

Designing a Virtual Education Model for Elementary School Teachers in Tehran: An Emergent Grounded Theory Approach

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ABSTRACT

Purpose: The present study aimed to design a comprehensive virtual education model for elementary school teachers in Tehran using an emergent grounded theory approach.

Methods and Materials: This applied qualitative study was conducted using an emergent grounded theory methodology. The research population consisted of experts in educational management who held doctoral degrees and possessed substantial experience through academic publications, research activities, and professional practice in the field. Using purposive theoretical sampling, 15 experts were selected for participation. Data were collected through semi-structured interviews designed to explore the dimensions, components, and indicators of an effective virtual education model for elementary school teachers. Initially, an extensive review of the literature and in-depth interviews with experts were conducted. The collected data were analyzed through open coding to extract initial concepts and indicators. Subsequently, axial coding was employed to categorize these indicators into broader dimensions and components. Finally, selective coding and brainstorming sessions with the experts were used to refine, validate, and finalize the proposed model.

Findings: The analysis of qualitative data led to the identification of a multidimensional framework for virtual education in elementary teacher development. Through systematic coding procedures, 92 indicators were extracted and organized into 16 components and 5 overarching dimensions. The findings demonstrated a strong consensus among experts regarding the necessity of integrating technological, pedagogical, organizational, professional, and evaluative dimensions within virtual teacher education programs. The resulting model reflects a comprehensive structure that addresses both the instructional and professional development needs of elementary school teachers in digital learning environments. Expert validation confirmed the coherence, relevance, and applicability of the identified dimensions and components. Following prioritization and refinement, the final model was graphically represented and re-evaluated, receiving confirmation from the expert panel as a valid framework for virtual teacher education.

Conclusion: The proposed model provides a comprehensive and context-sensitive framework for enhancing virtual education among elementary school teachers in Tehran. By incorporating multiple dimensions and a wide range of indicators, the model offers educational policymakers, school administrators, and teacher training

institutions a practical roadmap for designing, implementing, and evaluating effective virtual professional development programs. The findings highlight the importance of adopting a holistic approach to virtual education that simultaneously addresses technological infrastructure, pedagogical effectiveness, organizational support, professional competencies, and continuous assessment.

Keywords: *Virtual Education, Elementary School Teachers, Teacher Professional Development, Grounded Theory, Educational Management, Virtual Learning Model.*

1. Introduction

The rapid advancement of digital technologies has transformed educational systems worldwide and fundamentally altered the nature of teaching and learning processes. The integration of information and communication technologies into educational environments has shifted learning from traditional teacher-centered approaches toward more flexible, interactive, and learner-centered models. In this context, virtual education has emerged as one of the most influential innovations in contemporary education, providing opportunities for continuous learning beyond temporal and geographical constraints. Elementary education, as the foundational stage of formal schooling, has been particularly affected by these developments because the quality of instruction at this level significantly influences students' future academic success and lifelong learning trajectories. Consequently, enhancing teachers' competencies and designing effective virtual education frameworks have become strategic priorities for educational policymakers and institutions worldwide (Pimenta et al., 2022; Singh, 2023). The increasing reliance on virtual learning environments has highlighted the need for comprehensive models that address not only technological requirements but also pedagogical, organizational, and human dimensions of teacher professional development (Bercasio, 2024; Szűts et al., 2023).

The unprecedented educational disruptions experienced during recent years accelerated the adoption of virtual and blended learning models across educational systems. Schools and teachers were required to rapidly adapt to online instruction, often without adequate preparation or institutional support. While these circumstances revealed the resilience and adaptability of educators, they also exposed significant challenges related to technological readiness, instructional design, digital literacy, and educational equity. Research has demonstrated that successful implementation of virtual learning environments depends on the availability of robust technological infrastructures, appropriate learning management systems, and well-designed digital content capable of engaging learners effectively (McCormick & Guilbault, 2023; Zainil et al., 2024). Moreover, studies have

emphasized that merely providing access to technology is insufficient; effective virtual education requires teachers who possess the knowledge and skills necessary to integrate technology meaningfully into instructional practices (Persada & Sobandi, 2023; Putri et al., 2023). These challenges are particularly important in elementary education, where teachers must simultaneously address cognitive, emotional, and social aspects of student development while utilizing digital tools effectively.

