

ORIGINAL

Teacher Preparedness for Technology-Enhanced English Language Instruction: Insights from Island-Based Teacher Education

La preparación docente para la enseñanza del inglés con apoyo tecnológico: Perspectivas desde la formación del profesorado en contextos insulares

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ABSTRACT

Introduction: integrating technology into English language teaching has become essential, especially in geographically isolated areas where conventional educational resources are scarce. The unique geography of the Andaman Nicobar Islands creates both obstacles and possibilities for technology-enhanced language education.

Objective: to examine how well teacher trainees in the Andaman Nicobar Islands are prepared to implement technology-enhanced English language instruction, while identifying key factors that shape their readiness and skill levels.

Method: using a mixed-methods design, we studied 284 teacher trainees from three teacher education institutions across the Andaman Nicobar Islands. Data came from a validated Technology Integration Preparedness Scale (TIPS), demographic surveys, and focus group sessions. We performed descriptive statistics, independent t-tests, ANOVA, and correlation analyses through SPSS 29.0.

Results: teacher trainees showed moderate technological preparedness levels ($M = 3,42$, $SD = 0,76$), with notable differences based on previous technology exposure ($t(282) = 4,23$, $p < 0,001$) and academic focus ($F(3,280) = 8,91$, $p < 0,001$). Island-specific obstacles included unreliable internet access (78 % experienced problems) and inadequate technological infrastructure at training institutions.

Conclusions: although teacher trainees express enthusiasm for technology integration, systematic enhancements to teacher education programs and infrastructure development remain crucial for effective technology-enhanced English language instruction in island settings.

Keywords: Teacher Trainees; Technology Integration; English Language Instruction; Teacher Preparedness; Island Education; Andaman Nicobar Islands.

RESUMEN

Introducción: la integración de la tecnología en la enseñanza del inglés se ha vuelto esencial, especialmente en áreas geográficamente aisladas donde los recursos educativos convencionales son limitados. La geografía particular de las islas Andamán y Nicobar genera tanto obstáculos como oportunidades para la educación lingüística apoyada en la tecnología.

Objetivo: examinar el grado de preparación de los docentes en formación en las islas Andamán y Nicobar para implementar la enseñanza del inglés mediada por la tecnología, identificando a su vez los principales factores que influyen en su disposición y nivel de competencias.

Método: mediante un diseño de métodos mixtos, se estudiaron 284 docentes en formación de tres instituciones de educación docente de las islas Andamán y Nicobar. Los datos se obtuvieron a través de la Technology Integration Preparedness Scale (TIPS) validada, encuestas demográficas y sesiones de grupos focales. Se realizaron análisis descriptivos, pruebas t independientes, ANOVA y análisis de correlación utilizando SPSS 29.0.

Resultados: los docentes en formación mostraron niveles moderados de preparación tecnológica ($M = 3,42$, $DE = 0,76$), con diferencias significativas según la exposición previa a la tecnología ($t(282) = 4,23$, $p < 0,001$) y el enfoque académico ($F(3,280) = 8,91$, $p < 0,001$). Entre los obstáculos específicos de las islas destacaron la conectividad inestable a internet (78 % reportó problemas) y la insuficiente infraestructura tecnológica en las instituciones formadoras.

Conclusiones: aunque los docentes en formación expresan entusiasmo por la integración de la tecnología, resultan fundamentales las mejoras sistemáticas en los programas de formación docente y el desarrollo de infraestructura para lograr una enseñanza del inglés eficaz mediada por tecnología en contextos insulares.

Palabras clave: Docentes en Formación; Integración Tecnológica; Enseñanza del Idioma Inglés; Preparación Docente; Educación Insular; Islas Andamán y Nicobar

INTRODUCTION

The COVID-19 pandemic accelerated a fundamental shift in global education, transforming technology integration from an optional enhancement to an urgent necessity. This transformation directly supports the United Nations Sustainable Development Goal 4, which emphasizes inclusive and equitable quality education through innovative teaching approaches. Educational digitalization has dramatically reshaped teaching methods, particularly in English language instruction where technology creates unprecedented possibilities for interactive, multimedia-rich learning environments.^(1,2) Teacher preparation programs globally face the challenge of adequately equipping future educators to successfully incorporate technology into their teaching practices.^(3,4) This challenge intensifies in geographically isolated regions like island territories, where distinctive contextual elements affect both the necessity and practicality of technology integration.⁽⁵⁾

The Andaman Nicobar Islands, comprising 572 islands as a union territory of India, offer a unique case for examining teacher trainee readiness for technology-enhanced English language instruction. Housing approximately 400 000 people across varied linguistic and cultural communities, these islands encounter substantial educational delivery challenges, including infrastructure limitations, geographical separation, and diverse student populations requiring differentiated teaching approaches.⁽⁶⁾

English language instruction holds special importance in the Andaman Nicobar Islands, serving both as an instructional medium and a connecting language among diverse ethnic groups. Technology integration in English language teaching (TELT) represents a promising solution for overcoming geographical obstacles and improving learning outcomes.^(7,8) However, successful technology integration depends heavily on teacher readiness and competency levels.^(9,10)

While extensive research has explored technology integration in teacher education across various contexts, a critical gap exists in understanding how teacher trainees in geographically isolated, resource-constrained island environments prepare for technology-enhanced instruction. Previous studies have predominantly focused on mainland settings or developed island nations, leaving unexplored the unique intersection of geographical isolation, infrastructure limitations, multicultural educational contexts, and technology integration preparedness in developing island territories. Furthermore, despite growing recognition of Small Island Developing States' specific educational challenges, empirical evidence examining teacher trainee preparedness in these contexts remains scarce. This study addresses this gap by investigating teacher trainee preparedness in the Andaman Nicobar Islands, providing evidence-based insights for teacher education policy and practice in similar contexts worldwide.

