Engineering and Technology Journal e-ISSN: 2456-3358

Volume 11 Special Issue 06 June-2026, Page No.- 22-29

DOI: 10.47191/etj/v11iSPC6.04, I.F. – 8.595

A Study on Examining the Relationship Between Innovative Leadership in Educational Technology and Student Learning Outcomes

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ABSTRACT: The high rate at which digital technologies are being integrated in education has augmented the challenge of having effective leadership that will guarantee meaningful learning practices among students. The paper investigates the connection between innovative leadership in educational technology and technology integration as well as student learning outcomes in contemporary learning institutions. The quantitative cross-sectional research design was chosen and primary data were gathered through a structured online questionnaire, which was sent to students, teachers and educational administrators involved in digital learning settings. Perceptions of leadership practices, technology integration, and learning outcomes were measured by a five-point Likert scale. Descriptive statistics revealed that there was a high level of innovative leadership, successful integration of technology and positive student learning outcomes. The rank-order correlation of Spearman analysis revealed that innovative leadership and technology integration were highly correlated positively (0.538, $p < 0.01$). Similarly, technology integration displayed a strong positive relationship with student learning outcomes (0.627, $p < 0.01$). They provide evidence that innovative leadership considerably facilitates the effective adoption of technology that in turn leads to increased student engagement, improved academic achievement, and overall learning effectiveness. This paper contains quantitative evidence regarding the role of leadership in digital learning and provides worthwhile advice to both teachers and educational authorities on how to promote technology-based learning environments.

KEYWORDS: innovative leadership, educational technology, technology integration, student learning outcomes, academic performance.

I. INTRODUCTION

The rapidly increasing pace in the development of digital technologies has completely changed the way education is carried out worldwide, and the traditional models of teaching, learning, and evaluation are being redefined. Technology in Education (EdTech) is playing a key role not only in the effective provision of educational services but also in creating the conditions for personalized learning and enabling access to digital educational resources that is remote and unrestricted by geography [1]. Educational institutions are examining various tools which include learning management systems and online platforms and artificial intelligence applications and multimedia materials to improve their teaching methods and student engagement practices.

However, it is not just access to infrastructure and devices that ensures successful adoption of these technologies. It involves a thoughtful vision, organizational preparedness, and leadership that is capable of leading the stakeholders through the complicated change in technology. The leaders of the educational institutions must also make sure that the atmosphere that they create promotes innovation and constant improvement as well as collaboration between teachers and students. Such deficiency in leadership may lead to failure to successfully implement such technologies or lack of them

making a significant difference in learning outcomes [2]. Therefore, leadership can now be discussed as one of the most significant aspects of the idea that technological investments contribute to successful educational practices and student acquisition.

The innovative Leadership in educational technology is a phrase that is applied to the possibility of leaders to facilitate a change, experimentation and support the successful application of digital tools in educational practices [3]. These leaders can provide resources and create a culture that adheres to creativity, professional learning and data-driven decision-making [4]. It can also contribute towards eliminating impediments to technology adoption including resistance of teachers to change, technological illiteracy, lack of training and organizational impediments. By providing a long term continuous professional development, establishing learning community, and modeling how technology can be utilized, leaders can enable teachers to integrate digital tools into their teaching in meaningful ways. It is also through proper leadership that ensures the technology programs are applied within the parameters of the curriculum objectives and growth requirements of students other than being taken as secluded or purely technical solutions to a problem. With the appropriate leadership, the integration of technology

will have a positive impact on student engagement, help the learners in acquiring higher-order thinking skills, active learning and help learners to perform academically [5]. To find out the overall impacts of the digital revolution on education, one can look into how effective and innovative leadership has changed the way technology is used and students' learning results.

A. Purpose of the Study

The main goal of this research is to explore how the new leadership behaviors in educational technology affect student learning outcomes. Of special interest is the finding of what is impact of effective technology integration to the existing learning institutions.

