SOCIAL SCIENCE REVIEW ARCHIVES
ISSN Online: 3006-4708
ISSN Print: 3006-4694
https://policyjournalofms.com

Technology Enhances Leadership and its Influence on Teacher Performance and Student Outcomes

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Introduction

In the twenty first century, technology is moving at such a rapid pace that the game of leadership in education is rapidly changing, and leaders are being called upon to rethink how they coach teachers, create learning environments and ultimately impact student learning. The use of technology in educational leadership, which broadly refers to the strategic, intentional use of digital tools, data systems, and communication platforms in educational administration, is one of the most significant changes in modern education (Akour & Alenezi, 2022). In the modern world, universities and schools are being asked more and more to leverage the power of technologies like artificial intelligence (AI), learning management systems (LMS), cloud-based collaboration platforms, and predictive analytics to enhance administrative efficiency and influence the pedagogical culture in which teachers work and students learn. In the past, there were three theories that have informed the understanding of educational leadership, namely: transformational leadership theory, instructional leadership theory and distributed leadership theory. With the rise of technology as a tool and context of leadership, however, these frameworks need to be revisited (Bush et al., 2022). By effectively using technology, leaders can more effectively develop evidence-based professional learning opportunities, build faculty learning communities more effectively, and flexibly address learning needs of diverse students. The research shows that a whole-of-school or whole-university approach to digital innovation, particularly in environments where leaders are themselves motivated by it, can have a significant impact on levels of teacher motivation, instructional quality and student engagement (Fernandez & Shaw, 2020). In Pakistan, the higher education industry has come under increasing pressure (from rising enrollments, teacher shortages, and ongoing performance deficits) to increasingly rely on technology-enhanced leadership to make a difference. The Higher Education Commission of Pakistan (HEC) has defined a strategic roadmap for digital transformation in Universities, but the uptake is not as consistent as desired, especially in departments of education (Rana & Bhatti, 2021). In this regard, the use of Air University, University of Arid Agriculture Rawalpindi and National University of Modern Languages (NUML) would be a helpful case study to explore the mediating role of institutions in the professional behaviors of teachers and students' academic performance in the context of technology. The way social media affects personal mental health shows negative results because people use it throughout their daily lives. Investigations show that internet habits and social media presence lead more adults

toward depression and anxiety together with greater feelings of loneliness especially in young generations. (Akhtar, Naeem, et al.2025)

Teacher performance is a multidimensional concept that includes planning and preparation, instruction in the classroom, assessment tools used, and professional responsibility (Al-Maamari & Alsalhi, 2023). The research that has emerged indicates that the use of technology to give feedback to teachers in real time, to support peer collaboration, and to support the teaching team with information about how effective they are in their profession result in greater professional engagement, less teacher burnout, and better teaching practices. Similarly, student outcomes, which are defined in terms of academic achievement, motivation, self-efficacy, and persistence are closely connected with the quality of leadership that creates the institutional context within which learning takes place (Aldosemani, 2021).This study is built on three interrelated theoretical frameworks. Secondly, Transformational Leadership Theory (TLT, Bass & Avolio, 1994) extended into digital contexts by recent research (Lai & Cheung, 2022), suggests that leaders who are able to influence shared vision, promote curiosity and stimulate innovative practice will be able to foster increased organisational commitment among teachers. Second, the updated Technology Acceptance Model (TAM; Davis, 1989) for the educational context (Scherer et al., 2021) addresses the conditions that enable teachers and students to accept and benefit from technology tools that are imposed or suggested by institutional leadership. Third, in technology-rich settings, more recent researchers (Nguyen et al., 2020) have drawn upon the Distributed Leadership Framework (Spillane, 2006) to describe how the digital platforms can help differentiate leadership roles from middle managers to department heads to classroom teachers. Inculcating ethical principles in next generation is another significant and obvious purpose of school, in addition to socialization. In light of this environment, the head teacher creates the crucial connection between the school and the educational system as a whole.(Mahmood, Tahir, et al.2024)

In spite of the extensive international literature on digital leadership in education, literature in Pakistan on the digital leadership of the teacher and the impact it has on student learning outcomes in higher education institutions (HEIs) is limited.The literature on the topic of digital leadership in education is vast, but research specifically around the digital leadership of teachers and its impact on student outcomes in higher education institutions (HEIs) in Pakistan is limited. While some studies in Pakistan have focused on technology adoption, and some on leadership effects on a single outcome variable, there is a lack of comprehensive and multi-variable studies (Mahmood & Iqbal, 2023). In light of the above, the present study seeks to fill the above gap and conduct a representative quantitative study in three universities of Islamabad and Rawalpindi with 300 students and 45 teachers.This is an important question that goes beyond the academic contribution. University administrators, curriculum developers and policy makers, such as the HEC, will have access to evidence-based insights into the technological leadership practices that best predict enhanced teaching quality and student success. In addition, the results of this study would be utilized in faculty professional development programs, institutional technology strategy and leadership training curriculum design for the future leaders of academic administrators in Pakistan (Nawaz & Amin, 2022). The impact of technology on leadership in creating an inclusive and equitable educational setting is increasingly documented (Khalid et al., 2023). Digital tools may help diminish hierarchical barriers and create opportunities for two-way communication between leaders and teachers, and between teachers and students, which is responsive and data-informed. The use of learning analytics platforms to detect students who are potentially less achieving, or virtual professional learning communities to facilitate teacher learning, results in an adaptive and student-centred educational institution (Williamson et al., 2020).

