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Comparison of Effects of Teacher Training Programs on TPACK and Self-efficacy of Primary School Teachers

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A R T I C L E I N F O	**A B S T R A C T**
	Utilizing a probability sampling approach, this study employs a sample size of 500 primary school teachers within a designated county to examine the Technological Pedagogical Content Knowledge (TPACK) status among primary educators. The TPACK scores of primary school teachers exhibit a discernible shift from elevated to diminished levels in correlation with the progression of teaching experience. Specifically, concerning Technological Knowledge (TK) and the intersection of Technological Pedagogical Content Knowledge (TPCK), there is a demonstrable decline in the average scores concomitant with an increase in teaching tenure.

Conversely, an augmentation in educational background correlates positively with an upward trajectory in the overall TPACK scores. The enhancement of primary school teachers' TPACK is attainable through the implementation of strategies encompassing teacher promotion and training initiatives. An examination of primary school teachers' self-efficacy reveals uniformly elevated scores across various dimensions, indicating a pervasive sense of confidence. The formulation and evolution of teachers' self-efficacy are determined by the interplay of individual subjective factors, cognitive considerations, and external environmental influences.

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1. Introduction

The swift advancement of contemporary information technology persistently propels the digitization of education, thereby profoundly influencing the educational landscape. Consequently, educators encounter novel challenges amid this transformative paradigm. In the information age, TPACK has emerged as a pivotal attribute, signifying its indispensability among teachers navigating the dynamic intersection of technology and education (Yue, 2022). With the advent of the intelligent era, the landscape of intelligent education environments imposes novel demands on primary school educators, particularly in the realm of TPACK. Consequently, there is a growing imperative and urgency to intensify research efforts focused on enhancing the understanding of primary school teachers' TPACK within the context of intelligent education environments (Ioannou & Angeli, 2015). TPACK research is bifurcated primarily into theoretical system construction and teacher education, encompassing elements such as the conceptual framework of TPACK, its structural composition, measurement methodologies, and the specific contextual standing within individual subjects. Keller and Mishra, for instance, laid the foundation by delineating the fundamental nature, comprising seven constituent elements and contextual factors of TPACK. However, the interrelation between the structural composition and the quantitative aspects of these elements was not explicitly addressed in their initial conceptualization (Ioannou & Angeli, 2015).

Teachers exhibit distinct levels of practical application proficiency across five facets, particularly discernible variances among various demographic groups. Notably, the practical application proficiency of information technology (IT) among teachers manifests diverse levels. An analytical examination underscores a correlation between teachers' age and their IT application proficiency, revealing noteworthy variations in proficiency levels among teachers of different age groups (Messina & Tabone, 2014; Ndongfack, 2015). To enhance the IT application proficiency of primary school teachers, comprehensive development initiatives outlined in Table 1 should be implemented. This approach aims to foster evaluation, establishing a robust standardized system for assessing IT application abilities. Notably, among surveyed institutions, there is a 35% coverage rate. Encouraging teachers to apply acquired knowledge, coupled with step-by-step management at varying levels, fosters continuous improvement in teachers' autonomous learning abilities, thereby enhancing information-based teaching evaluations.

Table 1

The Ways to Promote Primary School Teachers' Ability to Use Information Technology.

Key principles	Produced effect	Proportion (%)
Promote application by evaluation	Encourage teachers to apply what they have learned	45
Promote evaluation by building	Establish and improve the standardized evaluation system	35
Step by step management at different levels and stages	Continuously improve teachers' autonomous learning ability.	32
Adopt a variety of training methods	Enrich the technical knowledge of primary school teachers.	68

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TST denotes the subjective assessment made by educators regarding their capacity to impact students' learning endeavours and the overall educational outcomes within the school context (Al–Yagon & Mikulincer, 2004; Sladoljev-Agejev, Kolić-Vehovec, & Jazbec, 2021). It exerts a direct influence on educators' proactivity and significantly shapes the instructional calibre of teachers. Certain research findings indicate that inadequate self-efficacy impedes the advancement of teachers' pedagogical proficiency, diminishing confidence in classroom settings and yielding adverse educational consequences, such as discontent and disillusionment with instructional outcomes. Conversely, a robust sense of teaching self-efficacy holds the potential to enhance pedagogical enthusiasm, subsequently elevating teaching quality and fostering the enhanced professional development of educators (Gunduz, 2016; Tufan, Erden, & Ozus, 2015).

Both TPACK and self-efficacy among primary school teachers have a consequential impact on teaching quality, with teacher training programs playing a significant role (Srivastava, 2012). This study primarily examines the current state of TPACK among primary school teachers, scrutinizes factors influencing their self-efficacy, evaluates the impact of teacher training initiatives on TPACK and self-efficacy, and conducts a comparative analysis. The objective is to furnish valuable insights for enhancing the overall teaching quality of primary school educators.

