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Teacher Professional Development and Technological Proficiency of Educators: Empirical Evidence from Ethiopia Higher Education Institutions.

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Abstract

Educators (Higher education teachers) play a significant role in equipping future professionals and contributing to societal progress. They are responsible for preparing competent citizens who serve various societal roles. Hence, examining educators' perceptions regarding professional development and technological proficiency is crucial. This study examines educators' perceptions of professional development and technological proficiency in Ethiopian higher education institutions, focusing on curriculum content, interdisciplinary integration, and aligning theory with practice. The impetus for this study is the growing necessity for educators to possess technological proficiency to meet global educational standards and the demand for innovative teacher education programs. It addresses Educators' perceptions of (1) Their technological proficiency, (2) The relevance and interdisciplinary integration of teacher education curricula, (3) The alignment of theoretical and practical curriculum components, and (4) The integration of technological training in teacher development programs. A structured questionnaire was utilized to collect data from instructors across various university categories. The analysis employed descriptive statistics, ANOVA, and post hoc tests. The findings indicate that educators perceive their technological proficiency as moderate (M = 3.0, SD = 0.66) and regard curriculum relevance and interdisciplinary integration as slightly above average (M = 3.1, SD = 0.64). Research universities demonstrate consistently higher scores across all variables, including technological training and curriculum alignment, than comprehensive and applied universities. Technological training integration and the alignment of theoretical and practical elements were identified as areas requiring improvement (M=2.8, SD=0.58; M=2.9, SD=0.67). Significant differences in perceptions were observed based on university type, qualifications, and experience, with research universities exhibiting the highest levels of perceived innovation and technological adoption. The study highlights gaps in technological training and curriculum alignment in Ethiopian higher education, urging strategic policies and resources to improve teacher education programs. By Emphasizing the importance of integrating theory and practice and fostering technological proficiency, the study calls for collaborative efforts to tackle the educational challenges of the 21st century.

Keywords: Teacher Professional Development, Competency, Higher Education, Technological Proficiency.

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Introduction

Teacher education is crucial for teachers to enhance their skills and competence in teaching. It focuses on cultural competence, relational sensitivity, communication, consistency, imagination, and skillful activity application (Forzani, 2011). Teacher education is fundamental for advancing sustainable education in both schools and society. An effective education program can balance innovative concepts and time-tested approaches, equipping learners for the twenty-first century's challenges stemming from the interplay of environment, culture, society, and economy (Mohanty, Kundu, Mukherjee, & Pandey, 2022). Quality teacher education is designed around a clear, shared vision of good teaching. It is coherent in linking theory with practice, offers opportunities to learn aligned with the vision of good education, and offers opportunities to enact teaching(Jenset, Klette, & Hammerness, 2018). The focus on policy and structural adjustments plays a pivotal role in shaping the effectiveness of teacher education programs in equipping aspiring teachers to empower their students for successful futures in both their personal and professional lives (Linda Darling-Hammond, 2015).

Teacher education is a sacred trust because teaching is the work on which all professions depend(Linda Darling-Hammond, 2016). The ability to cultivate sustainable educational environments in the education system and broader society pivots on educators' competence and values, the design of teacher education, and the methods used to prepare teachers for their roles (Rieckmann, 2022). High-achieving countries invest heavily in teacher training and support, offering equitable salaries and professional learning opportunities and distributing well-trained teachers to all students, ensuring a more efficient and effective teaching process(Linda Darling-Hammond, 2016). Hence, investing time, human, and financial resources in teacher education and competency development teachers is crucial to equipping teachers with the competency needed to aspire to and empower future professionals in their personal and professional lives.

Competency in teaching refers to the ability of educators to apply their knowledge and skills in practical settings. This includes planning lessons, managing classrooms, and using student assessments to guide instruction. (Vitello, Greatorex, & Shaw, 2021).Key 21st-century competencies include integrating technology, managing inclusive classrooms, and designing lessons that cater to different learning styles (Real, 2022; Wahyuni & Sugihartini, 2021; Zamora & Zamora, 2022). Teacher resilience is a core competency where educators must develop personal and contextual resources to manage professional challenges (Mansfield, Beltman, Broadley, & Weatherby-Fell, 2016; Ungar et al., 2020).

Teachers must develop skills in curriculum design, ensuring that lessons provide multiple means of representation and cater to diverse learning needs(Akintayo et al., 2024; Jonnaert, Masciotra, Barrette, Morel, & Mane, 2007; Tran & O'Connor, 2024). Emotional competence, including stress management and well-being promotion, is essential for long-term teacher effectiveness(Jennings & Greenberg, 2009; Kyriacou, 2011; Schonert-Reichl, 2017). Early-career teacher competency often focuses on building

professional engagement, resilience, and a sense of experienced well-being. (Johnson et al., 2014). Managing a classroom environment and creating a safe, productive space for learning is a fundamental teacher competency(Vitello et al., 2021). Competence in adaptive teaching involves tailoring lessons to meet student's individual needs, including those with learning difficulties (Alok, 2023; Mavroudi, 2014).

