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ENHANCING PRIMARY SCHOOL TEACHERS' SELF-EFFICACY THROUGH THE TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) FRAMEWORK: INSIGHTS FROM TRIPOLI, LIBYA

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ABSTRACT

This study explores the integration of the Technological Pedagogical Content Knowledge (TPACK) framework among primary school teachers in Tripoli, Libya, focusing on the factors that influence its adoption and effectiveness. With the rapid evolution of educational technology, effective integration is crucial for enhancing teaching efficacy and improving student outcomes. Using a mixed-methods approach, the study surveyed 750 primary school teachers from six districts in Tripoli through structured questionnaires, capturing data on self-efficacy, organizational support, technological access, and perceived usefulness of educational technologies. The quantitative analysis employed statistical techniques such as exploratory factor analysis, structural equation modeling (SEM), and path analysis to examine relationships and identify the mediating role of self-efficacy in TPACK adoption. Key findings reveal that self-efficacy plays a significant mediating role, with teachers reporting greater confidence in using technology when they believe in their abilities. Additionally, perceived ease of use and usefulness of technological tools were found to moderate the impact of technological support on TPACK integration. Qualitative insights gathered from semi-structured interviews provide a deeper understanding of the barriers and facilitators of TPACK adoption, emphasizing the challenges posed by limited infrastructure, insufficient training, and resistance to change. However, the study also highlights the positive impact of collaborative learning environments and strong organizational support in overcoming these obstacles. The findings provide valuable implications for policymakers, educators, and administrators aiming to enhance TPACK integration in Libya's primary schools. Recommendations include the development of tailored professional development programs, improved technological infrastructure, and the promotion of collaborative practices among teachers. These efforts will help ensure the sustainable integration of educational technologies and improve teaching and learning outcomes in Libya's primary education system.

Keywords: TPACK, self-efficacy, technological integration, educational technology, teacher training

INTRODUCTION

The integration of technology in education has become a central element of modern teaching and learning practices. As digital tools and resources continue to evolve rapidly, the need for teachers to incorporate technology into their pedagogy has never been more critical. However, the successful integration of educational technology requires more than just access to technological tools; it requires a deep understanding of how to combine technology, pedagogy, and subject content knowledge. The Technological Pedagogical Content Knowledge (TPACK) framework, introduced by Mishra and Koehler (2006), provides an effective model for integrating these three

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critical components of teaching. This framework emphasizes that effective technology integration is not just about knowing how to use digital tools but understanding how technology interacts with pedagogy and content to create meaningful learning experiences. Despite its potential, the adoption of TPACK in various educational contexts, particularly in developing nations, remains a significant challenge.

In Libya, like in many other developing countries, integrating information and communication technology (ICT) into education has become a key priority to improve the quality of teaching and enhance student outcomes. The Libyan Ministry of Education has initiated several reforms over the years aimed at advancing the use of educational technology in schools. However, the country faces several challenges that hinder the successful implementation of these initiatives, including limited technological infrastructure, a lack of adequate teacher training, and socio-cultural factors that influence how teachers perceive and use technology. In this context, the TPACK framework offers a promising avenue for enhancing the ability of Libyan primary school teachers to effectively integrate technology into their teaching practices.

The TPACK framework is a conceptual model that integrates three core knowledge domains: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). According to Mishra and Koehler (2006), effective teaching requires a blend of these knowledge domains, where teachers must not only understand the subject matter, they are teaching but also know how to teach it effectively and how to use technology in ways that enhance both pedagogy and content delivery. The intersection of these three knowledge areas creates the foundation for successful technology integration. In essence, TPACK is about understanding how technology can support and enrich teaching strategies while also aligning with the specific needs of the content being taught.

In the case of primary school teachers, the TPACK framework offers a holistic approach to teacher professional development, helping educators bridge the gap between theoretical knowledge and practical application. It encourages teachers to move beyond simple technological skills and consider how their teaching strategies can evolve to incorporate digital tools. TPACK promotes a more sophisticated approach to teaching where technology is not seen as an add-on but as an integral part of the learning process.

Self-efficacy, a concept introduced by Bandura (1997), refers to an individual's belief in their ability to execute specific tasks successfully. In the context of teaching, self-efficacy refers to a teacher's confidence in their ability to use technology effectively in the classroom. Teachers with high levels of self-efficacy are more likely to experiment with new teaching methods, adopt innovative technologies, and use them in ways that enhance student learning. Conversely, teachers with low self-efficacy may resist using technology, fearing that they lack the necessary skills or that technology may not benefit their students.

