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Factors Contribute to Innovative Leadership Practices in Integrating Technology to Enhance Quality of Education at a College of Teacher Education in Oromia Regional State, Ethiopia

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The purpose of this study was to identify factors that contribute to leadership practice in integrating technology to improve the quality of education at the college of teacher education in Oromia regional state, Ethiopia. The integration of technology is important for enhancing the quality of education as well as preparing students for the digital age. This study fills the research gap in the specific factors that contributed to technology integration to improve the quality of education. The study employed mixed research methods with concurrent nested design. In this study, structured questionnaires and interviews were the main data collection tools from college leadership and academic staff from 4 government colleges of teacher education, using systematic random sampling, stratified sampling, and the Yamane formula for sample size determination to ensure a representative and comprehensive data collection process, contributing to the validity and reliability of the study findings. The findings from factor analysis, correlation, and regression indicate

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that technology infrastructure, technology potential, and technology policy and strategy are the major factors contributing to leadership practice to integrate technology to improve education quality. Similarly, the finding indicated a strong positive correlation between the independent variable and the dependent variable. Furthermore, the model summary indicates the adjusted r2 (54.1%) explains the significance portion of variance in education quality. In conclusion, focusing on factors that contribute to leadership practice, such as technology infrastructure, technology potential, and technology policy and strategy, is crucial for improving education quality. Education leaders should invest in technology integration and develop comprehensive policy and strategy to facilitate successful integration of technology in education. It also recommended that further study assess specific competence of leadership in integrating technology within the context of college teacher education.

Introduction

Technology integration in education is fundamental for delivering quality learning and teaching in preparing students for the digital era (Haleem et al., 2022; Lohans Kumar Kalyani, 2024). The rapid development in technology makes the students develop critical thinking ability, problem solving skill to succeed in the 21st century world. Technology enables individualized learning and teaching experiences, which boost academic success and promote digital literacy (Voogt et al., 2013).

As technology transforms the traditional teaching paradigm, educational institutions adapt to new teaching approaches and pedagogies. This paradigm shift towards technology-enabling learning provides students with the required technological skills to be successful in a technology-driven future (Haleem et al., 2022).The COVID-19 pandemic has further accelerated the adoption of digital tools and remote learning platforms, underscoring the importance of technological integration in education (Ibrahim et al., 2023). The recent COVID-19 Pandemic has further institutionalized the applications of digital technologies in education. These digital technologies have made a paradigm shift in the entire education system.

Leadership in educational institutions has a role and responsibility in transforming changing educational environments, leading the complexity of implementing technology-based learning platforms, and providing an innovative culture among the staff (Mdhlalose & Mlambo, 2023; Moges, 2014). Leadership is the ability to listen, observe, and use expertise while promoting dialogue and leading people to achieve desired outcomes (Voogt et al., 2013; Voogt & Knezek, 2008).

Colleges of teacher education are vital for nation development, providing skilled humans and information for generating new ideas and developing social levels (Seitebakeng, 2018; Yallew, 2020). Leadership in this organizations plays a pivotal role in changing academic staff, creating social collaboration, and aligning the institutional goal with a broader social context.

Despite the recognized importance of technology integration education, most educational organizations, particularly colleges of teacher education in Ethiopia, face significant challenges

in integrating technology in education. The major challenges were inefficient technology infrastructure, policy and strategy limitations, and challenges from leadership and academic staff (Tadesse & Muluye, 2020; Temtim Assefa Birhanu Abera Birara Gebru, 2022; Yallew, 2020).

Educational leadership is required to take advantage of technology to transform the quality of learning and create a shared vision for how technology integrates. The COVID-19 pandemic has highlighted the use of effective technology integration in education; however, the lack of clear policies and strategic leadership in the integration of technology impacts the implementation (Tadesse & Muluye, 2020). Similarly, limited technology resources, such as inadequate infrastructure, limited technology potential, and funding in technology integration, challenge the education system (Stoltzfus, 2015; Timotheou et al., 2023).

According to the study findings indicated that, the importance of quality internet, technology hardware, and software in improving the quality of implementing educational activity(Tiekam, 2019). The study also highlighted the barriers to ICT integration, such as inadequate access and technical support. Similarly, Zheng et al. say that strong leadership is required when executing planning for success for technology integration in educational settings. Furthermore, the Ethiopian study reveals that system inefficiencies, a lack of comprehensive policy and strategy, and a lack of training and professional development are address challenges to integrating technology in higher education(Alemu, 2015; Moges, 2014; Tadesse & Muluye, 2020).

Even if the previous study has shown various aspects of technology integration, it is evident that there is a study gap regarding the factors contributing to leadership practice in integrating technology to improve quality of education at the college of teacher education in Oromia regional state, Ethiopia. This study aims to fill this gap by assessing the factors that contributed to leadership practice for integrating technology in education in Ethiopian higher education to improve the quality of education. The general objective of this study is to assess the factors that contribute to leadership practice in technology integration to improve the quality of education at the College of Teacher Education in Ethiopia.

The study was guided by the following research question:

1. What factors contribute to leadership practices in integrating technology at colleges of teacher education?

2. What are the causal relationships between contributory factors and the quality of education resulting from practices implemented by college leadership?

The significance of this study lies in its potential to provide valuable insights into the factors that contribute to leadership practices in technology integration at the College of Teacher Education in Oromia, Ethiopia. This research is supposed to contribute to the existing body of knowledge and practices aimed to understand the factors that contribute to leadership practices as integrating technology to improve education quality in Oromia, Ethiopia. Accordingly, the research is supposed to be of great importance for Ministry of Education, higher education leadership, professional literature and participants of the study.