Teachers' ongoing professional development is crucial for maintaining and improving competency in teaching practices (Avalos, 2011; Collin, Van der Heijden, & Lewis, 2012; Linda Darling-Hammond, Hyler, & Gardner, 2017; Guskey, 2002; Sancar, Atal, & Deryakulu, 2021). Teachers must be proficient in incorporating technology into their teaching and using it as both an instructional and administrative tool (Bauer & Kenton, 2005; Gorder, 2008; Instefjord & Munthe, 2016; Oliver & Townsend, 2013; Rogers, 2000). Teacher education plays a foundational role in shaping educators' abilities to manage classrooms, design practical lessons, and integrate new teaching strategies, including the use of technology (Vitello et al., 2021). In higher education, where future professionals develop, teachers must be equipped with advanced competencies that reflect the complexity and diversity of modern learning environments (Real, 2022; Wahyuni & Sugihartini, 2021).

Thus, a high-quality education system requires competent teachers with pedagogical skills, content knowledge, ethical behavior, interpersonal and communication skills, pedagogical adaptability, classroom management, professional development, cultural competence, and technological proficiency conducting studies and identifying areas for improvement in this field can provide valuable insights for policymakers and stakeholders to take proactive measures.

This article explicitly emphasizes the importance of teacher professional development and technological proficiency in higher education. These areas are essential in preparing educators for the constantly changing demands of 21st-century teaching and learning environments. Technological competency is essential because of the increasing role of digital tools in education. Instructors need to adapt to new technologies, both as instructional aids and as administrative tools, to foster student engagement and manage learning processes more effectively(Bauer & Kenton, 2005; Instefjord & Munthe, 2016). By concentrating on technological proficiency, the study aims to assess teachers' utilization and mastery of technology for their professional purposes and guide students in navigating the technological landscape, which is integral to future professional success (Rieckmann, 2022).

Professional development within higher education is essential for preparing instructors who will subsequently train future educators and professionals in diverse fields. This process generates a multiplier effect, whereby enhancing the competencies of higher education institution teachers helps to directly elevate the quality of education delivered across all levels (L. Darling-Hammond, 2015). Given the shift toward blended learning models and the increasing reliance on digital platforms for both teaching and learning, instructors must possess the skills to integrate these technologies effectively,

ensuring that education remains relevant and sustainable in a rapidly changing world(Mohanty et al., 2022).

This study is globally significant because Teacher professional development represents a fundamental pillar of quality education on a global scale. By addressing the challenges of aligning theoretical frameworks with practical applications, professionals can draw parallels to similar gaps in their own contexts, allowing for cross-country comparisons and identifying shared solutions(Linda Darling-Hammond et al., 2017). This research addresses a pervasive issue in contemporary teacher education systems. Technological proficiency is the focus of the study. In the 21st century, technological integration in education is no longer an optional addition but an essential component for effective teaching and learning (Koehler & Mishra, 2009). This study examines the current level of technological proficiency among university teachers. It provides global decision-makers and key stakeholders insights on preparing educators for an increasingly technology-driven education. The study offers empirical evidence for integrating technology training into teacher education programs, which aligns with international goals such as those outlined in the Sustainable Development Goals (SDG 4: Quality Education), which emphasize the role of technology in education (United Nations, 2015).

Researchers in this area identified various Ethiopian education systems and teacher education programs from different perspectives. These include education and teacher education in Ethiopia, which overemphasize theoretical knowledge, which often undermines the development of practical skills and a lack of curriculum relevance to real-world applications. Addressing these issues is vital for enhancing educational outcomes and better preparing students for the demands of the workforce(Mohammed, 2014; Semela, 2014; Yizengaw, 2004). Inadequate teacher preparation, insufficient professional development, and poorly managed pre-service and in-service training further compromise the quality of education(Abebe & Woldehanna, 2013; Zewdie & Bridges, 2000). Additionally, educational reforms have often overlooked local needs and needed more professional involvement, contributing to students' declining performance in national exams.

This highlights the need for urgent improvements in teacher education practices and technological integration (Aweke et al.; Tamrat, 2021). Thus, this study may address the persistent gaps in Ethiopia's teacher education system, which overly emphasizes theoretical knowledge while neglecting practical skills crucial for classroom effectiveness and future employment (Mohammed, 2014; Semela, 2014). Additionally, insufficient professional development and inadequate pre-service and in-service training limit the ability of teachers to deliver quality education(Abebe & Woldehanna, 2013). Tamrat, 2021; stated that Understanding higher education instructors' perceptions of teachers' professional development and technological proficiency is essential for modernizing teacher training programs and improving student outcomes in a rapidly evolving educational landscape.

Hence, this study investigated educators' professional development and technological proficiency from a teacher perspective within Ethiopian higher education institutions. It seeks to enhance our understanding of how teachers perceive their professional growth and the integration of technology into their educational practices. This is also of particular significance in developing and resource-constrained contexts. Although Ethiopia is the case study, the findings elucidate broader issues other developing nations contend with. Several countries face comparable obstacles, including restricted access to resources, insufficient training programs, and gradual technological integration in education (Antoninis et al., 2023). The challenges highlighted, such as interdisciplinary integration and balancing content relevance with technological training, are common in Ethiopia.