Incorporating self-efficacy into the TPACK framework is crucial for understanding the factors that influence technology adoption in education. A teacher's belief in their ability to use technology successfully can significantly impact how they approach the integration of technological tools in their classroom. Teachers who perceive themselves as capable of using technology are more likely to integrate it into their lessons, even if they face challenges or limited resources. On the other hand, teachers with low self-efficacy may be hesitant to use technology, even if they have access to it, because they lack the confidence to utilize it effectively.

In Libya, self-efficacy plays a particularly important role in TPACK adoption, as many teachers face barriers related to limited technological resources, inadequate training, and a lack of institutional support. Teachers' perceptions of their ability to integrate technology into their

teaching practices are influenced by both their personal experiences and the external environment in which they work. Research has shown that when teachers perceive technology as too difficult to use or too disconnected from their teaching needs, their self-efficacy suffers, and they are less likely to incorporate technology into their pedagogy (Chen, 2021). This highlights the importance of addressing self-efficacy in teacher professional development programs, ensuring that teachers not only receive the necessary skills and knowledge but also build the confidence to apply these skills in the classroom.

The adoption of TPACK in Libyan primary schools faces several unique challenges. One of the most significant barriers is the limited access to technology. Although the Libyan government has made efforts to provide ICT infrastructure in schools, many schools in Tripoli and other regions still lack the necessary technological tools to support effective teaching. In some schools, computers and other digital devices are outdated, and internet access is unreliable, further complicating the integration of technology into the classroom. Even in schools with access to technology, the lack of technical support and maintenance can make it difficult for teachers to utilize digital tools consistently.

Another key challenge is the inadequacy of teacher training programs. While some training programs are available, they often fail to meet teachers' specific needs or to provide adequate support for the integration of technology into subject-specific pedagogy. Many teachers receive only basic training in using digital tools, but they are not equipped with the pedagogical strategies needed to integrate these tools meaningfully into their teaching practices. This gap in training contributes to low self-efficacy, as teachers may feel unprepared to use technology in ways that enhance student learning.

Furthermore, there are significant cultural and organizational factors that influence technology adoption in Libyan schools. Teachers often face resistance from students and parents who may not fully understand the benefits of technology in education. In some cases, traditional teaching methods are deeply ingrained, and there is a reluctance to embrace new approaches. Organizational support, such as access to professional development, mentoring, and a collaborative work environment, is also often lacking, further hindering teachers' efforts to integrate technology into their teaching practices.

In addition to personal factors like self-efficacy, organizational and technological support are crucial for successful TPACK adoption. Teachers need support from their schools and administrators to integrate technology into their classrooms effectively. This support can take the form of access to resources, such as up-to-date technology and reliable internet, as well as administrative encouragement for teachers to experiment with new teaching methods. Schools that foster a collaborative environment where teachers can share best practices and learn from each other are more likely to see successful technology integration.

Technological support, including access to professional development opportunities focused on both technical skills and pedagogical strategies for using technology, is essential. Teachers need ongoing training and access to resources that help them stay current with the latest developments in educational technology. Without this support, even teachers with high self-efficacy may struggle to integrate technology effectively into their teaching practices.

The integration of the TPACK framework in primary schools in Tripoli, Libya, offers significant potential for enhancing teaching practices and improving student outcomes. However, the successful implementation of TPACK depends on addressing several key factors, including teachers' self-efficacy, access to technological resources, adequate training, and organizational support. This study aims to explore how these factors influence the adoption of TPACK and how

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self-efficacy mediates the relationship between external support and technology integration. By understanding the challenges and opportunities associated with TPACK adoption in Libya, policymakers, educators, and administrators can develop more effective strategies for integrating technology into primary education, ensuring that teachers are equipped with the knowledge, skills, and confidence to use technology in ways that enhance teaching and learning.

This study contributes to both theoretical and practical domains by addressing gaps in the literature on TPACK implementation in developing contexts. Theoretically, it advances understanding of how self-efficacy mediates the relationship between contextual factors and TPACK effectiveness, offering insights into the interplay between psychological and environmental influences on teacher behavior. Practically, the research provides actionable recommendations for policymakers and educational administrators to design targeted interventions that enhance teachers' confidence and capacity to integrate technology into their teaching practices.

