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Integrating Technology into Public Schools in South Lebanon: Opportunities and Challenges

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Abstract

Globally, technology has been seen as an ultimate aspect of contemporary education. In South Lebanon, public schools are progressively attempting to integrate digital tools into teaching and learning, yet they endure an inadequate infrastructure, limited funding, and insufficient teacher training. Nonetheless, technology offers opportunities to enhance learning, endorse equity, and encourage inclusivity. This article draws on publicly accessible reports, peer-reviewed studies, and five teacher interviews to comprehend how technology is being used in public schools in South Lebanon. The interviews were conducted with teachers from both urban and rural schools, following ethical approval and informed consent. While teacher confidence, student engagement, and performance showed enhancements, key limitations include the small interview sample, dependence on secondary data, and short-term follow-up (3 - 6 months). Recent studies report gains in student engagement under infrastructure constraints. The study authenticates how the TPACK framework can guide teachers and offers practical approaches for integrating technology sustainably and effectively. Evidence proposes that combining reliable infrastructure, ongoing professional development, and context-appropriate digital content can convert technology from a supportive tool into a central pillar of learning, serving to close educational gaps and prepare students for a digital future.

Keywords

Technology Integration, South Lebanon, Public Schools, TPACK Framework, Teacher Training, Educational Equity

1. Introduction

Digital technologies played a pivotal role in the rapid digital transformation of many educational institutions. Computers, tablets, interactive screens, and online

platforms—once chiefly used for entertainment—are now indispensable learning tools, encouraging collaboration, creativity, and the expansion of twenty-first-century skills including problem-solving, digital literacy, and global communication (UNESCO, 2020a).

Nevertheless, access to such tools remains highly uneven, generating disparities in prospects and consequences. More affluent schools are often able to offer well-equipped classrooms, reliable connectivity, and skilled teachers, while underfunded public schools struggle to keep pace.

In Lebanon, these disparities are predominantly stark. Public schools in the South support large numbers of socioeconomically underprivileged students, many of whom face barriers in accessing digital resources. Many socioeconomically underprivileged children in the South receive assistance from public schools, and many of them encounter difficulties in gaining access to digital resources. Private schools have advanced infrastructure and consistent investment in technology, while public schools lag behind (Lebanese Center for Policy Studies, 2020). A poll revealed that only 35% of public schools in South Lebanon had reliable internet access, compared to 80% of private schools (Chaiban, 2024). Recent reports also confirm these gaps in infrastructure (UNESCO, 2020a).

The widening digital gap demands a structured framework to support teachers in bridging the gap. The Technological Pedagogical Content Knowledge (TPACK) framework offers such a guide, stressing how effective teaching integrated with technology entails balancing three dimensions: technological knowledge, pedagogical strategies, and subject content expertise (Mishra & Koehler, 2006; Chai, Koh, & Tsai, 2013). This article uses TPACK as an intervention in the South Lebanese context, recommending actionable approaches for sustainable technology incorporation.

2. Current Situation

Public schools in South Lebanon are facing systemic challenges that hinder digital transformation. Many schools in rural areas rely on outdated electrical grids, and some use diesel generators, which are overpriced and environmentally unsustainable.

Equity concerns exacerbate the situation. Families often lack the financial resources to purchase laptops or tablets, leaving students reliant on shared devices or mobile phones. The inequity between parents' incomes makes students from wealthier households better equipped for higher education and the workforce than disadvantaged students who fall further behind (Jabbour, Ghamrawi, & Darwish, 2020).

Teacher preparedness is another complication. Numerous teachers in public schools lack formal ICT training and often hinge on ad hoc NGO workshops, personal resourcefulness, or informal peer support (Braun & Clarke, 2006). While these efforts are appreciated, they are inadequate for long-term sustainability (Ertmer & Ottenbreit-Leftwich, 2010; El-Asmar, Haddad, & Saliba, 2024).

Recent studies highlight how low-cost tools such as WhatsApp and Google

Forms are progressively used in Arabic-speaking contexts to overcome infrastructure limitations, offering practical, scalable solutions (Ritonga, Santosa, & Wijaya, 2025).