These challenges reflect broader global issues that require collaborative solutions. This research facilitates dialogue among specialists, policymakers, and educators from various countries on effective strategies for teacher development in diverse contexts. This research is relevant to specialists worldwide because it provides actionable insights and a transferable framework for addressing persistent gaps in teacher education. It is a foundation for developing innovative strategies to enhance teacher training and technological proficiency, making it a valuable resource for advancing global education systems.

1.1. Research Aim

The primary aim of this study is to examine perceptions of teacher professional development and technological Proficiency within Ethiopian higher education institutions, focusing on educators' perspectives.

1.2. Research Objectives

1. To describe higher education teachers ' perceived level of technological proficiency among educators in higher education institutions.

2. To evaluate higher education teachers' perceptions of the relevance and interdisciplinary integration within the teacher education curriculum.

2. To assess higher education teachers' perspectives on aligning theoretical concepts and practical applications in the teacher education curriculum.

3. To investigate higher education teachers' perceptions of the technological training components in teacher education development programs.

2. Research Method

This study employs a quantitative approach to examine university teachers' perceptions of professional development and technological proficiency in Ethiopia. It focuses on four key areas: technological proficiency, the alignment of theoretical and practical components in teacher education curricula, the interdisciplinary integration and relevance of curriculum content, and the inclusion of technological training in professional development programs. A quantitative methodology is particularly appropriate for this study, as it provides a structured and objective framework that

ensures reliable and valid results while laying the groundwork for evidence-based decision-making (Creamer, 2018; Creswell, 2013).

The primary data collection tool is a five-point Likert scale questionnaire, which allows for systematic measurement of perceptions by having participants rate their agreement or disagreement with specific statements. Likert scales are well-regarded for their effectiveness in capturing attitudes and opinions in a quantifiable manner(Joshi, Kale, Chandel, & Pal, 2015). This method ensures consistency across responses and enables researchers to comprehensively and comparably evaluate various variables, including technological proficiency, curriculum alignment, interdisciplinary integration, and technological training (Boone Jr & Boone, 2012). Furthermore, the Likert scale facilitates efficient data collection from large and dispersed populations, yielding robust results suitable for statistical analysis and subgroup comparisons (Cohen, Manion, & Morrison, 2018).

The structured questionnaire, utilizing a five-point Likert scale, delivers precise and actionable insights for policymakers, educators, and other stakeholders concerning critical aspects of teacher education programs in Ethiopia. This methodology facilitates a comprehensive understanding of participants' perceptions and supports robust statistical analysis to draw meaningful conclusions (Creswell & Creswell, 2017; Tashakkori & Teddlie, 2010). The study aims to assess higher education teachers' perceptions of teacher professional development and technological proficiency by implementing self-developed five-Likert scale questionnaires. Through the integration of expert reviews, an ethical evaluation process that ensures the confidentiality of study participants, a pilot testing phase, and the incorporation of feedback from participants, as well as the implementation of a statistical evaluation approach, the development of self-administered questionnaires can be optimized to achieve high levels of acceptability, thereby ensuring their efficacy as instruments for the collection of meaningful data(Boone Jr & Boone, 2012; Cohen et al., 2018; Taber, 2018; Zamanzadeh et al., 2015).

2.1. Data Gathering Procedure and Tool

Following a comprehensive literature review, five Likert scale questionnaires were developed, meticulously assessed, and refined with input from the supervisor and field experts. Subsequently, the tool was submitted to the institutional review board for ethical approval. Once the requisite approval had been obtained, a pilot study was conducted to assess the reliability of the instruments. To test the efficacy of the questionnaires, I distributed them to a sample of 50 university teachers. The tool's reliability was confirmed using Cronbach's alpha, confirming its dependability. The reliability of the variables is demonstrated by high reliability across all variables, with each scoring above 0.70 and an overall score of 0.94. Subsequently, the primary data were distributed through the Qualtrics software platform to 460 higher education teachers and 450 respondents who completed the survey.

2.2. Sampling procedures and scientific sample size determination

2.2.1. Stratified random sampling procedures.

In our study, we assessed all the prominent public universities in Ethiopia and arranged them according to the Ministry of Education's most recent classification. Our stratification strategy was based on this classification. A diagram of the university selection process is provided (see Fig. 1).

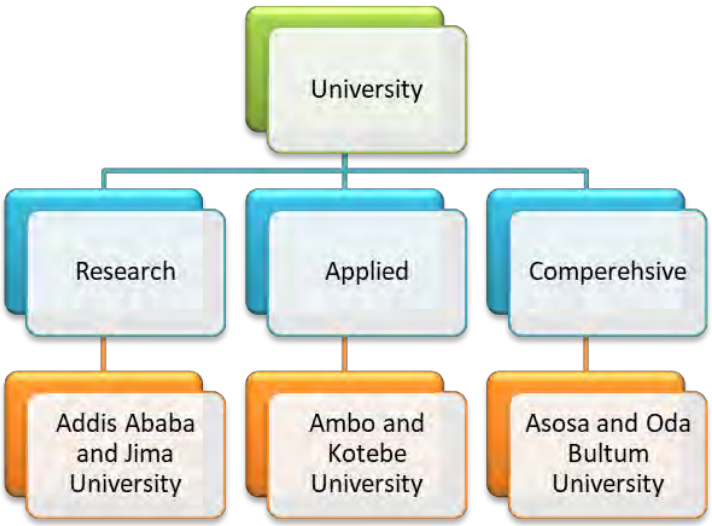

Figure 1 shows the sampling techniques used in Ethiopia's higher public institutions.