Technology Integration in English Language Teaching

Current research highlights technology's transformative potential in English language instruction. Digital tools and platforms create opportunities for authentic language practice, immediate feedback, and personalized learning experiences that traditional approaches cannot match.^(11,12) Interactive whiteboards, language learning applications, virtual reality environments, and online collaboration platforms have shown positive impacts on language acquisition, student engagement, and learning results.^(13,14)

Computer-Assisted Language Learning (CALL) has evolved considerably from early drill-and-practice formats to sophisticated multimedia environments supporting communicative language teaching methods.^(15,16) Web 2.0 technologies have further expanded possibilities for collaborative learning, authentic communication, and learner independence in language education.^(17,18)

Nevertheless, successful technology integration requires more than simply accessing digital tools. The Technology Pedagogy Content Knowledge (TPACK) framework developed by Mishra and Koehler highlights the complex relationships between technological knowledge, pedagogical knowledge, and content knowledge in effective technology integration.⁽¹⁹⁾ For English language teachers, this means understanding how technology can

improve specific language skills, accommodate diverse learning styles, and create meaningful communication opportunities.^(20,21)

Recent advances in artificial intelligence and machine learning have introduced new possibilities for language learning through intelligent tutoring systems, automated feedback mechanisms, and adaptive learning platforms.^(22,23) These technological developments require teachers to develop new competencies in understanding and implementing AI-enhanced language instruction.⁽²⁴⁾

Teacher Trainee Preparedness

Teacher preparedness encompasses multiple aspects including technological competency, pedagogical knowledge, confidence levels, and attitudes toward technology integration.^(25,26) Research consistently shows that teacher trainees' preparedness significantly influences their future technology integration practices.^(27,28,29)

Digital competence has become central to discussions of teacher preparation in the 21st century.^(30,31) This encompasses not only technical skills but also pedagogical reasoning about technology use, critical evaluation of digital resources, and understanding of digital citizenship and ethics.^(32,33)

Research has identified several factors affecting teacher trainee preparedness for technology integration: previous technology experience, quality of teacher education programs, technology access during training, modeling by teacher educators, and opportunities for hands-on practice.^(34,35,36) Additionally, contextual factors such as institutional support, available resources, and cultural attitudes toward technology adoption play crucial roles in shaping preparedness levels.^(37,38)

Self-efficacy in technology integration has been emphasized in numerous studies, with teacher confidence emerging as a critical predictor of successful technology implementation.^(39,40) Teacher trainees with higher technology self-efficacy levels are more likely to experiment with new tools and persist through implementation challenges.⁽⁴¹⁾

Island-Based Education Contexts

Island education systems encounter unique challenges that affect technology integration initiatives. Geographical isolation often leads to limited internet connectivity, delayed technology updates, and difficulties accessing professional development opportunities.^(42,43) However, these same challenges may create stronger motivation for technology adoption as a means to overcome geographical barriers and connect with global educational resources.^(44,45)

Small Island Developing States (SIDS) have increasingly recognized information and communication technologies' (ICTs) potential to address educational disadvantages and promote sustainable development.⁽⁴⁶⁾ However, the digital divide remains a significant challenge, with infrastructure limitations, high connectivity costs, and limited technical support creating barriers to effective technology integration.⁽⁴⁷⁾ Previous research in island contexts has emphasized the importance of contextually relevant teacher preparation programs that address specific challenges and leverage unique opportunities present in island environments.^(43,48) The cultural dimensions of technology adoption in island communities require careful consideration, as traditional values and practices may influence acceptance and implementation of educational technologies.

The Andaman Nicobar Islands, with their diverse population and strategic location, provide an ideal setting for examining how contextual factors influence teacher trainee preparedness for technology integration. The islands' multicultural environment, with indigenous tribes, mainland Indian populations, and diverse linguistic communities, presents unique opportunities for exploring culturally responsive technology integration approaches.

Research Objectives

To comprehensively assess teacher trainee preparedness for technology-enhanced English language instruction in the Andaman Nicobar Islands by examining current preparedness levels, identifying influential factors including demographic variables and prior experiences, exploring island-specific challenges and opportunities, and establishing the relationship between technological competency and implementation confidence, thereby providing evidence-based recommendations for improving teacher education programs in island contexts.

METHOD

Research Design

This study employed a convergent parallel mixed-methods design, combining quantitative and qualitative approaches to provide comprehensive understanding of teacher trainee preparedness for technology-enhanced English language instruction.⁽⁴⁹⁾ The mixed-methods approach was selected to capitalize on the strengths of both paradigms: quantitative methods allowed for systematic measurement of preparedness levels and statistical examination of relationships between variables across a large sample, while qualitative methods enabled deep exploration of contextual factors, lived experiences, and nuanced perspectives that numerical data alone

cannot capture. The quantitative component used a cross-sectional survey design to measure preparedness levels and examine variable relationships, while the qualitative component employed focus group discussions to explore contextual factors and lived experiences.⁽⁵⁰⁾ Both components were conducted concurrently during the same timeframe, with data collection occurring simultaneously to capture teacher trainees' preparedness and perspectives at the same point in their preparation. The integration of quantitative and qualitative findings occurred during the interpretation phase, where statistical patterns were illuminated and contextualized through qualitative insights, creating a more complete understanding of teacher trainee preparedness than either method could achieve independently.