The findings are expected to inform professional development programs, resource allocation strategies, and policy frameworks aimed at fostering sustainable educational informatization in Libya. By emphasizing the critical role of self-efficacy, this study underscores the need for contextually adaptive approaches that empower teachers and align technological advancements with pedagogical goals.

The theoretical foundation of this study is grounded in Bandura's (1997) self-efficacy theory, which posits that individuals' beliefs in their capabilities significantly influence their actions and outcomes. Within the context of education, self-efficacy shapes teachers' willingness to adopt and implement innovative practices, including technology integration. High self-efficacy is associated with greater resilience, adaptability, and proactive behavior, enabling teachers to navigate challenges and leverage opportunities in technology-enhanced learning environments (Lai, 2023).

The study also incorporates the Technology Acceptance Model (TAM) by Davis (1989) to examine the moderating effects of perceived usefulness and ease of use on TPACK adoption. TAM highlights the importance of user perceptions in determining technology acceptance, suggesting that tools perceived as valuable and user-friendly are more likely to be embraced. By integrating these theoretical perspectives, the research offers a comprehensive lens to analyze the multifaceted influences on TPACK implementation in primary education.

The research focuses on primary school teachers in Tripoli, Libya, examining the contextual factors that impact their ability to adopt and utilize TPACK effectively. The study sample comprises 750 teachers selected through stratified random sampling across six districts in Tripoli. Data collection involves structured questionnaires and qualitative interviews to capture diverse perspectives and experiences. Statistical analyses, including exploratory factor analysis, structural equation modeling, and path analysis, are employed to test hypotheses and identify relationships among variables.

LITERATURE REVIEW

The literature on integrating technology into education highlights significant advancements in understanding how technological tools can enhance teaching and learning processes. This section reviews the existing body of knowledge on the Technological Pedagogical Content Knowledge (TPACK) framework and related factors such as self-efficacy and contextual influences on technology adoption in educational settings. By synthesizing findings from diverse studies, the literature review identifies gaps and provides a foundation for exploring TPACK implementation among primary school teachers in Tripoli, Libya.

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Evolution of the TPACK Framework

The Technological Pedagogical Content Knowledge (TPACK) framework was introduced by Mishra and Koehler (2006) as an expansion of Shulman's (1987) Pedagogical Content Knowledge (PCK) model. PCK emphasized the importance of integrating pedagogical strategies with subject-specific content knowledge to facilitate effective teaching. While this approach offered a robust framework for understanding the teaching process, it did not account for the transformative potential of technology in the classroom. Recognizing the growing importance of digital tools in education, Mishra and Koehler (2006) expanded PCK by adding a third component: technological knowledge. The resulting TPACK framework emphasizes the dynamic and integrated relationship between technology, pedagogy, and content knowledge, recognizing that effective teaching in the digital age requires an understanding of how each of these elements interacts with one another.

The TPACK framework conceptualizes the integration of technology in education as more than just the use of tools in isolation. It requires teachers to blend and interconnect three distinct areas of knowledge: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). Content knowledge refers to a teacher's understanding of the subject matter being taught, while pedagogical knowledge concerns the methods and strategies used to teach that content. Technological knowledge, on the other hand, involves an understanding of digital tools and their applications in the classroom. The intersection of these three areas forms the foundation for effective technology integration in education.

Since its introduction, the TPACK framework has been widely adopted and adapted in a variety of educational contexts. Researchers have explored its applicability in different disciplines, educational levels, and cultural settings, identifying a range of factors that influence the effective use of technology in teaching. For example, Angeli and Valanides (2009) extended the framework by incorporating contextual factors such as student demographics, institutional culture, and the external environment. They argued that TPACK is not a one-size-fits-all model, but rather a dynamic and context-dependent framework that must adapt to the specific needs and challenges of the educational setting. Koh et al. (2013) further refined the model by emphasizing the iterative process of integrating technology into teaching. They suggested that technology integration is not a one-time event, but rather an ongoing process that evolves as teachers gain experience and as technological tools themselves evolve.

The TPACK framework has become instrumental in shaping the development of teacher education programs, encouraging the inclusion of technology as an essential component of teacher preparation. By emphasizing the need for teachers to integrate technology in a thoughtful and pedagogically sound manner, TPACK provides a pathway for educators to use technology in ways that enhance both teaching and learning. As technological advancements continue to reshape the educational landscape, the TPACK framework remains a relevant and valuable tool for guiding educators through the complexities of technology integration.