One of the most widely accepted frameworks for understanding technology integration in education is the Technological Pedagogical Content Knowledge (TPACK) model, which emphasizes the interaction among technological, pedagogical, and content knowledge. Research has consistently shown that teachers who possess stronger TPACK competencies are more effective in designing and implementing virtual learning experiences. Investigations conducted among primary school teachers have demonstrated positive relationships between technological knowledge, pedagogical competence, and student learning outcomes (Patalinghug & Arnado, 2022; Sothayapetch & Lavonen, 2022). Similarly, studies focusing on elementary teacher preparation have highlighted the importance of strengthening teachers' beliefs, competencies, and confidence regarding technology integration in educational settings (Aprilia et al., 2023). Sustained professional development initiatives grounded in the TPACK framework have also proven effective in enhancing teachers' instructional practices and supporting long-term educational innovation (Meletiou-Mavrotheris & Paparistodemou, 2024). These findings indicate that any virtual education model designed for elementary school teachers should incorporate systematic strategies for developing teachers' technological and pedagogical capabilities.

The concept of digital literacy has become increasingly central to discussions concerning teacher effectiveness in virtual learning environments. Digital literacy encompasses not only the technical ability to use digital tools but also the critical, ethical, and pedagogical competencies required for meaningful engagement in digital educational contexts.

Contemporary research suggests that teachers' experiences with digital technologies significantly influence their instructional decisions, confidence, and willingness to adopt innovative pedagogical approaches (Jung et al., 2024). Furthermore, emerging technologies such as artificial intelligence are reshaping educational practices and necessitating the continuous updating of teacher preparation programs. Scholars have argued that teacher education curricula must evolve to include competencies related to artificial intelligence, media literacy, and digital citizenship to prepare educators for future educational challenges (Henriquez et al., 2026; Скрипка, 2025). As digital transformation continues to redefine educational environments, elementary school teachers require ongoing support to navigate complex technological ecosystems while maintaining high-quality instructional practices.

Teacher professional development remains one of the most influential factors affecting educational quality and innovation. Effective professional learning programs provide teachers with opportunities to acquire new knowledge, reflect on practice, collaborate with colleagues, and implement evidence-based instructional strategies. Longitudinal studies examining professional development initiatives have demonstrated that sustained and well-structured programs contribute significantly to teacher growth and educational improvement (Teemant et al., 2024). Similarly, research investigating organizational conditions has revealed that institutional support, leadership practices, and collaborative cultures play critical roles in shaping teachers' self-efficacy and implementation of newly acquired skills (Hayes et al., 2024). Teacher well-being is another essential consideration, as educators who experience higher levels of professional satisfaction and support are more likely to engage effectively with innovative teaching approaches and maintain positive classroom environments (Maunula & Harju-Luukkainen, 2026). Consequently, virtual education models should incorporate mechanisms that promote continuous professional learning, organizational support, and teacher well-being.

In addition to teacher-related factors, the characteristics and needs of students represent a crucial dimension of virtual education. Elementary school students differ significantly from older learners in terms of cognitive development, attention span, self-regulation, and technological independence. Therefore, virtual learning environments designed for young learners must be developmentally appropriate, engaging, and supportive. Research has emphasized the importance of adaptive instructional

approaches that accommodate diverse learning needs and promote active student participation (Kaloka et al., 2023). Furthermore, studies examining literacy development have demonstrated that educators play a central role in addressing learning challenges through innovative pedagogical approaches and learner-centered instructional practices (Halik et al., 2023). The increasing availability of immersive technologies such as virtual reality also offers new possibilities for enhancing engagement and experiential learning among elementary school students (Lenggenhager et al., 2024). These developments suggest that effective virtual education models should prioritize student-centered design principles and incorporate diverse learning experiences that foster active participation and meaningful learning.