The findings fostered professional development programs for educational leaders, encouraging innovative thinking and improve educational quality. Practitioners, such as teachers and

instructional designers, had an increased understanding of leadership strategies for effective technology integration, allowing them to work more effectively with educational leaders and advocate for needed resources. The findings of the study contribute significantly to scientific knowledge and address a gap in the literature regarding leadership practices in the context of technology-enhanced education, particularly in college teacher education.

Literature Review

Innovative Leadership in Education

Innovative leadership in education involves the introduction of new methods and ideas to address current and future challenges. This type of leadership combines various styles to motivate employees towards creativity and innovation, playing a crucial role in achieving an organization's vision and mission (Sagaya, 2019 , Chansirisira, 2022). Innovative leaders possess essential qualities such as foresight, commitment, and a deep understanding of social, political, and economic factors that influence educational environments (Chansirisira, 2022). Their ability to identify potential threats and opportunities is vital for maintaining organizational competitiveness.

Organizations lacking innovative leadership often struggle to adapt to changes, emphasizing the need for leaders who can foster a culture of innovation(Timotheou et al., 2023). Such leaders not only inspire creativity but also guide their teams through the complexities of modern educational demands. The effectiveness of innovative leadership is particularly evident in its capacity to promote collaboration and knowledge sharing among staff, which is essential for driving educational improvements.

Technology Integration in Education

Technology integration in education is increasingly recognized as a critical component of sustainable development rather than just a tool for immediate improvement (Pouezevara et al., 2014; Armenta et al., 2012). This approach emphasizes long-term benefits aligned with sustainability goals, suggesting that technology initiatives should focus on enduring educational advancements (Polly et al., 2010; Yarime et al., 2012). In Ethiopia, the integration of digital technology is hindered by limited infrastructure and resources. The government has initiated programs like the School Net initiative to enhance access to technology in education.

Despite these efforts, significant gaps remain in teacher training and resource allocation. Continuous professional development for teachers and reforms in teacher education are critical for effectively utilizing digital tools (UN E-Government Development Index, 2018). The Ethiopian Education Development Roadmap (2018–2030) emphasizes the role of ICT as a strategic pillar for economic transformation, highlighting its importance in enhancing educational quality and accessibility.

The Role of Educational Leadership in Integrating Technology

Educational leaders are instrumental in guiding the integration of technology within schools. They must navigate the complexities associated with technological advancements while fostering an environment conducive to innovation (Alsolami et al., 2016; Ismail et al.,

2010). Effective leaders exhibit risk tolerance and possess comprehensive knowledge of their organizational domains, enabling them to make informed decisions that drive innovation (Davis, 2019).

Leadership is characterized by attributes such as openness to new ideas, confidence, and a focus on collaboration. These qualities are essential for creating an atmosphere where diverse perspectives are valued and innovation can flourish (Abdullrazak & Alyamani, 2019). Leaders must also be action-oriented, translating their vision into tangible actions that positively impact their organizations.

Technology integration in Ethiopian Education

In Ethiopia, technology integration in education is significantly influenced by the Technological, Pedagogical, and Content Knowledge (TPACK) framework, which emphasizes the need for educators to effectively combine technology with pedagogy and subject matter knowledge (Mishra & Koehler, 2006). Leadership plays a crucial role in guiding these integration efforts, as seen in initiatives like the Satellite Plasma TV Project and the GEQIP II project, which aim to modernize education through technology. However, challenges such as rapid content delivery, language disparities, and inconsistent policy implementation highlight the importance of strong leadership in establishing effective communication channels and fostering collaboration among stakeholders (Kim & Gebeyehu, 2014; Berhanu, 2016).

The willingness of school teachers to embrace digital technology suggests that school-level leadership is instrumental in creating an environment conducive to technology adoption (Kim & Gebeyehu, 2014). Despite this potential, there are significant gaps in teacher training regarding the ethical and critical use of digital technology (GIZ, 2016), necessitating a commitment from leadership to develop comprehensive curricula. Furthermore, Ethiopia's educational policies reflect a governmental commitment to development; however, challenges in policy implementation signal the need for leadership to address issues like frequent changes and inadequate infrastructure (Government of Ethiopia, 2018a).

Overall, effective leadership is vital for navigating the complexities of technology integration in Ethiopian education. By prioritizing clear communication, collaboration, and strategic policy implementation, educational leaders can facilitate the successful adoption of technology and address existing challenges. Initiatives such as the national School Net project and partnerships like FHI 360's K-Mobile demonstrate how leadership can foster impactful collaborations that enhance educational outcomes through technology integration.

Factors Contributing to Technology Integration

The successful integration of technology in education hinges on several critical factors, which are essential for creating an effective digital learning environment. Three primary determinants are identified: Technology Infrastructure, Technology Potential, and Technology Policy and Strategy.

A robust technology infrastructure is fundamental for effective technology integration in educational settings. This includes the availability and functionality of learning devices, high-speed internet access, and other essential digital tools. Challenges such as limited access to

projectors and difficulties in setting up equipment highlight the need for strategic investments in infrastructure to facilitate seamless technology incorporation (Ertmer et al., 2012). Additionally, the shortage of qualified technology instructors and insufficient resources emphasize the leadership's role in advocating for necessary training and funding. Effective leaders recognize the importance of investing in teacher development to ensure educators have the skills and confidence needed to integrate technology into their teaching methodologies.

The effectiveness of digital learning is intricately linked to the potential of technology to enhance educational experiences. Barriers such as teachers' lack of knowledge, skills, and efficacy underscore the importance of addressing these challenges to maximize technology's potential (Brinkerhoff, 2006; Hew & Brush, 2007). Ensuring access to high-speed internet is crucial, and practical strategies for equitable digital access should be implemented. This includes collaborating with local internet service providers and supporting community-wide digital inclusion initiatives. Furthermore, the time required for preparing technology-enhanced materials presents another challenge that highlights the need for resource support and collaborative platforms where teachers can share resources (Ertmer, 2005).