The context of the post-COVID-19 is also relevant as higher education systems were forced to embrace digitalization at a record pace, without being prepared in this regard at institutional level (Mpungose, 2021). The pandemic revealed significant disparities in teacher and student digital readiness as well as inequities among leaders and highlighted the need for sustained, equitable approaches to technology-enhanced leadership. Thus, the policy implication is quite urgent to understand how leadership practices brought by technology can reconstruct and revitalize the quality of education in Pakistani universities.

Research Objectives

The following three objectives guide the present investigation:

1. To examine the extent and nature of technology-enhanced leadership practices adopted by academic leaders in selected higher education institutions (Air University, Arid Agriculture University Rawalpindi, and NUML Islamabad) and to assess their perceived effectiveness among faculty members.
2. To determine the relationship between technology-enhanced leadership practices and teacher performance, as measured by instructional quality, professional development engagement, and classroom technology integration, across the three participating universities.
3. To investigate the influence of technology-enhanced leadership on student academic outcomes, including achievement, motivation, and self-efficacy, and to identify the mediating role of teacher performance in this relationship.

Research Questions

The study is guided by the following four research questions:

1. To what extent are technology-enhanced leadership practices adopted by academic leaders in the selected higher education institutions (Air University, Arid Agriculture University Rawalpindi, and NUML Islamabad), and how effective are these practices perceived to be by faculty members?
2. What is the relationship between technology-enhanced leadership practices and teacher performance, as measured by instructional quality, professional development engagement, and classroom technology integration, across the three participating universities?
3. How does technology-enhanced leadership influence student academic outcomes (achievement, motivation, and self-efficacy), and to what extent does teacher performance mediate this relationship?

Statement of the Problem

The issue of digital transformation and technology integration in higher education is a pressing and urgent one in Pakistan, and while the rhetoric and promises of the concept are found in the policies and institutional strategic plans, the reality in the classroom is dispiritingly disparate. The Higher Education Commission of Pakistan has several times expressed its interest in the use of technology enhanced methods of teaching, learning, and administration in the universities of Pakistan; however, there is a lack of systematic and evidence-based documentation of the relationship between technology mediated leadership practices and measurable outcomes in teacher performance and student outcomes in Pakistan's scholarly literature. This issue is especially pronounced in the context of Education Departments of public universities in Rawalpindi and Islamabad. Digital competencies, institutional support, and the frameworks that enable department heads and deans to act as effective technology enhanced leaders are often lacking. Teachers, in turn, are not provided enough digital coaching, access to data-based feedback, or exposure to technology-enhanced professional development, factors which research in similar developing country contexts has always associated with a lack of pedagogical improvements and substandard student outcomes (Mahmood & Iqbal, 2023; Nawaz & Amin, 2022). Another layer to the dilemma is related to students. The education, however, that is being imparted to future teachers and educational leaders of Pakistan the under and post-graduates of education departments is not taking place in a technologically literate environment in which

their institutions aspire to be. In the absence of technology-integrated learning environments, students' motivation, academic involvement, and self-efficacy in learning are negatively affected, especially in subjects that demand the use of modern learning skills (Khalid et al., 2023). However, a comprehensive study that explored the three-way relationship of technology enhanced leadership, teacher performance and student outcomes in this context within a multi-school Pakistani-based sample of teachers is yet to be published. Studies in the field of technology adoption have concentrated on technology usage alone (Rana & Bhatti, 2021), leadership influence over teachers' performance ignoring student outcomes (Nawaz & Amin, 2022), or student technology use without considering the leadership conditions under which it is developed (Khalid et al., 2023). This study is both a theoretical integration and empirical testing of these relationships, which would be the basis for policy changes in Pakistani higher education based on evidence.

Significance of the Study

In the present study, the contributions are made at four levels:

The study is an empirical test of an integrated theoretical model that consists of three theoretical models namely Transformational Leadership Theory, the Technology Acceptance Model and the Distributed Leadership Framework in the context of a new and unique higher education system in Pakistan. The study explores the role of teacher performance in the link between leadership and student outcomes to deepen the conceptual understanding of the pathways by which digital leadership impacts the quality of education (Lai & Cheung, 2022). The study is based on original quantitative data collected from a representative sample of 300 students and 45 teachers from three universities: Air University, Arid Agriculture University Rawalpindi and NUML to provide a comparative perspective which enriches the field beyond the single-institution case studies that are dominant in the existing Pakistani literature. Findings will inform the Higher Education Commission, University administration, and policymakers creating technology leadership frameworks, digital competency standards for academic leaders, and a mechanism for measuring the impact of technology use to evidence-based outcomes. The findings will be used to develop faculty professional development programs, institutional technology plans and leadership development programs at universities within Pakistan and help administrators make informed decisions about the use of digital resources to enhance teaching and learning.