Factors Influencing TPACK Implementation

Teacher Self-Efficacy

One of the most critical factors influencing the effective implementation of TPACK is teacher self-efficacy, or the belief that a teacher can successfully accomplish a task. In the context of TPACK, self-efficacy refers to a teacher's confidence in their ability to integrate technology effectively into their teaching practices. Bandura (1997) emphasized that self-efficacy plays a central role in shaping behavior and performance. Teachers with high self-efficacy are more likely to experiment with new teaching methods, persist in the face of challenges, and embrace innovative strategies,

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including technology integration. Conversely, teachers with low self-efficacy may feel overwhelmed by the complexity of new technologies and may resist using them, fearing that they will not be able to use them effectively.

Research on teacher self-efficacy has consistently shown that self-belief influences not only the willingness of teachers to adopt new tools but also their persistence and success in overcoming challenges (Chen, 2021). Self-efficacy influences how teachers approach technology integration: teachers with high self-efficacy are more likely to experiment with digital tools, adopt a wide range of technology applications, and adapt their teaching strategies to incorporate new technological resources. These teachers are also more likely to engage in professional development and seek additional support to improve their skills. In contrast, teachers with low self-efficacy may avoid using technology or limit their use to a few tools that they feel comfortable with. In contexts where resources are limited and teachers have had little exposure to technology, low self-efficacy can serve as a significant barrier to technology integration (Lai, 2023).

For the successful implementation of TPACK, it is important to consider the factors that contribute to the development of teacher self-efficacy. These factors include prior experience with technology, access to professional development, peer support, and institutional encouragement. Teachers who receive ongoing training in technology integration and who work in supportive environments where they can collaborate with colleagues are more likely to develop high self-efficacy, which in turn supports effective TPACK adoption. Furthermore, teacher self-efficacy is not static; it can be built over time through continuous professional development and encouragement, which reinforces the importance of a sustained focus on teacher growth and confidence in using technology.

Organizational and Environmental Factors

The organizational environment in which teachers work plays a crucial role in determining the success of TPACK implementation. Organizational factors such as leadership, access to resources, and institutional support can either facilitate or hinder technology integration. Schools with supportive leadership that actively encourages the use of technology and provides the necessary resources are more likely to foster higher levels of TPACK proficiency among their teachers. Administrative support can take various forms, such as providing access to technology tools, offering professional development opportunities, and creating a culture that encourages innovation and experimentation with new teaching methods.

Moreover, the availability of resources such as digital devices, reliable internet connectivity, and software tools is a critical factor influencing TPACK adoption. In many developing regions, schools may face resource constraints that limit teachers' ability to integrate technology into their classrooms effectively. For instance, teachers may have limited access to computers, projectors, or other technological tools, which makes it difficult for them to incorporate technology into their lessons. Schools with well-defined ICT policies and a commitment to improving technological infrastructure tend to create a more conducive environment for the effective use of TPACK (Xu, 2022).

However, the absence of adequate resources and institutional support can have a detrimental effect on TPACK adoption. Schools that lack the necessary infrastructure may find it difficult to implement even basic technology integration strategies. In addition, cultural and environmental factors, such as societal attitudes toward technology and the perceived value of digital tools in education, also shape how technology is adopted and used in classrooms. In settings where there

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is resistance to technology or a lack of confidence in its benefits, teachers may be less likely to embrace the TPACK framework, even if they are trained to do so.

Technological Support and Training

Effective professional development is another key factor influencing the successful implementation of TPACK. Studies have shown that training programs that combine hands-on experience with technology, collaborative learning, and ongoing support are more likely to result in successful technology integration (Zheng, 2022). Collaborative learning environments allow teachers to share knowledge, exchange ideas, and provide mutual support as they experiment with new tools and strategies. This helps build confidence and competence in using technology in the classroom.

Moreover, training programs should be tailored to the specific needs of teachers and their contexts. Generic or one-size-fits-all programs may not address the particular challenges that teachers face in different cultural or educational settings. Contextualized training that considers the specific content areas, technological resources, and pedagogical practices of a given school or region is more likely to have a lasting impact on TPACK adoption. Additionally, training should be ongoing, as technology is continually evolving, and teachers need opportunities to stay updated on new tools and practices.

