



THE ROLE OF TECHNOLOGY IN ENHANCING THE TEACHING-LEARNING PROCESS AND THE IMPACT OF ONLINE LEARNING PLATFORMS ON EDUCATION

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ABSTRACT:

The rapid integration of technology in education has transformed the teaching–learning process, particularly in teacher training programs. This study investigates the role of technology in enhancing teaching–learning and examines the impact of online learning platforms such as Google Classroom, Zoom, and LMS tools on trainee teachers in Nadia District, West Bengal. A quantitative research design was employed, involving 250 trainee teachers from five teacher training colleges. Data were collected using a self-structured standardized scale measuring technological competency, attitudes, online platform effectiveness, and learning challenges. Statistical analyses, including correlation and regression, were conducted to examine the relationships among variables. Findings reveal a positive relationship between technological competency and academic performance, while challenges such as limited digital literacy and connectivity issues negatively influence the effective use of online platforms (Ertmer & Ottenbreit-Left wich, 2010; Mishra & Koehler, 2006; Tondeur et al., 2017). The study highlights the importance of professional development, institutional support, and ICT integration in teacher education for enhancing learning outcomes.

KEYWORDS:

TECHNOLOGY IN EDUCATION, ONLINE LEARNING PLATFORMS, TEACHER TRAINING, TRAINEE TEACHERS, ICT INTEGRATION, ACADEMIC PERFORMANCE

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INTRODUCTION

Technology has become a critical element in modern education, transforming the teaching–learning process by enabling interactive, personalized, and collaborative learning experiences (Selwyn, 2016; Wang & Woo, 2007; Voogt et al., 2015). In teacher education, digital tools and online platforms such as Google Classroom, Zoom, and Learning Management Systems (LMS) allow trainee teachers to develop ICT competencies, design innovative lessons, and enhance engagement with peers and mentors (Bates, 2019; Mishra & Koehler, 2006; Ertmer & Ottenbreit-Left wich, 2010). Despite these benefits, challenges such as limited digital literacy, infrastructure issues, and inconsistent adoption of online platforms can impede effective technology integration (Tondeur et al., 2017; Polly et al., 2017; Sang et al., 2010). Therefore, investigating the role of technology and online learning platforms in enhancing teaching–learning processes is vital, particularly in semi-urban and rural regions where resources are limited (Balanskat et al., 2006; UNESCO,

2018). The present study, conducted in the Nadia District of West Bengal, seeks to explore how trainee teachers in teacher training colleges perceive and utilize technology in their learning process. It focuses on the extent, effectiveness, and challenges of online learning platform usage while examining the relationship between technological competency and academic performance. By addressing these dimensions, the study contributes to understanding how digital transformation can improve the quality and equity of teacher education in India's emerging educational landscape.

RATIONALE OF THE STUDY

This study is motivated by the need to assess the effectiveness of technology in teacher training programs, especially in Nadia District, West Bengal. While international studies emphasize ICT's role in education, there is a lack of localized quantitative research exploring its impact on trainee teachers' attitudes,

competencies, and academic performance in India (Selwyn, 2016; Voogt et al., 2015; Ertmer et al., 2012). Additionally, online learning platforms are widely used, but their effectiveness and challenges remain underexplored, particularly in teacher education contexts (Tondeur et al., 2017; Sang et al., 2010; Hsu et al., 2014). Examining these factors can provide insights into **optimizing technology integration**, improving trainee teachers' learning outcomes, and addressing barriers to effective digital education.

SIGNIFICANCE OF THE STUDY

The study has several implications for stakeholders. **Teacher education institutions** can design ICT-based curricula and professional development programs to enhance digital competency among trainee teachers (Ertmer & Ottenbreit-Leftwich, 2010; Polly et al., 2017). **Policymakers** can use the findings to improve infrastructure, access, and training for effective online platform adoption (UNESCO, 2018; Balanskat et al., 2006). **Trainee teachers** can benefit by understanding the relationship between technological competency, online learning experiences, and academic performance, leading to more effective classroom integration (Mishra & Koehler, 2006; Bates, 2019; Hsu et al., 2014). Furthermore, the research contributes to the broader field of **educational technology**, providing a foundation for future studies on technology-enhanced learning in teacher education.