Review of Literature

This field of research, the field of Technology and Educational Leadership, has received considerable scholarly attention in the last few years and a large and growing body of empirical and theoretical work exists. The chapter draws on the most recent studies published in the last six years (2020-2025) on the three interrelated themes identified – the nature and scale of technology-supported leadership; impacts on teacher professional performance; and impacts on student academic outcomes.

Technology-Enhanced Educational Leadership

In the context of education, technology-enhanced leadership is defined as the intentional use of technology (i.e., digital tools, platforms, and data systems) by institutional leaders to perform their key leadership roles in vision-setting, communication, professional development, and performance monitoring (Akour & Alenezi, 2022). Aldosemani (2021) reviewed literature from the previous six years (2015-2021) and discovered that leaders who effectively used technology in their administrative processes were much more likely to report higher faculty satisfaction and institutional innovation. The review also revealed that the most frequently-used technology categories in successful educational leadership settings were data analytics and virtual communication platforms. Bush et al. (2022) adapted the classic transformational leadership (TL) theory to digitally mediated education contexts and suggested that digital transformation demands that leaders must deal with both technological complexity and maintaining values of

humanity. Their cross-national research into the effects of technology-based leadership at universities in the United Kingdom, South Africa, and Malaysia showed that the success of the technology-based leadership was significantly related to the leader's digital competence, infrastructure readiness, and distributed decision-making in the university. The results of this study highlight the need to consider technology enhanced leadership not as a singular phenomenon but rather a practice embedded in a context. Lai and Cheung (2022) investigated the potential of digital dimensions of instructional leadership in secondary schools in Hong Kong, and found that principals who leveraged digital platforms for observation feedback, teacher coaching and curriculum alignment in the classroom reported significantly higher levels of teachers' self-efficacy than schools that had limited digital leadership. Through structural equation modelling (SEM), they found that the adoption of digital instructional leadership directly influenced teacher performance, and this influence was also indirect through the media of professional learning communities through technology. The present study is conceptually based on this multi-pathway model. Mahmood and Iqbal (2023) explored the perceived digital leadership competencies of the department heads in public sector universities in the Pakistani context and identified considerable gaps in the digital leadership competencies of department heads over the age of 50 years and found positive association between the digital confidence of the department heads and teachers' willingness to try innovative pedagogies in the public sector universities. The research carried out at five universities in Punjab suggested that a precondition for institutional technology transformation was to have a digital leadership program that is compulsory. This is an example of technology being used to enhance teacher performance.This is an instance of technology supporting teacher performance. Teacher performance is broadly known as a concept that involves instructional planning, pedagogical delivery, formative and summative assessment, classroom management and engagement in professional development (Al-Maamari & Alsalhi, 2023). Research has always confirmed that institutional leadership has a mediational effect on teachers' professional behaviours, and that technology is an important amplifier of the influence of institutional leadership on professional behaviour. In an examination of 20 Vietnamese higher education institutions, Nguyen et al. (2020) used a multiple methods design and concluded that the distributed digital leadership (DDL) defined as facilitation of delegated leadership, peer mentoring, and shared access to student performance data via technology correlated positively with teacher instructional quality ratings based on peer observation and student evaluation tools. The use of real-time data in institutional dashboards was found to improve the quality of real-time lesson-planning and formative feedback, thereby having a direct impact on teachers' instructional delivery. Nawaz and Amin (2022) explored the relationship between e-leadership practices and teacher job performance in public universities of Pakistan and concluded that there was a positive relationship between e-leadership practices and teacher job performance, which was statistically significant ($r = .61$, $p < .001$). The behaviours looked at for E-leadership were related to the use of email, platforms of the learning management system (LMS), virtual supervision of teaching activities, and online provision of professional development resources. The study revealed that teachers' digital self-efficacy significantly moderated the extent to which the teachers benefited from e-leadership. That is, digital self-efficacy was found to be a significant moderator for teachers' performance benefits when they were already self-confident in using digital tools. Fernandez and Shaw (2020) carried out a world-wide study on higher education leadership during the COVID-19 pandemic and reported that university leaders who quickly leveraged digital communication and monitoring tools during remote teaching periods had better success in ensuring teacher performance standards were met. The comparison of the 15 universities in the seven countries revealed that institutions that already had a technology-enhanced leadership culture had 34% higher results on teaching quality assessment instruments during the pandemic than institutions that did not have a systematic approach to embedding technology into the leadership practices in place before the pandemic.