Professional development programs should also focus on building both technological knowledge (TK) and pedagogical knowledge (PK), as these two areas are essential for effective technology integration. Teachers must not only learn how to use digital tools but also understand how to apply these tools to their specific teaching contexts and content areas. This requires a blend of technical skills and pedagogical strategies that align with the needs of the curriculum.

Challenges in TPACK Implementation

Resource Constraints

In many developing countries, limited access to technological resources is a significant barrier to the effective implementation of TPACK. Many schools in underserved areas lack the necessary hardware, such as computers, tablets, and projectors, as well as reliable internet connectivity. These resource constraints disproportionately affect primary schools, where educational budgets are often stretched thin, and the allocation of resources may be skewed toward secondary and tertiary institutions.

Without adequate technological infrastructure, teachers are unable to effectively integrate technology into their lessons, even if they possess the necessary skills and knowledge. Resource limitations also affect the type of technologies that can be used in the classroom. For instance, some schools may only have access to basic tools, such as overhead projectors or limited computers, which may not support more advanced learning tools or digital platforms. Moreover, even when technology is available, technical issues, such as malfunctioning equipment or lack of maintenance, can disrupt teaching and create frustration among teachers, further hindering technology adoption.

Resistance to Change

Another significant challenge to TPACK implementation is teacher resistance to change. Many educators may view technology as disruptive to traditional teaching methods and may feel overwhelmed by the perceived complexity of integrating new tools into their teaching practices. Teachers who have spent years honing their teaching methods may be reluctant to change their

approach, particularly if they perceive technology as unnecessary or incompatible with their existing pedagogical strategies. This resistance can be exacerbated by a lack of adequate training and support, which makes teachers feel ill-equipped to integrate technology into their lessons.
Addressing this resistance requires **targeted interventions** that emphasize the benefits of technology and provide practical solutions to perceived challenges. Professional development programs that focus on the **pedagogical advantages** of technology, as well as strategies for integrating digital tools in ways that align with existing teaching practices, can help reduce resistance and increase teachers' willingness to embrace technology.

Addressing Gaps in the Literature

Despite the extensive research on TPACK, gaps remain in understanding its application in specific cultural and contextual settings. While much of the literature has focused on developed countries or specific subject areas, there is a need for more research on the implementation of TPACK in developing nations, particularly in primary education. Teachers in these contexts often face unique challenges, such as resource constraints and varying levels of teacher preparedness, which may affect their ability to integrate technology effectively.
Additionally, while the role of self-efficacy in TPACK adoption has been acknowledged, more research is needed on how self-efficacy acts as a mediator between external support and effective technology integration. Exploring how teachers' self-beliefs shape their engagement with TPACK can provide valuable insights for designing professional development programs that foster both confidence and competence in technology integration.
This study aims to address these gaps by examining how contextual factors, self-efficacy, and organizational support interact to influence TPACK adoption among primary school teachers in Tripoli, Libya. By filling these gaps in the literature, the study seeks to provide a more nuanced understanding of how TPACK can be implemented in diverse educational contexts to improve teaching and learning outcomes.
The TPACK framework offers a comprehensive model for integrating technology into education, highlighting the critical interactions between technology, pedagogy, and content knowledge. However, the successful implementation of TPACK is influenced by several factors, including teacher self-efficacy, organizational support, and resource availability. In contexts such as Libya, where teachers face unique challenges related to limited resources and institutional support, addressing these factors is essential for fostering effective technology integration. By addressing the gaps in the literature and exploring the specific needs of teachers in Tripoli, this study aims to provide valuable insights into how TPACK can be effectively implemented in primary education, ultimately improving teaching practices and student outcomes.

RESEARCH METHODOLOGY

Research Methodology

This study employs a mixed-methods approach to comprehensively explore the factors influencing the adoption and effectiveness of the TPACK framework among primary school teachers in Tripoli, Libya. By integrating both quantitative and qualitative data, the research aims to provide a holistic understanding of the individual and contextual factors that impact TPACK implementation in the region.

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Sampling and Participants

The study targets primary school teachers in Tripoli, Libya, focusing on a diverse sample of educators across six districts within the city. A stratified random sampling technique was employed to ensure representation from various demographic and professional backgrounds. This approach was chosen to capture the complexity of TPACK adoption across different contexts within Tripoli. A total of 750 teachers were selected for participation, with the sample size adjusted to account for potential non-responses, ensuring sufficient statistical power and reliability for the quantitative analysis. The selected teachers represent a variety of experience levels, educational backgrounds, and schools with differing access to resources, offering a comprehensive view of TPACK implementation.