Effective technology integration requires a well-defined policy and strategy framework. Support from leadership, technical assistance, and institutional backing from organizations like the Ministry of National Education (MoNE) are vital for successful integration (Ertmer, 2005; Andoh, 2012). The absence of a clear technology policy and the presence of technophobia among qualified teachers indicate the necessity for strong leadership that can provide guidance and support. Educational leaders must shape the vision and direction of technology integration initiatives, ensuring alignment with broader educational goals. Comprehensive roadmaps for procurement, distribution, management, and maintenance of digital devices are essential components of an effective policy framework. In summary, addressing these contributing factors technology infrastructure, technology potential, and technology policy and strategy is crucial for overcoming challenges in technology integration. By leveraging these determinants effectively, educational institutions can create a transformative digital learning environment that enhances educational outcomes.

Method

Research Design

The study investigated factors contributes to leadership technology integration at the College of Teacher Education using a mixed-methods research design. This approach recognizes the complexity of reality and utilizes both qualitative and quantitative methods to capture the richness of human experiences and provide statistical evidence (Cohen et al., 2007; Creswell, 2007). A research design serves as a critical framework for organizing data collection and analysis, ensuring it is aligned with the research purpose and objectives.

The concurrent embedded design was selected and employed in this study, where both quantitative and qualitative data are collected simultaneously but with more emphasis for the quantitative data(Creswell, 2014, 2015a). The sequence and weight of the quantitative and qualitative methods used in the study were QUAN + qual type, where both quantitative and qualitative data are collected simultaneously but with more emphasis for the quantitative data (Creswell, 2015b).

The source of data for this study was both primary and secondary sources. Primary sources included higher officials at leadership positions, academic staff members, and documents like strategic and operational plans, quarterly and annual reports, and monitoring and evaluation feedback. By integrating both primary and secondary sources of data, the study aims to enhance the depth and breadth of its findings, providing a comprehensive understanding of the research area.

Population, Sample Size, and Sampling Technique

This study focuses on the population of 263 academic staff members in the public College of Teacher Education in Oromia Regional State, Ethiopia, which is likely to possess relevant knowledge and experiences related to the research topic. Yamane's (1967) sample size determination formula was used to determine the sample size of respondents in the selected college of teacher education, ensuring reliable and accurate results. Purposive sampling was employed to select key informants for interviews, ensuring representation from different leadership roles and levels. Stratified random sampling was used to ensure proportional representation of academic leaders, faculty, and technology administrators, particularly suitable for colleges with diverse departments or streams(Fox & Hunn, 2009). This strategic use of sampling techniques enhances the validity, representativeness, and comprehensiveness of the study findings, enriching the research outcomes and contributing to a nuanced understanding of the research topic.

The sample population for this study consists of 153 academic and administrative staff members from the College of Teacher Education in Oromia. The selection criteria for participants are as follows:

Inclusion Criteria: Participants must be currently employed at the College of Teacher Education. Academic staff should have at least one year of experience in their current roles to ensure they have sufficient exposure to the institution's leadership and technology integration practices (Gyeltshen, 2021).

Exclusion Criteria: Staff members who are in temporary positions or interns was excluded from the study to maintain a focus on individuals with established roles and responsibilities (Haleem et al., 2022).

For college leaders, all 22 were selected using purposive sampling techniques for interviews. This method ensures that individuals with relevant knowledge and experience are included, providing valuable insights into the research topic. Overall, the combination of purposive sampling, stratified sampling, and the Yamane formula for sample size determination ensures a representative and comprehensive data collection process, contributing to the validity and reliability of the study findings.

$$n = \frac{N}{1+N(e)^2} \qquad n = \frac{262}{1+262(0.05)^2} \qquad n = \frac{262}{1+0.655} \quad \text{n= } \underline{159}$$

Where: *n* is the sample size, *N* is the population size, *e* is the margin of error (expressed as a proportion, typically between 0 and 1). The target population (*N*=262), let's assume a margin of error of 0.05 *e*=0.05 (5%).

Data Collection Methods

Data for this study was collected using a combination of questionnaire and interviews to ensure a comprehensive understanding of the study objective. A structured questionnaire was administered to the 153 academic and administrative staff members at the College of Teacher Education. The questionnaire included quantitative items designed to assess leadership competencies, technology integration practices, and perceived educational quality. This method allowed for the collection of standardized data that could be statistically analyzed to identify trends and correlations (Creswell, 2014). Semi-structured interviews were conducted with 22 college leader participants selected from 4 colleges of education, these interviews provided qualitative insights into their experiences and perceptions regarding leadership and technology integration. This method allowed for a deeper exploration of individual perspectives and the contextual factors influencing technology integration (Al-Karasneh & Jubran, 2013). The interviews were guided by open-ended questions that encouraged participants to share their thoughts on the effectiveness of current leadership practices and the challenges they faced in integrating technology.

Validity and Reliability of Tools

The validity and reliability of the instruments were ensured through conducting a pilot study at Sebata CTE, which is out of sampling colleges with 20 leadership and academic staff participants, and later adjusting the instrument items that were found to have been ambiguous and vague. Secondly, through seeking guidance and approval from the research advisory team during the process of instruments' development. The Kaiser-Meyer-Olkin (KMO) factor analysis was employed to assess the adequacy of the sample for factor analysis, while the Cronbach Alpha value was calculated 0.964 to evaluate the internal consistency of the questionnaire items. A Cronbach Alpha value of 0.70 or higher is generally considered acceptable (Sürücü et al., 2023).

Procedure of Data Collection and Analysis

Quantitative data was collected through a survey questionnaire, which was analyzed using descriptive statistics, independent sample t-tests, factor analysis, correlation, and regression techniques. The study utilized SPSS version 26 software to conduct a comprehensive data analysis, employing various statistical techniques to assess the factors influencing technology integration in education.