B. Motivation and Contribution of the Paper

The ongoing digital transformation in the education sector needs a deeper understanding of how leadership plays a role in effective technology integration into teaching and learning activities. Schools are struggling to improve student outcomes as their leaders' skills are lagging despite the large amount of money spent on educational technology. The paper is set to fill the research gap by investigating whether leadership styles that are aligned with innovation may be one of the factors for successful technology implementation that leads to improved student performance in modern educational settings. The study presents the following key points:

- To establish a link between innovative leadership, technology integration, and student learning outcomes.
- To offer practical insights for educators and policymakers for better decision-making.
- To contribute to the existing literature on educational technology and leadership.

C. Structure of the Paper

The paper is clearly divided into different sections that organize its content. The Introduction first of all, gives a background to the research and then announces the study's purpose and research objectives. The literature review is a kind of summary of the already existing research on leadership, technology integration, and learning outcomes. The methodology part is intended to tell about the research plan, data collection, and analysis procedures. The results and discussion present the findings which are followed by the conclusion and recommendations which show the main findings and their consequences and future research paths.

II.LITERATURE REVIEW

Recent research has examined how educational technology and leadership work together to improve student learning results. The research studies show conflicting results about how technology integration impacts education yet emphasize that leadership remains essential for achieving successful implementation.

In a study, Ponmozhi and Sangeetha (2025) conducted an experimental study among Grade 10 students in Tamil Nadu using a post-test design and found that technology integration did not significantly improve academic performance compared to traditional teaching methods. After one week, students in the treatment group learned about acids, bases, and salts using the Embibe software tool, which allowed for technology integration. The Achievement examinations had five parts and nineteen questions for each group. Memory, analysis, synthesis, and evaluation are the abilities that students will be tested on in the accomplishment test. Each group would have one and a half hours to complete the test. The maximum possible score on the accomplishment test is forty. The further computation was carried out using IBMSPSS23 using data obtained from both groups. In both groups, the pupil has done quite well. The incorporation of technology into the classroom does not affect the academic performance of high school pupils in science. According to the stepwise regression results, for the Treatment group, almost 48% of the success was attributable to the mothers' qualification, 22% to the parents' income, and 22% to the fathers' qualification. Parents' wealth and education level were weak predictors of their children's success in the treatment group, according to an analysis of the structural coefficient. The mothers' qualifications, however, were rather robust markers of the treatment group's success [6].

This study by Schmitz et al. (2023) aims to find out whether school administrators' transformational leadership methods help teachers use technology better in the classroom to engage students in more complex and cognitively demanding tasks. The relationship between transformative leadership and the incorporation of technology can be better understood by the study looked at the mediating roles of teachers' tech-friendly attitudes, technical abilities, school's digital infrastructure, and instructors' digital pedagogical ability. Transformational leadership significantly improved the digital school infrastructure, teachers' views and attitudes toward technology, their technical competency, and their capacity to utilise technology successfully in the classroom, according to a research of 22,47 secondary school teachers in Switzerland. In a similar vein, all of these factors pointed to the inevitable increase in technology integration, with the possible exception of the online educational infrastructure. Findings from this study stress the significance of transformational leadership styles among administrators in supporting teachers as technology intermediates in the classroom [7].

Using an online mathematics learning environment, Spitzer, Moeller, and Musslick (2023) analyzed the effects of different assignment strategies on the academic performance of students (n = 16,000, spanning 4th to 10th grade, with a total of approximately 170,000 problem sets) during the first and second periods of school closures in Germany caused by the pandemic. While school was open throughout both closures, students did much better academically than they had during the corresponding times last year. During that time, teachers routinely offered students single problem sets, which normally consist of eight mathematics exercises. Whether students were given large portions of the problem sets by their instructors or

allowed to choose their results showed that neither approach significantly improved student performance. In addition, when comparing the three different types of assignments, students performed better when given sets of one-problem problems. When considered as a whole, their findings suggest that online maths professors can influence their students' performance by controlling the type and amount of problems they assign [8].