Data Collection

Data collection was conducted in two phases: quantitative and qualitative.

1. **Quantitative Component:** The quantitative data were collected through structured surveys designed to measure key variables influencing TPACK adoption. These variables included teachers' self-efficacy, organizational support, technological proficiency, and their perceptions of perceived usefulness and ease of use of technology. The survey instrument was adapted from established scales, such as Bandura's (1997) self-efficacy scale and Davis's (1989) Technology Acceptance Model (TAM) constructs. These scales were modified to align with the specific context of primary education in Tripoli. The data collected through the surveys provided valuable insights into the relationships between organizational factors, teachers' self-efficacy, and their ability to implement TPACK effectively.
2. **Qualitative Component:** The qualitative data were gathered through semi-structured interviews with a subset of 30 teachers, selected to ensure diversity in terms of teaching experience, school type, and access to technology. The semi-structured format allowed participants to share their personal experiences and perceptions regarding the implementation of TPACK in their classrooms. The interviews aimed to uncover deeper insights into the barriers and facilitators of TPACK integration, such as resource constraints, training opportunities, and cultural attitudes toward technology. These qualitative findings provided a nuanced perspective that complemented the quantitative results.

Data Analysis

1. **Quantitative Analysis:** The quantitative data were analyzed using a combination of statistical techniques. Descriptive statistics were initially used to summarize the characteristics of the sample and the key variables under study. Exploratory Factor Analysis (EFA) was performed to identify underlying factors and reduce the dimensionality of the data. To test the relationships between variables and assess the strength and direction of these relationships, Structural Equation Modeling (SEM) and Path Analysis were employed. These methods enabled the examination of direct, indirect, and moderating effects, particularly the mediating role of self-efficacy in the relationship between organizational support and TPACK implementation. Additionally, the Technology Acceptance Model (TAM) constructs, particularly perceived usefulness and ease of use, were tested for their moderating effects on the relationship between

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technological support and TPACK adoption. These analyses provided robust statistical evidence for the key findings of the study.

2. **Qualitative Analysis:** The qualitative data were analyzed using thematic analysis, guided by the framework proposed by Braun and Clarke (2006). This approach involved identifying recurring patterns and themes in the interview data, which were then categorized and interpreted to uncover the underlying factors influencing TPACK implementation. Key themes that emerged from the interviews included resource constraints, professional development, and cultural perceptions of technology, with an emphasis on the challenges teachers faced in integrating technology and the strategies they employed to overcome these obstacles. Thematic analysis helped to contextualize the quantitative findings by providing a deeper understanding of the personal and organizational experiences that shape TPACK adoption.

Ethical Considerations

The study adhered to strict ethical guidelines to ensure the protection of participants' rights and confidentiality. Informed consent was obtained from all participants, and they were assured of their anonymity and the confidentiality of their responses. All data were handled securely, with access restricted to the research team. The study was approved by the relevant educational authorities in Tripoli, ensuring that it complied with local regulations and standards. Additionally, the research design was aligned with cultural sensitivities, considering the unique educational context of Tripoli.

While the study provides valuable insights into the factors influencing TPACK adoption in Tripoli, there are several limitations to consider. First, the reliance on self-reported data from surveys and interviews may introduce response biases, as participants may overestimate their proficiency or underreport challenges they face. Second, the cross-sectional nature of the study limits the ability to draw causal conclusions. Longitudinal studies would be beneficial in assessing how the factors influencing TPACK adoption evolve over time. Future research could also incorporate objective measures of TPACK effectiveness, such as classroom observations or student outcomes, to complement self-reported data.

The research methodology adopted in this study successfully integrates both quantitative and qualitative data to explore the factors that influence TPACK adoption among primary school teachers in Tripoli, Libya. The mixed-methods approach enabled a comprehensive analysis of the individual and organizational factors affecting technology integration in the classroom. The quantitative findings revealed significant relationships between organizational support, self-efficacy, and TPACK adoption, while the qualitative interviews provided a deeper understanding of the contextual barriers and facilitators of technology use. The study's findings contribute to the broader discourse on educational technology and offer actionable recommendations for improving TPACK implementation in primary schools.

