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Navigating Implementation Challenges in Designing and Delivering Blended TPACK Course: A Reflective Study

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Abstract:
The foundation of 21st-century teaching remains in the meaningful integration of technology, pedagogy, and content knowledge (TPACK). However, it poses a unique challenge for teacher educators to decode theoretical understanding into practical implementation through a blended learning approach. A qualitative description is adopted to provide a thorough understanding of the instructor's experiences through reflective practices. This paper aimed to present the challenges encountered by the instructor during the design, development, and implementation of a blended learning course to enhance TPACK competencies. It also focuses on the strategies used to overcome such challenges faced by the instructor. Key challenges included adopting technological tools suitable for instructional objectives, balancing face-to-face and online components, time management, supporting different levels of student digital literacy, sustaining learner engagement, institutional constraints and technical limitations. To address these challenges, adaptive planning, continuous course revision, scaffolded technological support, and responsive feedback mechanisms were employed.

Keywords: Challenges, TPACK, Blended Learning, Teacher Education, ICT Integration

INTRODUCTION:

Technology is becoming a central part of modern teaching and learning practices. To use it effectively and make the most of its potential, educators need strong and reliable learning frameworks to guide their instruction. A conceptual framework known as TPACK aids in communicating the fundamental information needed by teacher educators to effectively integrate technology into their lessons **(Baran et al., 2011; Mishra & Koehler, 2009). Shulman's (1986)** theory of pedagogical content knowledge (PCK), which took content knowledge and pedagogical knowledge structures into separate consideration, served as the foundation for TPACK **(Luckay, 2017).**

Technological Pedagogical Content Knowledge (TPACK) refers to the combination of knowledge teachers need to teach effectively in technology-rich learning environments. It highlights how educators bring together their understanding of subject content, teaching methods, and digital tools to create meaningful and engaging learning experiences. TPACK refers to the teacher's knowledge in three distinctive components: technology, pedagogy, and content and interrelated components. A teacher knowing those components would easily be able to select a suitable technology for their teaching-learning process. If technology is used in the classroom without strong support systems and well-designed learning activities, it can end up being little more than a flashy add-on with minimal real impact on student learning. However, when it is thoughtfully integrated and clearly connected to learning goals -such as building new knowledge, deepening understanding, or developing skills- it creates more meaningful and authentic learning experiences. In turn, students are better prepared with the knowledge and abilities they need to succeed beyond the classroom.

During the COVID period, we all became familiar with online education. After the pandemic, the focus gradually shifted to blended learning- a purposeful combination of face-to-face teaching and online activities. If the blended learning approach is implemented in a well-planned and organised way, it can shape the future of our Indian education system. Blended learning brings traditional and online teaching together by integrating digital resources with classroom instruction in a meaningful way. As noted by **UGC (2022),** it is not just a simple mix of online and offline modes, but a thoughtful combination designed around learning outcomes and a learner-centred environment.