Qualitative data were thematically analyzed to extract key themes related to leadership competencies and technology integration. Interview transcripts were carefully reviewed, and significant statements were identified and coded.

Ethical Considerations

Ethical approval was obtained from University of Hawassa ethical clearance team, and informed consent was secured from all participants. Confidentiality and anonymity were maintained throughout the study to protect participants' identities and responses (Creswell, 2015a). Participants were informed of their right to withdraw from the study at any time. Data were stored securely, and only the researcher had access to the information. The study adhered to the ethical principles of respect for persons, beneficence, and justice.

Results

The study employed a mixed-methods approach to investigate the factors contributing to leadership practices in integrating technology and their impact on the quality of education. By combining these methods, the study aimed to provide a comprehensive assessment of the factors influencing leadership practices in technology integration and their implications for educational quality. The study distributed 159 copies of questionnaires to college academic staff, with 96.5% returning them. The result of the survey analysis is discussed as follows:

Factors contributed for technology integration

Factor analysis

Factor analysis is a statistical method used to identify underlying relationships between variables by grouping them into factors that explain the observed correlations among the variables. The Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity measure assessed sampling adequacy and significant relationships between variables.

Table 1: KMO & Bartlett's Test and Total Variance Explained statistics

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.724
Bartlett's Test of Sphericity	Approx. Chi-Square	356.190
	Df	3
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Tech. Infrastructure	2.587	86.245	86.245	2.587	86.245	86.245
Tech. Potential	.287	9.567	95.812			
Tech. Policy and strategy	.126	4.188	100.000			

Extraction Method: Principal Component Analysis.

In the above Table 1 show that, the Kaiser-Meyer-Olkin (KMO) value of 0.724 (72.4%) indicates that the data is suitable for factor analysis, as it falls within the acceptable range (0.7 to 0.8) for this type of analysis. A KMO value above 0.7 suggests that the variables share a substantial amount of common variance, which is essential for effective factor extraction. In similar above table Bartlett's Test of Sphericity yielded a Chi-Square value of 356.190 with a significance level of 0.000, indicating that the correlation matrix is not an identity matrix. This indicates strong relationship amongst the variables.

The Principal Components Loadings Table 1 indicates among three factors tech. infrastructure factors contribution is significant with loading which accounts 86.245% of total variance while tech. potential and tech. policy and strategy factors accounts 9.567 % and 4.188% variance as the eigenvalues respectively. Tech. Infrastructure is the primary deriver in technology integration practice of leadership. This analysis underscores the critical importance of infrastructure in enabling effective technology integration within organizations or systems.

The correlation matrix Table 2 indicates, the factors contributing to technology integration specifically Technology Infrastructure, Technology Potential, and Technology Policy and Strategy are 0.734, 0.738, and 0.737, respectively, in relation to Quality of Education. All of these correlations are statistically significant, with p-values of 0.00, indicating that these relationships are unlikely to have occurred by chance.

Table 2: Correlation Matrix Statistics

	Tech. Infrastructures	Tech. Potential	Tech. Policy and Strategy	Quality of Education
Tech. Infrastructures	1	.971**	.979**	.734**
Tech. Potential	.971**	1	.993**	.738**
Tech. Policy and Strategy	.979**	.993**	1	.737**
Quality of Education	.734**	.738**	.737**	1
Sig. (2-tailed)	0.00	0.00	0.00	0.00
N	153	153	153	153

** Correlation is significant at the 0.01 level (2-tailed).

Descriptive statics result

As indicated in the Table3, the analysis of data gained through the questionnaire on the first research question ascertains that for the technological infrastructure variable, the mean score for college leadership is 3.93 (SD = 0.652), while the mean for teachers on technological infrastructure is 3.70 (SD = 0.755). The result of the independent sample t test also illustrates a value of p = 0.031) with a p < 0.05 significant level, indicating that there is a statistically significant difference between the means of respondents.

Table 3: Independent sample t test statics (Factors contributed for technology integration)

Current position		N	Mean	Std. Deviation	F	Sig.	t	df
Tech Infrastructure	Instructor	114	3.75	0.755	4.753	0.031	-1.996	151
	Leadership	39	3.93	0.652				
Tech Potential	Instructor	114	3.73	0.787	7.624	0.006	-1.981	151
	Leadership	39	4.00	0.589				
Tech policy	Instructor	114	3.69	0.771	7.843	0.006	-1.922	151
	Leadership	39	3.94	0.626				

The other dimensions which are computed as technological potential factors table above the college leadership mean is 4.00 (SD = 0.589), whereas the mean score for teachers on technological potential is 3.73 (SD = 0.787). The t-test result indicates a statistically significant difference with a level p = 0.006) and a P value < 0.05. Furthermore, in the above table, the technology policy and strategy factor the college leadership mean is 3.94 (SD = 0.626), whereas the mean score for teachers on technology policy and strategy factors is 3.69 (SD = 0.771). The t-test result indicates a statistically significant difference with a level p = 0.006, and a P value < 0.05.