2. Current Situation and Improvement Strategy of TPACK for Primary School Teachers

2.1 Analysis of The Current Situation of Primary School Teachers' TPACK

The expansive integration of emerging technologies such as "Internet +," Augmented Reality (AR), Virtual Reality (VR), and artificial intelligence across diverse domains has propelled the unprecedented acceleration of educational informatization (Brantley-Dias & Ertmer, 2013; Su, Feng, & Liu, 2018). Hence, educators in the contemporary era are confronted with an imperative to enhance their holistic technical proficiency in teaching. The TPACK framework serves as a conduit for teachers to acquire mastery and adeptly employ information technology for the actualization of information-based teaching. The acquisition and application of this knowledge by teachers are frequently interwoven with various external factors, including societal influences, cultural dynamics, and psychological considerations (Maeng et al., 2013). Consequently, delineating the determinants of TPACK within the domain of technical education content knowledge emerges as a pivotal focal point for future advancements in this field.

Employing probability sampling, this study surveys 500 primary school teachers in a county to assess their TPACK. The questionnaire, designed based on Mishra and Koehler's TPACK framework and definition, and iteratively refined, achieved an 86% response rate (Brantley-Dias & Ertmer, 2013; Temple & Reynolds, 2007). This survey scrutinizes essential demographic details of teachers, encompassing variables such as gender, age, teaching experience, educational background, academic title, and teaching subject, as delineated in Table 2. The analysis of age distribution reveals a prominent concentration of teachers aged between 31 and 40, constituting 34.6%. Teachers aged 20-30 and 31-50 demonstrate comparable proportions at 25.9% each, while those above 50 are relatively scarce. In terms of teaching experience, the majority of teachers have 1-3 years and 4-10 years, accounting for 26.9% and 35.6%, respectively. Concerning educational attainment, the prevalent background is undergraduate education, with a notably small proportion of primary school teachers holding postgraduate degrees. Notably, a significant gender disparity exists, predominantly with a higher representation of female teachers.

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Table 2

Basic Information of the Surveyed Teachers.

Investigation item	Distribution	Proportion (%)
Age structure	20-30 years old	25.9
	31-40years old	34.6
	41-50 years old	23.6
	Over 50 years old	15.9
Teaching age structure	Less than 1 year	5.8
	1-3 years old	26.9
	3-10 years old	35.6
	10-20 years old	23.5
	More than 20 years old	8.2
Educational structure	Junior college	29.8
	Undergraduate course	55.8
	Graduate student	24.4
Sex	Male teacher	32.6
	Woman teacher	67.4

As depicted in Figure 1, primary school teachers predominantly utilize conventional software, including PPT and Word, constituting 87.65% of the teaching resources. Subsequently, pre-downloaded video resources and various forms of online materials account for 36.58%. Notably, the usage frequency of micro-lessons is the lowest. The survey findings indicate a prevailing inclination among teachers to rely on traditional multimedia resources in their daily teaching practices. However, the data reveals that over one-third of teachers integrate network resources and electronic whiteboards into their teaching, suggesting a blend of traditional and network-based instructional approaches. The adoption of interactive whiteboards is noted at 34.2%. Conversely, the usage frequency of micro-lessons is modest at 8.2%, signifying a limited incorporation of the flipped classroom teaching mode among primary school teachers.
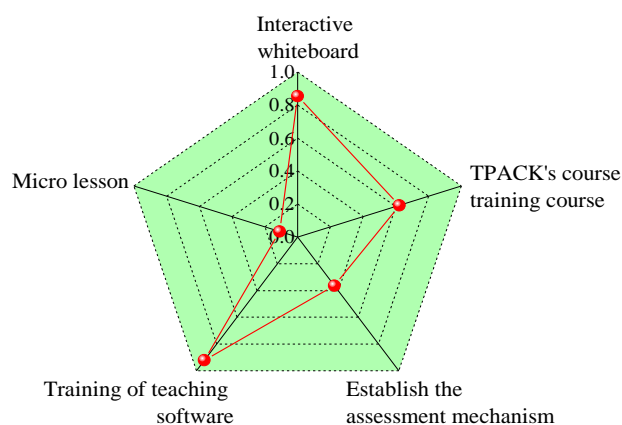

Figure 1: *Teachers Use the Most Teaching Resources in The Teaching Process.*

This study entails a comprehensive analysis of the overall TPACK and its various dimensions among primary school teachers across distinct teaching age groups, as elucidated in Table 3. The findings reveal a discernible shift in TPACK scores from high to low with the progression of

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teaching age, particularly evident in both TK and the broader TPACK dimensions, where average scores decrease proportionally. Consequently, teachers with shorter teaching experience exhibit higher average scores in TPACK, TK, and the intersection of TAPCK. Notably, primary school teachers with over 20 years of teaching experience demonstrate the highest average scores in these dimensions. Moreover, the average scores for PCK and CK dimensions exhibit a general trajectory from low to high. Teachers within the 1-3 years of teaching experience category manifest the lowest PCK and CK scores. This trend suggests that educators with extended teaching tenure accumulate substantial practical knowledge, exhibit heightened familiarity with teaching content, and adeptly employ various teaching methods and strategies in subject instruction.