The quality and design of educational content constitute another critical determinant of virtual learning effectiveness. High-quality digital content should be accessible, interactive, adaptable, and aligned with curricular objectives. Research has shown that the success of online and blended learning initiatives depends largely on the extent to which educational materials support engagement, collaboration, and personalized learning experiences (Szűts et al., 2023; Zainil et al., 2024). The design of digital learning resources for prospective elementary school teachers has also been identified as a strategic priority for strengthening educational resilience and innovation (Noviana et al., 2023). Moreover, flexible pedagogical approaches that allow adaptation to changing educational circumstances have demonstrated considerable effectiveness in supporting continuity of learning and maintaining instructional quality (Bercasio, 2024). Therefore, content development within virtual education models should extend beyond information delivery to include opportunities for interaction, reflection, collaboration, and authentic learning experiences.

Parental involvement and stakeholder collaboration represent additional factors influencing the success of virtual education at the elementary level. Unlike older students, elementary learners often require substantial support from parents or guardians to participate effectively in online learning activities. Consequently, virtual education initiatives must consider the role of families as active partners in the educational process. Research examining teacher preparation for elementary education has highlighted the importance of developing collaborative relationships among teachers, students, parents, and educational leaders to promote positive learning outcomes (Hidayah, 2023).

Similarly, studies exploring teachers' attitudes toward distance learning have identified stakeholder support and communication as essential elements for overcoming challenges associated with remote education (Shayeb et al., 2023). The effectiveness of virtual education is therefore influenced not only by technological and pedagogical factors but also by the quality of relationships and support systems surrounding learners and educators.

Recent educational research has increasingly emphasized the importance of innovative and context-sensitive pedagogical approaches capable of responding to evolving societal and environmental challenges. Studies examining nature-based professional development programs have demonstrated that transformative learning experiences can enhance teachers' professional capacities and foster innovative educational practices (Theodosaki et al., 2025). Likewise, investigations into pragmatics training and reflective learning processes have shown that carefully designed professional development activities can improve teachers' instructional competence and professional awareness (Yang, 2025). These findings underscore the necessity of designing virtual education models that are flexible, contextually relevant, and responsive to the diverse needs of teachers and learners. Rather than relying solely on technological solutions, effective models should integrate pedagogical innovation, organizational support, stakeholder collaboration, and continuous professional growth.

Despite the growing body of international research concerning virtual education, significant gaps remain regarding the development of comprehensive models tailored to the specific conditions of elementary education systems. Many existing studies focus on isolated dimensions such as technological competence, digital literacy, professional development, or instructional design, whereas fewer investigations have sought to integrate these dimensions into a coherent and validated framework. Furthermore, contextual factors such as organizational policies, infrastructure availability, stakeholder competencies, educational culture, and instructional methods may influence the effectiveness of virtual education differently across educational settings. Given the strategic importance of elementary education and the increasing integration of digital technologies into teaching and learning processes, there is a need to develop a comprehensive model capable of guiding the design, implementation, and evaluation of virtual education programs for elementary school teachers.

Therefore, the present study aims to design a virtual education model for elementary school teachers in Tehran using an emergent grounded theory approach.

2. Methods and Materials

The present study was applied in terms of purpose, qualitative in terms of data type, and categorized as an emergent grounded theory study in terms of its nature and methodological approach. The statistical population consisted of experts in educational management holding doctoral degrees and possessing scholarly publications, research experience, and practical expertise in the field. Using snowball sampling and based on the principle of theoretical saturation, 15 experts were selected. The research instrument was a semi-structured interview developed through open and axial coding procedures. Subsequently, selective coding was conducted through document review, interviews, and brainstorming sessions. At this stage, the dimensions, components, and indicators were finalized and prioritized by the experts. The model was then reconstructed based on the identified dimensions, components, and indicators and subsequently validated and confirmed by the experts. The validity and reliability of the instrument were established using the triangulation consensus method. Data collection was conducted through document review, in-depth interviews with experts, and continued until theoretical saturation was achieved. Data analysis was performed through three stages: open coding, axial coding, and selective coding.