According to Thapa and Thapa (2025) there are a number of elements that might influence the learning outcomes of students when it comes to educational technology. There are a lot of things to think about, including the integration of technology, student motivation and engagement, digital literacy, and institutional policies and support. The study's 317 participants were selected at random from the student body of the Kathmandu Valley using a quantitative research strategy. To investigate the way these factors influenced the final grade, the researchers decided to do regression analysis. Digital literacy of students, institutional support and policies, student engaging and motivation, and technology integration are positive and significant factors that collectively have a great impact on learner's outcomes. Such study results can be of great help to the education stakeholders to formulate better use of technologies by making relevant policies and practices leading to long-term benefits to students. The paper presents new empirical findings on various aspects determining digital learning platforms and their impacts on student achievement. It rests on theories of collaborative learning and engagement-driven technology integration, and also helps to the rising literature in educational technology [9].

According to Harrison et al. (2021) EASs can be effective in changing the way of implementing student retention and improving it by using technology. In order to investigate hypotheses on the association between EAS and retention rates, a regional university in Australia evaluated data from 16,091 students over the course of 156 weeks and used several microeconometric approaches. There were statistically substantial correlations between the EAS and student retention after accounting for a plethora of potential confounding factors. To better understand the elements that contribute to student retention, it is necessary to capture the dynamic interactions between the explanatory variables and the discontinuation hazard [10].

This study by Zhang, Chen and Wang (2023) adds to their knowledge of innovation in university "Technology-enhanced learning" (TEL) and teaching by incorporating a theoretical and practical examination of knowledge production into the innovation diffusion model. Instead of concentrating on individuals and goods, studies on innovation in institutions have mostly ignored the steps involved in creating new knowledge, which are crucial to the initial and ongoing dissemination of innovations. This qualitative study focused on Tsinghua University, a renowned school in China that has been at the forefront of digital pedagogy and produced remarkable, long-lasting innovations in education across the board. The university was monitored for four years by the research, which used a framework that combines theories of T&L innovations and the diffusion of organisational knowledge creation. There are four distinct phases of information creation associated with technology invention and adoption, as shown in the case study. Knowledge externalization processes were identified as critical at this level for utilising co-creation of knowledge to innovate academic institutions. The study also showed that middle management's knowledge management skills and the middle-up-down leadership style made it possible to move away from exploratory work in groups and toward innovative organizational practices. Future directions for academic technology policy and cutting-edge teaching methods are also discussed [11].

TABLE I. EMPIRICAL EVIDENCE ON THE ROLE OF EDUCATIONAL TECHNOLOGY AND LEADERSHIP IN STUDENT LEARNING OUTCOMES

Author(s) / Year	Data & Context	Methodology	Focus	Key Findings	Future Directions
Ponmozhi & Sangeetha (2025)	Grade 10 students in Chengalpattu District, Tamil Nadu (N = 33)	Experimental Post-Test–Post-Test design with control & treatment groups	Impact of technology integration vs traditional teaching on science achievement	Technology integration showed no significant improvement in achievement; parental factors (mother's education, income) influenced outcomes	Investigate larger samples and long-term effects of technology integration across subjects
Schmitz et al. (2023)	Survey of 2,247 upper secondary teachers in Switzerland	Multilevel correlation & Structural Equation Modeling	Transformational leadership of principals and technology integration	Leadership positively influenced teachers' beliefs, skills, and technology use, indirectly enhancing student engagement	Examine direct impact on student achievement and cross-cultural leadership effects
Spitzer, Moeller &	~16,000 students (Grades 4–10) in	Large-scale quantitative	Assignment strategies in	Small, repeated assignments improved	Explore pedagogical strategies combined