To choose educators proportionately from each university, we employed a stratified random selection process in conjunction with a basic random sampling technique. We view teachers as varied between universities and homogeneous within a university. Three strata were defined as part of our technique. All teachers at applied universities were included in the first stratum, teachers in research universities were included in the second, and teachers in general or comprehensive universities were included in the third.

2.2.2. Scientific Sample Size Determination

Stratified random sampling was used to analyze the sample size calculation for this study's 95% confidence level proportions. This formula is determined using the study's sample size(Cochran & Talwani, 1977).

$$n = \frac{Z^2.p.q}{e^2}$$

Where:

"n = the overall sample size determined by the formula.

Z = The Z-score that corresponds to the desired level of confidence

p = The approximate proportion of success

q = 1−p Proportion of Failure

e = the allowable margin of error

The formula for the calculation is as follows at a 95% confidence level, where Z=1.96, p=0.5, q=0.5, and e=0.05"

$$\frac{n = (1.96)^2 \times 0.5 \times 0.5}{(0.05)^2} = \frac{3.8416 \times 0.25}{0.0025} = 384$$

The researchers took into account a 50% chance for each because there is little literature in this field. We carefully considered the 15% sampling nonresponse and a 5% permissible margin of error. The entire sample included 460 university instructors. Four hundred sixty instructors received the questionnaire through institutional email addresses and the Qualtrics platform. Out of them, 450 teachers finished the survey, and just ten respondents did not.

2.3. Data analysis method

The researchers used both descriptive and inferential statistics in this article. Using SPSS 29, descriptive statistics, including frequency distributions, mean, and standard deviation, were used to give a thorough picture of the data. However, acknowledging that descriptive statistics alone are inadequate for drawing policy conclusions and making informed decisions, we also incorporated inferential statistics. Specifically, we applied ANOVA to evaluate the significant differences in beliefs between the current state of teachers' professional development and the technological proficiency of higher education teachers in Ethiopia. This analysis considered university categories, complemented by Tukey HSD post hoc analysis, which allows for comparisons of university teachers' perceptions across different university categories to identify where perceptions are highest.

2.4. Participants

2.4.1. The sociodemographic characteristics of respondents

This section provides an in-depth overview of the sample group by delving into the respondents' demographic characteristics. According to the descriptive analysis of the study, 460 instructors from a broad group were given the questionnaire. Of these, 450 completed the survey, 335 (74.4%) were men and 115 (25.6%) were women. The qualifications of the responders were equally varied, with 173 (61.6%) having a PhD or above and 277 (61.6%) having an MA/MSC.

200 (44.4%) instructors from Research University, Applied University 146 (32.4%), and Comprehensive University 104 (23.1%) participated in the survey, according to the university categories analysis. The results of the teachers' experience indicate that 26 (5.8%) have 1–5, 127 (28.2%) have 6–10, and 141 (31.3%) have 11–15.

Table 1

Summary results based on the sociodemographic characteristics of respondents.

Variables	Category	Frequency
University category	Research University	200
	Applied University	146
	Comprehensive University	104
	Total	450
Gender	Female	115
	Male	335
	Total	450
Educational level	MA/MSC	277
	PhD and above	173
	Total	450
Work experience	1-5	26
	6-10	127
	11-15	141
	16-20	96
	21-25	53
	26 and above	7
	Total	450

3. Results of the study

This section presents the study's results, including the results of the perception of university teachers regarding teacher education program content relevance and interdisciplinary integration, the current level of technological proficiency teachers in higher education institutions, the perception of university teachers on the integration of the teacher education curriculum's theoretical and practical implementation, and perception of university teachers the extent of technological training components integrated into teacher education development programs. This result may help to understand the perception of the university on Professional development and technological proficiency of educators. After that, we use inferential statistics to present our findings using ANOVA and Tukey HSD post hoc analysis.

3.1. Results of variables related to educators' professional development and technological proficiency.

Table 2 provides the descriptive statistics for four composite variables derived from multiple scale-type items. Composite scores were obtained by averaging responses across related items on a 5-point Likert scale, where 1 indicates Strongly Disagree and 5 indicates Strongly Agree. The computed mean (M) and standard deviations (SD) illustrate the central tendency and variability of the responses about teachers' perceptions regarding the current technological competency level among higher education

institutions' teachers. Additionally, they reflect the relevance and interdisciplinary integration of teacher education curriculum content, alignment between theoretical and practical implementations of the curriculum, and the integration of technological training components into teacher education development programs.

Table 2

The mean (M) and standard deviation (SD) results of variables related to educators' Professional Development and Technological Proficiency from the teachers' perspective.