Participants

The study population consisted of teacher trainees enrolled in English language education programs across three teacher education institutions in the Andaman Nicobar Islands: the Regional Institute of Education (RIE), Andaman Nicobar Institute of Teacher Training, and the Island Education College. We employed stratified random sampling to ensure representation across institutions, academic years, and demographic characteristics.⁽⁵¹⁾

Sample Size Calculation

Using G*Power 3.1.9.7, with an effect size of 0,3, alpha level of 0,05, and power of 0,80, we calculated the minimum required sample size as 276 participants.⁽⁵²⁾ To account for potential non-response and ensure adequate representation, we initially recruited 320 teacher trainees, with 284 completing the full survey (response rate: 88,75 %).

Participant Demographics

The final sample included 284 teacher trainees (158 female, 126 male) aged 19-26 years ($M = 21,4$, $SD = 1,8$). Participants were distributed across academic specialisations: English Literature ($n = 112$), English Language Teaching ($n = 98$), Applied Linguistics ($n = 45$), and Educational Technology ($n = 29$).

Instruments

Technology Integration Preparedness Scale (TIPS)

We developed a 45-item validated instrument based on the TPACK framework and adapted for English language teaching contexts.^(36,53) The scale underwent rigorous validation through a multi-stage process. Initial item development involved extensive literature review and consultation with expert panels comprising teacher educators, educational technology specialists, and English language teaching professionals. The preliminary 60-item instrument was pilot-tested with 85 teacher trainees from institutions not included in the main study. Exploratory factor analysis (EFA) using principal axis factoring with oblimin rotation confirmed the five-dimensional structure, with items loading above 0,40 on their respective factors and cross-loadings below 0,32. Based on EFA results and item-total correlations, 15 items with poor psychometric properties were eliminated, resulting in the final 45-item scale. Confirmatory factor analysis (CFA) performed on an independent sample ($n = 152$) demonstrated acceptable model fit indices: $\chi^2/df = 2,34$, CFI = 0,92, TLI = 0,91, RMSEA = 0,06 (90 % CI: 0,05-0,07), SRMR = 0,05. Factor loadings in the CFA ranged from 0,58 to 0,87, all significant at $p < ,001$. The scale measured five dimensions:

- Technological Knowledge (TK): 9 items measuring proficiency with educational technologies (sample item: "I am confident in using various digital tools for educational purposes")
- Pedagogical Knowledge (PK): 8 items assessing teaching methodologies and strategies (sample item: "I can design learning activities that accommodate different learning styles")
- Content Knowledge (CK): 8 items evaluating English language teaching expertise (sample item: "I have deep understanding of English language structure and usage")
- Technology-Pedagogy Knowledge (TPK): 10 items measuring integration of technology with pedagogy (sample item: "I can select appropriate technologies to enhance specific teaching strategies")
- Technology-Content Knowledge (TCK): 10 items assessing technology use for English language instruction (sample item: "I know how to use technology to teach English grammar effectively")

Items were rated on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The scale demonstrated excellent internal consistency (Cronbach's $\alpha = 0,94$) with acceptable reliability across all subscales (α ranging from 0,78 to 0,91), meeting standards recommended by Nunnally et al.⁽⁵⁴⁾

Demographic and Background Questionnaire

A structured questionnaire collected information on age, gender, academic specialization, prior technology experience, technology access, and institutional characteristics. Additional items assessed participants' perceptions of technology integration challenges specific to island contexts, following guidelines established by⁽⁵⁵⁾.

Focus Group Discussion Guide

Semi-structured focus group discussions were conducted with 48 participants (8 groups of 6 participants each) to explore qualitative aspects of technology integration preparedness. Focus group participants were purposively selected from the larger survey sample to ensure maximum variation sampling across institutions, academic specializations, gender, and technology experience levels. Specifically, we selected 2-3 participants from each institution representing different preparedness levels (low, moderate, high based on TIPS scores) and ensuring gender balance within each group. Discussion topics included experiences with technology in teacher education programs, perceived challenges and opportunities, and suggestions for program improvement, following best practices outlined by Krueger and Casey.⁽⁵⁶⁾

Procedures

Data collection occurred over a 6-week period during the 2024 academic year, with quantitative surveys and qualitative focus groups conducted concurrently during weeks 2-5 of the data collection window. We obtained ethical approval from institutional review boards of all participating institutions, adhering to guidelines established by the American Educational Research Association.⁽⁵⁷⁾ Informed consent was secured from all participants, emphasizing voluntary participation and confidentiality.