ANALYSIS AND FINDINGS

Quantitative Findings

The quantitative findings of this study provide important insights into the relationships between various factors influencing the implementation of the TPACK (Technological Pedagogical Content Knowledge) framework among primary school teachers in Tripoli, Libya. The analysis reveals key findings related to organizational support, self-efficacy, and the impact of

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technological support on TPACK implementation. These factors are instrumental in shaping teachers' ability to effectively integrate technology into their teaching practices.

A prominent finding in this study is the critical role of organizational support in shaping teachers' self-efficacy and their ability to implement TPACK successfully. Organizational support encompasses factors such as access to technological resources, leadership encouragement, and availability of training and professional development opportunities. The study found that schools providing adequate technological infrastructure, including computers, tablets, projectors, and reliable internet access, enabled teachers to integrate technology more seamlessly into their teaching practices. Schools with effective leadership that advocated for technology use and encouraged teachers to experiment with digital tools reported higher levels of TPACK proficiency among their teaching staff. For instance, teachers in schools with robust ICT policies and consistent technological support scored significantly higher in TPACK assessments. Teachers who participated in regular professional development programs focused on technology integration performed 25% better in TPACK knowledge compared to those who did not have access to such programs. This finding underscores the importance of institutional commitment to providing both material and professional support for technology adoption.

The study also highlighted the mediating role of self-efficacy in the successful implementation of TPACK. Teachers with high self-efficacy were found to be more confident and willing to use technology in their lessons. These teachers frequently displayed innovative teaching practices, such as creating digital lesson plans, incorporating multimedia resources, and using interactive educational tools to enhance student engagement. Teachers with higher self-efficacy were also better at adapting technology to fit their pedagogical strategies, which contributed to their overall TPACK proficiency. Conversely, teachers with lower self-efficacy exhibited reluctance to integrate technology into their teaching, often avoiding unfamiliar digital tools or limiting their use to basic applications. This finding aligns with existing literature, which emphasizes the importance of teacher confidence in the adoption of technology (Bandura, 1997).

Moreover, perceived usefulness and ease of use were found to moderate the relationship between technological support and TPACK implementation. Teachers were more likely to adopt technology when they perceived the tools as user-friendly and aligned with their pedagogical goals. Tools that facilitated easier integration into teaching strategies were more widely used, whereas more complex or difficult-to-navigate platforms saw less adoption. This suggests that for effective TPACK implementation, educational technology should be designed with user-friendliness in mind, and professional development programs should prioritize equipping teachers with the skills to use these tools efficiently.

Qualitative Findings

The qualitative analysis provided further insights into the barriers and facilitators of TPACK implementation, shedding light on the personal experiences and perceptions of teachers. The thematic analysis of the interviews revealed that while teachers were eager to integrate technology into their classrooms, several obstacles hindered their ability to do so effectively. The most frequently cited barrier was limited access to technological resources. Teachers reported difficulties in acquiring and maintaining the necessary tools, including computers, projectors, and reliable internet connections. One teacher shared, "We have the will to use technology, but the resources and guidance are not there." This suggests that despite the enthusiasm for technology integration, the lack of adequate infrastructure and resources prevented many teachers from fully embracing TPACK.

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Another significant barrier identified in the interviews was insufficient training. While some teachers had access to professional development programs, the quality and consistency of these programs varied significantly. Several teachers noted that training sessions were often not tailored to their specific needs or content areas, leaving them feeling underprepared to use technology effectively. Furthermore, the timing and duration of the training programs were mentioned as challenges. Many teachers found it difficult to attend extended training sessions due to time constraints, particularly given the demands of preparing lessons and managing classrooms. These findings underscore the importance of designing context-specific and flexible training programs that meet the diverse needs of teachers, especially in environments with limited resources.

However, the interviews also highlighted positive experiences where organizational support and collaboration played a key role in overcoming barriers to technology integration. Teachers who worked in schools with strong peer support networks and collaborative cultures were better able to navigate the challenges of using technology in the classroom. As one teacher described, "Our team approach to training sessions really helped us overcome initial challenges and explore new teaching strategies." This finding emphasizes the value of collaborative learning environments where teachers can share knowledge, discuss challenges, and learn from one another's experiences. It also suggests that peer-to-peer support can be an effective strategy for overcoming resistance to change and building confidence in the use of technology.

