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Research Paper

Digital Divide and Educational Inequality in Northeast Thailand: A Mixed-Methods Research and Development Study in Four Provinces

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Abstract:

Background: Educational inequality in Thailand's Northeast region has been exacerbated by the digital divide, particularly following COVID-19's acceleration of digital learning adoption. The intersection of technological disparities with existing socioeconomic inequalities creates complex barriers to educational equity in rural communities.

Purpose: This study examines the multifaceted nature of educational digital divides in Northeast Thailand and develops a comprehensive framework for addressing educational inequality through technology integration and community-based interventions.

Methods: A mixed-methods Research and Development (R&D) approach was employed across four provinces in Northeast Thailand (Khon Kaen, Udon Thani, Nong Khai, and Loei). Quantitative data were collected from 487 participants including students, teachers, and administrators across 48 schools. Qualitative data involved in-depth interviews with 45 stakeholders and focus group discussions. Statistical analyses included descriptive statistics, correlation analysis, and multiple regression analysis using SPSS 26.0.

Results: Significant disparities were found in digital access: urban schools averaged 78.3% high-speed internet connectivity compared to 34.7% in rural areas ($p < 0.001$). Students from higher socioeconomic backgrounds demonstrated superior digital literacy skills ($M = 4.2$, $SD = 0.7$) compared to their disadvantaged peers ($M = 2.8$, $SD = 0.9$), $t(485) = 14.23$, $p < 0.001$. The developed Educational Digital Equity Framework showed promising results in pilot implementation, with participant schools demonstrating 23% improvement in digital engagement and 18% increase in academic performance over six months.

Conclusions: Educational inequality in Northeast Thailand requires comprehensive interventions addressing infrastructure, digital literacy, teacher capacity, and community engagement. The research-developed framework provides actionable strategies for policymakers and educators to leverage technology as a tool for educational equity rather than division.

Keywords: digital divide, educational inequality, Northeast Thailand, rural education, mixed-methods research, R&D methodology

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1. INTRODUCTION

Educational inequality represents one of the most persistent challenges facing developing nations in the 21st century, with technology serving as both a potential equalizer and a source of new disparities (Reich & Mehta, 2020). Thailand's Northeast region, known locally as Isan, encompasses 20 provinces and houses approximately one-third of the country's population, yet consistently ranks lowest in educational achievement indicators nationally (Office of the Education Council, 2020). The region's educational challenges are compounded by geographic isolation, economic disadvantage, and linguistic diversity, creating complex barriers to educational equity that require innovative solutions.

The COVID-19 pandemic has accelerated global adoption of digital learning technologies while simultaneously exposing stark inequalities in technological access and digital literacy (König et al., 2020). In Thailand, the sudden shift to remote learning highlighted profound disparities between urban and rural educational opportunities, with many students in Northeast Thailand unable to participate effectively in digital education due to inadequate infrastructure, limited device access, and insufficient digital skills (Pholphirul & Rugchatjaroen, 2021).

Thailand's Northeast region provides a compelling context for examining educational digital divides due to its unique socioeconomic and cultural characteristics. The region exhibits the highest poverty rates nationally, with 85% of the population engaged in agricultural activities and significant portions employed in informal economic sectors (National Statistical Office, 2021). Additionally, the region's cultural and linguistic diversity, including Lao, Khmer, and various ethnic minority languages, creates additional layers of complexity in educational delivery and technology integration.

The significance of addressing educational inequality in Northeast Thailand extends beyond regional concerns to encompass national development goals outlined in the Thailand 4.0 initiative, which emphasizes transition toward a knowledge-based economy (Intarakumnerd & Chaminade, 2021). Educational equity becomes not merely a social justice imperative but an economic necessity for sustainable national development. The persistence of educational disparities threatens to create a stratified society where opportunities are predetermined by geographic and socioeconomic circumstances rather than individual potential.

This study addresses the critical need for evidence-based strategies to address educational digital divides in Northeast Thailand. Through a mixed-methods Research and Development (R&D) approach, the research examines current patterns of educational inequality, analyzes the role of digital technologies in either perpetuating or alleviating these disparities, and develops a comprehensive framework for promoting educational equity through strategic technology integration and community engagement.

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2. LITERATURE REVIEW

2.1 Digital Divide Theory and Educational Contexts

The concept of digital divide has evolved from simple binary distinctions between technology "haves" and "have-nots" to more nuanced understanding of multiple levels of digital inequality (Van Dijk, 2020). Van Deursen and Helsper (2015) identify four levels of digital divide: motivational access, material access, skills access, and usage access. In educational contexts, these levels manifest as disparities in student motivation to engage with technology, availability of devices and connectivity, digital literacy capabilities, and meaningful use of technology for learning enhancement.

Recent research emphasizes that digital divides in education are not merely technical challenges but reflect broader patterns of social and economic inequality (Beaunoyer et al., 2020). Students from disadvantaged backgrounds face compound barriers including limited home internet access, shared or outdated devices, inadequate technical support, and reduced digital literacy development opportunities. These technological disparities intersect with existing educational inequalities to create what scholars term "compound disadvantage" in digital learning environments.

2.2 Educational Inequality in Southeast Asian Contexts

Educational inequality across Southeast Asia reflects complex interactions between economic development patterns, cultural diversity, and governance structures (Bjork, 2019). Thailand's educational challenges parallel those of other middle-income countries in the region, including persistent rural-urban achievement gaps, quality variations between public and private schools, and limited access to higher education among disadvantaged populations.

Comparative studies across ASEAN nations reveal that countries with similar economic profiles face analogous educational equity challenges, suggesting that Thailand's experience offers broader regional relevance (Chudgar et al., 2019). The intersection of technological advancement with existing educational inequalities creates both opportunities and risks, with technology potentially serving as either an equalizing force or a source of additional stratification depending on implementation approaches.

2.3 Rural Education and Technology Integration

Rural education research emphasizes the unique challenges and opportunities associated with technology integration in geographically isolated communities (Azano & Stewart, 2015). Rural schools often face infrastructure limitations, teacher recruitment difficulties, and limited access to professional development opportunities, creating barriers to effective technology implementation. However, rural communities also demonstrate significant assets including strong social cohesion, local knowledge systems, and innovative problem-solving capabilities that can support educational technology initiatives.

Studies of successful rural technology integration emphasize the importance of community engagement, culturally responsive implementation, and sustainable support

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systems (Barbour & LaBonte, 2017). Programs that acknowledge and build upon local assets while addressing specific infrastructure and capacity needs demonstrate greater effectiveness than top-down technology initiatives that ignore local contexts and needs.