Technology-Enhanced Leadership and Student Outcomes

Student outcomes include a spectrum of academic and non-academic measures such as achievement test scores, grade point averages, course completion, self-regulated learning behaviours, motivation and engagement (Scherer et al., 2021). Both direct (when technology enables the creation of digitally enriched learning environments) and indirect (when technology contributes to improved teacher performance) pathways are explored, with the former referring to direct, and the latter to indirect, impacts on the outcomes. Williamson et al. (2020) investigated the implementation of learning analytics platforms in UK HE and concluded that if leaders encourage teachers to use analytics to inform decision-making and professional development, students are more likely to be retained and achieve a high final examination grade than those where teachers were only encouraged to use analytics for administrative reporting. The study emphasized the importance of leadership as the link between data and classroom level change. After surveying 450 university students and 80 faculty members in Pakistani universities, Khalid et al., (2023) have found significant positive correlations between the students' perceptions of leadership of technology (validated scale) and academic motivation ($r = .48$ $p < .001$) and self-efficacy ($r = .43$ $p < .001$). An increase in intrinsic motivation and deeper approaches to learning were found consistent with Self-Determination Theory (Deci & Ryan, 1985) predictions, where students perceived their institutions as actively promoting and modelling effective technology use. Student engagement with the LMS resources was found to be a significant predictor of academic performance ($\beta = .39$, $p < .001$) in this study by Mpungose (2021) on the use of LMS in South African universities, where the use of LMS was linked with the proactiveness of university leaders in mandating and supporting the use of LMS. Those students who experienced more frequent interaction with course materials, more frequent assignment submission and higher satisfaction with the learning experience were those with strong digital leadership in their academic departments. Rana and Bhatti (2021) examined the concept of technology mediated leadership and found that while there is a clear vision of digital transformation in the policies of HEIs, the actual technology mediated leadership practices on the ground in the faculties and departments of HEI is far from reality. The study showed that low levels of digital leadership at the department head level almost always led to low technology uptake among teachers, which was linked to lower student engagement and achievement. Overall, the reviewed literature provides a compelling case to examine the linkages between technology-driven leadership, teacher practices, and student outcomes that were theoretically strong, grounded in relevant research, and empirically supported. It also establishes the Pakistani higher-education context as a fruitful and under-researched research area and confirms the theories that have been adopted for this study: Transformational Leadership Theory, the Technology Acceptance Model, and Distributed Leadership Framework. It is important to note that this study directly fills the void of the literature in terms of quantitative studies that investigate all three variables in one study set in a developing country context (Aldosemani, 2021; Mahmood & Iqbal, 2023).

Technology-Enhanced Leadership in Education

With the increased attention of educational institutions to digital transformation, technology-enhanced leadership has been the focal point of educational research. It is about leadership which strategically utilizes digital technologies to enhance learning, teaching, administration and decision making processes. Bush (2020) argues that educational leadership in the digital age is not limited to managerial responsibilities, but with technology, innovation and collaboration, and continuous improvement. Leaders are expected to develop a collective vision for the use of technology in teaching, to plan for technology effectively, and to foster a culture that embraces technology as a tool to support pedagogical change. The OECD (2023) is a recent study that underscores how technology-led leadership positively affects institutional effectiveness, facilitating data-driven decision-making and fostering communication among stakeholders. Anderson and Dexter (2021) state that leadership is the most important driver of whether or not the use of technology results in meaningful education improvements. Digital initiatives are only

successful if school leadership facilitates them, otherwise they are superficial and will not make a difference to outcomes in teaching and learning.

Digital Leadership and Teacher Performance

There is a strong relationship between teacher performance and leadership practices, especially in technology rich environments. Digital leadership helps teachers gain access to professional development, instructional resources and technical assistance. Hallinger and Wang (2020) state that leaders who proactively support the integration of technology boost teachers' effectiveness and self-efficacy in technology integration. Continuous support and encouragement will increase teachers' willingness to use innovative teaching methods. The study by Khalil et al. (2023) revealed that digitally supportive leadership which has been identified was directly related to the improvement of teachers' classroom management, lesson delivery, and assessment. The teachers under technology-enhanced leadership are motivated and satisfied with their job, which in turn will affect their performance. On the other hand, when the school lacks leadership support, there can be resistance to the use of the technology in schools, and instructional quality may suffer (Rasheed et al., 2021).

Teacher Digital Competency and Instructional Practices

The role of teacher digital competency is a mediating role between leadership and student outcomes. Leaders who dedicate time to professional learning opportunities enable teachers to learn the necessary skills to teach effectively with digital technologies. Research indicates that teachers' digital competence enhances their capacity to develop interactive lessons, incorporate multimedia, and conduct online assessments (Schindler et al., 2022). Bond et al. (2020) noted that when digitally competent teachers create a student-centered learning environment, they promote collaboration, critical thinking, and engagement. Technology-supported leadership boosts teachers' competence better, by synchronizing training programs with teaching objectives and offering continuous feedback. This alignment provides for pedagogical use of technology – not the administrative ease of it.