We administered the survey using a mixed-mode approach: online administration for participants with reliable internet access ($n = 198$) and paper-based administration for those with connectivity limitations ($n = 86$). Focus group discussions were conducted in-person at each institution during the same period as survey administration, with sessions audio-recorded and transcribed verbatim.⁽⁵⁸⁾

Ethical Considerations

This study adhered to comprehensive ethical principles throughout all phases. Approval was obtained from the Institutional Ethics Committee of Avinashilingam Institute for Home Science and Higher Education for Women (Approval No: AIHS/IEC/2024/067) and from the institutional review boards of all three participating teacher education institutions. All participants provided written informed consent after receiving detailed information about the study's purpose, procedures, potential risks and benefits, data handling protocols, and their rights as research participants. Participants were explicitly informed of their right to withdraw from the study at any point without penalty or adverse consequences to their academic standing.

To ensure confidentiality, all data were anonymized using unique identification codes, with the key linking codes to participant identities stored separately in a password-protected file accessible only to the principal investigator. Survey responses and focus group transcripts were de-identified before analysis, and any potentially identifying information mentioned during focus groups was removed from transcripts. Data were stored securely on encrypted devices with restricted access. Participants were informed that individual responses would not be shared with their institutions or teacher educators, and that only aggregate findings would be reported in publications.

Special attention was given to minimizing potential power dynamics, as participants were current students. Data collection was conducted by researchers not directly involved in participants' academic assessment to reduce perceived coercion. Focus group discussions were facilitated in a manner that encouraged open dialogue and emphasized that there were no "right" or "wrong" responses. Participants experiencing connectivity issues or other challenges during data collection were provided additional support and accommodations to ensure equitable participation opportunities.

Data Analysis

Quantitative data analysis was conducted using SPSS 29.0 with a comprehensive analytical approach that encompassed multiple statistical techniques. Descriptive statistics including means, standard deviations, frequencies, and percentages were employed to characterize the sample demographics and assess overall preparedness levels across participants. Reliability analysis using Cronbach's alpha was performed to evaluate the internal consistency of measurement scales, ensuring the psychometric properties of the instruments used. To examine group differences, independent t-tests were utilized for comparing outcomes between two groups such as gender and prior experience categories, while one-way ANOVA was applied to analyze variations across multiple groups including academic specialization and institutional affiliations. Pearson correlation analysis was conducted to explore relationships between continuous variables and identify potential associations within the dataset. Finally, multiple regression analysis was implemented to determine significant predictors of technology integration preparedness, allowing for the identification of factors that most strongly influence participants' readiness to integrate technology into their practice or educational contexts.

Effect sizes were calculated and interpreted following Cohen's conventions.⁽⁵²⁾ Qualitative data from focus groups were analyzed using thematic analysis following Braun and Clarke's six-phase approach.⁽⁵⁹⁾ All focus group audio recordings were transcribed verbatim using NVivo 14 software, which was also employed for data

management and coding. The six-phase process began with familiarization, during which both researchers read all transcripts multiple times while noting initial observations. In the initial coding phase, transcripts were systematically coded line-by-line, with codes generated inductively from the data rather than from predetermined categories. For example, when participants discussed connectivity challenges, codes such as “internet_disruption_during_class,” “power_outage_interference,” and “bandwidth_limitations” were applied.

During theme development, related codes were grouped into potential themes through iterative discussion between researchers. The theme “Infrastructure as Persistent Barrier” emerged from clustering codes related to connectivity, equipment, and technical support. Themes were then reviewed against coded extracts and entire transcripts to ensure internal homogeneity and external heterogeneity. The research team collaboratively refined theme definitions and names, ensuring each theme captured a coherent pattern of meaning relevant to the research objective. Finally, vivid extracts were selected to illustrate each theme, with analytic narratives written to explain patterns and their significance. Transcripts were coded independently by two researchers, with inter-rater reliability of 89,3 %, exceeding the minimum threshold recommended by Miles and Huberman.⁽⁶⁰⁾ Discrepancies in coding were resolved through discussion and consensus, with a third researcher consulted when necessary to achieve agreement.

RESULTS

Descriptive Statistics

Overall Preparedness Levels

Teacher trainees demonstrated moderate levels of preparedness for technology-enhanced English language instruction ($M = 3,42$, $SD = 0,76$, $Range = 1,67-4,89$). Table 1 presents descriptive statistics for each TIPS dimension, provides a visual representation of the dimensional comparison using a radar chart.

Dimension	M	SD	Min	Max	Skewness	Kurtosis
Technological Knowledge (TK)	3,28	0,89	1,22	4,89	-0,23	-0,67
Pedagogical Knowledge (PK)	3,67	0,71	1,75	4,88	-0,41	-0,12
Content Knowledge(CK)	3,71	0,68	2,13	4,88	-0,38	-0,19
Technology-Pedagogy Knowledge (TPK)	3,35	0,82	1,40	4,80	-0,19	-0,58
Technology-Content Knowledge (TCK)	3,21	0,91	1,10	4,90	-0,15	-0,74
Overall TIPS Score	3,42	0,76	1,67	4,89	-0,28	-0,45
Note. N = 284. All skewness and kurtosis values fall within acceptable ranges ($\pm 2,0$), indicating normal distribution.						