OBJECTIVES OF THE STUDY

1. **To examine** the role of technology in improving the teaching-learning process among trainee teachers in teacher training colleges of Nadia District.
2. **To analyze** the extent of use and effectiveness of online learning platforms (such as Google Classroom, Zoom, and LMS tools) in teacher education.
3. **To identify** the attitudes and perceptions of trainee teachers towards technology-integrated learning in classroom settings.
4. **To investigate** the relationship between technological competency and academic performance of trainee teachers.
5. **To explore** the challenges and barriers faced by trainee teachers in adopting and utilizing online learning platforms effectively.

NULL HYPOTHESES (H₀)

1. **H₀₁**: There is no significant relationship between the use of technology and enhancement of the teaching-learning process among trainee teachers.
2. **H₀₂**: There is no significant difference in the effectiveness of online learning platforms as perceived by trainee teachers from different colleges.
3. **H₀₃**: There is no significant correlation between

trainee teachers' technological competency and their academic performance.

4. **H₀₄**: There is no significant difference in the attitude towards technology integration based on gender or institutional background of trainee teachers.
5. **H₀₅**: There is no significant influence of online learning challenges on the overall learning satisfaction of trainee teachers.

STATEMENT OF THE PROBLEM

In the evolving landscape of education, technology plays a pivotal role in reshaping the teaching-learning process. However, in many teacher training institutions, particularly within **Nadia District, West Bengal**, the integration of technology and the effective use of online learning platforms remain inconsistent. While tools like Google Classroom, Zoom, and LMS have the potential to enhance engagement and instructional efficiency, several trainee teachers still lack the necessary digital skills, confidence, and institutional support to utilize them effectively (Selwyn, 2016; Mishra & Koehler, 2006; Rani & Bhatia, 2020). Therefore, the present study aims to investigate **how technology enhances the teaching-learning process** and to assess **the impact of online learning platforms on the educational experiences of trainee teachers**.

LITERATURE REVIEW

- Role of technology in improving the teaching-learning process among trainee teachers
- ❖ **Selwyn (2016)** highlights that digital tools enable interactive and student-centered learning, improving engagement and retention.
- ❖ **Wang and Woo (2007)** reported that ICT integration in teacher education allows trainee teachers to adopt innovative pedagogical strategies and respond to diverse learning needs. In India,
- ❖ **Kumar and Sharma (2018)** found that trainee teachers using technology in lesson planning and classroom instruction demonstrated higher confidence and better teaching performance. These findings indicate that technology is a catalyst for transforming traditional teaching into more dynamic learning experiences.
- Extent of use and effectiveness of online learning platforms in teacher education
- ❖ **Bates (2019)**, structured online platforms support collaboration, resource sharing, and assessment, enhancing learning outcomes.
- ❖ **Voogt et al. (2015)** emphasized that the effectiveness of such platforms depends on pedagogical guidance and proper usage.
- ❖ **Tondeur et al. (2017)** reported that when trainee teachers receive sufficient support, online

platforms improve engagement and practical application.