Table 4: Quality of education improvement as a result of technology integration indicator statistics

Current position		N	Mean	Std. Deviation	F	Sig.	t	df
Tech input	Instructor	114	3.69	0.827	5.9	0.016	-0.831	151
	Leadership	39	3.84	0.888				
Tech process	Instructor	114	3.64	0.808	4.276	0.040	1.074	151
	Leadership	39	3.47	0.848				
Tech output	Instructor	114	3.74	0.848	4.583	0.034	1.702	151
	Leadership	39	3.55	0.842				

Regarding technology input, instructors reported a mean score of 3.69 (SD = 0.827), while college leadership had a mean of 3.84 (SD = 0.888) in Table 4. The t-test result indicates a statistically significant difference with a level F = 5.900, p = 0.016, and a P value < 0.05. The t-value is −0.831 with df=151, indicating that while there is a difference, it is not in favor of either group significantly. In terms of technology process, instructors reported a mean score of 3.64 (SD = 0.808), whereas college leadership scored 3.47 (SD = 0.848). The t-test results indicated a statistically significant difference (F = 4.276, p = 0.040) and a P value < 0.05. The t-value is 1.074 with df=151, suggesting that instructors perceive technology processes more favorably than leadership. Regarding technology output, six items were computed for analysis. Instructors scored a mean of 3.74 (SD = 0.848), while college leadership scored 3.55 (SD = 0.842). The t-test results indicated a significant difference (F = 4.583, p = 0.034). The t-value of 1.702 with df=151, indicates that instructors again have a higher perception compared to leadership.

Causal relationship of variables

In the Table 5, the result of the correlation analysis indicates that there is a significant relationship (r = 0.734, P<0.01). Thus, the *r* value specifies a high degree positive and significant correlation of technology infrastructure with quality of education. Similarly, the correlations of (r = 0.738, P<0.01) and (r = 0.737, P<0.01) between technology potential and technology policy and strategy with quality of education, respectively. Thus, the *r* value specifies a high degree positive significant correlation of technology potential and technology policy and strategy with quality of education. The significance values (Sig. 2-tailed) for all correlations are 0.00, indicating that the relationships between each independent variable and the dependent variable are statistically significant.

Table 5: The impact of contributory factors in integrating technology to improve education quality.

Model Summary[b]										
					Change Statistics					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.742[a]	.55	.541	.531	.550	60.66	3	149	.000	2.078

a. Predictors: (Constant), Tech. Policy and Strategy, Tech. Infrastructures, Tech. Potential
b. Dependent Variable: Quality of Education

The Model Summary Table 5 provides the results of linear regression of Tech. Policy and Strategy, Tech. Infrastructures, Tech. Potential and Quality of Education. Thus, as it is shown in the model summary, the adjusted R^2 value is 0.541 (54.1%) indicates the total variation in the dependent variable Quality of Education is explained by the independent variable, Tech. Policy and Strategy, Tech. Infrastructures, Tech. Potential. In other words, the amount of coefficient of non-determination which accounts for 45.9%, indicates that the effect of the independent variable is also significant. This is a significant proportion, indicating that the model has a good explanatory power. The F Value is 60.667, with degrees of freedom df1=3 and df2=149. The significance level (Sig. F Change) is 0.000, indicating that the model is statistically significant.

Qualitative Result

To triangulate the quantitative survey result, the interviews conducted with college leaders (college dean/vice dean, stream head, and ICT focal person) provided valuable insights into the technology importance, factors that contribute to technology integration, challenges that hinder technology integration, and strategies that are used by college leadership in the future in the College of Teacher Education.

As one of the deans of the college, responded that technology is important in shaping the quality of education. As his arguments indicate, *"integrating technology into our daily activity is not just beneficial; it is essential for preparing students for the future."* He noted that technology enhances learning experiences, fosters creativity, and equips students with vital skills needed in a technology world.

Similarly, other college vice deans argued that "*technology integration transforms the learning process by making it more interactive and engaging. He explained that when technology is effectively woven into the curriculum, it allows for personalized learning experiences, enabling students to learn at their own pace".* This sentiment reflects the understanding that technology is a critical tool for developing 21st-century skills among students.

The interview also conducted on the major factors that contribute to technology integration. As a result, one of the college dean responses on how tech. infrastructure contributes to tech. integration indicated that *"without a robust infrastructure, our efforts to incorporate new technologies are severely hampered. We need high-speed internet and reliable hardware to support innovative teaching methods*."

One leader emphasized that *"the emphasis on the integration of technology ensures that educators are not left behind in a rapidly changing educational environment, providing them with access to a wealth of resources and innovative teaching methodologies."*

One of the college stream heads argued that the establishment of clear technology policies is crucial for guiding the integration process. He stated, "*Clear policies are crucial for ensuring that technology is used effectively and ethically within our institutions. We must establish guidelines that not only promote innovation but also protect student data and privacy."* This perspective underscores the importance of having well-defined policies to navigate the complexities of technology use in education.

In response to the discussion on technology integration in education, one of the vice deans emphasized the critical need for trained personnel. He stated that, *"Educators must be equipped to leverage technology effectively. Continuous professional development ensures that our faculty can utilize these tools to enhance teaching and learning."* By investing in professional development, institutions can empower their faculty to embrace innovative teaching methods and adapt to the evolving educational landscape.

Other ICT coordinators added their perspectives on the importance of diverse educational technologies. He noted, *"We have access to a variety of tools today, such as interactive whiteboards, learning management systems (LMS), and educational apps".* These tools serve in the learning process, facilitating collaboration, communication, and personalized instruction. Underscoring the potential of technology to enhance student engagement and foster deeper learning experiences.

Interviewee pointed out the significant barrier for technology integration where Resistance to change, financial constraints, accessibility of technology tools, and clear technology policy and strategy. One leader remarked, "We often encounter resistance stemming from a lack of familiarity with new technologies or fear of altering established teaching practices." To counter this, leaders should foster an environment that encourages experimentation and open dialogue about the benefits of technology integration. By creating a supportive culture that values innovation and collaboration, institutions can mitigate resistance and promote a more seamless transition to technologically enhanced teaching methods.

Other college dean stating, "Without adequate funding, our ability to implement technology effectively is severely limited." Addressing these financial challenges may require innovative funding strategies or partnerships with technology providers to ensure institutions can maintain up-to-date infrastructure and support systems.

Discussion

The objective of this study was to assess the factors contributing to leadership in integrating technology for enhancing education quality in a teacher education college in the Oromia Regional State, Ethiopia.