2.4 Digital Literacy and Educational Outcomes

Digital literacy research reveals significant variations in students' technological capabilities, with socioeconomic status serving as a primary predictor of digital skill development (Hargittai & Micheli, 2019). Students from privileged backgrounds typically develop more sophisticated digital literacies through informal learning opportunities, family support, and access to diverse technological resources. In contrast, disadvantaged students may lack basic digital skills necessary for effective participation in technology-enhanced learning environments.

The relationship between digital literacy and educational outcomes is complex and mediated by multiple factors including teacher technological competency, curriculum integration, and institutional support systems (Hatlevik et al., 2018). Research suggests that meaningful integration of technology into learning requires comprehensive approaches that address both technical skills and critical digital literacy capabilities.

2.5 Teacher Professional Development and Technology

Teacher professional development emerges as a critical factor in successful educational technology implementation, with teacher technological pedagogical content knowledge (TPACK) serving as a key predictor of effective classroom technology integration (Koehler et al., 2017). Research consistently demonstrates that technology provision alone is insufficient without corresponding investments in teacher capacity building and ongoing professional support.

Studies of teacher professional development in developing country contexts emphasize the importance of culturally responsive approaches that acknowledge local contexts and build upon existing pedagogical strengths (Hennessy et al., 2020). Effective programs combine technical skill development with pedagogical innovation and provide sustained support for classroom implementation.

2.6 Community Engagement in Educational Technology

Community engagement research highlights the critical role of local stakeholders in successful educational technology initiatives, particularly in rural and disadvantaged communities (Warren et al., 2020). Programs that meaningfully involve parents, community leaders, and local organizations demonstrate greater sustainability and effectiveness than those implemented without community input or support.

Research on asset-based community development approaches suggests that educational technology initiatives should identify and leverage existing community resources rather than focusing solely on deficits and needs (Kretzmann & McKnight, 2019). This

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perspective emphasizes the importance of understanding local knowledge systems, social networks, and cultural assets that can support educational improvement efforts.

3. RESEARCH QUESTIONS

This study addresses four primary research questions:

RQ1: What are the current patterns and extent of digital divide affecting educational outcomes in Northeast Thailand's rural and urban schools?

RQ2: How do socioeconomic factors, geographic location, and institutional characteristics interact to influence student digital literacy and academic achievement?

RQ3: What are the perceived barriers and facilitators to effective educational technology integration from the perspectives of students, teachers, and community stakeholders?

RQ4: How can a comprehensive framework be developed to address educational digital divides and promote equity through strategic technology integration and community engagement?

4. OBJECTIVES

4.1 General Objective

To examine educational digital divides in Northeast Thailand and develop a comprehensive framework for promoting educational equity through strategic technology integration and community-based interventions.

4.2 Specific Objectives

1. To assess current levels of digital access, infrastructure, and literacy among students and teachers in Northeast Thailand schools
2. To analyze relationships between socioeconomic factors, geographic location, and educational technology outcomes
3. To identify perceived barriers and facilitators to effective educational technology integration through stakeholder perspectives
4. To develop and pilot test a comprehensive Educational Digital Equity Framework for addressing educational inequalities
5. To provide evidence-based recommendations for policymakers and educators regarding educational technology implementation in rural contexts

5. METHODOLOGY

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5.1 Research Design

This study employed a mixed-methods Research and Development (R&D) approach following Borg and Gall's (2007) framework, modified for educational technology contexts. The R&D methodology was selected to enable both systematic investigation of current conditions and development of practical solutions to identified problems. The research was conducted in three phases: (1) preliminary investigation and data collection, (2) framework development and pilot testing, and (3) evaluation and refinement.

The mixed-methods design incorporated both quantitative and qualitative components to provide comprehensive understanding of educational digital divides and stakeholder perspectives (Creswell & Creswell, 2018). Quantitative data provided statistical evidence of disparities and relationships, while qualitative data offered rich insights into experiences, perceptions, and contextual factors influencing educational technology outcomes.

5.2 Research Setting

The study was conducted in four provinces in Northeast Thailand: Khon Kaen, Udon Thani, Nong Khai, and Loei. These provinces were selected to represent diverse geographic, economic, and demographic characteristics within the Northeast region. Khon Kaen and Udon Thani represent more urbanized provinces with better infrastructure, while Nong Khai and Loei include more rural and remote areas with limited connectivity and resources.

Table 1: Research Setting Characteristics

Province	Population	Schools Selected	Urban/Rural Mix	Economic Profile
Khon Kaen	1,789,297	15	60% Urban, 40% Rural	Educational/Commercial Hub
Udon Thani	1,583,402	12	55% Urban, 45% Rural	Agricultural/Industrial
Nong Khai	515,657	11	30% Urban, 70% Rural	Border/Agricultural
Loei	641,729	10	25% Urban, 75% Rural	Agricultural/Tourism

5.3 Population and Sample

5.3.1 Quantitative Component

The quantitative population comprised students, teachers, and administrators from public schools in the four target provinces. Stratified random sampling was employed to ensure representation across geographic areas, school types, and socioeconomic levels.

Quantitative Sample (N = 487):

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- Students (Grades 7-12): n = 324
- Teachers: n = 126
- Administrators: n = 37

Sampling Criteria:

- Public schools with enrollment between 200-1,500 students
- Geographic distribution across urban, suburban, and rural areas
- Representation of different socioeconomic contexts
- Willingness to participate in research activities

5.3.2 Qualitative Component

Purposive sampling was used to select information-rich participants representing diverse perspectives and experiences with educational technology.

Qualitative Sample (N = 45):

- Students: n = 15
- Teachers: n = 18
- Administrators: n = 8
- Community members: n = 4

Selection Criteria:

- Diverse experience levels with educational technology
- Representation across geographic areas and school types
- Willingness to participate in in-depth interviews
- Ability to provide rich, detailed responses

5.4 Research Instruments

5.4.1 Quantitative Instruments

Digital Access and Infrastructure Survey (DAIS) A 45-item questionnaire measuring:

- Technology access at home and school (10 items)
- Internet connectivity quality and reliability (8 items)
- Device availability and functionality (7 items)
- Technical support availability (6 items)
- Digital learning platform usage (14 items)

Reliability testing yielded Cronbach's alpha coefficients ranging from .78 to .92 across subscales.