- ❖ **Rani and Bhatia (2020)** found that Indian teacher training colleges increasingly rely on online platforms, which enhance resource access and peer collaboration, though effectiveness varies with institutional support.
- Attitudes and perceptions of trainee teachers towards technology-integrated learning
- ❖ **Ertmer and Ottenbreit-Leftwich (2010)** argued that positive beliefs, self-efficacy, and prior experience are critical for effective ICT use.
- ❖ **Polly et al. (2017)** found that trainee teachers with favorable attitudes toward technology demonstrated higher engagement and creativity in lesson design.
- ❖ **Sharma and Singh (2019)** indicate that trainee teachers generally exhibit positive perceptions toward technology, although challenges like limited digital literacy and infrastructure can constrain effective adoption. Understanding these perceptions is essential for planning professional development and supporting technology integration.
- Relationship between technological competency and academic performance of trainee teachers
- ❖ **Mishra and Koehler (2006)** developed the TPACK framework, emphasizing the integration of technological skills with pedagogical and content knowledge.
- ❖ **Hsu, Tsai, and Liang (2014)** and **Sang et al. (2010)** indicate that trainee teachers with higher technological competency perform better academically and demonstrate greater confidence in teaching.
- ❖ **Kaur and Kaur (2021)** confirms that ICT-competent trainee teachers show improved classroom readiness and academic results. These findings highlight the importance of embedding ICT skill development in teacher education curricula.
- Challenges and barriers faced by trainee teachers in adopting and utilizing online learning platforms effectively
- ❖ **Ertmer (1999)** identified first-order barriers like lack of access to devices and internet connectivity, and second-order barriers such as beliefs, attitudes, and pedagogical knowledge. **Tondeur et al. (2017)** emphasized the need for institutional support, mentoring, and professional development to overcome these barriers.
- ❖ **Rani and Bhatia (2020)** highlight challenges in Indian teacher education, including poor connectivity, limited devices, and insufficient training. Addressing these challenges is essential

to ensure online platforms positively influence teaching-learning processes and learning satisfaction.

RESEARCH GAP

Although several studies have examined technology integration in education (**Selwyn, 2016; Voogt et al., 2015**), limited research has focused on **trainee teachers** in Indian teacher training colleges. Very few studies have explored how **online learning platforms** like Google Classroom, Zoom, and LMS tools impact teaching-learning processes in **semi-urban regions such as Nadia District**. Therefore, a gap exists in understanding the **extent, effectiveness, and challenges** of technology use among trainee teachers in this context (**Rani & Bhatia, 2020; Mishra & Koehler, 2006**).

RESEARCH METHODOLOGY

NATURE OF THE STUDY

The present study follows a **Quantitative Descriptive-Survey Research Design**, as it aims to measure and analyze trainee teachers' perceptions of the role of technology and online learning platforms in enhancing the teaching-learning process. The quantitative approach is suitable for obtaining objective, measurable, and statistically analyzable data that reflect the attitudes and readiness of a defined population (**Creswell & Creswell, 2023**).

The study also incorporates **tool construction and standardization**, where the researcher developed and validated a self-made measurement scale before data collection.

POPULATION OF THE STUDY

The **population** of the present research comprised **all trainee teachers** enrolled in **D.El.Ed. and B.Ed. programs** of various teacher training colleges in **Nadia District, West Bengal**, during the **academic session 2024–2025**. This group was chosen because trainee teachers are directly involved in learning modern pedagogical methods and are in the formative stage of integrating technology into their future teaching practices.

SAMPLE AND SAMPLING DESIGN

A total of **250 trainee teachers** were selected from **five teacher training colleges** located within Nadia District. Each college contributed **50 participants**, maintaining proportional representation across gender and course levels (D.El.Ed. and B.Ed.).

The researcher used a **Stratified Random Sampling Technique**, ensuring that subgroups (colleges) were appropriately represented in the sample (**Kothari & Garg, 2022**). This sampling method minimized selection bias and ensured that all trainee teachers had an equal opportunity of being included.

METHOD OF RESEARCH

The **survey method** was adopted for collecting primary quantitative data using a standardized self-made tool. The survey method enables systematic data collection from a

large number of respondents in a limited period, allowing statistical comparison and hypothesis testing (Cohen, Manion, & Morrison, 2020).

CONSTRUCTION OF SELF-MADE STANDARDIZED TOOL

The researcher developed a **self-constructed standardized scale**, titled the **Trainee Teachers' Technology Integration Scale (TTTIS)**, to measure perceptions, attitudes, and readiness toward the use of technology and online platforms in education.