Descriptive Statistics			
Major Variables	N	M	SD
The current level of technological competency of educators in higher education institutions	450	3.0	.66
Teacher education program content relevance and interdisciplinary Integration	450	3.1	.64
The integration of the teacher education curriculum's theoretical and practical implementation	450	2.9	.67
The extent of technological training components integrated into teacher education development programs.	450	2.8	.58
Valid N (listwise)	450		

The computed mean(M) and standard deviation (SD) result of The current level of technological competency of educators in higher education institutions (M = 3.0, SD = 0.66), the computed mean of 3.0 indicates that the general perception of the current level of technological competency of educators in higher education institutions is slightly moderate. The standard deviation suggests moderate variability in responses, meaning that while many respondents view this aspect positively, there is some divergence in opinions about the current teacher education program. Content relevance and interdisciplinary integration are (M = 3.1, SD = 0.64). With the highest mean of 3.1, respondents perceive this variable as slightly above average.

Teacher education program content relevance and interdisciplinary integration indicate that perceptions are consistent, with many respondents sharing a similarly positive view of integrating the teacher education curriculum's theoretical and practical implementation(M = 2.9, SD = 0.67). The mean of 2.9 shows that beliefs are closer to neutral, but under average points, the average point is 3. The relatively high standard deviation indicates that perceptions vary more widely, suggesting that some respondents may view this aspect above moderate or under moderate than others.

Integrating technological training components into teacher education development programs (M = 2.8, SD = 0.58), this variable has the lowest mean (2.8), showing that it is perceived as the least under moderate out of the four variables, with the perception hovering around neutral. However, the lower standard deviation suggests that beliefs of this variable are more consistent among respondents, indicating less variation in opinions. Generally, to describe a teacher education program, content relevance and

interdisciplinary integration are better-perceived aspects of higher education, with the highest mean score. However, the lowest mean score could indicate that the integration of the teacher education curriculum's theoretical and practical implementation is seen as less favorable or potentially needs improvement within the context of higher education. The moderate standard deviations across all variables suggest that while there are generally positive perceptions, opinions still vary, indicating that not all respondents agree uniformly on these aspects.

Table 3 presents the results of an ANOVA (Analysis of Variance) that tests the perception of higher education institution instructors across different university categories for four variables: the current level of technological competency among instructors in higher education institutions (V1), teacher education program Content relevance, and interdisciplinary Integration(V2), the integration of the teacher education curriculum's theoretical and practical implementation(V3), the extent of technological training components integrated into teacher education development programs(V4). The key metrics include each variable's F-value and Significance (Sig.) level.

Table 3

The result of the ANOVA analysis of variables related to Professional Development and Technological Proficiency from the teachers' perspective.

ANOVA result		
Major variables	F	Sig.
The current level of technological competency of educators in higher education institutions	211.88	<.001
Teacher education program Content relevance and Interdisciplinary Integration	81.64	<.001
The integration of the teacher education curriculum's theoretical and practical implementation.	61.34	<.001
The extent of technological training components integrated into teacher education development programs.	32.942	<.001

(P value <0.05)

The ANOVA tests whether there are statistically significant differences in the perceptions of instructors on the current level of technological competency among instructors in higher education institutions, teacher education program content relevance, and interdisciplinary integration, coherence of the teacher education curriculum's theoretical and practical application, the extent of technological training components integrated into teacher education development programs of higher education institution instructors across different university categories. The significance level (Sig.) is reported as < .001 as the P value is < 0.05 for all variables, meaning that the opinions of instructors among the different categories of the university are significantly different from the current level of technological competency among instructors in higher education institutions, teacher education program content relevance, and interdisciplinary integration, the connection of the teacher education curriculum's

theoretical and practical execution, the extent of technological training components integrated into teacher education development programs.

Table 4 summarizes the results of the Tukey HSD post hoc analysis, which compares university teachers' perceptions across three types of institutions: Comprehensive/General Universities, Applied Universities, and Research Universities. This analysis focuses on their perception regarding four key variables: 1. Educators' Current level of technological proficiency. 2. Content relevance and interdisciplinary integration in teacher education programs 3. The extent of technological training components in teacher education. 4. Alignment between theoretical and practical implementation of teacher education curricula.

The post hoc analysis (Tukey HSD) highlights significant differences in university teachers' perceptions across various dimensions. Research universities consistently receive the highest ratings. In terms of technological proficiency, they are rated significantly higher than Comprehensive/General Universities (mean difference = 0.570, $p < 0.001$) and Applied Universities (mean difference = 1.173, $p < 0.001$). At the same time, Comprehensive/General Universities have a higher perception rate than Applied Universities (mean difference = 0.603, $p < 0.001$). Regarding the relevance of teacher education programs, research universities also lead, with significantly higher ratings compared to comprehensive/general universities (mean difference = 0.741, $p < 0.001$) and applied universities (mean difference = 0.591, $p < 0.001$).

However, this area has no significant difference between Comprehensive/General and Applied Universities (mean difference = -0.150, $p = 0.088$). Similarly, research universities excel in technological training, with notably higher ratings than comprehensive/general universities (mean difference = 0.688, $p < 0.001$) and applied universities (mean difference = 0.805, $p < 0.001$). In contrast, no significant difference is observed between comprehensive/general and applied universities (mean difference = -0.117, $p = 0.165$).