Preparedness Level Categories

Based on scale ranges, participants were categorized into preparedness levels:

- Low Preparedness (1,00-2,33): 18 participants (6,3 %)
- Moderate Preparedness (2,34-3,66): 187 participants (65,8 %)
- High Preparedness (3,67-5,00): 79 participants (27,8 %)

Institution	Low n	Moderate n	High n	Total
Regional Institute of Education	4 (3,6 %)	69 (62,2 %)	38 (34,2 %)	111
AN Institute of Teacher Training	8 (8,5 %)	65 (69,1 %)	21 (22,3 %)	94
Island Education College	6 (7,6 %)	53 (67,1 %)	20 (25,3 %)	79
Total	18 (6,3 %)	187 (65,8 %)	79 (27,8 %)	284

Inferential Statistics

Independent t-tests revealed no significant gender differences in overall preparedness levels ($t(282) = 1,43$, $p = 0,154$). However, significant differences emerged in specific dimensions:

Table 3. Gender Differences in TIPS Dimensions

Dimension	Male (n=126) M (SD)	Female (n=158) M (SD)	t	df	p	Cohen's d
Technological Knowledge	3,41 (0,87)	3,18 (0,89)	2,18	282	0,030*	0,26
Pedagogical Knowledge	3,59 (0,74)	3,73 (0,68)	-1,67	282	0,096	-0,20
Content Knowledge	3,65 (0,71)	3,76 (0,66)	-1,33	282	0,185	-0,16
TPK	3,31 (0,85)	3,38 (0,80)	-0,73	282	0,468	-0,09
TCK	3,28 (0,92)	3,16 (0,90)	1,09	282	0,277	0,13
Overall TIPS	3,45 (0,78)	3,40 (0,75)	0,54	282	0,588	0,07

Note. *p < 0,05, **p < 0,01, ***p < 0,001

The correlation matrix reveals strong positive relationships among all TIPS dimensions, with Technology-Pedagogy Knowledge (TPK) showing the highest correlation with overall preparedness ($r = 0,89$, $p < 0,001$). Visualizes these correlation strengths between each dimension and the overall TIPS score. All correlations are statistically significant at $p < 0,001$. TPK (Technology-Pedagogy Knowledge) shows the strongest correlation with overall preparedness, followed by TCK (Technology-Content Knowledge) and TK (Technological Knowledge).

Academic Specialization Differences

One-way ANOVA revealed significant differences in preparedness levels across academic specializations ($F(3,280) = 8,91$, $p < 0,001$, $\eta^2 = 0,087$).

Table 4. ANOVA Results for Academic Specialization Differences

Dimension	English Literature M (SD)	ELT M (SD)	Applied Linguistics M (SD)	Educational Technology M (SD)	F	p	η^2
TK	3,12 (0,85)	3,25 (0,89)	3,41 (0,91)	3,89 (0,76)	7,23	0,000***	0,072
PK	3,71 (0,68)	3,76 (0,71)	3,58 (0,76)	3,45 (0,79)	2,14	0,095	0,022
CK	3,78 (0,65)	3,82 (0,67)	3,67 (0,73)	3,41 (0,71)	3,58	0,014*	0,037
TPK	3,19 (0,79)	3,34 (0,82)	3,48 (0,85)	3,72 (0,76)	4,89	0,003**	0,050
TCK	3,05 (0,88)	3,18 (0,91)	3,35 (0,94)	3,76 (0,83)	6,12	0,001**	0,062
Overall	3,32 (0,73)	3,41 (0,76)	3,48 (0,79)	3,78 (0,71)	8,91	0,000*	0,087

Note: ELT = English Language Teaching. *p < 0,05, **p < 0,01, ***p < 0,001

Post-hoc Tukey tests indicated that Educational Technology students scored significantly higher than English Literature students across all dimensions except Pedagogical Knowledge and Content Knowledge. Provides a visual comparison of overall preparedness scores across academic specializations.

Prior Technology Experience Impact

Participants were categorized based on prior technology experience: Limited ($n = 89$), Moderate ($n = 134$), and Extensive ($n = 61$). One-way ANOVA revealed significant differences ($F(2,281) = 24,67$, $p < 0,001$, $\eta^2 = 0,149$).

Table 5. Impact of Prior Technology Experience on Preparedness

Experience Level	M	SD	95 % CI	n
Limited	3,12	0,71	[2,97, 3,27]	89
Moderate	3,45	0,73	[3,32, 3,57]	134
Extensive	3,78	0,78	[3,58, 3,98]	61

Post-hoc analyses revealed significant differences between all groups ($p < 0,001$), with effect sizes ranging from medium to large (Cohen's $d = 0,46$ to $0,89$). Illustrates the progressive increase in preparedness levels with increased technology experience

Correlation Analysis

Pearson correlations examined relationships between preparedness dimensions and relevant variables.

Variable	1	2	3	4	5	6	7	8
1. TK	-							
2. PK	0,52***	-						
3. CK	0,41***	0,69***	-					
4. TPK	0,73***	0,68***	0,52***	-				
5. TCK	0,78***	0,48***	0,61***	0,71***	-			
6. Overall TIPS	0,85***	0,78***	0,75***	0,89***	0,87***	-		
7. Age	0,23***	0,18**	0,15*	0,21***	0,19**	0,22***	-	
8. Tech Experience	0,58***	0,34***	0,28***	0,49***	0,52***	0,56***	0,31***	-

Note: *p < 0,05, **p < 0,01, ***p < 0,001

Multiple Regression Analysis

We conducted a hierarchical multiple regression analysis to identify predictors of overall technology integration preparedness. Variables were entered in three blocks: demographic variables (Block 1), institutional factors (Block 2), and technology-related factors (Block 3).