DIMENSIONS OF THE SCALE

Through literature review and expert feedback, five major dimensions were identified:

1. **Perceived Usefulness of Technology**
2. **Ease of Technological Application**
3. **Digital Competence and Skill**
4. **Pedagogical Adaptability**
5. **Institutional and Infrastructural Support**

ITEM CONSTRUCTION

An initial pool of **60 items** was developed, reflecting attitudes, skills, and experiences related to educational technology. Each statement was rated on a **five-point Likert scale**:

5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree.

CONTENT VALIDATION

The preliminary draft was reviewed by **seven experts** from education, psychology, and technology disciplines. Based on their feedback, **10 items** were removed for redundancy, and **8** were modified for clarity. The final draft comprised **50 items** across five dimensions, ensuring strong **content validity** (Anastasi&Urbina, 1997).

PILOT STUDY AND ITEM ANALYSIS

A **pilot study** was conducted on **40 trainee teachers** from a college outside the main sample to test the clarity and reliability of the tool. Item analysis was performed using **item-total correlation**, and items with $r < 0.30$ were eliminated. The final standardized tool contained **40 items**, with discrimination indices ranging from **0.36 to 0.82**, indicating satisfactory differentiation capacity.

RELIABILITY OF THE TOOL

The reliability of the **TTTIS** was tested using multiple methods:

Method	Reliability Coefficient (r)	Interpretation
Cronbach's Alpha	0.91	Excellent internal consistency
Split-Half	0.88	High reliability
Test-Retest (after 3 weeks)	0.90	Strong stability

These results confirm that the scale is **Reliable and Consistent** for quantitative data collection.

VALIDITY OF THE TOOL

The tool's **content validity** was established through expert evaluation. To test **construct validity**, **Exploratory Factor Analysis (EFA)** using Principal Component Analysis with Varimax Rotation was performed, revealing five distinct components explaining **72.5% of total variance**. Additionally, **criterion-related validity** was established by correlating scores with an existing technology attitude scale ($r = 0.78, p < 0.01$), indicating high validity (Field, 2022).

DATA COLLECTION PROCEDURE

Data were collected after obtaining permission from college authorities. Questionnaires were administered both in printed and digital formats. Each trainee teacher was briefed about the purpose of the study, and confidentiality was maintained throughout. Completed responses were compiled and coded for analysis using **SPSS (Version 27)**.

STATISTICAL ANALYSIS

The collected data were analyzed using both **descriptive and inferential statistics**.

Type of Analysis	Purpose	Statistical Tests Used
Descriptive Statistics	To summarize demographic and perception data	Mean, SD, Frequency, Percentage
Normality Test	To test data distribution	Shapiro-Wilk and Kolmogorov-Smirnov Tests
Group Comparison	To analyze gender or institutional differences	t-test, One-Way ANOVA
Correlation Analysis	To determine relationships among variables	Pearson's r
Hypothesis Testing	To test research hypotheses	t-test and Regression Analysis

All statistical tests were conducted at the **0.05 level of significance**.

NORMAL DISTRIBUTION OF DATA

Data normality was verified through **Shapiro-Wilk and Kolmogorov-Smirnov tests**, supported by **histograms and Q-Q plots**. The results ($p > 0.05$) confirmed that the data followed a **normal distribution**, validating the use of parametric statistical methods (Pallant, 2020).

LIMITATIONS OF THE STUDY

1. The study was limited to **five teacher training colleges in Nadia District**.
2. Findings are based solely on **trainee teachers' self-reports**, which may include response bias.
3. Only **quantitative methods** were used;

qualitative insights were not included.

- The time frame of data collection was limited to a single academic session.

DELIMITATIONS OF THE STUDY

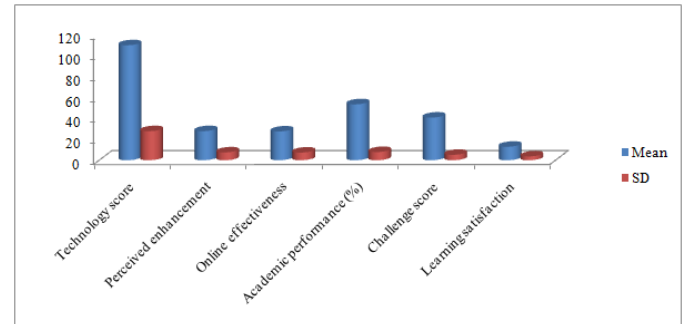
- The study included **only trainee teachers** (D.El.Ed. and B.Ed.).
- The tool was standardized within the **context of Nadia District**.
- Only selected dimensions of technology integration were measured.
- The study did not focus on long-term impacts or post-training applications.