In terms of aligning theoretical and practical aspects of the teacher education curriculum, research universities again receive significantly higher ratings than both comprehensive/general universities (mean difference = 0.506, $p < 0.001$) and applied universities (mean difference = 0.496, $p < 0.001$), with no significant difference noted between comprehensive/general and applied universities (mean difference = 0.010, $p = 0.985$). Research universities consistently achieve the highest ratings across all dimensions, excelling in technological proficiency, program relevance, training, and curriculum alignment.

Table 4

The Tukey HSD post hoc analysis results of variables related to educators' Professional Development and Technological Proficiency comparing university teachers' perceptions across three types of universities

Tukey HSD post hoc analysis results							
Dependent Variable	(I) University category	(J) University category	Mean Difference (I-J)	Std. Error	Sig.	95% Lower Bound	Upper Bound
The perceptions of university teachers on the Technological Proficiency of Educators	Research University	Comprehensive/ General University	.57037*	.05152	<.001	.4492	.6915
		Applied University	1.17328*	.05802	<.001	1.0368	1.3097
	Comprehensive/ General University	Research University	-.57037*	.05152	<.001	-.6915	-.4492
		Applied University	.60291*	.06170	<.001	.4578	.7480
	Applied University	Research University	-1.17328*	.05802	<.001	-1.3097	-1.0368
		Comprehensive/ General University	-.60291*	.06170	<.001	-.7480	-.4578
The perceptions of university teachers Teacher education program Content relevance and Interdisciplinary Integration	Comprehensive/ General University	Applied University	-.14986	.07090	.088	-.3166	.0169
		Research University	-.74078*	.06668	<.001	-.8976	-.5840
	Applied University	Comprehensive/ General University	.14986	.07090	.088	-.0169	.3166
		Research University	-.59092*	.05921	<.001	-.7302	-.4517
	Research University	Comprehensive/ General University	.74078*	.06668	<.001	.5840	.8976
		Applied University	.59092*	.05921	<.001	.4517	.7302
The perceptions of university teachers on The extent of technological training components integrated into teacher education development	Comprehensive/ General University	Applied University	-.11724	.06450	.165	-.2689	.0344
		Research University	.68824*	.07263	<.001	.5174	.8590
	Applied University	Comprehensive/ General University	.11724	.06450	.165	-.0344	.2689
		Research University	.80548*	.07723	<.001	.6239	.9871
	Research University	Comprehensive/ General University	-.68824*	.07263	<.001	-.8590	-.5174
		Applied University	-.80548*	.07723	<.001	-.9871	-.6239
The Perceptions of University Teachers on the Alignment Between the Theoretical and Practical Implementation of Teacher Education Curriculum	Comprehensive/ General University	Applied University	.00980	.05907	.985	-.1291	.1487
		Research University	.50552*	.06652	<.001	.3491	.6619
	Applied University	Comprehensive/ General University	-.00980	.05907	.985	-.1487	.1291
		Research University	.49571*	.07073	<.001	.3294	.6620
	Research University	Comprehensive/ General University	-.50552*	.06652	<.001	-.6619	-.3491
		Applied University	-.49571*	.07073	<.001	-.6620	-.3294

**. The mean difference is significant at the 0.05 level.*

Table 5

The computed mean and standard deviation results of variables related to educators' Professional Development and Technological proficiency-based qualification are presented.

Descriptives				
Variable	Qualification	N	M	SD
The current level of technological competency of educators in higher education institutions	MA/MSC	251	3.1	.66
	PhD and above	199	2.9	.63
	Total	450	3.0	.66
Teacher education program Content relevance and Interdisciplinary Integration	MA/MSC	251	3.1	.56
	PhD and above	199	3.0	.69
	Total	450	3.1	.64
The extent of technological training components integrated into teacher education development programs	MA/MSC	251	2.7	.65
	PhD and above	199	2.9	.48
	Total	450	2.8	.58
The compatibility of the teacher education curriculum's theoretical and practical execution	MA/MSC	251	2.9	.68
	PhD and above	199	2.9	.66
	Total	450	2.9	.67

The computed mean (M) and standard deviation result of instructors' perceptions based on qualification on education development and instructors' technological competency revealed the current level of technological competency among instructors in higher education institutions. Instructors with an MA/MSC degree have a higher mean score (3.1, SD=.66) compared to those with a PhD or above (2.9 SD=.63). The current level of technological competency among instructors in higher education institutions is moderate; however, the PhD holder service below moderate teacher education program content relevance and interdisciplinary integration instructors with an MA/MSC degree have a higher mean score (3.1, SD =.66) compared to those with a PhD and above (3.0, SD=56), indicating perceptions of teacher education program content relevance and interdisciplinary integration among master's degree holders is slightly above average however PhD holders perceive neutral.

The congruence of the curriculum for teacher education between theory and practice both groups have remarkably similar perceptions with mean scores of (MA/MSC) (M= 2.9, SD=.65) and (PhD and above) (M=2.9, SD=.48). SD), The extent of technological training components integrated into teacher education development programs institutions instructors with a PhD have a slightly higher mean score (M=2.9, SD=.68) compared to those with an MA/MSC (M=2.8, SD=.66), suggesting that PhD holders have a marginally better perception but, both groups perceive that the extent of technological training components integrated into teacher education development programs and institutions is below average.