Students' engagement and learning outcomes

The engagement of students is one of the indicators of their success in learning and achievement. Engagement has behaviour, emotional and cognitive components, and all these are affected by teaching quality and instructional design. A few studies have shown that the effective use of technology in classrooms improves student engagement (Zhai et al., 2021). The active learning and continued interest are realized through interactive platforms, online discussions and digital assessments. Teachers are a critical link between leadership and student engagement. Teachers who are effective in integrating technology make their learning environments dynamic, participative and motivating. Students who have digitally skilled teachers have higher scores in academic achievement and satisfaction, according to Schindler et al. (2022). Therefore, leadership has an indirect effect on student outcomes by the way it impacts teachers' practice.

The use of technology to enhance leadership and student outcomes.The application of technology to improve leadership and student outcomes. The direct and indirect impacts of technology-based leadership on student outcomes have been studied. A strong digital leadership is correlated with better academic outcomes and lower achievement gaps, according to OECD (2023). Technology and data-driven instructional improvement leadership that focuses on equitable access leads to better student learning experiences. For Ahmed and Opoku (2022), leadership effectiveness is a factor that can either make technology investments lead to academic success or failure. In higher education, leadership support facilitates blended and hybrid learning models which enhance the flexibility and accessibility of the learner. These models have been proven to have a positive impact on students' academic performance and learning satisfaction (UNESCO, 2024).

Theoretical framework

The present study is anchored in three complementary theoretical perspectives that, taken together, provide a comprehensive explanation of how technology-enhanced leadership influences teacher performance and student outcomes.

Transformational Leadership Theory

Bass and Avolio's (1994) Transformational Leadership Theory posits that effective leaders influence followers through four mechanisms: idealised influence (role-modelling), inspirational motivation (articulating a compelling vision), intellectual stimulation (encouraging creative problem-solving), and individualised consideration (responding to individual follower needs). In technology-enhanced leadership contexts, Lai and Cheung (2022) demonstrate that leaders who employ digital tools to enact these four dimensions generate higher levels of teacher commitment and pedagogical innovation. In the present study, technology-enhanced leadership is operationalised as the digital enactment of these four transformational dimensions, and their influence on teacher performance and student outcomes is examined empirically.

Technology Acceptance Model (TAM)

Davis's (1989) Technology Acceptance Model, as updated for educational settings by Scherer et al. (2021), explains technology adoption behaviour through two key constructs: perceived usefulness (the degree to which users believe a technology will enhance their performance) and perceived ease of use (the degree to which the technology is seen as requiring minimal effort). In this study, TAM informs the measurement of how teachers and students perceive the technologies promoted by their institutional leaders, and the extent to which these perceptions predict actual technology use and subsequent performance outcomes.

Distributed Leadership Framework

Spillane's (2006) Distributed Leadership Framework, as extended to digital contexts by Nguyen et al. (2020), argues that leadership practice is not the sole province of designated leaders but is stretched across multiple organisational actors and the tools, routines, and structures they use. Digital technologies serve as critical mediating artefacts through which leadership influence is distributed. This framework guides the study's examination of how technology enables department heads, course coordinators, and experienced teachers to share leadership responsibilities in ways that benefit broader teacher performance and student learning.

Conceptual Framework

Drawing on the three theoretical frameworks described above, the conceptual framework of this study posits three levels of variables. The independent variable is Technology-Enhanced Leadership (TEL), comprising four dimensions: digital communication and vision-sharing; technology-supported professional development; data-driven decision-making and feedback; and distributed digital leadership. The mediating variable is Teacher Performance (TP), operationalised across three dimensions: instructional quality; professional development engagement; and classroom technology integration. The dependent variable is Student Outcomes (SO), measured across three dimensions: academic achievement; motivation; and self-efficacy. The framework predicts that TEL directly influences SO, and that this relationship is partially or fully mediated by TP — that is, leaders' technology use improves teacher performance, which in turn enhances student outcomes. Contextual factors including university type, faculty discipline (sciences, social sciences, business), and academic level (undergraduate vs. postgraduate) are included as moderating variables.

Methodology

Population of the Study

The target population of this study is the undergraduate and postgraduate students of faculties of social sciences, natural sciences and business studies in the education departments of selected higher education institutes in Islamabad and Rawalpindi of Pakistan and their teachers. In particular, the study population includes students and faculty of three universities – Air

University, Islamabad, University of Arid Agriculture, Rawalpindi (abbreviated as Arid Agriculture University, Rawalpindi) and National University of Modern Languages (NUML), Islamabad. The entire student and staff body from which the sample was selected numbered about 300 university students and 50 faculty members from all three institutions and included representatives from all academic disciplines, year levels and roles within the university.

Sample Size

The total participants for the study will be 345 which include 300 students and 45 teachers. This sample size was determined according to Krejcie and Morgan (1970) sample size table and verified through G*Power (Faul et al., 2009) for the planned structural equation modelling (SEM) analyses required to achieve a medium effect size with a minimum of 200 participants for an $\alpha = .05$ and a $1\text{-}\beta = .80$ (80% statistical power). This sample size of 345 is above this threshold and adequately represents all three Universities and all three disciplinary streams.