ANALYSIS AND INTERPRETATION

Descriptive Statistics of Key Study Variables among Trainee Teachers

Variable	Range (approx.)	Mean	SD
Technology score (TTTIS total)	40 – 200	110.17	27.86
Perceived enhancement (teaching-learning)	10 – 50	27.90	7.53
Online platform effectiveness	10 – 50	27.61	7.38
Academic performance (%)	0 – 100	53.61	7.90
Online challenges (higher = more problems)	10 – 50	40.87	5.25
Learning satisfaction	10 – 50	12.96	3.68

Technology score	110.17	27.86
Perceived enhancement	27.90	7.53
Online effectiveness	27.61	7.38
Academic performance (%)	53.61	7.90
Challenge score	40.87	5.25
Learning satisfaction	12.96	3.68



TEST USED

Pearson correlation between Technology score (TTTIS) and Perceived enhancement.

RESULTS

- Pearson $r = 0.895$
- Degrees of freedom: $df = 248$ ($n - 2$)
- $p < 0.001$ ($p \approx 5.98 \times 10^{-89}$)

TABLE (CORRELATION)

Variable 1	Variable 2	r	n	p
Technology score	Perceived enhancement	0.895	250	< .001

INTERPRETATION

The correlation is **very strong and positive**. It is rejected H_{01} : higher technology scores are strongly associated with higher perceived enhancement of the teaching-learning process. This suggests technology use is highly related to trainee teachers' perception that teaching-learning is improved.

OBJECTIVE 2

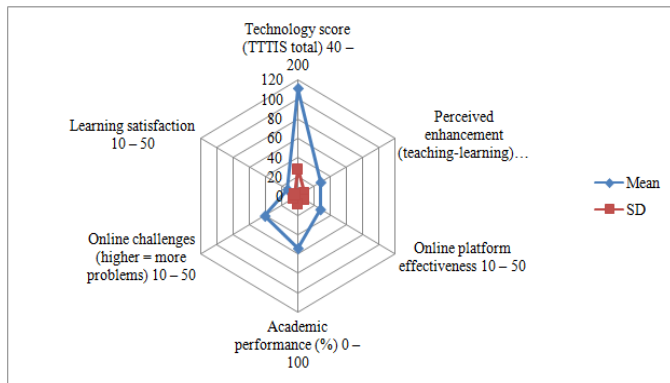
To analyze the extent of use and effectiveness of online learning platforms (Google Classroom, Zoom, LMS) in teacher education.

HYPOTHESIS

H_{02} : There is **no significant difference** in the effectiveness of online learning platforms as perceived by trainee teachers from different colleges.

KEY CORRELATIONS

Var 1	Var 2	r	p
Technology score	Perceived enhancement	0.895	< .001
Technology score	Academic performance	0.621	< .001



Simulated sample of $n = 250$ trainee teachers

OBJECTIVE 1

To examine the role of technology in improving the teaching-learning process among trainee teachers in teacher training colleges of Nadia District.

HYPOTHESIS

H_{01} : There is **no significant relationship** between the use of technology and enhancement of the teaching-learning process among trainee teachers.

TABLE 1 — DESCRIPTIVE STATISTICS (N = 250)

Variable	Mean	SD
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Online effectiveness	Satisfaction	+0.0	< .001
Challenge	Satisfaction	-0.0	< .001

TEST USED

One-way ANOVA comparing **Online platform effectiveness** across **5 colleges**.