Digital Literacy Assessment (DLA) A performance-based assessment measuring:

- Basic computer skills (15 tasks)
- Internet navigation and research (12 tasks)
- Digital communication and collaboration (10 tasks)
- Digital content creation (8 tasks)

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Inter-rater reliability exceeded .85 for all assessment components.

Academic Achievement Measure Standardized test scores from national assessments in mathematics, science, and Thai language arts for the 2021-2022 academic year.

5.4.2 Qualitative Instruments

Semi-structured Interview Protocol Interview guides were developed for different participant groups, covering:

- Personal experiences with educational technology
- Perceived barriers and facilitators to technology integration
- Community assets and support systems
- Recommendations for improvement
- Cultural and contextual factors affecting technology use

Focus Group Discussion Guide Structured protocols for group discussions addressing:

- Collective experiences with digital learning
- Peer support and collaboration in technology use
- Community perspectives on educational technology
- Shared challenges and potential solutions

5.5 Data Collection Procedures

5.5.1 Quantitative Data Collection

Data collection was conducted over a six-month period from January to June 2022. Research assistants were trained in standardized administration procedures to ensure consistency across sites. Schools were visited during regular class hours, with data collection scheduled to minimize disruption to instructional activities.

Survey Administration:

- Paper-based surveys administered in Thai language
- Group administration in classroom settings
- 45-60 minutes completion time
- Research assistant supervision and support

Digital Literacy Assessment:

- Individual computer-based assessments
- 90-minute time limit
- Standardized computer lab settings
- Trained proctor supervision

5.5.2 Qualitative Data Collection

Qualitative data collection occurred concurrently with quantitative data collection, enabling triangulation and deeper understanding of survey findings.

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Individual Interviews:

- 60-90 minute semi-structured interviews
- Audio recording with participant consent
- Thai language with local dialect accommodation
- Private, comfortable settings

Focus Group Discussions:

- 90-120 minute group discussions
- 6-8 participants per group
- Audio and video recording with consent
- Trained facilitator and note-taker

5.6 Data Analysis

5.6.1 Quantitative Analysis

Statistical analyses were conducted using SPSS 26.0 software. Descriptive statistics characterized sample demographics and key variables. Inferential statistics examined relationships between variables and tested research hypotheses.

Analytical Procedures:

1. Descriptive statistics (means, standard deviations, frequencies)
2. Correlation analysis (Pearson product-moment correlations)
3. Independent samples t-tests (group comparisons)
4. Multiple regression analysis (predictor identification)
5. ANOVA (group differences across multiple variables)

Statistical Assumptions:

- Normality assessed through Shapiro-Wilk tests and histograms
- Homogeneity of variance examined via Levene's tests
- Linearity evaluated through scatterplot analysis
- Missing data addressed through listwise deletion (<5% missing)

5.6.2 Qualitative Analysis

Qualitative data analysis followed Braun and Clarke's (2019) reflexive thematic analysis approach, emphasizing researcher reflexivity and iterative interpretation.

Analysis Phases:

1. Data familiarization through repeated reading and listening
2. Initial code generation using inductive approach
3. Theme construction through code clustering and pattern identification
4. Theme review and refinement through team discussion
5. Theme definition and naming with clear boundaries
6. Report writing with rich description and participant voice inclusion

Quality Assurance:

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- Multiple researcher coding for inter-coder reliability
- Member checking with selected participants
- Peer debriefing with research team
- Audit trail documentation

5.6.3 Mixed-Methods Integration

Quantitative and qualitative findings were integrated through joint displays, narrative weaving, and meta-inference development (Fetters et al., 2013). Integration occurred at multiple levels including data collection, analysis, and interpretation phases.

5.7 Framework Development Process

The Educational Digital Equity Framework was developed through iterative cycles of research, development, and testing following R&D methodology principles.

Development Phases:

1. **Literature Review and Needs Assessment:** Comprehensive review of existing frameworks and identification of gaps
2. **Stakeholder Input Integration:** Incorporation of qualitative findings and stakeholder recommendations
3. **Initial Framework Construction:** Development of preliminary framework components and relationships
4. **Expert Review:** Validation through educational technology and rural education experts
5. **Pilot Testing:** Small-scale implementation in three schools
6. **Evaluation and Refinement:** Framework modification based on pilot results and feedback

5.8 Ethical Considerations

This research received ethical approval from the Suan Sunandha Rajabhat University Research Ethics Committee (Protocol SSRU-2022-034). All participants provided informed consent, and confidentiality was maintained throughout the research process.

Ethical Protocols:

- Voluntary participation with right to withdraw
- Informed consent in Thai language
- Confidentiality and anonymity protection
- Cultural sensitivity and respect for local customs
- Benefit sharing with participating communities
- Data security and protection measures

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6. RESULTS

6.1 Participant Demographics

6.1.1 Quantitative Sample Characteristics

The quantitative sample included 487 participants across four provinces in Northeast Thailand. Table 2 presents demographic characteristics of the sample.

Table 2: Quantitative Sample Demographics

Characteristic	Category	Frequency	Percentage
Participant Type	Students	324	66.5%
	Teachers	126	25.9%
	Administrators	37	7.6%
Province	Khon Kaen	153	31.4%
	Udon Thani	132	27.1%
	Nong Khai	117	24.0%
	Loei	85	17.5%
School Location	Urban	189	38.8%
	Suburban	142	29.2%
	Rural	156	32.0%
Gender	Male	231	47.4%
	Female	256	52.6%

6.1.2 Qualitative Sample Characteristics

The qualitative sample comprised 45 participants selected through purposive sampling to represent diverse perspectives and experiences. Participants included students (n=15), teachers (n=18), administrators (n=8), and community members (n=4) across the four provinces.

6.2 Digital Access and Infrastructure Analysis

6.2.1 Technology Access Disparities

Significant disparities in technology access were identified across geographic locations and socioeconomic levels. Table 3 presents technology access indicators by school location.

Table 3: Technology Access by School Location

Access Indicator	Urban (n=189)	Suburban (n=142)	Rural (n=156)	F-statistic	p-value
High-speed Internet (%)	78.3	56.7	34.7	45.23	<.001***

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1:1 Device Ratio (%)	67.2	43.8	21.2	38.91	<.001***
Technical Support Available (%)	84.1	62.0	31.4	52.67	<.001***
Digital Platform Access (%)	89.4	71.8	48.1	41.55	<.001***

*Note: ***p* < *.001*

Analysis of variance revealed statistically significant differences across all technology access indicators between urban, suburban, and rural schools ($p < .001$). Post-hoc Tukey tests indicated significant pairwise differences between all location categories for each access measure.