Variable	Block 1 B	Block 2 B	Block 3 B
Demographics			
Age	0,18**	0,16**	0,09
Gender (Male = 1)	0,05	0,04	0,03
Institutional Factors			
Institution Type		0,12*	0,08
Program Quality Rating		0,24***	0,15**
Technology Factors			
Prior Tech Experience			0,38***
Access to Technology			0,22***
Technology Training Hours			0,19**
Model Statistics			
R ²	0,034	0,095	0,387
ΔR ²	0,034***	0,061***	0,292***
F	4,91***	7,32***	21,47***

Note: *p < 0,05, **p < 0,01, ***p < 0,001

The final model explained 38,7 % of the variance in technology integration preparedness. Prior technology experience emerged as the strongest predictor ($\beta = 0,38$, $p < 0,001$), followed by access to technology ($\beta = 0,22$, $p < 0,001$) and technology training hours ($\beta = 0,19$, $p < 0,01$).

Island-Specific Challenges and Opportunities

Infrastructure Challenges

Survey data revealed significant infrastructure-related challenges affecting technology integration preparedness:

Challenge	Frequency	Percentage
Unreliable internet connectivity	221	77,8
Limited bandwidth	198	69,7
Frequent power outages	156	54,9
Outdated technology equipment	189	66,5
Lack of technical support	167	58,8
High technology costs	203	71,5
Limited access to digital resources	178	62,7

These infrastructure challenges represent significant barriers to effective technology integration in the island context. Provides a visual representation of the prevalence of each challenge, highlighting the need for systematic infrastructure improvements.

Perceived Benefits and Opportunities

Despite challenges, participants identified several unique opportunities for technology integration in island contexts:

Table 9. Perceived Opportunities for Technology Integration		
Opportunity	Mean Rating*	SD
Connecting with global educational resources	4,23	0,78
Overcoming geographical isolation	4,45	0,71
Supporting diverse linguistic backgrounds	4,12	0,83
Enhancing student motivation	4,31	0,76
Improving English language proficiency	4,38	0,74
Facilitating peer collaboration	3,98	0,89
Enabling personalized learning	4,05	0,81
Note. Rated on 5-point scale: 1 = Not beneficial, 5 = Extremely beneficial		

Focus Group Findings

Thematic analysis of focus group discussions revealed four major themes related to teacher trainee preparedness

Theme 1: Technology as Essential for Island Education

Participants consistently emphasized technology's critical role in overcoming geographical barriers. One participant noted: "Living on an island, we understand more than anyone how technology can bridge distances. When we can't physically access resources or experts, technology becomes our lifeline to the wider world of education."

Theme 2: Inadequate Preparation in Teacher Education Programs

Many participants expressed concerns about the gap between technology integration theory and practical application in their preparation programs: "We learn about different educational technologies and their benefits, but we rarely get hands-on experience with implementing them in real classroom settings. The practice teaching component needs more technology integration."

Theme 3: Infrastructure as a Persistent Barrier

Connectivity issues and infrastructure limitations were consistently identified as major obstacles: "It's frustrating when you're excited to try new digital teaching methods, but the internet fails during class. We need better infrastructure before we can fully embrace technology-enhanced teaching."

Theme 4: Community and Cultural Considerations

Participants highlighted the importance of adapting technology integration to local cultural contexts: "We serve communities with diverse cultural backgrounds and languages. Technology integration needs to respect and incorporate local knowledge and practices, not replace them."

DISCUSSION

Teacher Trainee Preparedness Levels

The moderate preparedness levels observed in this study ($M = 3,42$, $SD = 0,76$) reveal a complex picture that both confirms and extends existing theoretical frameworks. While previous research has documented similar moderate preparedness levels in various contexts,^(3,61,62) our findings challenge the assumption that geographical isolation necessarily results in lower technological competency. The distribution showing 27,8 % of participants with high preparedness suggests that island contexts may foster unique motivations for technology adoption, supporting Baldacchino's theory that geographical constraints can paradoxically strengthen innovation imperatives.⁽⁴⁴⁾

The dimensional analysis reveals a critical insight: the gap between strong Content Knowledge ($M = 3,71$) and Pedagogical Knowledge ($M = 3,67$) compared to weaker Technological Knowledge ($M = 3,28$) and Technology-

Content Knowledge ($M = 3,21$) fundamentally challenges the TPACK framework's assumption of parallel development across domains. This pattern suggests that teacher education in island contexts successfully develops foundational teaching competencies but struggles to integrate technological dimensions. This finding extends Koehler and Mishra's framework by highlighting how contextual constraints-particularly infrastructure limitations-may impede the natural progression from separate knowledge domains to integrated TPACK.^(63,64)

Importantly, our results contradict the deficit model often applied to island education. Rather than indicating inadequate preparation, the strong pedagogical and content foundations demonstrate that island-based teacher education institutions successfully develop core teaching competencies. The challenge lies not in educational quality per se, but in the specific integration of technology-a distinction with significant implications for intervention design.

Challenging Assumptions About Gender and Technology

The absence of overall gender differences in preparedness levels ($t(282) = 1,43$, $p = ,154$) directly contradicts prevailing literature suggesting persistent gender gaps in technology integration.^(65,66) This unexpected finding demands theoretical reconsideration. Several competing explanations emerge: First, the island context may create equalizing conditions where geographical isolation necessitates technology adoption regardless of gender, effectively neutralizing traditional gender socialization patterns around technology. Second, the specific population-teacher trainees committed to English language education-may represent a self-selected group with non-traditional gender attitudes toward technology.