The most important stage of data analysis involved the coding process (open, axial, and selective coding), which was carried out as follows:

Open Coding: Documents and interview transcripts were transcribed and standardized. Scientific terminology consistent with the theoretical foundations of the study was assigned to the data, resulting in a list of concepts. These concepts were subsequently categorized into preliminary groups.

Axial Coding: The categories identified during open coding were linked and related to one another. This process established relationships among the codes generated during the open coding stage.

Selective Coding: During this stage, the integration, refinement, and improvement of categories were conducted. By creating a coherent structure and arrangement among the categories, the researcher organized them to facilitate theory

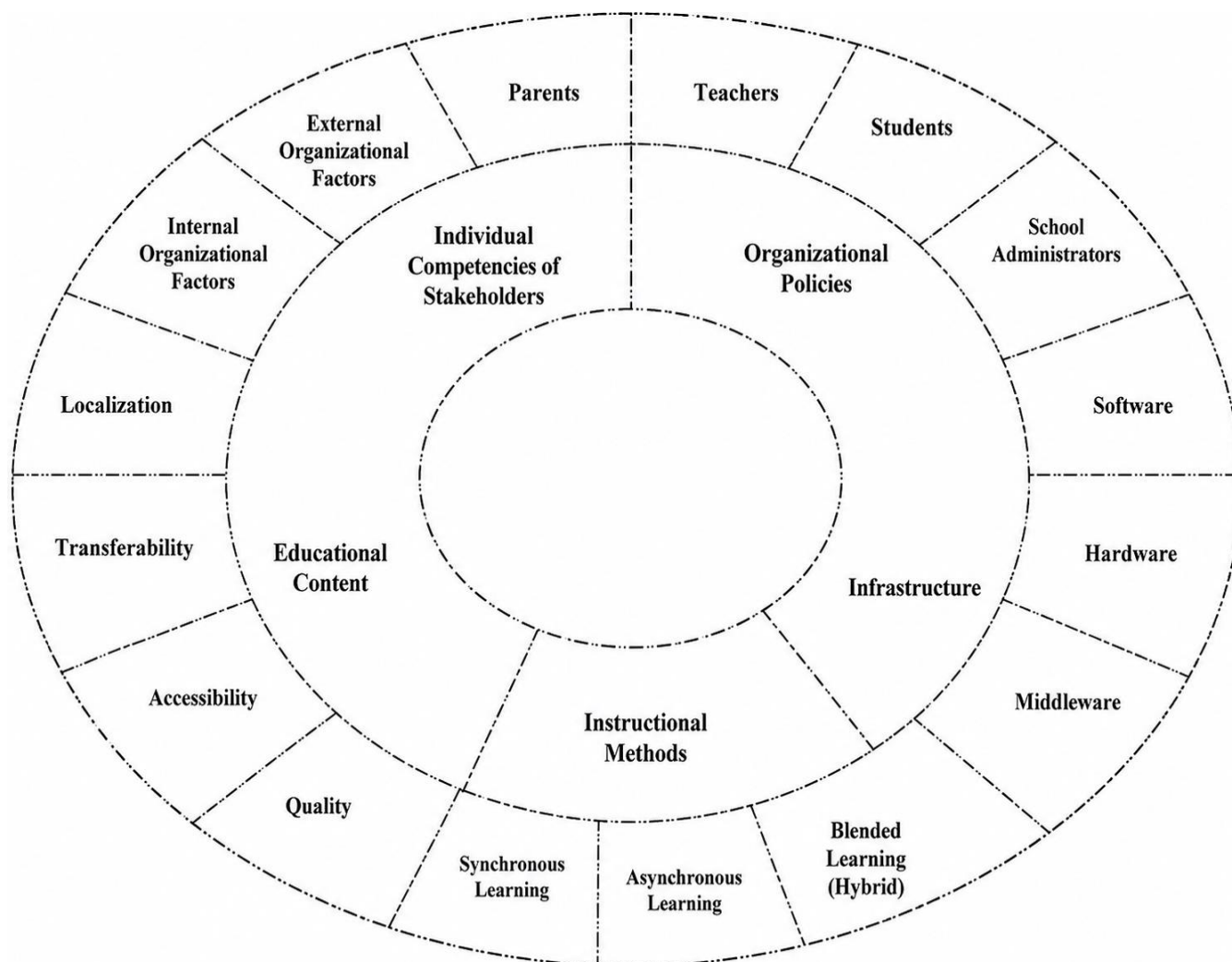
development. This process was made possible through the identification of a central category.