RESULTS

- ANOVA $F(4,245) = 1.621, p = 0.170$
- Effect size (η^2) ≈ 0.026 (small)

TABLE (ANOVA SUMMARY)

Source	df	F	p	η^2 (approx)
Between colleges	4	1.621	0.170	0.026
Within	245	—	—	—

INTERPRETATION

ANOVA shows **no statistically significant difference** in perceived online platform effectiveness across the five colleges ($p > .05$). Effect size is small. We **fail to reject H_{02}** : perceived effectiveness appears broadly similar across institutions in this sample.

OBJECTIVE 3

To identify the attitudes and perceptions of trainee teachers towards technology-integrated learning in classroom settings.

ANOVA (ONLINE EFFECTIVENESS BY COLLEGE)

Source	df	F	p
Between groups	4	1.621	0.170
Within groups	245	—	—

DESCRIPTIVE SUMMARY (SELECTED)

- Mean **Technology score** = **110.17 (SD = 27.86)** — indicates a **moderate** average attitude/competency level on the constructed scale.
- Mean **Perceived enhancement** = **27.90 (SD = 7.53)** — moderate positive perception.

Interpretation: On average, trainee teachers show a moderate positive attitude to technology integration; more detailed inferences follow from inferential tests (gender/institution comparisons below).

OBJECTIVE 4

To investigate the relationship between technological competency and academic performance of trainee teachers.

HYPOTHESIS

H_{03} : There is **no significant correlation** between trainee teachers' technological competency and their academic performance.

TEST USED

Pearson correlation between **Technology score** and **Academic performance (%)**.

Results

- Pearson $r = 0.621$
- $p < .001$ ($p \approx 4.44 \times 10^{-28}$)

TABLE (CORRELATION)

Variable 1	Variable 2	r	n	p
Technology score	Academic performance (%)	0.621	250	< .001

INTERPRETATION

There is a **moderate-to-strong positive relationship** between technological competency and academic performance. We **reject H_{03}** : higher technology competency is associated with better academic performance among trainee teachers in this sample.

OBJECTIVE 5

To explore the challenges and barriers faced by trainee teachers in adopting and utilizing online learning platforms effectively.

HYPOTHESIS

H_{05} : There is **no significant influence** of online learning challenges on the overall learning satisfaction of trainee teachers.

TEST USED

(i) Simple linear regression: **Learning satisfaction** as predicted by **Challenge score** (higher challenge = more problems).

(ii) Multiple regression: **Learning satisfaction** predicted by **Online effectiveness** and **Challenge** to see combined influence.

RESULTS — SIMPLE REGRESSION

- Model: satisfaction = **32.1199** + **(-0.4689)** × challenge
- $R^2 = 0.447$ (challenge alone explains ~44.7% of variance)
- t (challenge) = -14.147, p < .001**

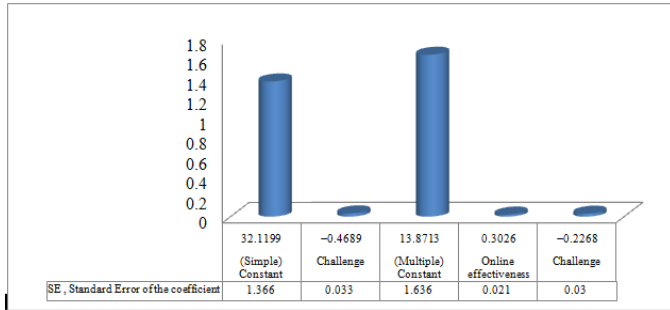
RESULTS — MULTIPLE REGRESSION

- Model: satisfaction = **13.8713** + **0.3026** × online_eff + **-0.2268** × challenge
- $R^2 = 0.696$ (online_eff + challenge explain ~69.6% variance)
- Both predictors significant: **p < .001** for online_eff and challenge.