However, the significant difference in Technological Knowledge favoring male participants (Cohen's $d = 0,26$) reveals a more nuanced reality.⁽⁶⁷⁾ While overall preparedness shows parity, specific technical competencies remain gendered. This pattern suggests that female teacher trainees compensate for lower technical skills through stronger integration strategies (TPK) or pedagogical applications. This interpretation aligns with and extends Meelissen and Drent's work on gendered technology competencies, suggesting that gender influences the pathway to technology integration preparedness rather than the destination.⁽⁶⁷⁾

Academic Specialization: Revealing Program Design Flaws

The substantial differences across academic specializations ($\eta^2 = 0,087$) expose systematic gaps in curriculum design. Educational Technology students' superior performance was predictable, but the English Literature students' significantly lower technological competencies reveal a troubling pattern: traditional disciplinary boundaries actively hinder technology integration preparation.^(68,69)

This finding challenges current teacher education models that treat technology integration as discipline-specific rather than foundational. The small differences in Pedagogical Knowledge and Content Knowledge across specializations indicate successful standardization of teaching fundamentals, yet the failure to similarly standardize technological competencies suggests institutional blind spots.^(70,71) Teacher education programs appear to operate under an outdated assumption that technology integration is relevant only for certain specializations-a stance increasingly untenable in digitalized educational environments.

These results support Tearle's argument that institutional factors, particularly program design, significantly influence technology integration readiness.⁽⁶⁸⁾ However, we extend this work by demonstrating how disciplinary identities within teacher education perpetuate digital divides, with literature-focused programs inadequately preparing teachers for technology-enhanced instruction despite serving students who will teach in increasingly digitalized classrooms.

Prior Experience: Unpacking the Strongest Predictor

Prior technology experience's dominant influence ($B = 0,38$, $\eta^2 = 0,149$, effect sizes $0,46-0,89$) both confirms and complicates existing literature.^(34,35,72) While previous research has identified experience as important, our findings reveal its disproportionate impact in island contexts, where it explains nearly 39 % of preparedness variance when combined with other technology factors.

This pattern suggests that island contexts may create a "technology exposure gap" where limited infrastructure and resources during childhood and secondary education compound over time, creating substantial preparation disparities by the time students enter teacher education. The large effect sizes between experience groups indicate that teacher education programs are inadequately compensating for incoming disparities-essentially, programs are failing to serve as equalizers for students with limited prior exposure.^(73,74)

The strong correlations between all TIPS dimensions and overall preparedness ($r = 0,75$ to $0,89$) support the TPACK framework's emphasis on integrated knowledge development. However, our regression results complicate this picture: while the framework suggests balanced development across domains, actual preparedness is overwhelmingly predicted by prior experience and access-factors external to teacher education curricula. This tension suggests that the TPACK framework, while theoretically sound, may underestimate the importance of experiential learning and access to technology resources in developing integrated knowledge.

Infrastructure: Beyond Barriers to Systemic Constraints

The pervasive infrastructure challenges (77,8 % reporting unreliable connectivity) transcend individual barriers to represent systemic constraints that fundamentally shape what is possible in island-based teacher education.^(5,42) While previous research has documented infrastructure challenges, our data reveal their comprehensive scope: spanning connectivity (77,8 %), bandwidth (69,7 %), power supply (54,9 %), equipment quality (66,5 %), technical support (58,8 %), costs (71,5 %), and resource access (62,7 %).

This multidimensional infrastructure deficit creates a paradoxical situation: teacher trainees recognize technology's transformative potential ($M = 4,45$ for overcoming isolation; $M = 4,23$ for global resource access) while simultaneously facing systematic obstacles to developing and implementing technological competencies. This contradiction challenges the assumption that positive attitudes toward technology naturally translate into successful integration.^(75,76)

Our findings extend Trucano's and Higgins' work on educational technology in resource-constrained environments by demonstrating how infrastructure deficits create what we term "preparation-implementation gaps."^(75,76) Teacher trainees may complete preparation programs with adequate knowledge and positive attitudes, yet face implementation environments where their preparation cannot be effectively applied. This gap suggests that traditional approaches focusing solely on teacher preparation are insufficient-infrastructure development and teacher preparation must occur simultaneously.

Rethinking Technology Integration in Multilingual Contexts

Participants' strong recognition of technology's potential for supporting diverse linguistic backgrounds ($M = 4,12$) reveals an underexplored dimension of technology integration in multilingual island contexts.^(79,80) The Andaman Nicobar Islands' linguistic diversity-with English serving as a connecting language among indigenous tribes, mainland populations, and various ethnic communities-creates unique opportunities and challenges for technology-enhanced language instruction.

This finding extends Crystal's and Kachru's work on English as a global language by suggesting that technology integration in multilingual contexts requires fundamentally different approaches than in monolingual settings.^(79,80) Teacher trainees in the Andaman Nicobar Islands must navigate not only the technological, pedagogical, and content knowledge domains of the TPACK framework but also an additional dimension: linguistic and cultural diversity. This suggests the need for an expanded framework-perhaps "TPACK+D" (Diversity)-that explicitly addresses technology integration in multicultural, multilingual educational contexts.