The provided ANOVA table tests whether there are statistically significant differences in instructors' perceptions to explain the extent of teacher education curriculum content relevance and interdisciplinary integration and to describe the current level of technological competency among instructors in higher education institutions based on their qualifications (MA/MSC vs. PhD and above). The key metrics include the F-value, which measures the degree of variation between groups, and the significance (Sig.) level, which indicates the probability of obtaining the observed results by chance.

Table 6

The ANOVA results of variables related to educators' Professional Development and Technological Proficiency-based qualification are presented.

ANOVA result		
Variable	F	Sig
The current level of technological competency of educators in higher education institutions	22.0	<.001
Teacher education program Content relevance and Interdisciplinary Integration	17.8	<.001
The extent of technological training components integrated into teacher education development programs	5.6	.018
The compatibility of the teacher education curriculum's theoretical and practical execution	.10	.744

(P value <0.05)

The current level of technological competency among instructors in higher education institutions (F = 22.0, Sig. < .001). There is a statistically significant difference in perceptions of the current level of technological competency among instructors in higher education institutions between instructors with MA/MSC degrees and those with PhDs. The high F-value (22.0) and significance level (<.001) indicate that qualifications play a substantial role in shaping perceptions of this variable teacher education program Content relevance and Interdisciplinary Integration (F = 17.8, Sig. < .001)

Like the current level of technological competency among instructors in higher education institutions, there is a statistically significant difference in perceptions of content relevance and interdisciplinary integration in teacher education programs. The F-value (17.8) and significance level (<.001) show that teachers' educational background influences their perceptions of teacher Education program content relevance and interdisciplinary integration among instructors in higher education institutions, with MA/MSC holders again showing better perceptions.

The extent of technological training components integrated into teacher education development programs (F = 0.107, Sig. = 0.744). There is no significant difference in perceptions of the extent of technological training components integrated into teacher

education development programs between instructors with MA/MSC degrees and those with PhDs. The exceptionally low F-value (0.11) and non-significant p-value (0.74) indicate that qualification does not impact instructors' perceptions of to assess the extent of technological training components integrated into teacher education development programs. This aligns with the descriptives showing similar mean scores for both groups.

The compatibility of the teacher education curriculum's theoretical and practical execution (F = 5.62, Sig. = 0.018) shows a statistically significant difference in perceptions Considering the consistency of the teacher education curriculum's theoretical and practical implementation on qualifications. However, the effect is less than the extent of technological training components integrated into teacher education development programs and the alignment between the theoretical and Practical implementation of the curriculum (F = 5.62, p = 0.018). PhD holders tend to perceive and examine the alignment between theoretical and practical implementation of teacher education curricula better than MA/MSC holders.

The following table provided ANOVA results to test the statistical significance of differences in instructors' perceptions of the current level of technological competency among instructors in higher education institutions, teacher education program content relevance, and interdisciplinary integration; the alignment between the theoretical and practical implementation of teacher education curriculum and the extent of technological training components integrated into teacher education development programs across different experience levels. The key metrics are F-value and significance (Sig.) level.

Table 7

ANOVA results of variables related to educators' Professional Development and Technological proficiency-based experience.

ANOVA result		
Variable	F	Sig
The current level of technological competency of educators in higher education institutions	14.2	<.001
Teacher education program Content relevance and Interdisciplinary Integration	5.1	<.001
The extent of technological training components integrated into teacher education development programs	21.4	<.001
The compatibility of the teacher education curriculum's theoretical and practical execution	2.7	.021

(P value <0.05).

The analysis shows that the current level of technological competency among instructors in higher education institutions is (F = 14.2, Sig. < .001). There is a statistically significant difference in perceptions of the current level of technological competency

among higher education institutions based on instructors' years of experience, a high F-value (14.2), and a significance level (<.001).

Instructors with various levels of expertise perceive the current level of technological competency among instructors in higher education institutions differently, and this difference is statistically significant. The result of teacher education program content relevance and interdisciplinary integration (F = 5.09, Sig. < .001). There is a statistically significant difference in perceptions of teacher education program content relevance and interdisciplinary integration based on experience. However, the effect is smaller than that of the current level of technological competency among instructors in higher education institutions. F-value (5.088) and significance level (<.001) indicate that experience influences perceptions of teacher education program content relevance and interdisciplinary integration but not as strongly as for the current level of technological competency among instructors in higher education institutions.

The extent of technological training components integrated into teacher education development programs (F = 2.69, Sig. = .021) There is a statistically significant difference in perceptions of the alignment between the theoretical and Practical implementation of teacher education curriculum (, F = 21.4, Sig. < .001). There is a vital statistically significant difference in beliefs about the alignment between the theoretical and practical implementation of teacher education curricula based on experience. The extremely high F-value (21.4) and significance level (<.001) show that experience has a significant impact on perceptions of the alignment between the theoretical and practical implementation of teacher education curricula. This variable is perceived differently across unique experience levels, indicating a strong relationship between experience and perceptions of the alignment between the theoretical and Practical implementation of teacher education curriculum.