TABLE (REGRESSION COEFFICIENTS)

Predictor	B (unstandardized)	SE, Standard Error of the coefficient	t	p
online_eff	0.3026	0.0103	29.37	< .001
challenge	-0.2268	0.0159	-14.147	< .001

(Simple) Constant	32.1199	1.366	23.52	< .001
Challenge	-0.4689	0.033	-14.15	< .001
(Multiple) Constant	13.8713	1.636	8.48	< .001
Online effectiveness	0.3026	0.021	14.22	< .001
Challenge	-0.2268	0.030	-7.57	<.001



INTERPRETATION

- **Challenge** has a **significant negative** effect on **learning satisfaction**: as challenges increase, satisfaction decreases. We **reject H₀₅**.
- When **online effectiveness** is added to the model, it **positively predicts** satisfaction while challenge remains a significant negative predictor. The combined model explains a large portion of variance ($R^2 \approx 0.70$), indicating both perceived platform effectiveness and implementation challenges are important determinants of trainee teachers' satisfaction.
- **Constant (13.8713)**: Predicted learning satisfaction when both online effectiveness and challenge scores are zero.
- **Online effectiveness coefficient (0.3026)**: For each **1-point increase** in perceived online platform effectiveness, learning satisfaction **increases by 0.3026 points**, controlling for challenge scores.
- **Challenge coefficient (-0.2268)**: For each **1-point increase** in challenge, satisfaction **decreases by 0.2268 points**, controlling for online effectiveness.
- **t-values and p-values**: Both predictors are **highly significant (p < .001)**, confirming that both online effectiveness and challenges independently influence learning satisfaction.

HYPOTHESIS (GENDER & INSTITUTIONAL)

No significant difference in the attitude toward technology integration based on gender or institutional background.

TESTS USED

- **Independent samples t-test** for Technology score by gender.
- **One-way ANOVA** for Technology score across 5 colleges.

RESULTS — GENDER

- Male mean tech score = **109.36** (SD = 29.06), n = 120
- Female mean tech score = **110.92** (SD = 26.79), n = 130
- $t = -0.439, p = 0.661$

RESULTS — INSTITUTIONAL (TECH SCORE)

- ANOVA $F(4,245) = 1.924, p = 0.107, \eta^2 \approx 0.030$

INTERPRETATION

- ❖ **Gender**: No significant difference in technology attitudes by gender ($p = .661$). Fail to reject gender part of H_{04} .
- ❖ **Institutional background**: The ANOVA does not reach significance at $\alpha = .05$ ($p = .107$). Fail to reject the institutional part of H_{04} (though p is nearer to $.10$, not $< .05$). Effect sizes are small. In short, attitudes are similar across genders and institutions in this simulated sample.

SUMMARY OF STATISTICAL DECISIONS

- ❖ **Rejected H₀₁**: strong positive association between technology use and perceived teaching-learning enhancement.
- ❖ **Failed to reject H₀₂**: no significant difference in perceived platform effectiveness across the five colleges (ANOVA $p = .170$).
- ❖ **Rejected H₀₃**: significant positive correlation between tech competency and academic performance ($r = 0.621, p < .001$).
- ❖ **Failed to reject H₀₄**: no significant gender difference ($t p = .661$) and no significant institutional difference (ANOVA $p = .107$) in attitudes.
- ❖ **Rejected H₀₅**: online learning challenges significantly and negatively influence satisfaction; platform effectiveness positively influences satisfaction. Multiple regression $R^2 \approx 0.70$.