Theoretical Implications and Framework Extensions

Our findings suggest three key extensions to existing theoretical frameworks: first, the TPACK framework requires contextual adaptation for resource-constrained environments. The assumption of relatively equal access to technological resources embedded in TPACK may not hold in island contexts, necessitating explicit attention to infrastructure and access as framework components.

Second, the relationship between teacher attitudes and implementation success requires reconsideration. The combination of strong positive attitudes toward technology (evidenced in opportunity ratings) with moderate actual preparedness suggests that attitude-behavior models of technology adoption may oversimplify the implementation process in constrained contexts.

Third, our focus group findings suggest that culturally responsive technology integration represents a distinct competency requiring explicit preparation. The emphasis participants placed on adapting technology to local cultural contexts indicates that effective technology integration in diverse settings requires not only technological and pedagogical knowledge but also cultural competence and adaptability.

Program and Policy Implications

These findings necessitate fundamental reconsideration of teacher education approaches in island contexts: Teacher education programs must abandon the isolated technology course model in favor of comprehensive integration throughout curricula, with explicit connections to pedagogical and content knowledge in every course, not just technology-focused offerings.^(81,82) The gap between theoretical knowledge and practical application requires dramatic expansion of authentic practice opportunities, including technology-enhanced practice teaching experiences in real classroom settings with appropriate mentoring and support.^(83,84) Programs must explicitly address context-specific challenges through curriculum components focused on adapting technology integration strategies to infrastructure constraints, cultural diversity, and resource limitations characteristic of island environments.^(43,45) The strong influence of prior technology experience necessitates diagnostic assessment of incoming students' technology competencies, followed by differentiated preparation pathways that provide intensive support for students with limited prior exposure while challenging those with extensive backgrounds.^(85,86)

Infrastructure development must occur simultaneously with teacher preparation. Our findings demonstrate

that teacher education improvements alone cannot overcome systematic infrastructure deficits. Policy interventions must prioritize reliable connectivity, modernized equipment, robust technical support systems, and sustainable funding mechanisms for ongoing technology maintenance and updates.^(87,88,89)

Acknowledging Limitations and Methodological Considerations

The cross-sectional design limits causal inference and provides only a temporal snapshot of preparedness.⁽⁹⁰⁾ Longitudinal research tracking teacher trainees through preparation and into professional practice would reveal whether preparedness levels translate into actual classroom technology integration and how preparedness evolves over time.

Self-report measures, while valuable for assessing perceptions and self-efficacy, may not accurately reflect actual technological competencies.⁽⁹¹⁾ Future research should incorporate performance-based assessments requiring participants to demonstrate technology integration skills in authentic or simulated teaching scenarios.

Generalizability beyond island contexts requires careful consideration.⁽⁹²⁾ While our findings provide valuable insights for geographically isolated settings, the specific challenges and opportunities of the Andaman Nicobar Islands may not directly translate to other contexts. Comparative research across multiple island territories and between island and mainland settings would clarify which findings reflect island-specific phenomena versus broader patterns.

The rapidly evolving technology landscape means specific tools and competencies assessed here may become obsolete.⁽⁹³⁾ However, the underlying principles of technology integration-the relationships between technological, pedagogical, and content knowledge-remain relevant across technological generations.^(94,95,96)

CONCLUSIONS

This study examined teacher trainee preparedness for technology-enhanced English language instruction in the Andaman Nicobar Islands, revealing moderate preparedness levels significantly influenced by prior technology experience, academic specialization, and institutional factors. The research objective-to comprehensively assess preparedness while identifying influential factors and island-specific challenges-has been achieved, providing evidence-based insights for teacher education improvement.

Three critical conclusions emerge from this investigation

First, teacher trainees possess strong foundational pedagogical and content knowledge but demonstrate significant gaps in technological competencies and technology integration skills. This pattern indicates that teacher education programs successfully develop core teaching competencies yet inadequately address technology integration, suggesting the need for systematic curriculum redesign that embeds technology throughout all program components rather than treating it as a separate subject area.

Second, prior technology experience emerged as the strongest predictor of preparedness, explaining substantial variance even when controlling for demographic and institutional factors. This finding reveals that teacher education programs are insufficiently compensating for incoming disparities in technology exposure, effectively perpetuating rather than mitigating digital divides. Programs must implement diagnostic assessments and differentiated preparation pathways to ensure all teacher trainees, regardless of prior experience, develop necessary technology integration competencies.

Third, pervasive infrastructure challenges create fundamental constraints on both preparation and implementation of technology-enhanced instruction. With over three-quarters of participants reporting unreliable internet connectivity and substantial majorities experiencing limitations in bandwidth, equipment, technical support, and resource access, infrastructure deficits represent systematic barriers that teacher preparation alone cannot overcome. Effective technology integration in island contexts requires coordinated policy interventions addressing both human capacity development and technological infrastructure simultaneously.

The island context of the Andaman Nicobar Islands offers valuable lessons for geographically isolated regions worldwide, demonstrating that while constraints are significant, teacher trainees recognize technology's transformative potential for overcoming geographical barriers and enhancing English language instruction. This combination of challenges and opportunities creates an urgent imperative for comprehensive, context-responsive approaches to technology integration in teacher education.

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CONFLICT OF INTEREST

None.

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