Musslick (2023)	Germany during COVID-19 school closures	analysis of online learning performance	online learning environments	student performance; large bundles showed no significant gains	with digital leadership in remote learning
Thapa & Thapa (2025)	317 students in Kathmandu Valley	Quantitative survey with regression analysis	Technology integration, motivation, digital literacy, and institutional support	All variables positively influenced learning outcomes	Examine mediating role of leadership and policy frameworks in digital education
Harrison et al. (2021)	16,091 university students in Australia	Microeconometric and survival analysis	Early Alert Systems (EAS) and student retention	EAS significantly improved retention outcomes	Explore integration with AI-based predictive analytics and leadership decision-making
Zhang, Chen & Wang (2023)	Longitudinal case study of Tsinghua University	Qualitative longitudinal study using knowledge creation framework	Technology-enhanced teaching innovation and leadership	Leadership strategies facilitated institutional innovation and knowledge co-creation	Test framework across different universities and education systems

As can be seen in the above Table I, despite the fact that previous research has tried in detail to analyze the nature of technology integration and its effects on the learning outcomes of students, the conclusions are not consistent. Other studies record some drastic improvements, whereas others show little or indirect impacts. In addition, very few studies have empirically tested the combined relationship between innovative leadership, technology integration, and student learning outcomes.

More specifically, there has been a lack of sufficient quantitative research on how the incorporation of technology impacts learning results. Thus, this research fills a need by investigating how innovative leadership affects the integration of technology and, by extension, the improvement of student learning outcomes.

III. METHODOLOGY

Examining the connection between innovative leadership in educational technology and student learning outcomes is the focus of this part, which details the research design, data collection procedures, data cleaning methods, and analytical tools used. The methodological approach was systematic and structured in ensuring credibility, reliability and accuracy of the findings.

A. Research Design

The research question that this study focused on was analyzing the connection of innovative leadership in educational technology and student learning outcome through cross-sectional quantitative research approach [12]. A survey technique was chosen for the study wherein a structured survey was administered to gather numerical data from the students, teachers, and the educational administrators of the institutions that have been digitally learning technologies-based.

The quantification technique enables researchers to measure various important aspects such as leadership backing for technology integration and student performance, student engagement, and student academic accomplishments through statistical methods.

The approach successfully predicts how creative leadership practices impact learning results over time while it also identifies trends that can be used to test relationships between different variables.

B. Data Collection

The research data were gathered through a structured questionnaire that was administered via Google Forms, a web-based survey tool [13]. The survey was directed at school officials, students, and instructors who had an interest in the use of educational technology in the classroom. Besides, close-ended questions were designed to elicit students' emotional responses towards innovative leadership in the field of educational technology, the level of technology integration, and their involvement and productivity perceptions as learners [14]. It was answered on a 5-point Likert scale, from Strongly Disagree to Strongly Agree. This was done to maintain the consistency of the responses and to make the analysis process easier.

Key features of the data collection process include:

- Inclusion of multiple stakeholder perspectives (students, teachers, administrators).
- Use of standardized measurement scales for consistency.
- Assurance of anonymity and confidentiality to enhance response reliability.

C. Data Cleaning and Pre-Processing

The following steps of screen and cleaning of answers were done after data collection to ensure accuracy and statistical analysis [15]. The data cleaning process involved:

- Elimination of incomplete or partially filled questionnaires.
- Removal of duplicate and inconsistent responses.
- Identification and treatment of missing values and outliers.
- Coding of Likert scale responses into numerical format.
- Organization and labeling of variables for statistical analysis.

The dataset gained improved reliability and validity through the steps taken which established a base for analyzing the following data that achieved high standards of quality and consistent performance [16].

D. Data Analysis Technique

The researchers conducted an examination of the cleaned data and explored the relationships among the study variables by employing the Statistical Package for the Social Sciences (SPSS) software tool. Besides, the investigation was done with the utilization of two separate groups of statistical tools, namely descriptive and inferential.