The study conducted a factor analysis to assess the contributory factors influencing technology integration in education. In the Table 1 factor analysis metrics of KMO value indicates 0.724 and Bartlett's Test of Sphericity, which confirm the suitability of the data for analysis. This finding aligns with the recommendations of Field (2013), who asserts that a KMO value above 0.7 suggests adequate sampling for factor analysis. The high KMO value indicates that the data is suitable for such analysis, confirming that the identified factors share substantial common variance.

The Principal Component Analysis (PCA) demonstrated that the first (Tech. Infrastructure) component accounted for 86.24% of the total variance, indicating a strong relationship between the variables included in the analysis. The strong loadings for technological infrastructure suggest it is paramount for successful integration efforts. Thus, investments in infrastructure should be prioritized by educational institutions seeking to enhance their technological capabilities. This supported with the work of Sürücü et al.,, who note that a single component

explaining a large portion of variance suggests that the variables are closely related and likely measure a common underlying construct(Sürücü et al., 2023).

The findings regarding the correlation of factors contributing to technology integration practice of leadership in Table 2, Tech. Infrastructure, Tech. Potential, Tech. Policy and Strategy with Quality of Education, revealing a significant, strong, positive relationship. The significant correlations (0.734, 0.738, and 0.737) with p-values of 0.00 indicate that these relationships are robust and unlikely to be due to chance. In conformity with this finding, Timotheou et al.,(2023) also observed that tech. infrastructure contributes to technology integration in educational institution. Similarly, these findings from (Raman & Thannimalai, 2019) , which emphasizes that strong technology infrastructure and effective policies are crucial for enhancing educational quality through technology integration.

The study assessing technology infrastructure factors contributes to technology integration by using descriptive statistics such as mean, standard deviation, and independent t-test. In the Table 3, the finding regarding the importance of technology infrastructure, with college leadership scoring a mean of 3.93 and teachers scoring a mean of 3.70. Key components of technology infrastructure identified include reliable devices, adequate internet connectivity, well-equipped computer labs, and access to multimedia resources and open educational materials. These components are essential for enhancing student learning experiences and fostering digital literacy skills in higher education institutions. College leadership reported a mean score of 3.93, while teachers rated it lower at 3.70. This difference, confirmed by a statistically significant t-test result ($p < 0.05$), suggests that leaders may have a more favorable view of the existing technological resources than the faculty members who utilize them daily.

Supporting this finding, the study conducted by Tabowei emphasizes that effective integration of digital technologies in education relies on the development of infrastructure, including high-quality broadband connections, which significantly enhance educational activities(Tabowei, 2021). Similarly, Stoltzfus , found that limited access to technology and lack of technical support are significant barriers to ICT integration, underscoring the need for adequate resources and infrastructure to facilitate effective teaching and learning(Stoltzfus, 2015).

In terms of technology potential factors contributing to technology integration, college leadership scored a mean of 4.00, while teachers had a mean score of 3.73. This reflects a significant emphasis from both groups on the importance of technology potential as a contributing factor. Technology potential encompasses aspects such as support staff proficiency, adaptive learning platforms, professional development opportunities for educators, and the integration of social media and online communities for collaboration. These elements are vital for enhancing student engagement, improving learning outcomes, and preparing students for success in a technology-driven world.

The findings of Sürücü et al., support this perspective, emphasizing the importance of professional development in equipping educators with the necessary skills to integrate technology effectively into their teaching practices, thereby enhancing student engagement and learning outcomes(Sürücü et al., 2023). Additionally, Temtim Assefa Birhanu Abera Birara Gebru highlight the positive impact of professional development opportunities on teachers' confidence and competence in using technology, which in turn enhances student engagement and learning outcomes(Temtim Assefa Birhanu Abera Birara Gebru, 2022).

Similarly, regarding the contribution of technology policy and strategy factors to technology integration, college leadership had a mean score of 3.94, while teachers scored 3.69. Effective technology integration necessitates clear policies and strategies, including accessibility for diverse staff, robust governance structures, alignment with institutional goals, and ethical technology use. Collaboration between college leadership and teachers is crucial for developing and implementing these policies to ensure successful technology integration at all levels of the institution. Such collaboration can help bridge any gaps in perceptions and priorities among different stakeholders, ultimately leading to more cohesive and effective technology initiatives.

Supporting this finding, the study conducted by Voogt & Knezek emphasizes that strong leadership and strategic planning are essential for the successful implementation of technology integration in schools, highlighting the importance of clear policies that support technology use in educational settings(Voogt & Knezek, 2008). Furthermore, Timotheou et al., argue that effective technology integration requires comprehensive policies that provide guidance for students and parents, logistical support, and teacher training, ensuring that digital technologies are embedded into the educational experience(Timotheou et al., 2023).

The study assessed the impact of technology integration on the quality of education, focusing on technology input indicators. In Table 4, College leadership scored a mean of 3.84, while instructors had a mean of 3.69, indicating a strong consensus among both groups regarding the importance of technology input factors. These factors include adequate resources, ongoing training programs, and effective resource allocation by the human resources department. Supporting this finding, Amaniampong & Hartmann , highlight that the availability of ICT resources, including hardware and software, increases the likelihood of teachers integrating technology into their curriculum, thereby improving teaching practices(Amaniampong & Hartmann, 2023). Additionally, Rahmeta et al., and Seitebakeng , suggests that inadequate technical support and poor-quality hardware can discourage teachers from effectively using ICT, reinforcing the importance of robust technology input factors(Rahmeta et al., 2019; Seitebakeng, 2018).