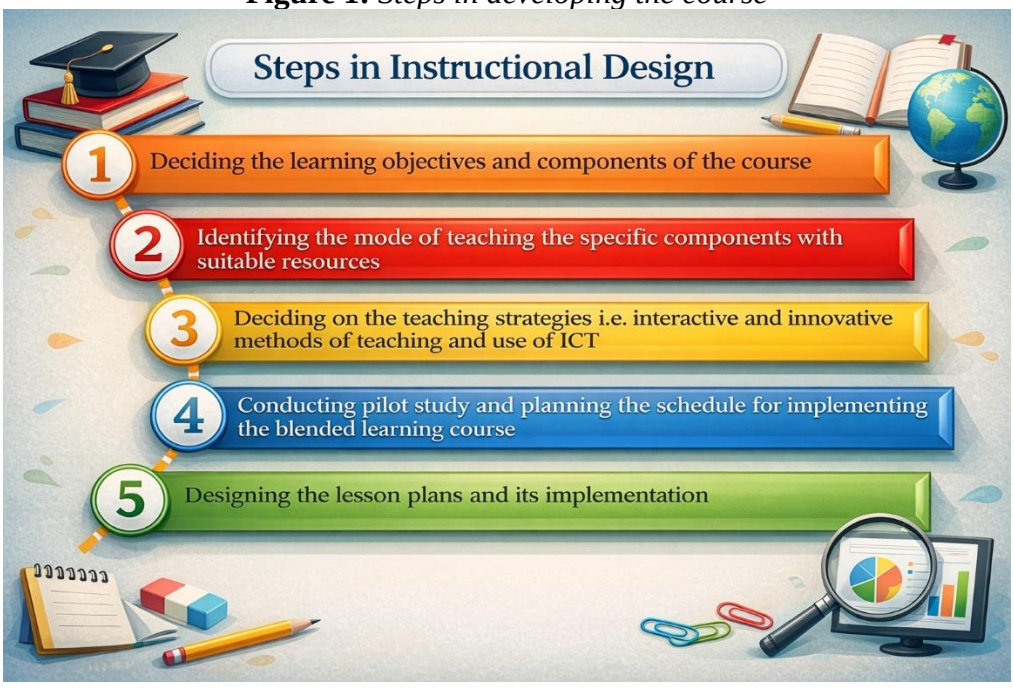
However, the real challenge rests with teacher educators, who are expected not only to develop the necessary competencies themselves but also to nurture these skills in the next generation of teachers. Many teachers face challenges such as limited technological skills, not enough time to plan ICT-integrated lessons, and a lack of continuous training and institutional support. These constraints make it difficult for them to fully harness the untapped strength of information and communication technology (ICT) in their teaching practice **(Akram, 2022).**

While numerous studies examine the effectiveness of blended learning interventions, very few investigations focus on the challenges faced while designing and implementing such interventions. Especially with teacher education programs operating within institutional constraints, the alignment of technological tools, pedagogical strategies and subject content presents multiple practical difficulties. This study addresses this gap by examining the challenges encountered during the design and delivery of a blended TPACK course for trainee mathematics teachers. Rather than focusing on outcomes, this paper foregrounds the process-level difficulties that emerged during course execution.

COURSE DESIGN AND DEVELOPMENTAL CONTEXT:

The blended learning course was designed using the following steps, shown in Figure 1, to enhance the TPACK competencies conceptualised by Punya Mishra and Matthew J. Koehler.

Figure 1: *Steps in developing the course*



The course comprised two modules, each containing four units structured around core TPACK components: Unit 1 (Content Knowledge), Unit 2 (Pedagogical Knowledge), Unit 3 (Technological

Knowledge), and Unit 4 (Integrated TPACK application). Following each course, assignments were given to strengthen conceptual knowledge and real-world application. The course was delivered entirely in blended mode over 30 hours spread throughout one and a half months. The Flex model of blended learning was adopted for instructional delivery, allowing students to access online content alongside structured face-to-face interactions. For course development, an IPSIT-based approach (Identify–Provide–Scaffolding–Identification–Testing) guided the organisation and sequencing of content.

Edmodo was selected as the Learning Management System to offer the online components, which made it easier to submit assignments, get comments on discussions, make announcements, share learning materials and conduct quizzes and polls, etc.

80 pre-service teachers of mathematics enrolled in a B.Ed. program and integrated B.Ed. programs were among the participants. Numerous subject-specific digital tools on Mathematics were incorporated, such as GeoGebra, Geoboard, Kahoot, Socrative, Piktochart, Mindomo, Live worksheets and Google Meet, etc. The content of the Blended TPACK Course was validated through an evaluation proforma submitted to four experts- a psychologist, an educational researcher, a teacher educator, and a subject expert. Coordinating with these experts, collecting their feedback within the stipulated time, and consolidating their responses for necessary modifications required careful planning and communication.