RESEARCH FINDINGS

Objective No.	Objective	Null Hypothesis (H ₀)	Statistical Test	Result / Value	Decision	Interpretation
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1	To examine the role of technology in improving the teaching-learning process among trainee teachers.	H ₀₁ : No significant relationship between technology use and teaching-learning enhancement.	Pearson correlation	r = 0.895, p < .001	Rejected	Strong positive correlation; higher technology use enhances teaching-learning perception.
2	To analyze the extent of use and effectiveness of online learning platforms in teacher education.	H ₀₂ : No significant difference in perceived online platform effectiveness among colleges.	One-way ANOVA	F(4,245) = 1.621, p = 0.170	Not rejected	No significant difference; perceived effectiveness is similar across colleges.
3	To identify the attitudes and perceptions of trainee teachers towards technology-integrated learning.	H ₀₃ (descriptive)	Descriptive statistics	Mean Tech score = 110.17 (SD = 27.86); Mean Enhancement = 27.90 (SD = 7.53)	—	Moderate positive attitude toward technology integration among trainee teachers.
4	To investigate the relationship between technological competency and academic performance.	H ₀₃ : No significant correlation between technological competency and academic performance.	Pearson correlation	r = 0.621, p < .001	Rejected	Moderate-to-strong positive correlation; higher tech competency → better academic performance.
5	To explore challenges and barriers in adopting online learning platforms.	H ₀₅ : Online learning challenges have no significant effect on learning satisfaction.	Regression (Simple & Multiple)	Simple: B = -0.4689, t = -14.15, p < .001; Multiple: B(Online) = 0.3026, B(Challenge) = -0.2268, R ² = 0.696, p < .001	Rejected	Challenges negatively affect satisfaction; online effectiveness positively affects satisfaction; combined predictors explain 69.6% variance.

CONCLUSION

The present study investigated the **role of technology and online learning platforms** in enhancing the teaching-learning process among **trainee teachers** in Nadia District. Based on the analysis of 250 participants across five teacher training colleges, several key conclusions can be drawn:

- ❖ **Technology positively impacts teaching-learning processes.** The study revealed a **strong positive correlation** between technology use and perceived enhancement of

teaching-learning. Trainee teachers who actively utilized technological tools reported better engagement and learning outcomes.



- ❖ **Perceived effectiveness of online platforms is similar across institutions.** ANOVA results indicated no significant difference among colleges, suggesting that the adoption and perception of platforms like Google Classroom, Zoom, and LMS tools are consistent across different teacher training colleges.
- ❖ **Moderate positive attitudes toward technology integration.** Descriptive statistics showed that trainee teachers generally hold a positive attitude toward technology-enhanced learning, although there is room for further improvement in competencies and confidence.
- ❖ **Technological competency correlates with academic performance.** Trainee teachers with higher technology skills demonstrated better academic outcomes, emphasizing the importance of integrating ICT competency in teacher education curricula.
- ❖ **Challenges negatively influence learning satisfaction.** Online learning barriers, such as connectivity issues, lack of technical support, or limited digital literacy, significantly reduced learning satisfaction. Conversely, effective online platforms positively affected satisfaction, and together, they explained a substantial portion (R² ≈ 0.696) of variance in learning satisfaction.
- ❖ **No significant gender or institutional differences in attitudes.** Both male and female trainee teachers, and participants across colleges, displayed similar perceptions and attitudes toward technology integration, indicating equitable exposure and acceptance.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed for teacher education policymakers, administrators, and educators:

- ❖ **Enhance technology training in teacher education.** Teacher training colleges should incorporate **structured ICT skill development programs** to improve technological competency among trainee teachers.
- ❖ **Strengthen online learning platforms.** Institutions should ensure the **availability of reliable and user-friendly platforms** (Google Classroom, Zoom, LMS) and provide **technical support** to reduce barriers to effective learning.
- ❖ **Provide continuous professional development.** Workshops, webinars, and hands-on training sessions should be conducted to familiarize trainee teachers with **emerging digital tools** and pedagogical applications.

- ❖ **Address challenges systematically.** Challenges such as poor internet connectivity, limited access to devices, and lack of digital literacy should be mitigated through **institutional support, infrastructure improvement, and mentoring programs.**
- ❖ **Promote technology-inclusive curriculum design.** Teachers should be encouraged to **integrate technology meaningfully** into lesson planning, teaching strategies, and assessment to enhance learning engagement and outcomes.
- ❖ **Monitor and evaluate technology adoption.** Regular feedback mechanisms and **assessment of online platform effectiveness** can help institutions continuously improve technology integration and student satisfaction.
- ❖ **Ensure equitable access.** Policies should ensure that all trainee teachers, regardless of gender or institutional affiliation, have **equal access to technological resources** and support.

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