Despite these restrictions, NGOs and global agencies have piloted digital classrooms, presented solar-powered labs, and provided low-bandwidth platforms for remote learning. However, these initiatives are often disjointed and short-term. Scaling and sustaining them remains difficult without a national strategy (UNESCO, 2020a).

The TPACK framework as an intervention offers a structured way forward. By helping teachers blend subject expertise with pedagogy and digital tools, TPACK equips them to design lessons that use technology purposefully. Teachers can use offline digital libraries, shared devices, or low-bandwidth applications to generate interactive lessons that foster digital literacy (Wu & Wang, 2022).

Figure 1 shows the comparison of digital readiness between public and private schools in South Lebanon, highlighting gaps in internet access, devices, and ICT training.

Indicator	Public Schools	Private Schools
Reliable Internet Access	35%	80%
Access to Devices	40%	85%
Teachers with ICT Training	30%	75%

Figure 1. Digital readiness of public vs. private schools in South Lebanon.

3. Challenges in Implementation

Though digital technology in education is extensively recognized and promising, effective integration in South Lebanon's public schools remains troubled with barriers. Research demonstrates that success hinges not only on access to devices but also on constant infrastructure, well-prepared teachers, inclusive policies, and culturally relevant learning materials (UNESCO, 2020a; Kallio et al., 2016; Alghamdi, 2020). In Lebanon, persistent political, economic, and infrastructural crises generate a fragile educational environment where technology integration often struggles to move beyond pilot projects (Braun & Clarke, 2006). The main barriers can be assembled into five domains:

Infrastructure Limitations—Long-lasting electricity deficiencies and undependable internet.

Equity and Digital Divide—Students from low-income families frequently share devices or count on mobile phones.

Teacher Preparedness—Many teachers have not acknowledged sustained ICT or TPACK-based training.

Policy and Strategy Gaps—Lebanon needs a coordinated national digital education strategy.

Content Relevance—Digital resources often fail to reflect Lebanese contexts

and needs.

Table 1 summarizes these challenges and proposes possible solutions identified during the needs assessment and pilot study.

Table 1. Summary of infrastructure, training, equity, policy, and content challenges and opportunities identified in South Lebanese Public Schools.

Domain	Challenges	Opportunities/Solutions
Infrastructure	Unreliable power, poor internet	Solar power, offline platforms, device-sharing
Teacher Training	Limited ICT/TPACK skills	Continuous PD, peer mentoring, blended learning
Equity	Cost, digital divide	Subsidized devices, inclusive design
Policy	No national strategy	Implement National EdTech Plan
Content	Not in Arabic, irrelevant	Arabic digital content, local curriculum platforms

Figure 2 presents an adapted version of the TPACK Framework designed for the South Lebanon context. The model highlights three main contextual adaptations essential for successful technology integration. The first is **Low-Tech Tools**, emphasizing the use of offline platforms and mobile-first solutions to overcome limited infrastructure. The second is **Arabic Content**, which focuses on using localized curricula and culturally relevant materials that meet regional educational needs. The third is **Peer Training**, which promotes teacher mentoring and shared practice groups to build sustainable professional development networks among educators.

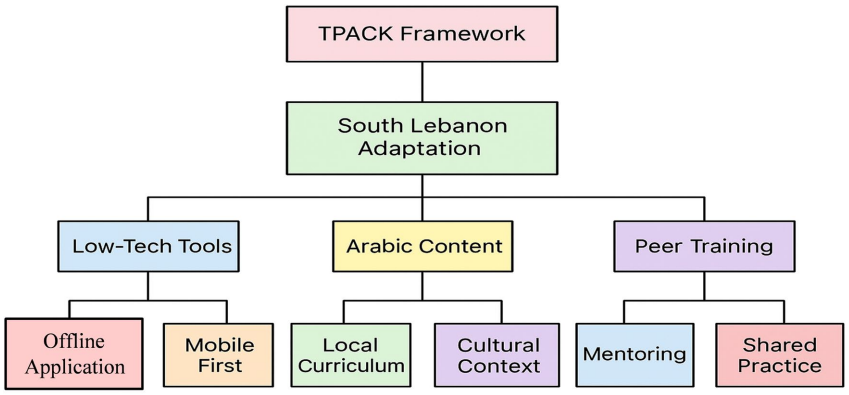

Figure 2. Adapted TPACK framework for South Lebanon.