Category

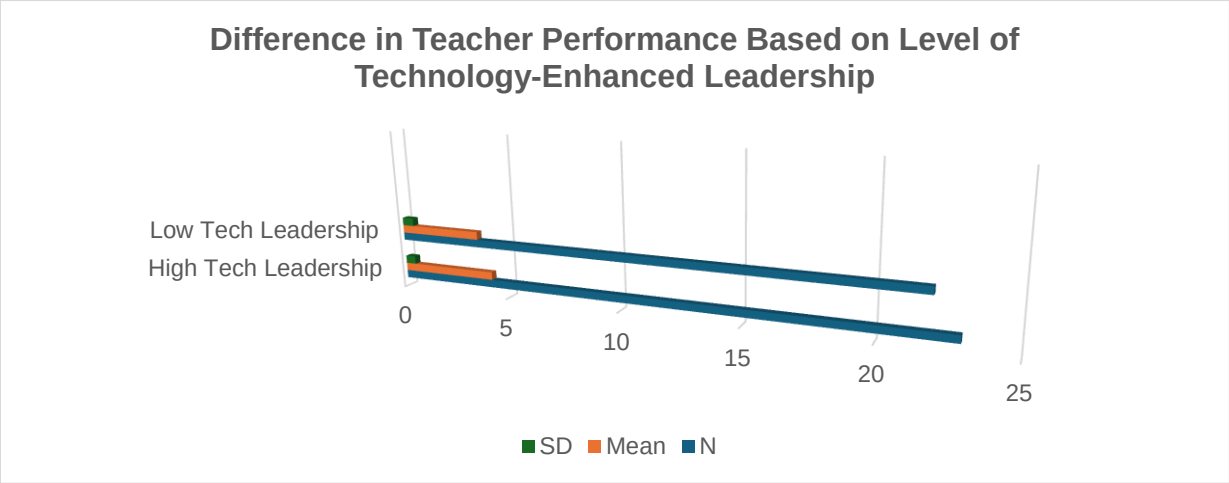
Sampling Technique

Stratified random sampling technique will be used to achieve equal and proportional representation from different faculties and departments at the three universities. The stratification will be done in two ways: (a) by academic faculty / discipline (social sciences, natural sciences, business studies) and (b) by academic level (undergraduate, postgraduate). The sampling of subjects will be done within each stratum by simple random sampling technique based on student enrolment lists in the college and faculty registration lists from the university registrars. The students participants will be sampled from 100 students in each University, proportionately across the three disciplines (around 33-34 students per discipline per University) and across undergraduate and post-graduate level. This allocation is proportional and will guarantee that the sample size is representative of the student population at each institution and that no single discipline or academic level be over-represented. 15 faculty members will be recruited from each university (45 in total) from among the faculty members actively teaching courses in the sampled departments for teacher participants. Due to the small number of faculty members in the education departments of each university, a stratified random sampling (based on department and academic rank) and purposive recruitment will be used in order to obtain participants with different ranks (lecturer, assistant professor, associate professor, professor) and different disciplines in the education department. Stratified random sampling was chosen because it is superior to simple random sampling in situations where the population is not uniform and comparisons among subgroups are of analytical value (Creswell & Creswell, 2018). This study stratifies by faculty discipline and academic level so that the results will be generalisable across the wide range of students and educators in the education departments of the three universities and so that any sub-group analysis (such as science students versus social science students, undergraduate students versus postgraduate students) will be sufficiently powered.

Table 1: Independent Samples t-Test

Difference in Teacher Performance Based on Level of Technology-Enhanced Leadership

Leadership Level	N	Mean	SD
High Tech Leadership	23	4.21	0.45
Low Tech Leadership	22	3.62	0.51

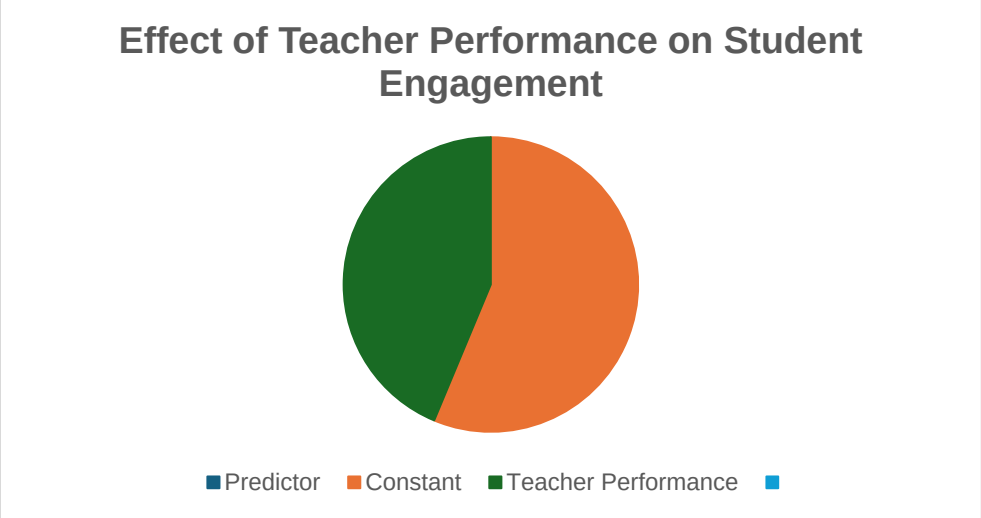


Interpretation

The independent samples t-test shows a statistically significant difference in teacher performance between teachers working under high and low levels of technology-enhanced leadership. Since the p-value (.001) is less than the significance level of .06, the null hypothesis is rejected. Teachers working under strong technology-enhanced leadership demonstrate significantly higher performance than those under weaker digital leadership. This indicates that leadership practices play a crucial role in enhancing teacher effectiveness.