METHODOLOGY:

A qualitative action research approach was adopted to provide an in-depth understanding of the instructor's experiences as both the course instructor and investigator. Data were gathered through reflective practices and journals, field notes, informal feedback interactions, assignment submissions of the students and expert validation documentation.

CHALLENGES IN DESIGNING AND DELIVERING THE BLENDED TPACK-BASED COURSE:

The researcher developed the blended learning course to develop TPACK competencies among trainee teachers of Mathematics. This course's design, development and implementation presented unique challenges. The challenges and overcoming strategies addressed by the researcher are classified as follows-

1. **Design-Level Challenges-** Designing the course was far more demanding than initially anticipated. Translating the theoretical constructs of CK, PK, TK, and their intersections into structured, sequential learning units required deep reflection and repeated restructuring. While the TPACK framework appears conceptually clear, operationalising it into meaningful classroom experiences for mathematics pre-service teachers was complex and time-consuming. A major difficulty lay in identifying appropriate subject-specific digital resources. Considerable time was spent searching open educational resources that aligned with the Indian B.Ed. curriculum and mathematics pedagogy. In many cases, available resources were either too generic or technologically advanced for beginners or misaligned with curricular needs. This compelled the development and adaptation of original materials to ensure contextual relevance.

Another challenge was personal technological preparedness. Before introducing tools such as GeoGebra or other mathematics applications to students, it was necessary to explore, experiment, and gain confidence in using them independently. This process of self-learning added to the preparation load but was essential to ensure smooth facilitation. Designing TPACK-oriented lesson plan assignments also proved challenging. Initially, many students treated technology as an add-on rather than an integrated pedagogical tool. Guiding them toward deeper conceptual integration required sustained scaffolding and careful task design.

To address design-related complexities, the course structure was revisited periodically. Units were reorganised to improve conceptual flow, and additional exemplars were introduced to clarify the

difference between mere technological usage and meaningful TPACK integration. Scaffolded lesson-plan templates were gradually refined to guide students toward deeper alignment of content, pedagogy, and technology.

2. Technological and Infrastructure Constraints- The implementation phase brought forward practical realities that significantly shaped the blended learning experience. Limited ICT infrastructure posed persistent challenges. The absence of a dedicated ICT laboratory restricted hands-on experimentation, and scheduling shared digital spaces often created logistical difficulties. Since regular academic activities had resumed after COVID-19, classrooms and computer laboratories were frequently unavailable due to scheduled lectures and other institutional engagements. Internet connectivity issues occasionally disrupted online sessions, affecting continuity and engagement.

Some students faced device limitations, which influenced their ability to participate consistently in online activities. These interruptions, though seemingly minor, required frequent flexibility in deadlines and instructional pacing. The reliance on digital platforms also meant navigating technical glitches, platform unfamiliarity, and initial hesitation among students who were not accustomed to structured online academic engagement. Addressing these issues demanded patience, reassurance, and continuous technical support alongside pedagogical facilitation.

Technological constraints were managed through flexibility in deadlines and blended scheduling. When ICT laboratory access was limited, demonstration-based teaching was used initially, followed by rotational hands-on sessions. Students were also encouraged to collaborate and share devices where necessary, fostering peer support networks.

3. Pedagogical Alignment Complexities- Balancing the online and face-to-face components of the course was not a straightforward process. It required continuous adjustments based on student responses, time constraints, and the flow of the B.Ed. schedule. At times, students expressed that the online activities felt like an added burden rather than an integrated part of the learning experience. This perception required repeated clarification, motivation, and restructuring to help them see the value of blended engagement. Another significant challenge was designing assessment rubrics that could genuinely capture the depth of TPACK integration. It was relatively easy to identify whether a digital tool was used; however, evaluating whether technology was meaningfully aligned with pedagogy and content demanded careful thought and multiple revisions of the assessment criteria. The refinement of rubrics became an evolving process alongside the course itself.