In terms of technology process indicators, college leadership scored a mean of 3.64, while instructors scored 3.47. This reflects a higher level of agreement among both groups about the significance of technology process factors, which involve incorporating technology into the curriculum, providing timely feedback, and ensuring inclusive access to technology resources for all students. Furthermore, Kingsley-Jones and Kiong, argue that the presence of supportive policies significantly influences educators' ability to integrate technology effectively, reinforcing the need for institutional alignment with educational goals(Kingsley-Jones, 2016; Kiong, 2023).

Similarly, regarding technology output indicators, college leadership scored a mean of 3.74, while instructors had a mean of 3.55. This indicates a strong consensus on the importance of technology output factors, which include personalized learning platforms, individualized support, and feedback mechanisms that cater to diverse learning styles and needs. This alignment can enhance their views on technology integration, fostering a more cohesive and effective learning environment for all students. Franklin & Bolick , highlight the significance of technology output factors, such as the use of digital tools and platforms, in preparing students for success in a technology-driven world by promoting digital literacy and collaborative skills(Franklin & Bolick, 2007).

In addition to factor analysis, the study conducted multiple regression analyses to assess the causal relationship between the factors contributing to leadership practice in integrating technology and the quality of education. The multiple regression analysis results in Table 5, revealed that the three predictors technology policy and strategy, technology infrastructure, and technology potential explained approximately 55% of the variance in the quality of education ($R^2 = 0.550$). This model was statistically significant ($F = 60.667$, $p < 0.001$), reinforcing the conclusions drawn effective leadership practices and strategic planning are essential for the successful implementation of technology integration in educational settings(Tondeur, 2018).

These findings underscore the importance of prioritizing technology infrastructure, potential, and policy and strategy, educational institutions can enhance the learning environment and foster better educational outcomes. This is consistent with the conclusions of a well-structured approach to technology integration, supported by strong leadership, can significantly improve student engagement and learning outcomes(Stoltzfus, 2015).

The interviews with college leaders in the College of Teacher Education revealed the importance of technology in shaping education quality and preparing students for the future. Technology enhances learning experiences, fosters creativity, and equips students with essential skills. It also transforms the learning process by making it more interactive and engaging.

Factors contributing to technology integration include robust infrastructure, clear technology policies, trained personnel, and diverse educational technologies. Educators need access to high-speed internet and reliable hardware to support innovative teaching methods. Clear technology policies promote innovation and protect student data and privacy. Investing in professional development empowers faculty to embrace innovative teaching methods.

However, barriers to technology integration include resistance to change, financial constraints, accessibility of technology tools, and clear technology policy and strategy. To overcome these challenges, leaders should foster an environment that encourages experimentation and open dialogue about the benefits of technology integration. Additionally, financial constraints may require innovative funding strategies or partnerships with technology providers to maintain up-to-date infrastructure and support systems.

Conclusion

The study's findings underscore the critical role of technology integration in enhancing the quality of education, highlighting several key factors that contribute to effective leadership practices in this area. The strong consensus among college leadership and instructors regarding the importance of technology infrastructure, potential, and policy indicates a shared recognition of the essential components needed for successful technology integration.

The analysis revealed that technology infrastructure, including reliable devices and adequate internet connectivity, is foundational for fostering digital literacy and improving student learning experiences. Additionally, the emphasis on technology potential, such as support staff proficiency and professional development opportunities, demonstrates the necessity of equipping educators with the skills required to effectively utilize technology in their teaching practices.

Furthermore, the study highlights the significance of clear technology policies and strategies, which are crucial for aligning institutional goals with technology integration efforts. The collaboration between college leadership and instructors is vital for bridging gaps in perceptions and ensuring that technology initiatives are cohesive and effective.

The factor analysis and subsequent correlation and regression analyses reinforce the importance of these contributory factors, revealing a strong relationship between technology integration and educational quality. By prioritizing the development of robust technology infrastructure, fostering potential through targeted professional development, and establishing comprehensive policies, educational institutions can create an enhanced learning environment that promotes better educational outcomes.

In conclusion, the findings advocate for a strategic approach to technology integration, emphasizing the need for strong leadership and collaboration among stakeholders to effectively leverage technology in education. This alignment is essential for fostering an educational landscape that is responsive to the needs of students and educators alike, ultimately leading to improved engagement and learning outcomes.

Recommendations

1. The Ministry of Education (MoE) and the Regional Education Bureau should collaborate to develop national guidelines for technology integration in education, emphasizing innovative leadership and providing a clear implementation framework.

2. The MoE, Regional Education Bureau and Colleges should provide training and support for college leaders to develop technology integration strategies. Facilitating collaboration among colleges can enhance resource sharing and knowledge exchange.

3. College leadership should develop a comprehensive digital transformation plan that aligns with the college's strategic goals and prioritizes user experience is essential. Fostering a supportive and inclusive culture that encourages experimentation with new technologies is crucial.

4. Further research is recommended to explore the specific competencies required for innovative leadership in technology integration within the context of the College of Teacher Education in the Oromia Regional State, Ethiopia.

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References

Alemu, B. M. (2015). Integrating ICT into Teaching-learning Practices: Promise, Challenges and Future Directions of Higher Educational Institutes. *Universal Journal of Educational Research*, *3*(3), 170–189. https://doi.org/10.13189/ujer.2015.030303

Amaniampong, A., & Hartmann, H. M. D. (2023). Factors Affecting Technology Integration in Colleges of Education. *International Journal of Studies in Education and Science*, *4*(2), 176–194. https://doi.org/10.46328/ijses.69

Chansirisira, P. (2022). The Innovation Leadership Model For School Principal Under The Provincial Administrative Organizations In Province Zone Roi-Kaen-Sara-Sin, Northeastern Thailand. In *2022 1 Journal of Management Information and Decision Sciences* (Vol. 25, Issue 2).

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education, Sixth Edition*.

Creswell, J. W. (2007). *An Introduction to Mixed Methods Research*.