Table 3

Basic Information of the Surveyed Teachers.

Age distribution	Distribution	TK	TPCK	PCK	CK
Less than 1 year old	Average score	29.5	56.8	28.9	25.3
	Standard score	6.9	7.9	3.4	2.9
	The highest score	52.0	51.0	64.0	31.0
	Lowest mark	12.0	27.0	15.0	19.0
1-3 years old	Average score	26.7	55.0	20.3	25.2
	Standard score	7.6	6.8	3.6	3.1
	The highest score	48.0	60.0	40.0	25.0
	Lowest mark	12.0	27.0	15.0	16.0
3-10 years old	Average score	24.3	53.3	24.1	25.3
	Standard score	8.7	6.8	3.9	3.0
	The highest score	32.0	45.0	27.0	18.0
	Lowest mark	12.0	41.0	17.0	15.0
10-20 years old	Average score	23.2	52.5	24.0	25.8
	Standard score	8.1	7.3	4.3	3.2
	The highest score	31.0	45.0	27.0	18.0
	Lowest mark	12.0	36.0	13.0	12.0
More than 20 years old	Average score	19.0	50.1	24.9	25.0
	Standard score	5.5	4.3	3.3	2.7
	The highest score	34.0	45.0	27.0	18.0
	Lowest mark	12.0	25.0	7.0	6.0

Upon scrutinizing the TPACK status across varying educational backgrounds, it is discerned that teachers possessing postgraduate education exhibit the highest TPACK average scores. Furthermore, a positive correlation is observed between TPACK scores and educational backgrounds, indicating an ascending trajectory as educational levels improve. Across the four questionnaire dimensions, the average scores for primary school teachers in distinct educational background categories generally display a progression from lower to higher values with improved educational backgrounds. Notably, a substantial and statistically significant discrepancy is evident in the TPACK scores among primary school teachers with diverse educational backgrounds, indicating that heightened educational backgrounds correspond with elevated TPACK levels among teachers. This observation underscores a positive association between enhanced educational levels and improved levels of information technology proficiency, subject-specific content knowledge, knowledge of subject teaching methods, and the integration of technology-supported subject teaching knowledge among primary school teachers. This underscores the impact of postgraduate education in pedagogy and underscores the imperative of advancing the educational levels of primary school teachers.

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Disparities exist in the IT proficiency of male and female teachers, with male teachers typically demonstrating higher IT proficiency. To investigate potential discrepancies in TPACK levels between male and female teachers, an independent sample T-test was executed, and the findings are delineated in Table 4. The outcomes indicate a significance level below 0.05 solely in the PK dimension, signifying distinctions in pedagogical knowledge between male and female teachers. However, no substantial overall difference in TPACK is observed between the two genders.

Table 4

Tpack Gender Difference Analysis Table for Primary School Teachers.

Dimensionality	Sex	Number of people	Mean value	Standard deviation
TK	Male	208	3.80	0.99
	Female	204	3.82	0.98
PK	Male	208	4.24	0.79
	Female	204	4.43	0.79
CK	Male	208	4.23	0.77
	Female	204	4.34	0.78
PCK	Male	208	4.18	0.76
	Female	204	4.30	0.86
TPK	Male	208	4.12	0.94
	Female	204	4.24	0.93
TCK	Male	208	4.23	0.93
	Female	204	4.34	0.94
TPACK	Male	208	4.20	0.86
	Female	204	4.23	0.85

2.2 TPACK Promotion Strategies for Primary School Teachers

2.2.1 Self-Promotion Strategies

The disparities in the utilization levels of information-based teaching tools by teachers are systematically examined, as illustrated in Figure 2. The statistical P values for TK, PK, CK, PCK, TCK, TPK, and overall TPACK were all below 0.05, indicating substantial differences across the entire spectrum. This underscores the pivotal role played by the proficiency in utilizing information-based teaching tools in shaping the development of teachers' TPACK.
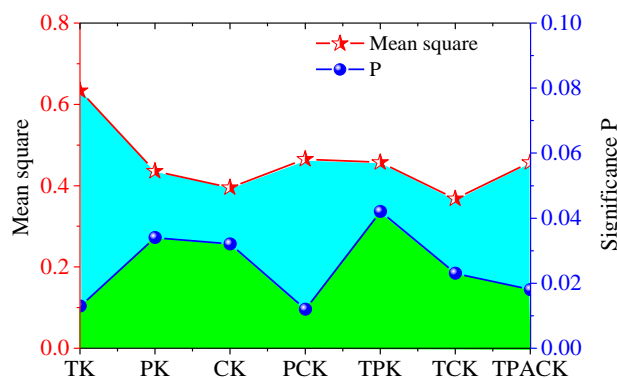