6.2.2 Socioeconomic Factors and Digital Access

Correlation analysis examined relationships between socioeconomic status indicators and digital access measures. Table 4 presents correlation coefficients.

Table 4: Correlations Between Socioeconomic Factors and Digital Access

Variable	1	2	3	4	5	6
1. Household Income	-					
2. Parental Education	.68***	-				
3. Home Internet Access	.54***	.47***	-			
4. Device Ownership	.61***	.52***	.73***	-		
5. Digital Literacy Score	.43***	.48***	.59***	.64***	-	
6. Academic Achievement	.39***	.44***	.51***	.57***	.72***	-

*Note: ***p* < *.001*

Strong positive correlations were identified between socioeconomic indicators and digital access measures, with particularly strong relationships between device ownership and digital literacy ($r = .64$, $p < .001$) and digital literacy and academic achievement ($r = .72$, $p < .001$).

6.3 Digital Literacy Assessment Results

6.3.1 Overall Digital Literacy Performance

Digital literacy assessment results revealed significant variations in student performance across different skill domains and demographic groups. Table 5 presents mean scores by skill domain.

Table 5: Digital Literacy Assessment Results by Skill Domain

Skill Domain	Mean Score	Standard Deviation	Range	Reliability (α)
Basic Computer Skills	3.2	1.1	1.0-5.0	.87

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Internet Navigation	2.9	1.3	1.0-5.0	.84
Digital Communication	3.4	1.0	1.2-5.0	.89
Content Creation	2.6	1.2	1.0-4.8	.91
Overall Digital Literacy	**3.0**	**1.0**	**1.1-4.9**	**.92**

Students demonstrated highest competency in digital communication skills and lowest performance in content creation abilities. Overall digital literacy scores indicated moderate proficiency levels with substantial room for improvement.

6.3.2 Digital Literacy by Demographic Groups

Independent samples t-tests examined digital literacy differences across demographic groups. Table 6 presents results for key comparisons.

Table 6: Digital Literacy Differences by Demographic Groups

Comparison	Group 1	Group 2	Mean Difference	t-statistic	p-value	Cohen's d
Gender	Male (3.1)	Female (2.9)	0.2	2.14	.033*	0.24
Location	Urban (3.6)	Rural (2.4)	1.2	8.93	<.001***	1.21
SES	High SES (4.2)	Low SES (2.1)	2.1	14.23	<.001***	1.84
Grade Level	Grade 10-12 (3.4)	Grade 7-9 (2.6)	0.8	6.78	<.001***	0.89

*Note: *p < .05, **$p < .001$*

Large effect sizes were observed for location and socioeconomic status comparisons, indicating substantial practical significance of these demographic factors in digital literacy development.

6.4 Multiple Regression Analysis

Multiple regression analysis was conducted to identify significant predictors of academic achievement, with digital literacy, socioeconomic factors, and demographic variables as potential predictors.

Table 7: Multiple Regression Results Predicting Academic Achievement

Predictor Variable	B	SE B	β	t	p
(Constant)	1.23	0.34	-	3.62	<.001
Digital Literacy Score	0.68	0.08	.52	8.50	<.001***
Household Income	0.24	0.06	.21	4.00	<.001***
Parental Education	0.18	0.07	.14	2.57	.011*
School Location (Urban)	0.45	0.12	.19	3.75	<.001***

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Internet Access Quality	0.22	0.09	.13	2.44	.015*
Teacher Technology Training	0.31	0.11	.15	2.82	.005**

*Note: *p < .05, **p < .01, ***p < .001*
R^2 = .67, Adjusted R^2 = .66, F(6,317) = 45.82, p < .001

The regression model explained 67% of variance in academic achievement scores. Digital literacy emerged as the strongest predictor (β = .52, p < .001), followed by household income (β = .21, p < .001) and school location (β = .19, p < .001).

6.5 Qualitative Findings

6.5.1 Perceived Barriers to Technology Integration

Thematic analysis of qualitative data revealed five major themes regarding barriers to effective educational technology integration:

Theme 1: Infrastructure Limitations Participants consistently identified inadequate technological infrastructure as the primary barrier to effective technology integration. A rural teacher explained:

"We have tablets from the government program, but no reliable internet connection. Sometimes electricity goes out for hours. How can we use technology for learning when basic infrastructure is missing?" (Teacher, Rural Loei School)

Theme 2: Digital Skills Gaps Both teachers and students acknowledged significant gaps in digital literacy skills, particularly among older teachers and economically disadvantaged students.

"My teacher knows mathematics very well, but struggles with the computer. Students help her with technology, but then who teaches the lesson?" (Student, Grade 10, Nong Khai)

Theme 3: Socioeconomic Disparities Participants emphasized how family economic situations directly affected student access to technology and digital learning opportunities.

"Rich students have laptops and unlimited internet at home. Poor students share one old phone among siblings. How can they compete in digital assignments?" (Administrator, Urban Udon Thani School)

Theme 4: Cultural and Linguistic Barriers Participants noted that most educational technology content was designed for urban, middle-class contexts and failed to reflect rural cultural values and local languages.

"The learning software is in Central Thai, uses Bangkok examples. Our students speak Isan dialect, live in rice farming families. The content feels foreign to them." (Community Leader, Rural Khon Kaen)

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Theme 5: Insufficient Support Systems Lack of ongoing technical and pedagogical support emerged as a critical barrier to sustainable technology integration.

"They give us tablets and one day of training, then disappear. When problems arise, we have no one to help. The equipment sits unused." (Teacher, Suburban Loei School)

6.5.2 Facilitators and Success Factors

Analysis also revealed positive factors that facilitated successful technology integration:

Theme 6: Community Collaboration Schools with strong community partnerships demonstrated more effective technology integration through shared resources and collective problem-solving.

"Our village pooled money to improve internet connectivity. Parents volunteer to help with computer classes. When community works together, students benefit." (Parent, Rural Nong Khai)

Theme 7: Teacher Innovation and Adaptation Creative teachers developed innovative approaches to overcome technological limitations while maintaining educational quality.

"I download videos at home with good internet, then bring to school on USB drive. Students can still learn from digital content even without online access." (Teacher, Rural Khon Kaen)

Theme 8: Peer Learning Networks Student-to-student learning emerged as an effective strategy for building digital literacy and supporting technology integration.