Key Themes

1. Resource Constraints: One of the most frequently mentioned obstacles to TPACK implementation was resource constraints. Teachers identified inadequate infrastructure, such as limited access to hardware, unreliable internet connections, and outdated software, as primary barriers to technology adoption. Schools in underserved areas, particularly those with fewer financial resources, struggled to provide the necessary tools for effective technology integration. These limitations hindered teachers' ability to design and deliver technology-enhanced lessons, as many digital tools required stable internet access and updated devices. Teachers also expressed frustration with the maintenance and repair of technology, which often fell outside of the school's budget. To overcome these challenges, the study suggests that investment in technological infrastructure, including both hardware and software, is critical for supporting the successful implementation of TPACK.

2. Professional Development: Another key theme that emerged from the qualitative analysis was the importance of professional development in supporting TPACK adoption. Teachers who participated in well-designed training programs were better able to integrate technology into their teaching practices. However, the inconsistency in the quality and availability of these programs was a concern. Teachers expressed the need for training that was both relevant and context-specific, tailored to the content areas they taught and the particular challenges they faced in their classrooms. The study highlights the importance of ongoing training that addresses both the technical aspects of using digital tools and the pedagogical strategies for integrating technology in ways that enhance student learning. The study recommends that professional development programs be more structured, contextualized, and collaborative to ensure that teachers have the necessary skills and confidence to implement TPACK successfully.

3. Cultural Perceptions: The final theme identified in the qualitative findings relates to cultural perceptions of technology and change. Resistance to change, particularly among senior teachers, was a notable barrier to the adoption of the TPACK framework. Many teachers, especially those with more years of experience, expressed reluctance to incorporate technology into their teaching

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practices. This resistance was often rooted in a belief that traditional teaching methods were more effective or a fear of the complexity of new technologies. Interestingly, younger teachers appeared more open to adopting new technologies, reflecting a generational shift toward digital learning tools. This finding suggests that age and experience may influence teachers' willingness to embrace technological innovations. To address these cultural barriers, the study recommends involving senior teachers in the change process, highlighting the benefits of technology integration, and fostering a growth mindset that encourages lifelong learning.

CONCLUSION AND RECOMMENDATIONS

This study provides valuable insights into the factors that influence the implementation of the TPACK framework among primary school teachers in Tripoli, Libya. The quantitative findings revealed that organizational support, self-efficacy, and technological support were critical factors in determining the success of technology integration in teaching practices. Teachers with access to adequate resources, training, and peer support were more likely to develop high levels of TPACK proficiency and incorporate technology effectively into their lessons. The qualitative findings further highlighted the challenges faced by teachers, particularly resource constraints and insufficient training. However, positive experiences with collaborative learning and organizational support demonstrated that overcoming these barriers was possible.

To enhance the adoption of the TPACK framework among primary school teachers in Tripoli, several recommendations are essential. First, tailored professional development programs should be designed to address the specific needs of teachers, with a strong focus on the practical applications of the TPACK framework. These programs should prioritize hands-on learning experiences, ongoing support, and collaboration to help teachers build their confidence and competence in effectively using technology in their classrooms. Additionally, investment in technological resources is crucial to overcoming the significant resource constraints that many schools face. It is imperative that schools prioritize improving hardware, software, and internet access to ensure that teachers have the necessary tools to integrate technology into their teaching practices seamlessly.

Moreover, promoting collaboration among teachers is vital for the successful implementation of the TPACK framework. Schools should encourage collaborative approaches to learning and problem-solving, fostering an environment of peer-to-peer support and shared learning experiences. This collaborative setting can assist teachers in overcoming challenges and help them feel more confident in using technology. Addressing resistance to change is also a critical factor in technology integration. Policymakers and administrators should work to involve senior teachers in the change process and clearly demonstrate the benefits of technology integration. Workshops, mentorship programs, and success stories can play a key role in reducing resistance and encouraging a positive perspective toward technology use.

Lastly, educational policies must be aligned with the realities faced by teachers in the field. Policies should provide clear guidelines, support mechanisms, and funding that can make technology adoption feasible and practical for educators. This alignment will ensure that the policies are effective and grounded in the actual needs of teachers, leading to more successful and sustainable implementation of the TPACK framework. By implementing these recommendations, educational stakeholders in Tripoli can create an environment conducive to the effective integration of technology. Furthermore, future research should explore longitudinal studies to assess the long-term impact of these interventions, offering deeper insights into the evolving role of technology in education.

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