Figure 2: *Analysis of Differences in The Use Level of Information-Based Teaching Tools.*

Henceforth, the pedagogical strategy for advancing TAPCK among primary school teachers encompasses two principal facets. Firstly, there is a requisite paradigm shift in teaching philosophy. Given the ongoing progress of educational informatization, technical knowledge assumes a paramount role in the instructional milieu (Spector, 1966). It is imperative for educators to cultivate a precise comprehension of the amalgamation of information technology with educational practices, emphasizing the significance of their professional development (McAinsh & Kops, 2023).

The second facet involves enhancing teachers' awareness and proficiency in the application of information technology. Presently, the collective technological proficiency of primary school teachers tends to hover within the intermediate to lower-middle range. Reflecting upon and addressing the question of how technology can be effectively employed throughout the entire teaching continuum—before, during, and after class—to genuinely enhance pedagogy is a pertinent and contemplative endeavour. For instance, considerations include adeptly sourcing pertinent teaching resources and making requisite adjustments prior to class. Within the classroom setting, strategic utilization of the functionalities inherent in information-based teaching tools to augment interaction and communication between teachers and students warrants thoughtful consideration (Sakellariou & Rentzou, 2012). Subsequent to the instructional sessions, considerations encompass how to leverage information technology for guiding students towards independent or personalized learning. The discernment and contemplation of how technology can be effectively employed to advance pedagogical objectives necessitate a nuanced understanding on the part of educators.

2.2.2 Training Strategies

The teacher training strategy designed to promote TAPCK among primary school educators is depicted in Figure 3, encompassing four key dimensions, allowing teachers a range of choices. The initial dimension involves the implementation of training initiatives focused on interactive electronic whiteboard usage and related competencies. Survey data indicate that 85.4% of primary school teachers express an interest in electronic whiteboard training, particularly emphasizing proficiency in leveraging interactive functionalities within the classroom. However, a noticeable disparity exists, with only a limited number of teachers adept at integrating subject-specific teaching content. Given this context, it is imperative to formulate training programs that amalgamate both technical aspects and case studies. Online resources are provided for fundamental utilization and courseware creation for electronic whiteboards, allowing teachers flexibility in learning at their convenience (Prasetya, Widiyaningtyas, & Arifin, 2017).

The percentage of individuals who conducted course training on TPACK was recorded at 62.1%. Despite the commendable teaching proficiency and ample practical experience possessed by primary school educators, there persists a need for ongoing enhancement in the depth and breadth of theoretical learning in pedagogy (Woodley et al., 2017). TPACK stands as the most recent and comprehensive imperative for the professional development of educators. Educational authorities ought to orchestrate courses dedicated to TPACK, enabling teachers to attain a lucid comprehension of the knowledge framework inherent in TPACK. This includes an elucidation of the framework's constituent elements, their respective definitions, and their developmental status. TPACK exhibits characteristics of comprehensiveness, contextuality, practicality, tacit knowledge, and variability, rendering it challenging for primary school teachers to fully grasp and apply.

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Consequently, heightened efforts at the theoretical level are warranted to effectively elevate the proficiency in TPACK among primary school teachers.

Subsequent to the establishment of the post-training assessment mechanism, there emerged a 36.4% surge in research requests for the construction of teaching resources. The educational department conducted various theoretical course training sessions, yet failed to attain the desired impact. In response, it is suggested that the educational department institute a post-training assessment mechanism. Teachers, guided by the TPACK knowledge framework, can develop specific teaching cases encompassing elements such as teaching design, courseware, and instructional videos. Each semester assigns corresponding tasks, with successful completion leading to external performance assessments that serve to incentivize teachers' learning motivation. The educational department mandates schools to collect these resources, establish a public learning platform, and showcase exemplary course cases for collective observation and learning. Acknowledging outstanding cases through the issuance of certificates further internalizes motivation for learning among teachers. This approach emphasizes that only through active teacher participation in the entire process of crafting teaching cases can a profound understanding and contemplation of TPACK be attained.