"Students who are good with computers help others. They explain in local language, understand local problems. Sometimes better than formal training." (Administrator, Suburban Udon Thani)

6.6 Framework Development and Pilot Testing

6.6.1 Educational Digital Equity Framework Components

Based on quantitative findings and qualitative insights, the Educational Digital Equity Framework was developed with four interconnected components:

1. Infrastructure and Access Enhancement
2. Digital Literacy Development
3. Teacher Capacity Building
4. Community Engagement and Support

6.6.2 Pilot Implementation Results

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The framework was pilot tested in three schools over six months (September 2022 - February 2023). Table 8 presents pre-post implementation results.

Table 8: Pilot Implementation Results

Outcome Measure	Pre-Implementation	Post-Implementation	Change	Effect Size
Digital Literacy Score	2.3 (0.8)	2.8 (0.7)	+0.5	0.67
Academic Achievement	3.1 (0.9)	3.7 (0.8)	+0.6	0.72
Technology Usage Frequency	1.8 (1.1)	3.2 (0.9)	+1.4	1.39
Student Engagement	3.4 (0.7)	4.2 (0.6)	+0.8	1.24
Teacher Confidence	2.1 (0.9)	3.5 (0.8)	+1.4	1.66

Note: Values shown as Mean (Standard Deviation)

All outcome measures showed statistically significant improvements ($p < .001$) with medium to large effect sizes, indicating practical significance of the framework implementation.

7. DISCUSSION

7.1 Digital Divide Patterns in Northeast Thailand

The findings reveal complex patterns of digital divide that extend beyond simple urban-rural distinctions to encompass intersections of geography, socioeconomic status, and institutional capacity. The 43.6 percentage point gap in high-speed internet connectivity between urban and rural schools represents more than a technical disparity—it reflects systemic inequalities that perpetuate educational disadvantage across generations.

These findings align with international research demonstrating that digital divides in education are multidimensional phenomena requiring comprehensive interventions (Reich & Mehta, 2020). The strong correlation between socioeconomic status and digital access ($r = .54$ for household income and internet access) suggests that technology may be amplifying existing inequalities rather than serving as an equalizing force, consistent with Van Dijk's (2020) theoretical framework.

7.2 Socioeconomic Determinants of Digital Literacy

The substantial effect size ($d = 1.84$) for socioeconomic differences in digital literacy indicates that family economic conditions exert profound influence on students' technological capabilities. This finding supports Hargittai and Micheli's (2019) research demonstrating that

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digital literacy development occurs primarily through informal learning opportunities that are more available to privileged students.

The regression analysis revealing digital literacy as the strongest predictor of academic achievement ($\beta = .52$) suggests that technological capabilities have become fundamental to educational success in contemporary contexts. This relationship indicates that students lacking digital literacy face compound disadvantages affecting multiple academic domains, not merely technology-related subjects.

7.3 Geographic and Infrastructure Barriers

The qualitative findings provide crucial context for understanding how infrastructure limitations translate into educational barriers. Rural teachers' accounts of unreliable electricity and internet connectivity reveal that technological solutions must address fundamental infrastructure challenges before pedagogical innovations can be effective.

The geographic disparities identified in this study reflect broader patterns documented across developing countries, where rural communities face systematic disadvantages in accessing digital technologies (Barbour & LaBonte, 2017). However, the community collaboration examples documented in qualitative data suggest that local innovations can partially compensate for infrastructure limitations when supported by collective action.

7.4 Teacher Capacity and Professional Development Needs

The significant relationship between teacher technology training and academic achievement ($\beta = .15$, $p < .005$) emphasizes the critical role of educator capacity in mediating technology's educational impact. Qualitative findings revealing teachers' creative adaptations to technological limitations demonstrate that pedagogical innovation can occur even in resource-constrained environments when educators receive appropriate support.

These findings align with research emphasizing that teacher professional development must address both technical skills and pedagogical integration strategies (Koehler et al., 2017). The framework component focusing on teacher capacity building addresses this need through comprehensive training approaches that combine technological competency with culturally responsive pedagogy.

7.5 Cultural and Linguistic Considerations

The qualitative theme regarding cultural and linguistic barriers provides important insights often overlooked in educational technology research. Students' and teachers' observations about content being designed for "Bangkok contexts" highlight how technological solutions can inadvertently marginalize rural and ethnic minority communities when cultural responsiveness is neglected.

This finding supports research emphasizing the importance of culturally sustaining pedagogies in educational technology implementation (Paris & Alim, 2017). The framework

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addresses this concern through community engagement components that emphasize local content development and cultural asset integration.

7.6 Framework Development and Implementation

The pilot implementation results provide encouraging evidence that comprehensive interventions can address multiple dimensions of digital divide simultaneously. The large effect sizes for teacher confidence (d = 1.66) and technology usage frequency (d = 1.39) suggest that targeted professional development and infrastructure improvements can produce meaningful changes in educational practice.

However, the six-month pilot period represents only initial implementation effects. Longitudinal research will be necessary to determine whether improvements are sustained over time and whether they translate into long-term educational outcomes for students.

7.7 Policy Implications

The research findings have several important implications for educational policy in Thailand and similar contexts:

Infrastructure Investment Priorities: The strong relationship between connectivity quality and educational outcomes suggests that universal high-speed internet access should be prioritized as educational infrastructure rather than luxury enhancement.

Teacher Professional Development: The critical role of teacher capacity indicates that technology hardware provision must be accompanied by comprehensive, ongoing professional development that addresses both technical skills and pedagogical integration.

Community Engagement: The success factors identified in qualitative data emphasize that sustainable technology integration requires authentic community partnership rather than top-down implementation approaches.

Equity-Focused Implementation: The substantial socioeconomic disparities documented suggest that educational technology policies should include specific provisions for addressing inequalities rather than assuming that universal access will automatically promote equity.

7.8 Theoretical Contributions

This study contributes to digital divide theory by demonstrating how multiple levels of inequality intersect in educational contexts. The finding that socioeconomic status, geographic location, and institutional capacity combine to create compound disadvantages extends Van Dijk's (2020) framework by emphasizing intersectionality in digital inequality analysis.

The research also contributes to rural education literature by documenting specific mechanisms through which geographic isolation translates into educational disadvantage in digital learning environments. The community asset identification and mobilization strategies

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identified in qualitative data provide practical approaches for building upon rural community strengths rather than focusing solely on deficits.

7.9 Limitations

Several limitations should be acknowledged in interpreting these findings:

Geographic Scope: While four provinces provide diverse representation within Northeast Thailand, generalizability to other regions or countries requires additional research.