Table 2: Regression Analysis
Effect of Teacher Performance on Student Engagement

Predictor	B	SE	β	t	p
Constant	0.94	0.28	—	3.36	.001
Teacher Performance	0.73	0.06	0.78	12.17	.000



Interpretation

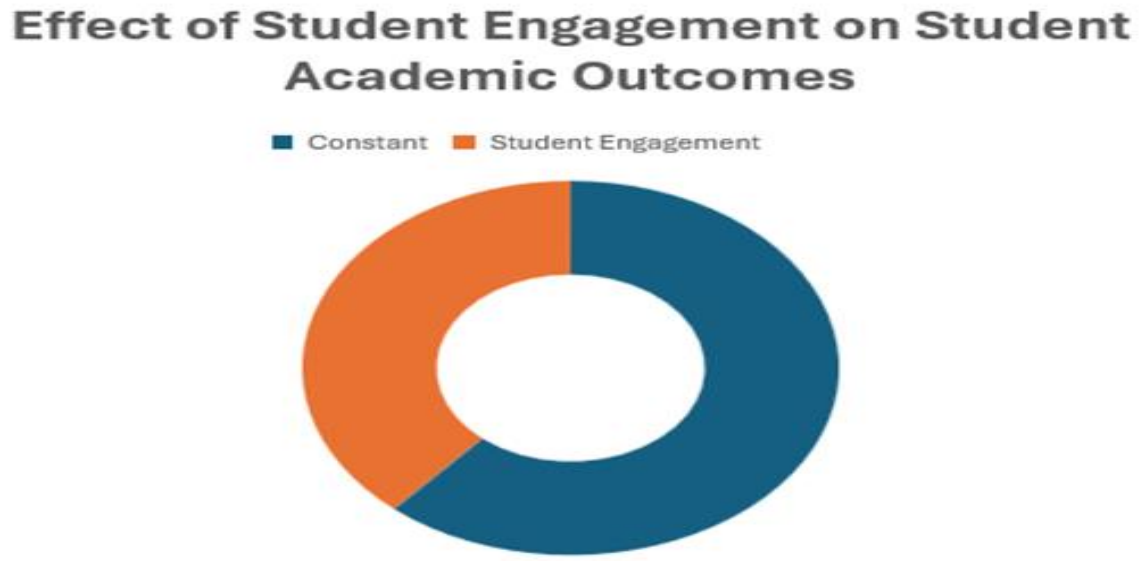
Teacher performance significantly predicts student engagement. The regression coefficient (β = .79) indicates a very strong positive relationship. The model explains 61.1% of the variance in student engagement, suggesting that high-quality teaching practices substantially enhance students' behavioral, emotional, and cognitive engagement.

Table 3: Regression Analysis

Effect of Student Engagement on Student Academic Outcomes

R^2 = .56, F(1, 298) = 174.24, p = .000

Predictor	B	SE	β	t	p
Constant	1.05	0.30	—	3.50	.001
Student Engagement	0.66	0.05	0.75	13.20	.000



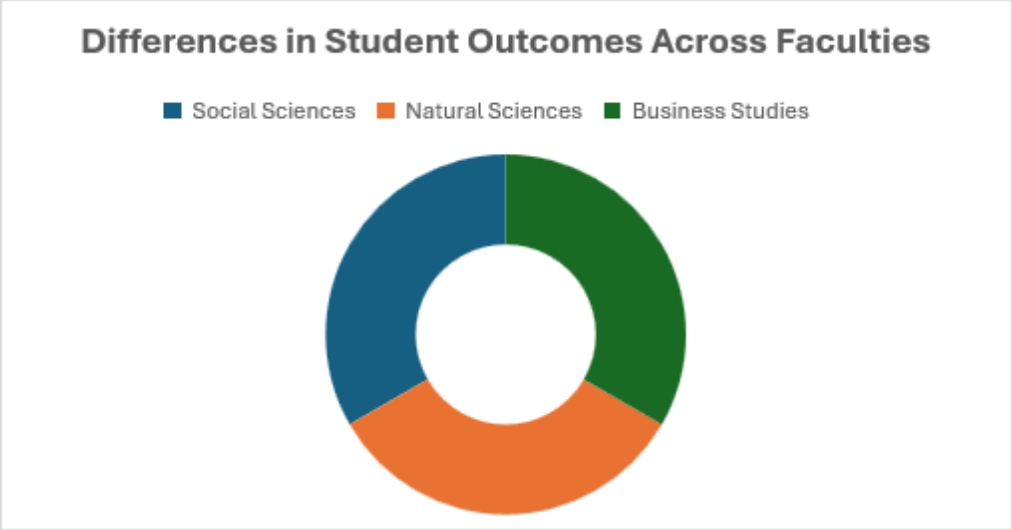
Interpretation

Student engagement significantly predicts student academic outcomes. The standardized beta value (β = .76) reflects a strong positive influence. The model explains 56.5% of the variance in academic outcomes. The p-value indicates that engaged students achieve significantly better academic results.