The demand for training in instructional software accounted for a notable 92.2%. Mastery of class optimization involves the recording of students' academic performance, homework completion, and related metrics. It is imperative for educators to acquire proficiency in utilizing information technology to adeptly oversee and manage students' learning processes. Offline institutions organize specialized training sessions conducted by experts, predominantly focusing on case studies specific to various disciplines. This encompasses comprehensive teaching design, courseware development, and related components. Through exposure to diverse teaching cases, guidance from accomplished experts, and engagement in reflective peer exchanges, teachers can derive inspiration and deepen their understanding. It is emphasized that genuine learning occurs for educators when theoretical knowledge is applied practically through such training initiatives.
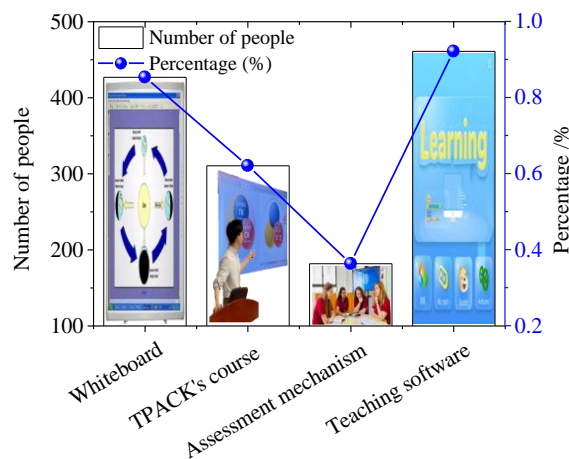

Figure 3: *Teacher Training Strategy.*

3. Teacher Training and Its Impact on Primary School Teachers' TPACK and Teachers' Self-Efficacy

3.1 Analysis of Teaching and Training Needs

The preliminary requirements of educators undergoing training are examined and analysed, encompassing facets such as "knowledge proficiency," "professional competence," and "classroom instructional aptitude." (Kosovich, Flake, & Hulleman, 2017). As depicted in Table 5, regarding knowledge requisites, the most sought-after knowledge proficiencies among the surveyed teachers are "educational and scientific research methods" and "professional subject knowledge," constituting 78.3% and 68.9% of the total sample, respectively. Subsequently, "moral education and mental health education-related theory," "knowledge pertaining to the use of information technology," and "interpretation of new curriculum standards" represent the second tier, with proportions of 58.03%, 50.23%, and 43.87%, respectively. Conversely, knowledge domains such as "professional ethics of teachers" are perceived as less imperative, garnering endorsements from less than 30% of the surveyed teachers.

Regarding professional competence, a substantial majority of the surveyed teachers, constituting 78.9%, identify "class management and educational activities" as the most immediate professional skill they need to acquire. Subsequent priorities include "teaching design," "teaching and learning implementation," and "communication and cooperation," each surpassing the 50% mark and representing 65.62%, 57.78%, and 62.32% of the overall sample, respectively. Simultaneously, a subset of interviewed teachers acknowledges certain training needs in the professional abilities of "reflection and development" and "education and teaching evaluation." Conversely, other facets of classroom teaching skills, such as "difficult teaching effect detection ability," teaching organization proficiency, and teaching language expression acumen, each register at less than 45%.

Table 5

Interviewed Teacher Training Needs.

Specific Aspect	Demand Side	Proportion (%)
	Educational research method	78.30
	Professional subject knowledge	68.90
	Theory of correlation between moral education and mental health education	58.03
Knowledge-ability	Information technology application -related knowledge	52.03
	Interpretation of new curriculum standards	43.87
	Teachers' professional ethics and other aspects	< 30
	Class management and educational activities	78.90
Professional competence	Teaching and learning design	65.62
	Teach and practice	57.78
	Channel and cooperation	62.32
	Difficult teaching effect detection ability	32
Classroom teaching ability	Teaching organization ability	41
	Teaching language expression ability	38

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3.2 Characteristics and Influencing Factors of Teachers' Self-Efficacy

3.2.1 Characteristics of Teachers' Self-Efficacy

Table 6 delineates the comprehensive analysis of self-efficacy among primary school teachers in this survey. The data reveals an aggregate self-efficacy score of 3.7856 points for primary school mathematics teachers, signifying that their overall self-efficacy surpasses the average level. This trend is likely intricately linked to the nation's emphasis on bolstering primary school teacher competence. Noteworthy national initiatives, such as the "national training program," "sending teachers to rural areas," and "return-to-work training," have been implemented to enhance teachers' professional aptitude, elevate teaching confidence, and consequently augment the overall self-efficacy perception among primary school teachers.

Table 6

Analysis of Primary School Teachers' Self-Efficacy.