Temporal Limitations: The cross-sectional design and six-month pilot period limit conclusions about long-term impacts and causal relationships.

Self-Selection Bias: Schools and participants volunteering for research may not represent the most disadvantaged or resistant populations.

Measurement Challenges: Digital literacy assessment focused on technical skills rather than broader digital citizenship or critical media literacy capabilities.

Cultural Specificity: Framework components may require adaptation for implementation in different cultural or linguistic contexts.

8. CONCLUSION

This study provides comprehensive evidence of significant digital divides affecting educational equity in Northeast Thailand while demonstrating that targeted interventions can address multiple dimensions of technological inequality simultaneously. The substantial disparities documented across urban-rural locations and socioeconomic groups indicate that digital technologies are currently amplifying rather than reducing educational inequalities.

However, the successful pilot implementation of the Educational Digital Equity Framework suggests that comprehensive approaches addressing infrastructure, digital literacy, teacher capacity, and community engagement can transform technology from a source of division into a tool for educational equity. The framework's emphasis on building upon community assets while addressing systemic barriers offers a promising model for rural educational technology implementation.

The research contributes to both theoretical understanding and practical application by demonstrating how multiple forms of inequality intersect in digital learning environments and providing evidence-based strategies for addressing these challenges. The strong relationships identified between digital literacy and academic achievement underscore the critical importance of ensuring equitable access to technological learning opportunities.

Key Recommendations:

Prioritize Infrastructure Equity: Ensure universal high-speed internet access as fundamental educational infrastructure rather than optional enhancement.

Implement Comprehensive Teacher Development: Provide sustained professional development that integrates technical skills with culturally responsive pedagogical approaches.

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Foster Community Partnerships: Engage local communities as partners in educational technology implementation rather than passive recipients of external interventions.

Address Socioeconomic Barriers: Develop specific policies and programs to ensure that family economic circumstances do not determine student access to digital learning opportunities.

Emphasize Cultural Responsiveness: Ensure that educational technology content and implementation approaches reflect and build upon local cultural assets and knowledge systems.

The COVID-19 pandemic has accelerated global adoption of educational technologies while exposing profound inequalities in technological access and digital literacy. Thailand's experience in Northeast regions provides valuable insights for addressing similar challenges across developing countries where rural communities face systematic disadvantages in accessing digital learning opportunities.

Future research should examine long-term impacts of comprehensive digital equity interventions and explore adaptations of the framework for different cultural and geographic contexts. Additionally, investigation of student voice and agency in educational technology implementation could provide important insights for developing more responsive and effective approaches.

The transformation of Thailand's educational system to promote equity in the digital age requires sustained commitment to addressing both technological and social dimensions of inequality. This research provides evidence that such transformation is both necessary and achievable when comprehensive, community-engaged approaches are implemented with adequate resources and political support.

References

Azano, A. P., & Stewart, T. T. (2015). Exploring place and practicing justice: Preparing pre-service teachers for success in rural schools. *Journal of Research in Rural Education*, 30(9), 1-12. http://jrre.psu.edu/articles/30-9.pdf

Barbour, M. K., & LaBonte, R. (2017). State of rural education: Understanding the issues facing rural schools and communities. *Rural Educator*, 38(3), 1-9. https://doi.org/10.35608/ruraled.v38i3.231

Beaunoyer, E., Dupéré, S., & Guitton, M. J. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behavior*, 111, 106424. https://doi.org/10.1016/j.chb.2020.106424

Bjork, C. (2019). *Indonesian education: Teachers, schools, and central bureaucracy*. Routledge.

Borg, W. R., & Gall, M. D. (2007). *Educational research: An introduction* (8th ed.). Pearson.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589-597. https://doi.org/10.1080/2159676X.2019.1628806

Insight into Modern Education
ISSN: 3057-0050 (Online), Vol 1 No 1 (January-April, 2023)

Chudgar, A., Chandra, M., & Rajan, A. (2019). Gender gaps in learning in South Asia: Examining the role of access, grade-for-age, and learning environment. *International Journal of Educational Development*, 67, 11-23. https://doi.org/10.1016/j.ijedudev.2019.02.007

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—principles and practices. *Health Services Research*, 48(6pt2), 2134-2156. https://doi.org/10.1111/1475-6773.12117

Hargittai, E., & Micheli, M. (2019). Internet skills and why they matter. In M. Graham & W. H. Dutton (Eds.), *Society and the internet: How networks of information and communication are changing our lives* (pp. 109-124). Oxford University Press.

Hatlevik, O. E., Throndsen, I., Loi, M., & Gudmundsdottir, G. B. (2018). Students' ICT self-efficacy and computer and information literacy: Determinants and relationships. *Computers & Education*, 118, 107-119. https://doi.org/10.1016/j.compedu.2017.11.011

Hennessy, S., Haßler, B., & Hofmann, R. (2020). Challenges and opportunities for teacher professional development in interactive use of technology in African schools. *Technology, Pedagogy and Education*, 29(5), 557-577. https://doi.org/10.1080/1475939X.2020.1815087

Intarakumnerd, P., & Chaminade, C. (2021). Innovation policies in Thailand 4.0: Challenges and ways forward. In P. Intarakumnerd & T. Schiller (Eds.), *Science, technology and innovation policy for the future of Thailand* (pp. 15-38). Springer.

Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2017). The technological pedagogical content knowledge framework. In M. J. Bishop, E. Boling, J. Elen, & V. Svihla (Eds.), *Handbook of research on educational communications and technology* (pp. 101-111). Springer.

König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: Teacher education and teacher competence effects among early career teachers in Germany. *European Journal of Teacher Education*, 43(4), 608-622. https://doi.org/10.1080/02619768.2020.1809650

Kretzmann, J., & McKnight, J. (2019). *Building communities from the inside out: A path toward finding and mobilizing a community's assets*. Asset-Based Community Development Institute.

National Statistical Office. (2021). *Household survey on the use of information and communication technology 2021*. National Statistical Office of Thailand.

Office of the Education Council. (2020). *National education plan 2017-2036*. Office of the Education Council, Ministry of Education.

Paris, D., & Alim, H. S. (2017). *Culturally sustaining pedagogies: Teaching and learning for justice in a changing world*. Teachers College Press.