Creswell, J. W. (2014). Research-Design_Qualitative-Quantitative-and-Mixed-Methods-Approaches. *Sage*.

Creswell, J. W. (2015a). *A concise introduction to mixed methods research*. SAGE Publications, Inc.

Creswell, J. W. (2015b). A concise introduction to mixed methods research. *SAGE Publications, Inc.*

Creswell, J. W., & David Creswell, J. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*.

Fox, N., & Hunn, A. (2009). Sampling and Sample Size Calculation. *The NIHR RDS for East Midlands*, *1*(1), 1–4.

Franklin, C. a., & Bolick, C. M. (2007). Technology integration: A review of the literature. *Society for Information Technology & Teacher Education.*, *March*, 1–83. http://eric.ed.gov/ERICWebPortal/recordDetail?accno=ED504169

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*(February), 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Ibrahim, U., IBRAHIM ARGUNGU, J., Musa Mungadi, I., & Sani Yeldu, A. (2023). E-Learning and Remote Education Technologies: Lessons from The Pandemic. *International Journal of Educational and Life Sciences*, *1*(3). https://doi.org/10.59890/ijels.v1i3.828

Johnston, S. W. V. D. D. (2001). *Methods For Research Everyday Life, Blending Qualitative and Quantitative Approaches: Vol. I.*

Kingsley-Jones, M. (2016). Leadership challenge. *Airline Business*, *32*(3), 36–38. https://doi.org/10.1057/9781137488145_3

Kiong, J. F. (2023). The Impact of Technology on Education: A Case Study of Schools. *Journal of Education Review Provision V*, *2*(2), 43–47. https://doi.org/10.55885/jerp.v2i2.153

Lohans Kumar Kalyani. (2024). The Role of Technology in Education: Enhancing Learning Outcomes and 21st Century Skills. *International Journal of Scientific Research in Modern Science and Technology*, *3*(4), 05–10. https://doi.org/10.59828/ijsrmst.v3i4.199

Mdhlalose, D., & Mlambo, G. (2023). Integration of Technology in Education and its Impact on Learning and Teaching. *Asian Journal of Education and Social Studies*, *47*(2), 54–63. https://doi.org/10.9734/ajess/2023/v47i21021

Moges, B. (2014). The Role of Information and Communication Technology (ICT) in Enhancing the Quality Education of Ethiopian Universities : A Review of Literature. *Journal of Education Research and Behavioral Sciences Vol.*, *3*(8), 246–258.

Rahmeta, O., Lemma, M., & Ababa, A. (2019). Role of Information Communication Technology (ICT) Integration on Performance of College of Agriculture and Veterinary Medicine Jimma , University. *Journals.Ju.Edu.Et*, *2*(December), 30–53. https://journals.ju.edu.et/index.php/jbeco/article/download/614/68

Raman, A., & Thannimalai, R. (2019). Importance of Technology Leadership for Technology Integration: Gender and Professional Development Perspective. *SAGE Open*, *9*(4). https://doi.org/10.1177/2158244019893707

Sagaya, A. A. (2019). Influence Of Innovative Leadership Techniques On Students' Academic Performance. In *Journal Of Education* (Vol. 6, Issue 1).

Seitebakeng, S. D. (2018). Information and communication technology use in higher education : Perspectives from faculty Seitebaleng Susan Dintoe Memorial University of Newfoundland , Canada. *International Journal of Education and Development Using Information and Communication Technology*, *14*(2), 121–166.

Stoltzfus, J. (2015). Determining Educational Technology and Instructional Learning Skill Sets (details): A New Approach to the LoTi Framework for the 21 st Century. *ResearchGate*, *March*, 1–18. http://www.sjsolutions

Sürücü, L., Şeşen, H., & Maslakci, A. (2023). *Regression, mediation / moderation, and structural equation modeling with SPSS, AMOS, and PROCESS Macro* (Issue January).

Tabowei, A. (2021). *Technology Enhanced Learning: A Case Study of the Potentials of Mobile Technologies in Nigerian College of Education*. *June*.

Tadesse, S., & Muluye, W. (2020). The Impact of COVID-19 Pandemic on Education System in Developing Countries: A Review. *Open Journal of Social Sciences*, *08*(10), 159–170. https://doi.org/10.4236/jss.2020.810011

Temtim Assefa Birhanu Abera Birara Gebru. (2022). ICT Integration in Ethiopian High

Schools ICT Integration in Ethiopian High Schools MENACIS 2021 Agadir ICT Integration in Ethiopian High Schools Association for Information Systems AIS Electronic Library (AISeL) ICT Integration in Ethiopian High School. *ResearchGate, February*.

Tiekam, A. (2019). *Digital Leadership Skills that South African Leaders need for Successful Digital Transformation Asmitha Tiekam Student No: 98102398*.

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Monés, A. M., & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. In *Education and Information Technologies* (Vol. 28, Issue 6). Springer US. https://doi.org/10.1007/s10639-022-11431-8

Tondeur, J. (2018). Enhancing future teachers' competencies for technology integration in education: Turning theory into practice. *Seminar.Net*, *14*(2), 216–224. https://doi.org/10.7577/seminar.2981

Voogt, J., & Knezek, G. (2008). International Handbook of Information Technology in Primary and Secondary Education. In *Springer*.

Voogt, J., Knezek, G., Cox, M., Knezek, D., & Ten Brummelhuis, A. (2013). Under which conditions does ICT have a positive effect on teaching and learning? A Call to Action. *Journal of Computer Assisted Learning*, *29*(1), 4–14. https://doi.org/10.1111/j.1365-2729.2011.00453.x

Yallew, A. (2020). Higher Education in Ethiopia: Recent Developments and Challenges Higher Education In Ethiopia: Recent Developments And Challenges. *AfricArXiv*. https://doi.org/10.14293/111.000/000009.v1