Dimensionality	Evaluation mean	Standard deviation
Effect evaluation	3.8077	0.9112
Knowledge accomplishment	3.7845	3.7871
Plan preparation	3.8456	3.8434
Classroom management	3.7445	3.7457
Total schedule	3.7856	3.7833

Figure 4 illustrates the impact of educational background on teachers' self-efficacy. Distinct educational backgrounds engender varied educational cognitions and self-efficacy among teachers, with educational cognitions and self-efficacy demonstrating a positive correlation with educational background. Primary school teachers consistently exhibit high self-efficacy scores across various dimensions, displaying full confidence in their capabilities for class management and environmental adaptation. However, when juxtaposed, primary school teachers' self-assessment of their abilities in education and scientific research appears somewhat deficient. This observation underscores the multi-dimensional nature inherent in primary school teachers' self-efficacy.
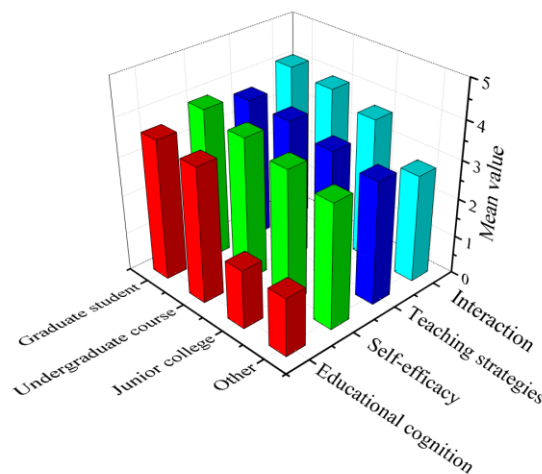

Figure 4. *Influence of Educational Background on Teachers' Self-Efficacy.*

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Acknowledgment of the intrinsic worth of compulsory education is prevalent among educators. A consensus is evident among most teachers regarding the standing and value of compulsory education, underpinned by a resolute conviction that compulsory education serves as a fundamental cornerstone in the lifelong developmental trajectory of students. Given the swift and transformative development of children during the compulsory education phase, coupled with their considerable learning potential, primary school teachers are notably attentive to fostering positive learning attributes. There exists a firm belief among educators that instilling qualities such as concentration, perseverance, and patience during the compulsory education period is pivotal, anticipating that such habits will imbue students' future development with vitality (Ma, O'Toole, & Keppell, 2008).

Divergent perceptions of work abilities are evident among the primary school teachers in the study. Notably, these educators exhibit a pronounced lack of confidence in various aspects of teaching work, particularly in safe handling, organizing educational activities, educational guidance, and addressing the inefficiency of individual students' education. Among young primary school teachers, a unanimous concern is expressed about witnessing poor student performance, particularly among primary school children who may display inadequate self-control, manifesting in playful behaviour and a lack of enthusiasm for learning. The potential negative impact on parents' attitudes becomes a primary source of pressure for these teachers.

Class management success hinges on administrative involvement and class management effectiveness. Most participants perceive administrative engagement as a valuable avenue for personal growth, evincing strong confidence in their abilities recognized by school administrators. As primary school teachers engage in internal school management, they courageously venture into new areas, demonstrating versatile work capabilities. This hands-on exploration enhances their work experience, resulting in a progression from a sense of achievement starting from weakness to strength and from unfamiliarity to proficiency.

Perceptions of efficacy in interpersonal communication within a teacher's network revolve around the pivotal relationship nodes of students, parents, colleagues, and leaders (Wong & Lam, 2007). Concerning teacher-student interaction, survey respondents exhibited a notably elevated sense of self-efficacy. They assert that both current and post-graduation teacher-student communication elicit strong feelings of pleasure and happiness. This sentiment is attributed, in part, to the inspiration derived from curriculum development during interactions with students. In this teacher-student dynamic, young teachers adeptly adjust their roles, providing students with ample opportunities for self-expression and reaping unforeseen positive outcomes.

The perception of a delay in observational evaluation is noteworthy. Teachers exhibiting heightened efficacy in observation and evaluation paradoxically experience divergent sentiments regarding "having children in their eyes." The primary school teachers' relationship with students is characterized by a reciprocal dynamic of "seeing" and "being seen." This perceptual act of "seeing" encompasses not only visual tracking and capture but also entails professional observation and guidance. Conversely, "being seen" transcends superficial student behaviours, emphasizing the imperative recognition of underlying interests and needs manifested through their conduct (Agostinho et al., 2019; Sampson et al., 2013).

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3.2.2 Influencing Factors of Teachers' Self-Efficacy

The genesis and progression of teachers' self-efficacy are shaped by the interplay of individual subjective factors, cognitive elements, and external environmental influences. Teachers' self-efficacy transcends mere external behaviours, constituting an internal belief and psychological disposition. Bandura's theoretical framework posits that the perception of efficacy arises from the reciprocal interaction between individuals and their environment (Chang et al., 2012). As a subjective perception and belief system, teachers' self-efficacy undergoes its formative and developmental processes, with teachers' personal subjective factors constituting the core elements and intrinsic conditions influencing self-efficacy. Teachers' attributes, encompassing gender, life stage, experience, educational philosophy, motivation, cognitive style, self-imposed standards, and professional capital, wield a considerable impact on their self-efficacy. To investigate the significance of gender differences in the self-efficacy of primary school teachers, an independent sample T-test was conducted. The specific outcomes are detailed in Table 7. Notably, with t=-1.8826 and p=0.0645 > 0.05, the results indicate that there is no statistically significant difference in self-efficacy among primary school teachers based on gender.