Insight into Modern Education
ISSN: 3057-0050 (Online), Vol 1 No 1 (January-April, 2023)

Pholphirul, P., & Rugchatjaroen, A. (2021). Digital divide and educational inequality during COVID-19: Evidence from Thailand. *World Development Perspectives*, 23, 100354. https://doi.org/10.1016/j.wdp.2021.100354

Reich, J., & Mehta, J. (2020). Systematic educational equity requires systemic school reform: Lessons for and from the pandemic. *Educational Researcher*, 49(6), 384-388. https://doi.org/10.3102/0013189X20938899

Van Deursen, A. J., & Helsper, E. J. (2015). The third-level digital divide: Who benefits most from being online? *Communication and Information Technologies Annual*, 10, 29-52. https://doi.org/10.1108/S2050-206020150000010002

Van Dijk, J. A. (2020). *The digital divide*. Polity Press.

Warren, M. R., Hong, S., Rubin, C. L., & Uy, P. S. (2020). Beyond the bake sale: A community-based relational approach to parent engagement in schools. *Teachers College Record*, 111(9), 2209-2254. https://www.tcrecord.org/Content.asp?ContentId=15975

APPENDICES

Appendix A: Informed Consent Form

Participant Information and Consent Form

Research Title: Digital Divide and Educational Inequality in Northeast Thailand: A Mixed-Methods Research and Development Study in Four Provinces

Researcher: Dr. Napasri Suwanajote, Suan Sunandha Rajabhat University

Purpose of the Study: This research examines educational technology access and digital literacy in Northeast Thailand schools. The study aims to understand current challenges and develop strategies for promoting educational equity through technology integration.

What Will Happen: If you agree to participate, you may be asked to:

- Complete a 45-minute survey about technology access and digital skills
- Participate in a digital literacy assessment (90 minutes)
- Join an interview or focus group discussion (60-120 minutes)
- Allow researchers to observe classroom technology use

Risks and Benefits: Participation involves minimal risk. You may experience mild fatigue during assessments. Benefits include contributing to research that may improve educational opportunities in your community.

Confidentiality: Your identity will be kept confidential. All data will be stored securely, and you will be assigned a code number instead of using your name in research reports.

Voluntary Participation: Participation is entirely voluntary. You may withdraw at any time without penalty or explanation. Withdrawal will not affect your grades, employment, or relationship with your school.

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Contact Information: For questions about this research, contact: Dr. Napasri Suwanajote Email: napasri.su@ssru.ac.th Phone: 02-160-1000 ext. 1234

Consent Statement: I have read and understood the information about this research. I voluntarily agree to participate and understand I may withdraw at any time.

Participant Name: _____ Signature: _____ Date: _____

Researcher Name: _____ Signature: _____ Date: _____

Appendix B: Research Instruments

B.1 Digital Access and Infrastructure Survey (DAIS)

1. **Section A: Technology Access at Home and School**
2. How often do you have access to high-speed internet at home? a) Always b) Usually c) Sometimes d) Rarely e) Never
3. What type of device do you primarily use for schoolwork at home? a) Desktop computer b) Laptop c) Tablet d) Smartphone e) No device available
4. How many people in your household share internet-connected devices? a) Device per person b) 2-3 people share c) 4-5 people share d) More than 5 share e) No shared devices
5. How would you rate the internet connection speed at your school? a) Very fast b) Fast c) Moderate d) Slow e) Very slow
6. How often does your school's internet connection work reliably? a) Always b) Usually c) Sometimes d) Rarely e) Never

Section B: Digital Learning Platform Usage

1. Which digital learning platforms have you used in the past year? (Check all that apply) □ Google Classroom □ Microsoft Teams □ Line for Education □ Zoom □ YouTube for Education □ Khan Academy □ Thai MOOC □ Other: _____
2. How comfortable are you using online learning platforms? a) Very comfortable b) Comfortable c) Neutral d) Uncomfortable e) Very uncomfortable
3. How often do you submit assignments digitally? a) Always b) Usually c) Sometimes d) Rarely e) Never

Section C: Technical Support

1. When you have technology problems at school, who helps you? a) Teacher b) IT staff c) Classmates d) No one available e) Other: _____
2. How satisfied are you with technical support at your school? a) Very satisfied b) Satisfied c) Neutral d) Dissatisfied e) Very dissatisfied

B.2 Digital Literacy Assessment Tasks

Task Category 1: Basic Computer Skills

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Task 1.1: File Management

- Create a new folder named "School Projects"
- Save a document in the folder
- Rename the folder to "My Assignments"
- Delete an unnecessary file

Task 1.2: Software Navigation

- Open a word processing program
- Format text (bold, italic, font size)
- Insert an image
- Save the document in PDF format

Task Category 2: Internet Navigation and Research

Task 2.1: Information Search

- Use search engines to find information about renewable energy
- Evaluate website credibility
- Bookmark useful resources
- Cite sources properly

Task 2.2: Email Communication

- Compose a professional email to a teacher
- Attach a file to the email
- Use appropriate subject lines and signatures
- Organize emails using folders

Task Category 3: Digital Content Creation

Task 3.1: Presentation Creation

- Create a 5-slide presentation about local culture
- Include text, images, and transitions
- Use appropriate design principles
- Present using projection technology

Task 3.2: Multimedia Integration

- Record a short video explanation
- Edit video using basic tools
- Add background music or narration
- Export in appropriate format

Appendix C: Qualitative Interview Protocols

C.1 Student Interview Protocol

Opening Questions:

1. Tell me about your experience using technology for schoolwork.
2. What devices do you use most often for learning?

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Technology Access and Barriers: 3. Describe the technology available at your home and school. 4. What challenges do you face when trying to use technology for learning? 5. How do internet connectivity issues affect your studies?

Digital Learning Experiences: 6. Which digital learning activities do you find most helpful? 7. How has online learning during COVID-19 affected your education? 8. What would improve your digital learning experience?

Peer and Family Support: 9. How do friends and family help you with technology use? 10. Do you help other students with digital skills?

Cultural and Contextual Factors: 11. How well does educational technology content relate to your daily life? 12. Are there cultural or language barriers in using educational technology?

Recommendations: 13. What changes would make technology more useful for learning? 14. How can schools better support students with technology?

C.2 Teacher Interview Protocol

Background and Experience:

1. How long have you been teaching, and what subjects do you teach?
2. Describe your experience with educational technology.

Technology Integration Practices: 3. How do you currently use technology in your teaching? 4. What educational technology tools have you found most effective? 5. How has your technology use changed since COVID-19?

Barriers and Challenges: 6. What obstacles do you face in integrating technology into your teaching? 7. How do infrastructure limitations affect your ability to use technology? 8. What support do you need to better integrate technology?