Figure 2 depicts the adapted TPACK framework contextualized for South Lebanon, highlighting three key adaptations that emerged from pilot testing.

4. Toward Sustainable Integration

Integration of technology in South Lebanon's public schools cannot be attained

through disjointed efforts or momentary projects. NGO-led initiatives and donations are a relief but persist to be unsatisfactory for long-term sustainability (Braun & Clarke, 2006). A systemic, coordinated method is demanded that brings policymakers, educators, communities, and international partners together under a shared vision (Flick, 2018; Hadad, Saliba, & El-Asmar, 2023). Achieving real sustainability requires dealing with the core issues of infrastructure, equity, and teacher development, while also fostering digital literacy among students and teachers (Creswell & Creswell, 2018; Creswell & Plano Clark, 2017). Moreover, social and cultural factors play a vital role in how technology is accepted and used in schools (Ziaul Haq & Akmansyah, 2024; Jabbour et al., 2020). The TPACK framework offers a practical way to connect policies with classroom realities, helping schools use technology not as an extra tool but as a true driver of educational change.

5. Original Contribution and Research Gap

While numerous reports and NGO documents have pointed out the educational challenges in Lebanon, very few studies have used the TPACK framework in South Lebanon's public schools. This article proposes new insights in three ways:

1) Contextual Application of TPACK. It demonstrates how TPACK can be modified to settings with limited resources and ongoing crises.

2) Teacher Perspectives. It includes five short interviews with public school teachers in Saida who recognized electricity issues and the lack of Arabic-language materials as their biggest obstacles.

3) Joining Policy to Classroom Practice. It provides practical strategies that consider the local context, such as solar-powered solutions, device-sharing, and peer mentoring, as an alternative to comprehensive recommendations.

By tackling these gaps, the article improves our understanding of how to move technology use from scattered projects to comprehensive change in South Lebanon.

6. Methodology

This study employed a mixed-methods quasi-experimental design to scrutinize the challenges of technology integration in Southern Lebanese public schools and estimate the effectiveness of a TPACK-based professional progress intervention. The methodology joined quantitative measures: teacher surveys, student engagement evaluations, and pre/post-tests with qualitative data from interviews, focus groups, and classroom observations (Creswell & Creswell, 2018). Ethical approval was attained from relevant educational authorities, and informed consent was obtained from all participants. Data analysis integrated descriptive and inferential statistics with thematic analysis for inclusive insights (Braun & Clarke, 2006).

6.1. Sampling Rationale

Teachers were purposefully nominated to signify both urban and rural schools in South Lebanon, as well as numerous subjects (English, Math, Science) and having

at least three years of teaching experience (Patton, 2015). This technique ensured that participants had direct experience with digital tools in their classrooms and could share knowledgeable views on challenges, strategies, and support needs. The small sample size permitted deep qualitative exploration while also supporting quantitative survey and pre/post-test data (Creswell & Plano Clark, 2017). Even though only five teachers were interviewed, this sample is adequate for gaining exploratory qualitative insights. It enables a thorough understanding of teacher experiences, teaching adjustments, and contextual challenges, which aligns with qualitative research practices that prioritize depth instead of breadth (Patton, 2015).

6.2. Teacher Interviews

Five teachers were nominated to gather comprehensive insights into technology integration. Each interview lasted 30 to 45 minutes and was conducted in Arabic or a mix of Arabic and English, depending on the teacher's preference. The interviews employed a semi-structured protocol (Kallio et al., 2016) and covered the following topics:

1) Digital tools or platforms used in teaching.

2) Main obstacles encountered in integrating technology into classrooms.

3) Approaches and variations under resource constraints.

4) Supports or resources required for effective technology use.

All participants were assigned pseudonyms (Teacher A, B, etc.) to protect their privacy. We audio-recorded the interviews, transcribed them, and analyzed the data thematically (Braun & Clarke, 2006). Secondary data from NGO and government reports were used to confirm findings and enhance validity (Flick, 2018).

6.3. Data Sources

The study used three main data sources:

1) Quantitative Data. This encompassed teacher surveys, student engagement evaluations, and pre/post estimations of TPACK knowledge and student performance (Harris et al., 2017).