Table7

An Analysis of The Influence of Gender on Primary School Teachers' Self-Efficacy.

Dimensionality	Male	Female	t	p
Interactive communication	3.5340 ±1.0423	3.8816±0.8071	-1.1232	0.2231
Effect evaluation	3.5530±1.0156	3.9002±0.8654	-2.1254	0.1182
Knowledge accomplishment	3.5845 ±0.0645	3.8871 ±0.6854	-1.9867	0.1091
Plan preparation	3.6452±1.0768	3.8334±0.7243	-1.5342	0.0928
Classroom management	3.7349±0.8974	38257±0.7012	-1.6232	0.0523
Teaching strategy	3.6152 ±0.7965	3.8823 ±0.6812	-1.6732	0.0632
Total schedule	3.6852±0.8765	3.9633±0.6734	-1.8826	0.0645

Cognitive factors in primary education denote the intricate processes by which teachers assimilate and attribute meaning to both internal and external information. The variances in cognitive styles exert a discernible influence on the self-efficacy perceptions of primary school teachers. Cognitive styles, in this context, pertain to the distinctive and enduring patterns that individuals manifest in cognitive organization and function during the processing of information (Anderson, Evertson, & Brophy, 2010). Young teachers classified as field-dependent tend to be more susceptible to external environmental influences in the processing and perception of information. On the contrary, field-independent young teachers possess distinct reference systems and standards, rendering them less susceptible to external factors. Teachers' self-efficacy, being an embodiment of teachers' subjective perception, entails the selection of diverse self-referents during the process of self-evaluation, a choice that varies among individual teachers.

Self-efficacy is the self-appraisal that teachers generate through their interactions with the environment. The classroom constitutes the central domain of primary school endeavours, exerting a direct influence on teachers' confidence in effectively amalgamating their educational prowess. The calibre of school culture and the level of support extended

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to primary school teachers emerge as pivotal factors influencing teachers' self-efficacy. Insufficient support within working conditions and scenarios can readily lead to teacher frustration, consequently exerting adverse effects on their self-efficacy.

3.3 Effects of teacher training programs on primary school teachers' TPACK and self-efficacy

3.3.1 Influence of Teacher Training on TPACK Of Primary School Teachers

Teacher training, as a consequential external determinant, holds substantial sway in shaping the tangible manifestation of teacher TPACK. This pertains to educational and training initiatives targeted at individuals employed in the education sector, aiming to enhance their professional knowledge, teaching skills, and instructional disposition, thereby facilitating more effective student education (Singal, 2015). The training program is designed to foster the educational technology proficiency of pre-service teachers, with the objective of equipping prospective educators with robust information quality and competence in information education. The impact of teacher training on the TPACK of primary school teachers is illustrated in Figure 5.

As the primary venue for teacher training, schools can furnish students with a conducive technical environment, forming the foundational underpinning for enhancing the TPACK proficiency of pre-service teachers. The establishment of the hardware environment necessitates collaboration between the school administration department and management personnel, requiring an awareness of information technology integration curricula among education management personnel and teachers. For instance, the provision of multimedia laboratories, network teaching environments, and the development of teachers' TPACK can mitigate hardware deficiencies, ensuring a robust foundation for enhancing teachers' TPACK proficiency. Additionally, hardware resources constitute the essential elements of the teaching environment, with the adequacy and appropriateness of software playing a pivotal role in the entire training process. In pre-service teacher training, the provisioning of a software environment encompasses both the design and development of original resources. Furthermore, the reconfiguration and repurposing of existing teaching resources, along with the provision of a robust software environment, contribute significantly to the augmentation of teachers' TPACK levels.
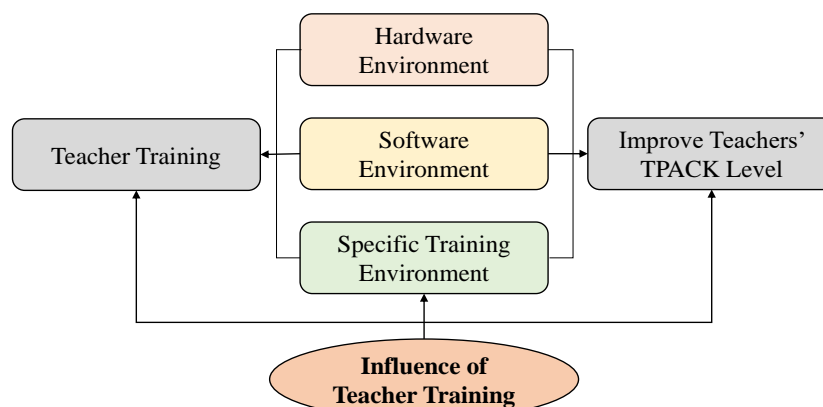