Professional Development: 9. What technology training have you received? 10. What additional training would be most helpful?

Student Differences: 11. How do you address differences in student technology access and skills? 12. What strategies help students with limited technology experience?

Community and Cultural Factors: 13. How does the local community view educational technology? 14. How do you make technology relevant to local contexts?

Future Vision: 15. What would ideal educational technology integration look like in your context? 16. What policy changes would support better technology use in schools?

Appendix D: Statistical Analysis Output

D.1 Descriptive Statistics Summary

Table E.1: Descriptive Statistics for Key Variables

Variable	N	Mean	SD	Min	Max	Skewness	Kurtosis
Digital Literacy Score	487	3.02	1.04	1.10	4.90	-0.12	-0.89
Academic Achievement	487	3.45	0.87	1.25	5.00	-0.31	-0.45
Internet Access Quality	487	2.78	1.23	1.00	5.00	0.23	-1.12
Household Income (log)	487	4.12	0.56	2.30	5.89	0.45	0.34

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Technology Usage Frequency	487	2.89	1.15	1.00	5.00	0.18	-0.67

D.2 ANOVA Results for Location Differences

Table E.2: One-Way ANOVA Results for Digital Literacy by School Location

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial η^2
Between Groups	89.23	2	44.62	52.67	<.001	.18
Within Groups	410.45	484	0.85			
Total	499.68	486				

Post-Hoc Tukey HSD Results:

- Urban vs. Rural: Mean Difference = 1.20, SE = 0.13, $p < .001$
- Urban vs. Suburban: Mean Difference = 0.78, SE = 0.14, $p < .001$
- Suburban vs. Rural: Mean Difference = 0.42, SE = 0.15, $p = .017$

Appendix E: Framework Implementation Materials

E.1 Educational Digital Equity Framework Overview

Component 1: Infrastructure and Access Enhancement

Objective: Ensure reliable, high-quality digital infrastructure and device access for all students and teachers.

Key Strategies:

- Universal high-speed internet connectivity (minimum 25 Mbps)
- 1:1 device program with take-home privileges
- Technical support network establishment
- Infrastructure maintenance and upgrade systems

Implementation Timeline: 12-18 months *Estimated Cost:* 2.4 million THB per school *Success Metrics:* 95% uptime connectivity, 100% device availability

Component 2: Digital Literacy Development

Objective: Build comprehensive digital literacy skills among students, teachers, and community members.

Key Strategies:

- Age-appropriate digital literacy curriculum integration
- Peer mentoring and collaborative learning programs
- Family digital literacy workshops
- Community-based digital skills training

Implementation Timeline: 6-12 months *Estimated Cost:* 850,000 THB per school annually *Success Metrics:* 80% proficiency on digital literacy assessments

Component 3: Teacher Capacity Building

Objective: Enhance teacher technological pedagogical content knowledge and confidence.

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Key Strategies:

- Comprehensive technology integration training (60+ hours)
- Ongoing coaching and mentoring support
- Teacher learning communities and peer networks
- Leadership development opportunities

Implementation Timeline: 9-15 months *Estimated Cost:* 1.2 million THB per school *Success Metrics:* 90% teacher technology integration competency

Component 4: Community Engagement and Support

Objective: Build sustainable community partnerships supporting educational technology initiatives.

Key Strategies:

- Community asset mapping and resource identification
- Parent and community member engagement programs
- Local content development and cultural integration
- Collaborative governance and decision-making structures

Implementation Timeline: 6-24 months *Estimated Cost:* 450,000 THB per school *Success Metrics:* 75% community participation in technology initiatives

F.2 Pilot Implementation Evaluation Report

Pilot School Profiles:

School A (Urban Khon Kaen): 847 students, good infrastructure, mixed SES *School B (Rural Loei):* 234 students, limited infrastructure, low SES
School C (Suburban Udon Thani): 456 students, moderate infrastructure, middle SES

Implementation Activities Completed:

1. **Infrastructure Enhancement:**
   - Internet speed upgrades (25 Mbps minimum)
   - Device procurement and distribution
   - Technical support team training
2. **Professional Development:**
   - 40-hour teacher training program
   - Monthly coaching sessions
   - Peer observation and feedback cycles
3. **Community Engagement:**
   - Parent digital literacy workshops
   - Community technology access points
   - Local content development projects

Evaluation Results Summary:

Quantitative Outcomes:

- Digital literacy scores improved by 22% on average
- Technology usage frequency increased by 78%

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- Academic achievement gains of 18% across subjects
- Teacher confidence ratings improved by 67%

Qualitative Feedback:

- High satisfaction with training quality and relevance
- Appreciation for community-centered approach
- Continued concerns about sustainability and ongoing support
- Positive changes in student engagement and motivation

Recommendations for Scale-Up:

1. Extend implementation timeline to allow for deeper cultural integration
2. Increase ongoing technical support allocation
3. Develop train-the-trainer models for sustainability
4. Create regional networks for resource sharing and collaboration
5. Integrate evaluation and continuous improvement systems from initial implementation

Appendix F: Funding and Independence Statement

Funding Declaration:

This research was conducted as an independent study without external funding from government agencies, private organizations, or international institutions. All research costs including data collection, analysis, and dissemination were supported through the researchers' institutional affiliations and personal resources.

Resource Support:

- Suan Sunandha Rajabhat University: Institutional support, ethics review, administrative assistance
- Mahachulalongkornrajavidyalaya University, Khon Kaen Campus: Research collaboration, regional expertise, logistical support
- Personal funds: Travel, materials, participant incentives, technology costs

Independence Statement:

The researchers declare complete independence in research design, data collection, analysis, interpretation, and reporting. No external parties influenced research questions, methodology, findings, or conclusions. All decisions regarding research conduct and publication were made solely by the research team.

Data Ownership and Sharing:

All research data remain the property of the research team and participating institutions. De-identified datasets will be made available to qualified researchers upon reasonable request and approval from institutional ethics committees and participating communities.

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The authors also recognize the contribution of AI-assisted tools in manuscript preparation. ChatGPT was employed to support aspects of literature review, preliminary data analysis assistance, writing clarity, and formatting. All AI-generated content was thoroughly reviewed and edited by the authors to ensure scholarly rigor and accuracy. The authors take full responsibility for the final version of the manuscript.

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Conflict of Interest Declaration:

The authors declare no conflicts of interest related to this research. None of the researchers have financial, professional, or personal relationships that could potentially bias the research process or findings.