Descriptive statistics, including calculation of the mean and standard deviation, were used to summarize the perceptions of respondents towards innovative leadership practices and technology integration and student learning outcomes. Demographic profiling of the sample group was done by the authors through frequency and percentage analysis methods.

The following inferential statistical techniques were employed:

- Correlation analysis (Spearman/Pearson) to examine relationships between variables
- Hypothesis testing to assess statistical significance of relationships

These analytical techniques enabled a comprehensive evaluation of the research model, providing both descriptive insights and empirical evidence regarding the impact of innovative leadership on technology integration and student learning outcomes.

IV. RESULTS AND DISCUSSION

Here are the results of the statistical analysis carried out on the collected data and the link between those results and the study goals. The research methodology involved demographic profiling, descriptive statistics, and correlation analysis to investigate the innovative leadership styles, technology usage, and student learning experiences.

A. Demographic Profile of Respondents

This study can see the gender, age range, school type, and educational background of the respondents (both students and instructors).

The demographic information provided in Table II depicts varied trends of the student respondents and teacher respondents who took part in the research by indicating their gender and age and the nature of school and level of education they attended. Of the number of students (N=31), they mostly were female (41.9%), male (38.7%), and 19.4% of them did not disclose their gender; in the same way, it is the same with teachers (N=69) as they were mainly female (62.3%), then male (34.8%), and a very small percentage (2.9) did not disclose their gender. The student population has 90.3 percent of the student population having the age range within 15 to 17 years which is the age range of secondary school students and the teachers exhibit a distribution of all age range of adults with the highest numbers being in the 35 to 44 years and the 45 years and above range (34.8 and 31.9) respectively, indicating the presence of experienced employees. Most of the respondents of both groups are students of urban schools as 61.3% of students and 75.4% of teachers are represented by urban schools, nevertheless, the teachers also present a considerable presence of rural students with 21.7%. The educational attainment of students shows the secondary level of their studies with 83.9% of students, while teachers hold professional qualifications that include Diplomas in Education (31.9%) and Bachelor's degrees (30.4%) and Master's degrees (24.6%), which show that the teaching staff possesses high educational credentials.

TABLE II. DEMOGRAPHIC PROFILE OF RESPONDENTS (STUDENTS AND TEACHERS)

Statement	Category	Students (N=31)	Percent	Teachers (N=69)	Percent
Gender	Male	12	38.7	24	34.8
	Female	13	41.9	43	62.3
	Prefer not to say	6	19.4	2	2.9
Age Group	15–17 years	28	90.3	–	–
	18–24 years	2	6.5	2	2.9
	25–34 years	1	3.2	21	30.4
	35–44 years	–	–	24	34.8
	45 years and above	–	–	22	31.9

Type of School	Urban school	19	61.3	52	75.4
	Peri-urban school	8	25.8	2	2.9
	Rural school	4	12.9	15	21.7
Level of Education	Secondary	26	83.9	1	1.4
	Tertiary	1	3.2	2	2.9
	Diploma in Education	1	3.2	22	31.9
	Bachelor's Degree	–	–	21	30.4
	Postgraduate Diploma	–	–	3	4.3
	Master's Degree	1	3.2	17	24.6
	Doctoral Degree	–	–	1	1.4
	Others	2	6.5	2	2.9

The sample shows that the teacher population consists mainly of female teachers who work in urban areas and have completed their necessary educational requirements while serving secondary schools with their young student body.

B. Descriptive Statistics of Key Variables

This subsection provides a summary of the central tendency and dispersion measurements for the three main study variables, which include innovative leadership practices, technology integration and student learning outcomes.