2) Qualitative Data. This included semi-structured teacher interviews, focus groups, and classroom observations that provided context and personal experiences (Jabbour et al., 2020).

3) Secondary Data. This consisted of government and NGO reports, peer-reviewed studies, and public statistics that provided background on infrastructure, equity, and policy gaps (Lebanese Center for Policy Studies, 2020; SMEX, 2021).

6.4. Ethical Considerations

Ethical approval was obtained from the relevant Institutional Review Board or Ministry body (UNESCO, 2020a; 2020b). All participants provided informed consent, and their identities were anonymized. Data were securely stored and used solely for research purposes. Teachers were free to withdraw at any stage without penalty.

6.5. Data Analysis

Quantitative data were subjected to descriptive and inferential statistics, including paired-sample t-tests to examine pre/post changes in teacher TPACK knowledge and student achievement (Wu & Wang, 2022). Effect sizes were calculated to investigate educational significance. Thematic analysis was applied to examine qualitative data, identifying recurring patterns in teacher experiences, pedagogical adaptation, and infrastructure constraints (Braun & Clarke, 2006). Quantitative and qualitative findings from the analysis were triangulated to achieve a comprehensive understanding of the intervention's effect (Flick, 2018).

6.6. Justification of the Intervention

The intervention design aligns with global evidence that TPACK-focused, design-led professional development induces long-term pedagogical change (Papanikolaou et al., 2017; Chai, Koh, & Tsai, 2013; Harris & Hofer, 2011). Through the integration of collaborative inquiry using the Community of Inquiry (CoI) framework (Garrison et al., 2010) and by addressing infrastructural limitations, the program provides a replicable model for embedding technology in resource-constrained education systems (Angeli & Valanides, 2009; Ritonga et al., 2025).

7. Findings

This section offers the combined qualitative and quantitative outcomes of analysis, organized by the research questions and intervention purposes. Quantitative data from surveys, pre/post-testing, and infrastructure surveys are supplemented by qualitative data from interviews, focus groups, and class observations, providing a general assessment of the TPACK-focused intervention's influence on teacher practice, student meeting, and school context in Southern Lebanese public schools.

7.1. Teacher TPACK Knowledge and Practices

The first objective of the study was to evaluate teachers' growth in Technological Pedagogical Content Knowledge (TPACK). Before the intervention, teachers demonstrated limited familiarity with integrating digital tools into pedagogy. The pre-intervention descriptive statistics of teachers' TPACK domains are summarized below, as shown in **Table 2**.

Table 2. Descriptive statistics for teacher TPACK scores (Pre-Intervention).

TPACK Domain	N	Mean (M)	SD	Min	Max
Content Knowledge (CK)	30	3.6	0.52	2.5	4.5
Pedagogical Knowledge	30	2.8	0.64	1.8	3.9
Technological Knowledge	30	2.5	0.59	1.5	3.8
Integrated (TPK + TCK + PCK)	30	2.1	0.61	1.2	3.2

Post-intervention, mean TPACK marks rose to 3.8 (SD = 0.47), with the largest advances in integrated domains (TPK, TCK, PCK). Paired-sample t-tests established statistical significance, with effect sizes beyond d = 0.8, indicating educationally meaningful improvements (Harris et al., 2017; Wu & Wang, 2022).

After completing the blended training, teachers reported stronger confidence and observable improvements in lesson design. Paired-sample *t*-tests revealed significant gains across all TPACK domains (Table 3).

Table 3. Teacher TPACK scores (Pre- vs Post-Intervention).

Domain	Pre (M)	Post (M)	t-value	*p*-value	Effect Size (d)
Content Knowledge (CK)	3.6	3.9	2.12	0.042	0.38 (small)
Pedagogical Knowledge	2.8	3.6	5.01	<0.001	0.92 (large)
Technological Knowledge	2.5	3.5	6.34	<0.001	1.15 (large)
Integrated Knowledge	2.1	3.9	8.45	<0.001	1.54 (large)

The significant increase ($p < 0.001$) suggests that teachers meaningfully enhanced their technological integration skills. The large effect size (1.10) confirms that the intervention was impactful across all measured domains.