In response to students perceiving online tasks as additional workload, explicit connections were drawn between online and face-to-face activities. Online discussions were integrated into classroom deliberations, and selected digital submissions were showcased during physical sessions. This helped reposition online engagement as an extension of classroom learning rather than a parallel requirement.

4. Learner Engagement and Adaptation Barriers- Motivating students to attend online sessions with their hectic B.Ed. schedule posed a constant challenge. Participation levels varied, and some students needed repeated encouragement to complete their tasks. A few students had low digital literacy and ICT knowledge, so extra efforts were needed to help them develop their basic knowledge of computers. Developing TPACK-based mathematics lesson plans from the trainee teachers required continuous scaffolding and feedback.

To enhance motivation and reduce hesitation toward digital platforms, brief orientation sessions were conducted on navigating the LMS and using mathematics applications. Gradually, as familiarity increased, resistance reduced, and participation stabilised.

5. Institutional and Researcher- Role Tensions- Institutional constraints, including rigid timetables and administrative procedures, limited flexibility. Simultaneously, managing dual responsibilities as educator and researcher created professional tension. Balancing instructional responsiveness with thorough documentation required deliberate negotiation throughout the course. However, continuous reflective journaling helped balance the dual roles of researcher and instructor. Rather than treating challenges as disruptions, they were documented as data points informing iterative course refinement.

Although the instructor encountered many challenges in different forms throughout the process, the experience showed something important: successful blended learning is less about strictly following a fixed plan and more about being flexible and responsive. The adaptive strategies used along the way highlight that overcoming challenges in blended environments requires openness to change, sensitivity to context, and continuous reflection, rather than rigidly adhering to predetermined instructional designs.

IMPLICATIONS FOR POLICY AND PRACTICE:

The study highlights key areas that require attention from teacher education institutions and policymakers:

- **Structured Curriculum Integration**- Embed TPACK-based modules directly into the core pedagogy curriculum rather than offering them as stand-alone workshops.
- **Institutional Infrastructure Support**- Ensure reliable internet connectivity, effective LMS platforms, and well-equipped digital labs to sustain blended learning implementation.
- **Faculty Professional Development**- Provide continuous training for teacher educators in blended instructional design and TPACK integration strategies.
- **Assessment Reform**- Develop multidimensional evaluation tools that assess integrated technological, pedagogical, and content competencies instead of relying solely on theoretical exams.
- **Workload Balancing**- Align blended modules with existing academic schedules to prevent overload and promote meaningful engagement and reflection.
- **Scalable Implementation Models**- Gradually expand pilot-tested modules with strong institutional backing to maintain instructional quality and sustainability.

By addressing these areas, teacher education programs can enhance the sustainability and effectiveness of blended TPACK-based instructional innovations.

DISCUSSION & CONCLUSION:

The journey of designing and implementing a blended course to develop TPACK competencies revealed that translating theory into practice is far more complex than it appears in conceptual models. While the framework offers a clear structure for understanding the relationship between content, pedagogy, and technology, bringing these elements together in a real teacher education setting required continuous adjustment, patience, and reflection.

Many of the challenges encountered were not simply technological in nature. They were embedded in institutional structures, and the time constraints of the B.Ed. program, limited infrastructure, and students' initial perceptions of online learning as an additional burden. Aligning digital tools meaningfully with mathematics pedagogy demanded sustained effort, both in preparation and during implementation. The process also required ongoing scaffolding to help pre-service teachers move beyond superficial technology use toward genuine integration.

Balancing the dual responsibilities of researcher and instructor added another layer of complexity. At several points, decisions had to be made between maintaining instructional flow and systematically documenting emerging issues. However, these moments of tension ultimately strengthened the reflective dimension of the study.

Rather than viewing the difficulties as setbacks, they gradually became opportunities for refinement and professional growth. The experience suggests that developing TPACK competencies through blended learning is not a fixed intervention but an evolving pedagogical journey that requires flexibility, contextual awareness, and institutional support. By documenting these implementation realities, this study hopes to contribute to a more grounded understanding of blended innovation in teacher education.

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