TABLE III. DESCRIPTIVE STATISTICS OF KEY STUDY VARIABLES

Variable	Mean	Std. Deviation
Innovative Leadership Practices (ILP)	4.25	0.93
Technology Integration (TI)	4.21	0.88
Student Learning Outcomes (SLO)	4.33	0.82

The descriptive statistics show that respondents achieved high performance in both innovative leadership and technology integration while their student learning outcomes demonstrated exceptional results. The educational technology implementation practices of institutions receive high support from educational institutions which find innovative leadership practices to have a mean score of 4.25. The Technology Integration score of 4.21 indicates that educators use digital tools for their teaching and learning activities. The highest mean score of Student Learning Outcomes which reached 4.33 shows that students have positive views about their academic performance and engagement. The moderate standard deviations indicate a reasonable level of agreement among respondents. (Table III)

C. Relationship between Innovative Leadership and Technology Integration

This section delves into the correlation between creative leadership styles and the success of incorporating technology into schools.

TABLE IV. CORRELATION BETWEEN INNOVATIVE LEADERSHIP PRACTICES AND TECHNOLOGY INTEGRATION

Variables Compared	Spearman's ρ	Significance (2-tailed)	Sample Size
Innovative Leadership Practices ↔ Innovative Leadership Practices	1.000	—	69
Innovative Leadership Practices ↔ Effective Technology Integration	0.538**	0.000	69
Effective Technology Integration ↔ Innovative Leadership Practices	0.538**	0.000	69
Effective Technology Integration ↔ Effective Technology Integration	1.000	—	69
Note: ** "Correlation is statistically significant at the 0.01 level (two-tailed)". (N = 69)			

Table IV shows the "Spearman's rank-order" relationship between innovative school leadership practices and the effective use of technology. There appears to be a positive link that is "statistically significant at the 0.01 level (2-tailed)" with a correlation coefficient of 0.538 and a matching significance

value of p = 0.000. An innovative approach by leaders is a guarantee that technology will be applied faster.

The relationship between leadership and educational technology implementation shows statistical significance because leaders have proven to be essential for enabling educational technology adoption and usage. The study results confirm existing research which shows that leadership vision and support together with strategic direction serve as essential factors for successful technology implementation.

D. Relationship between Technology Integration and Student Learning Outcomes

This subsection explores the association between the level of technology integration and student learning outcomes.

TABLE V. CORRELATION BETWEEN TECHNOLOGY INTEGRATION AND STUDENT LEARNING OUTCOMES

Variables Compared	Spearman's ρ	Significance (2-tailed)	Sample Size
Technology Integration ↔ Technology Integration	1.000	—	31
Technology Integration ↔ Student Learning Outcomes	0.627**	0.000	31
Student Learning Outcomes ↔ Technology Integration	0.627**	0.000	31
Student Learning Outcomes ↔ Student Learning Outcomes	1.000	—	31
(N = 31)			

The results in Table V demonstrate that technology integration produces a strong positive impact on student learning outcomes which researchers measured through the ρ value of 0.627 and the statistical significance of $p < 0.01$. The research shows that educational institutions which implement advanced technology systems achieve better academic results and higher student participation rates and improved learning outcomes.

The relationship between two elements shows great strength which requires educational institutions to adopt digital tools through methods that create actual learning experiences. The research discovered that successful technology implementation resulted in improved student learning outcomes because it established interactive environments that kept students engaged while offering various study methods.

V. CONCLUSIONS AND RECOMMENDATIONS

The researchers examined how educational institutions use their advanced educational technology leadership capabilities to implement their technology solutions which result in better student academic outcomes. The research results show that innovative leadership methods help schools to achieve successful technology implementation which results in improved student academic performance. The study shows that educational institutions need to establish digital adoption through their institutional support systems and strategic vision and leadership initiatives. Digital tools enable students to maintain their engagement which results in improved learning outcomes according to the study.

This research reveals that technological change in education needs to be supported by specific educational leadership to guide its implementation. Future studies ought to consider longitudinal designs to measure long-term effects, use larger and more diverse samples, and consider other variables like teacher preparedness, institutional facilitation and digital literacy as mediating or moderating variables. The researches would provide more insightful information regarding how to sustain effective technology-based learning settings.

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