU and KK; data curation, AU, KK and OAO; writing—original draft preparation, AU, KK and OAO; writing—review and editing, AU, KK and OAO; visualization, AU, KK and OAO; supervision, AU, KK and OAO; project administration, AU, KK and OAO. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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Appendix A: Questionnaire

Demographic Information:

1. Gender: [ ] Male [ ] Female [ ] Other

2. Age: [ ] Under 25 [ ] 25-35 [ ] 36-45 [ ] 46-55 [ ] 56 and above

3. Teaching Experience: [ ] Less than 5 years [ ] 5-10 years [ ] 11-20 years [ ] More than 20 years

4. Subject(s) Taught: [ ] Mathematics [ ] Science [ ] Language Arts [ ] Social Studies [ ] Other (please specify: _____)

In-Service Training Experience:

5. Have you participated in any in-service teacher training programs in the past? [ ] Yes [ ] No

• If yes, please specify the nature of the training program(s) you have attended: _____

6. How frequently do you attend in-service training programs? [ ] Rarely [ ] Occasionally [ ] Frequently [ ] Always

7. Rate the overall quality of the in-service training programs you have attended on a scale of 1 to 5, with 1 being poor and 5 being excellent.

Perceived Impact on Teaching Quality:

8. To what extent do you believe that in-service training programs have improved your teaching skills? [ ] Not at all [ ] Slightly [ ] Moderately [ ] Very much [ ] Completely

9. Have the training programs helped you incorporate new teaching methods or technologies into your classroom? [ ] Yes [ ] No

• If yes, please specify how they have helped: _____

10. Do you feel more confident in your ability to address diverse learning needs after participating in in-service training? [ ] Yes [ ] No

Perceived Impact on Student Achievement:

11. In your opinion, have in-service training programs contributed to improved student performance in your classes? [ ] Not at all [ ] Slightly [ ] Moderately [ ] Very much [ ] Completely

12. Have you observed any specific improvements in student engagement or motivation following your participation in training programs? [ ] Yes [ ] No

• If yes, please describe the observed improvements: _____

13. How do you measure student achievement in your classroom? (Check all that apply) [ ] Standardized tests [ ] Classroom assessments [ ] Student feedback [ ] Other (please specify: _____)

Suggestions for Improvement:

14. What aspects of in-service training programs do you find most beneficial for your professional development?

15. In your opinion, what could be done to enhance the effectiveness of in-service teacher training programs?

General Comments:

16. Is there anything else you would like to share about your experiences with in-service teacher training programs?

Appendix B: Interview Guide

Name (or Code):

Teaching Experience:

Number of years teaching: _____

Subjects taught: _____

School Type (e.g., Public, Private, Urban, Rural): _____

Participation in Training Programs:

Number of in-service training programs attended in the last year: _____

Section 1: Personal Experiences and Reflections on Training

1. General Overview:

Q1: Can you describe your overall experience with the in-service teacher training programs you have attended?

Follow-up: What aspects of the training did you find most valuable?

2. Motivation and Expectations:

Q2: What motivated you to participate in these training programs, and what were your expectations before attending?

Follow-up: To what extent were your expectations met?

3. Engagement and Participation:

Q3: How did you find the level of engagement and interaction during the training sessions?

Follow-up: Were there any specific activities or sessions that particularly engaged you? Please elaborate.

4. Training Content:

Q4: How relevant was the training content to your teaching needs and context?

Follow-up: Were there any topics you felt were missing or could have been included?

Section 2: Influence on Teaching Practices

5. Implementation of Strategies:

Q5: Can you provide specific examples of teaching strategies or practices you have implemented in your classroom as a result of the training?

Follow-up: How have these strategies affected your teaching approach?

6. Challenges and Barriers:

Q6: What challenges or barriers have you encountered in implementing new strategies from the training?

Follow-up: How have you addressed these challenges, if at all?

7. Support and Resources:

Q7: Did you receive any support or resources to help implement the training insights into your teaching practice?

Follow-up: What additional support do you think would be helpful?

Section 3: Perceived Impact on Student Engagement and Achievement

8. Student Engagement:

Q8: How has your participation in the training programs impacted student engagement in your classroom?

Follow-up: Can you share any specific examples or observations?

9. Student Achievement:

Q9: In your opinion, has there been any noticeable impact on student achievement as a result of changes in your teaching practices?

Follow-up: What evidence or indicators support this observation?

10. Feedback from Students:

Q10: Have you received any feedback from your students regarding changes in your teaching methods?

Follow-up: How have they responded to the new strategies?

Section 4: Suggestions for Improving Future Training Programs

11. Improvements:

Q11: Based on your experience, what specific improvements would you suggest for future in-service teacher training programs?

Follow-up: Are there any new topics or methods you believe should be included?

12. Training Delivery:

Q12: How do you think the delivery of these training programs could be enhanced to better meet teachers' needs?

Follow-up: Would you prefer more practical, hands-on sessions, or is the current balance of theory and practice adequate?

13. Long-term Support:

Q13: What kind of ongoing support or follow-up would be beneficial to sustain the benefits of the training programs?

Follow-up: How can schools or training organizations better support teachers in the long-term application of training insights?

14. Additional Comments:

Q14: Is there anything else you would like to share about your experience with in-service teacher training programs or any other relevant observations?