4. Discussion

The findings of this study provide critical insights into the gaps in teacher professional development and the technological proficiency of educators in Ethiopian higher education institutions. Educators technological proficiency was perceived as moderate (M = 3.0, SD = 0.66), reflecting global concerns about educators' readiness to integrate technology into teaching(Sa & Serpa, 2020). This finding suggests persistent challenges in digital competency, particularly in developing regions like Ethiopia, where technological pedagogical content knowledge (TPACK) remains underdeveloped(Koehler & Mishra, 2009). These challenges are consistent with previous research highlighting similar deficiencies in digital literacy among educators in developing countries(Bishaw & Melesse, 2017; Tefera, 2022).

The study also revealed that the teacher education curriculum's content relevance and interdisciplinary integration were rated slightly above average (M = 3.1, SD = 0.64). This finding aligns with earlier studies(Gugssa, 2024; Melese & Tadege, 2019), indicating some progress in curriculum development. However, the alignment between theoretical

and practical components was rated below average (M = 2.9, SD = 0.67), reflecting an ongoing challenge in Ethiopian teacher education programs, which tend to prioritize theoretical knowledge over practical experience(Linda Darling-Hammond et al., 2017; Taddese & Rao, 2023). Technological training within teacher education programs was identified as the weakest area, receiving the lowest rating (M = 2.8, SD = 0.58).

This finding underscores the insufficient integration of technology into teacher development programs and aligns with earlier research pointing to limited ICT adoption in Ethiopian teacher education(Alemu, 2015; Gebretsadik, Ebrahim, & Bezie, 2023; Gokak, Mehendale, & Bhāle, 2023). Despite policy advocacy for ICT usage, a lack of resources and structured training limits its practical implementation(Bass, 2011). Additionally, the study revealed significant differences based on university type, qualifications, and experience. Research universities consistently outperformed comprehensive and applied universities in technological training and curriculum alignment, highlighting resource allocation and innovation disparities.

These findings mirror global patterns where research-intensive institutions are better positioned to adopt technological advancements (Zougheib, 2021). Addressing these disparities requires equitable resource distribution and tailored interventions across university categories. The results highlight the urgent need for Ethiopian higher education institutions to invest in comprehensive reforms that enhance instructors' digital competencies and bridge the gap between theoretical knowledge and practical skills. Such reforms are essential to prepare future educators for the demands of a technology-driven educational landscape.

5. Conclusion

The findings indicate that while educators in Ethiopian higher education institutions perceive their technological proficiency as moderate, curriculum relevance and interdisciplinary integration are viewed as slightly above average. Research universities consistently perceived higher levels of technological training and curriculum alignment than comprehensive and applied universities, reflecting more incredible innovation and technological adoption.

Nevertheless, there are significant areas for improvement, particularly in integrating technological training and aligning theoretical and practical curriculum components. These areas require immediate attention, as they are fundamental to addressing the growing global demand for technologically proficient educators and innovative teacher education programs.

These results highlight the need for comprehensive curriculum reforms prioritizing technological competency and ensuring a cohesive relationship between theoretical concepts and practical skills. Teacher education programs must emphasize hands-on training, equipping educators with the technological tools necessary to excel in modern classrooms.

Moreover, higher education institutions should invest in targeted professional development initiatives tailored to address the diverse needs of instructors, considering their qualifications and experience. Collaboration among stakeholders, universities, policymakers, and international organizations will drive meaningful change. Efforts should be directed toward fostering an environment where technological innovation and practical teaching methodologies are seamlessly integrated into teacher education programs, preparing educators to meet the challenges of 21st-century education. Future research should explore the perspectives of a broader range of stakeholders, assess the effectiveness of specific technological tools in teacher training, and evaluate the long-term impacts of curriculum reforms to inform sustainable solutions.

6. Limitations of the study and future research directions.

6.1. Limitations of the study

Context-specific findings. While the study offers valuable insights into Ethiopian higher education, its context-specific nature limits its applicability to other regions without adjusting for local conditions.

Reliance on self-reported data. The dependence on self-reported perceptions introduces potential bias, as responses may reflect subjective viewpoints rather than actual practices or competencies.

Exclusion of key stakeholders. While perspectives from students, policymakers, and administrators should have been included, critical viewpoints that could inform a more holistic understanding of systemic challenges were omitted.

Limited variable scope. The study needs to address other influential factors, such as funding, institutional leadership, and infrastructure availability, which play significant roles in professional development and technological proficiency.

6.2. Future Research Directions

Cross-national comparisons. Conducting comparative studies across developing and developed countries could uncover shared challenges and context-specific solutions.

Qualitative inquiry. Employing qualitative methods like interviews or focus groups would provide richer insights into educators' lived experiences and the complexities of technological integration.

Longitudinal studies. Tracking the long-term effects of technological training and curriculum reforms could reveal the sustainability and effectiveness of interventions.

Student perspectives. Including teacher education students in future research could help assess how gaps in teacher preparation influence learning outcomes.

Policy implementation analysis. Investigating the gap between policy intentions, such as technology integration, and actual outcomes could help identify systemic bottlenecks hindering reform efforts.

Addressing these limitations and pursuing the suggested research directions can contribute to a richer global discourse on teachers' professional development and

technological integration. Such efforts will help education systems better prepare educators for the challenges of a rapidly evolving, technology-driven world.

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