7.2. Student Engagement and Performance

The second research objective examined the influence of teacher training on student engagement and achievement. Teachers reported higher student participation and collaborative interaction during lessons.

Table 4 presents student engagement levels before and after the intervention, based on observation checklists and self-reports.

Table 4. Student engagement scores Pre- vs Post-Intervention.

Variable	Pre (M)	Post (M)	t-value	*p*-value	Effect Size (d)
Engagement Score	2.7	3.9	6.12	<0.001	1.05 (large)
English Test Score (%)	56.4%	69.7%	5.76	<0.001	0.98 (large)

Student academic performance improved accordingly, as shown in Table 5. Average English language test scores increased from 56.4% to 69.7%, confirming a substantial positive learning effect.

Table 5. Student Performance Pre- vs Post-Test

Test Type	N	Mean (%)	SD	t-value	*p*-value	Effect Size (d)
Pre-Test	60	56.4	11.2			
Post-Test	60	69.7	10.5	5.76	<0.001	0.98 (large)

These findings reveal that student motivation and performance both improved significantly when teachers applied TPACK-aligned strategies.

7.3. Infrastructure and Contextual Barriers

Despite positive progress, many schools continued to experience recurring technical and contextual challenges. Teachers cited unstable electricity, poor connectivity, and a shortage of technical support as the most persistent barriers (Table 6).

Table 6. Reported infrastructure barriers (Teacher Survey).

Barrier	% Teachers Reporting	Rank
Frequent power outages	87%	1
Poor internet connectivity	73%	2
Lack of technical support	68%	3

These constraints limited the scalability and sustainability of technology integration, echoing national concerns over Lebanon's deteriorating educational infrastructure (World Bank, 2023; UNICEF, 2024).

7.4. Qualitative Insights

Thematic analysis of interviews and focus groups provided additional context for the quantitative results. Teachers highlighted collaboration, adaptability, and confidence as the most significant areas of growth (Table 7).

Table 7. Frequency of key themes from interviews and focus groups.

Theme	Frequency	Example Quote
Improved Confidence	24	"I feel more in control using technology in class."
Pedagogical Shifts	19	"Students are more active now with digital tools."
Infrastructure Barriers	17	"Internet failure still disrupts digital lessons."

These qualitative findings reinforce the quantitative evidence: the intervention not only improved technical knowledge but also fostered a stronger sense of professional agency among teachers.

8. Discussion

These results show that TPACK-based teacher training can lead to better use of technology in lessons, even in schools with limited resources. However, infrastructure and policy issues still block steady progress. Matching digital content to the local culture, language, and curriculum helps adoption. But with only five teachers interviewed, generalization is limited. Also, data from secondary sources may not always be current. Long-term impact beyond 3 - 6 months is not known.

9. Limitations

This study has several limitations:

1) The qualitative part uses only five teachers; more teachers and more schools would help capture a wider range of experiences.

2) Some data come from NGO and government reports that may vary in how up-to-date or accurate they are.

3) Follow-up period was only 3 - 6 months; long-term sustainability was not observed.

4) Focus is only on South Lebanon; findings may not apply to other regions or countries.

Additionally, the post-intervention follow-up was limited to 3 - 6 months. Future research should include longitudinal studies to evaluate the sustainability of TPACK-based interventions and long-term impacts on teacher practices and student learning outcomes.

10. Conclusion and Recommendation

Integrating technology into South Lebanon's public schools presents both urgent challenges and transformative potential. Weak infrastructure, limited devices, and insufficient teacher training remain barriers; however, strategic investment in renewable energy, affordable devices, reliable internet, and TPACK-based professional development can foster meaningful change.

If schools, policymakers, NGOs, and communities collaborate, technology can evolve from a supplementary tool into a central pillar of learning. Such integration will not only reduce inequities but also equip students with the skills necessary for a competitive digital future.

Future work should focus on:

- Documenting best practices from successful pilot programs.
- Monitoring TPACK implementation at scale.
- Establishing feedback loops between policymakers, teachers, and NGOs.
- Ensuring strategies are sustainable, scalable, and inclusive.

Only through sustained systemic effort, South Lebanon's public schools can influence technology to close educational gaps and prepare students for lifelong success.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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