Figure 5: *Influence of Teacher Training on TPACK Of Primary and Secondary School Teachers.*

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Tailored teacher training proves efficacious in enhancing teachers' TPACK. Within constrained timeframes, one effective approach to achieving optimal learning outcomes involves the careful selection of pertinent training content (Sassi, Monroy, & Testa, 2005). The training content should exhibit specificity, encompassing knowledge related to the integration of information technology tools. Moreover, the curriculum should afford students ample opportunities to apply the acquired content within the classroom setting. TPACK represents a holistic amalgamation of technology, subject content knowledge, and teaching method knowledge, thereby constituting a novel knowledge framework for educators in the information technology era.

3.3.2 Influence of Teacher Training on Self-Efficacy

Primary education holds significance as a pivotal stage for instilling fundamental knowledge and basic abilities in pupils, with teachers' professional competence intricately tied to both children's development and their own career progression. The impact of teacher training on the self-efficacy of primary school teachers manifests primarily in the subsequent facets.

Teacher training facilitates primary school educators in gaining a profound comprehension of educational advancements and requisites, fostering an extensive appreciation for educational and pedagogical theories. This, in turn, enhances their instructional capabilities, elevating their confidence in professional endeavours and augmenting their self-efficacy in teacher professional quality. Given the perennial significance of primary education in the realm of educational reform, ongoing learning and training initiatives serve as catalysts for the in-depth progression of educational reform (Daly, 2015). Within the context of learning and training, primary school educators acquire not only a profound grasp of emerging educational concepts and innovative teaching methodologies but also delve into the evolution of subject knowledge. This multifaceted learning equips teachers with the adeptness to effectively adapt to evolving educational scenarios and novel subject requirements. Consequently, it facilitates the refinement of teaching approaches, the implementation of innovative instructional methods, and the fortification of primary school teachers' self-efficacy in the domain of teaching.

Teacher training enhances teachers' proficiency in professional knowledge and teaching skills, fostering heightened professional competitiveness. In today's competitive milieu, continuous improvement of skills is essential for making a meaningful impact in the workplace. Accordingly, teacher training significantly elevates teachers' competitiveness, bolstering self-confidence, optimism, and a positive mindset in the face of challenges, thereby enhancing their sense of self-efficacy. Moreover, teacher training serves as a platform for primary school teachers to continually refine their teaching concepts, communication skills, and learning systems, translating theoretical insights into practical teaching applications.

By engaging in self-adjustment and persistent engagement in educational teaching research, primary school teachers can significantly enhance their teaching quality. Teacher training serves not only to enhance the professional skills of educators but also to catalyse personal growth among primary school teachers. The acquisition of new knowledge and skills not only facilitates adaptation to evolving educational landscapes but also prompts teachers to identify and address their own deficiencies, fostering continuous improvement and personal development. In adhering to the notion that education transcends mere instruction, encompassing the

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inspiration of intellect, stimulation of creativity, and cultivation of spiritual qualities, teacher training becomes instrumental in augmenting self-efficacy.

4. Conclusion

Drawing on an analysis of the present state and enhancement strategies for TPACK among primary school teachers, this study delves into the training needs of these educators while summarizing the attributes and determinants of teacher self-efficacy. The TPACK scores of primary school teachers exhibit a trajectory from high to low as their teaching experience grows, particularly in the dimensions of TK & TPCK, where average scores diminish with increasing teaching age. Conversely, an elevation in educational background correlates positively with an ascending trend in teachers' overall TPACK scores. Strategies for promoting TAPCK among primary school teachers involve both teacher promotion and training initiatives. A comprehensive analysis of primary school teachers' self-efficacy reveals consistently high scores across various dimensions. The development of teacher self-efficacy is influenced by the interplay of individual subjective factors, cognitive considerations, and external environmental influences. Schools, serving as primary training grounds, play a crucial role by providing a conducive technical environment for students, encompassing both hardware and software facilities, which forms the bedrock for enhancing the TPACK of pre-service teachers. Additionally, targeted teacher training emerges as an effective mechanism for elevating teachers' TPACK levels and bolstering their overall professional competence. Teacher training, as a conduit, empowers teachers to grasp professional knowledge and pedagogical skills, enabling them to adeptly navigate evolving educational landscapes and cultivate heightened self-efficacy.

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