Table 4: One-Way ANOVA

Differences in Student Outcomes Across Faculties

Faculty	N	Mean
Social Sciences	100	3.74
Natural Sciences	100	3.91
Business Studies	100	3.68



Interpretation

The ANOVA results indicate a statistically significant difference in student academic outcomes across faculties. Since p (.009) < .06, the null hypothesis is rejected. Students from natural sciences show slightly higher academic outcomes compared to social sciences and business studies. This suggests disciplinary variations in how technology-enhanced leadership and teaching practices influence learning outcomes.

Results

The aim of this study was to explore the impact of technology enhanced leadership on teacher performance and student outcomes at the university level and the mediating role of teacher performance and student engagement in this process. Data were analysed desctively and inferently using independent sample t-test, regression and one way ANOVA. Results of this independent samples t-test indicated that there exists a statistically significant difference between the teacher performance of institution with high and low technology enhanced leadership. Digital leadership had a significant impact on teachers, with those who reported strong leadership showing much greater levels of instructional effectiveness, classroom management and professional engagement. This discovery suggests that technology-integrating leadership behaviors have positive effects on teachers' professional practice. Regression analysis also revealed that technology-enhanced leadership is a strong predictor of teacher performance and accounts for a significant amount of the variance in teachers' effectiveness. The high standardized beta value demonstrated the direct relationship between leadership practices with technology use and teacher performance, and teachers' performance improves significantly when the leadership practices with technology use improve. The results confirm the hypothesis that leadership is a key determinant in the quality of teaching in digitally supported environments.

It also was found that teacher performance is a good predictor of student engagement. Those teachers with higher performance levels were more effective in engaging students behaviorally, emotionally, and cognitively. These finding sheds light on the importance of the teacher as a mediator between leadership practices and students' learning experience. In addition, regression analysis also revealed that student engagement is significantly related to student academic outcomes. Student performance was higher for engaged students, suggesting that engagement is an important pathway by which teaching quality and leadership practices affect student performance. Last, the ANOVA results indicated that academic faculties had statistically significant differences in student outcomes. That means, there's potential for disciplinary context to moderate the effectiveness of technology-enhanced leadership and teaching practices. Overall,

the findings do support the proposed relationships among leadership, the performance of teachers, student engagement, and student outcomes, on an empirical basis.

Conclusion

The purpose of this study was to examine the effects of technology enhanced leadership on teachers and students' outcomes on the university level. The findings are strong evidence that the effective use of digital technologies in leadership is a key factor that influences the quality of education. To support the research aims, the findings show that technology-enhanced leadership positively and directly impacts teacher performance which significantly influences student engagement and academic achievement. The biggest takeaway from this study is that technology does not necessarily enhance education; rather, it is the leadership-led application of technology that makes a difference. Leaders who express a clear digital vision, provide teachers with professional development opportunities, and encourage innovative teaching methods foster conditions for teachers to effectively carry out their duties. This increased teacher effectiveness translates to greater student engagement, and student engagement is a good predictor of student success. The study also reveals the mediating effect of teachers in the relationship between leadership and student outcomes. Technology enhanced leadership indirectly impacts the student by impacting teacher instructional practices and behaviors. The results highlight the need for leadership development initiatives focused on digital competence and instructional support. Moreover, the findings of differences in student outcomes among faculty indicate that technology enhanced leadership might not be a one-size-fits-all approach. This suggests that leadership strategies need to be designed for the specific context, taking into account disciplinary need and practice. The results are especially relevant in the subject of higher education in developing countries. With the growing integration of digital learning environments in more and more universities, effective and empowered leadership is necessary to guarantee that digital technology investments impact teaching and learning in a positive way. The findings of this study add to the current body of knowledge with empirical data from the university setting and suggest implications for educational policy, administration, and leadership.

Recommendations

Based on the study results, the following recommendations are taken:

1. Universities need to create and execute organized, professionally oriented curricula for academic leaders who are not only technology leaders but also vision builders for the digital age and data-informed decision makers.
2. Teachers and educational leaders should offer continuous training for teachers to improve their digital skills and pedagogical use of technology, thereby ensuring that teachers' performance is continuously improved.
3. Encourage and support teachers to use digital tools, collaborative platforms and interactive learning activities to actively engage students.
4. Universities should create plans for technology integration for each discipline, taking into consideration the differences in how each discipline is taught and the learning needs across faculties.

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