3. Findings and Results

In response to the research questions, the following findings were obtained and are explained below.

Figure 1

Virtual Education Model for Elementary School Teachers in Tehran



Research Question 2: What are the dimensions, components, and indicators constituting the proposed model, according to experts, and what is their order of priority?

To answer this question, the researcher identified examples and manifestations related to teacher virtual education. Initially, an interview checklist was developed, and expert opinions were collected. The interviews

Research Question 1: What is the virtual education model for elementary school teachers in Tehran?

The findings led to the development of the proposed virtual education model for elementary school teachers in Tehran, as illustrated in Figure 1.

generated numerous examples, indicating that virtual teacher education within the Ministry of Education may differ substantially from that of other organizations and institutions.

The semi-structured interviews with experts resulted in the identification of 100 initial codes (key concepts). Table 1 presents a selection of the initial codes extracted from the interview transcripts.

Table 1

Examples of Initial Codes Extracted from Expert Interviews

Interview Code	Extracted Indicator	Interview Excerpt
P1.013.p4.p7	Ability to adapt content based on students' individual needs and learning levels	"Content should be designed in a way that aligns with the learning level of each student. This means teachers should be able to create individualized plans for students to enhance learning effectiveness."
P11.p10.p6.p12	Use of diverse teaching methods (practical assignments, videos, articles)	"Diversity in teaching methods, such as videos, articles, and practical assignments, helps students learn topics from different perspectives and interact with content in multiple ways."
P2.p6.p9.15	Availability of diverse activities compatible with different learning speeds	"In online classes, some students may learn more quickly than others. Therefore, activities should be designed to accommodate different learning paces."
P1.p4.p8.p14.p9	Stability and proper performance of servers and networks	"To ensure uninterrupted online classes, servers and networks must be stable and function effectively to prevent technical issues."
P5.p9.p8.p11	Ability to report and track technical problems	"Students and teachers should be able to report technical issues so that support teams can quickly address and resolve them."
P2.p5.p9.p11.p13	Preventing excessively long classes and aligning schedules with elementary students' needs	"Online classes for elementary students should be concise and appropriately timed to prevent fatigue and loss of concentration. Scheduling should be adjusted according to their age and needs."
P3.p7.p8.p10.p11	School access to standard peripheral equipment (webcams, headsets, microphones)	"Effective virtual teaching requires appropriate equipment such as webcams, microphones, and headsets. These tools improve audio-visual transmission and enhance the learning experience."

Based on the analysis and coding process, the initial codes were standardized, and some were removed or revised. Ultimately, 85 open codes were identified, as presented in Table 2.

After identifying the open codes (indicators) associated with the virtual education model from the interview data, the researcher categorized these indicators. Since concepts constituted the primary unit of analysis during open and axial coding, concepts were generated through researcher labeling, either directly from interview transcripts or based

on shared patterns of application. The interview transcripts were systematically reviewed to identify indicators and components. As a result, 23 components were identified as factors contributing to the design of the virtual education model for elementary schools in Tehran.

Several concepts (indicators) collectively formed broader categories referred to as axial codes. The identified axial codes and their corresponding open codes are presented in Table 2.

Table 2

Axial Coding

Dimension	Component	Number of Indicators
Equipment and Infrastructure	Virtual education hardware equipment in schools	5
Equipment and Infrastructure	Communication and internet infrastructure in schools	5
Equipment and Infrastructure	Software and system infrastructure in schools	5
Teacher Competencies	Teachers' familiarity with educational technologies	3
Teacher Competencies	Online teaching and virtual classroom management skills	3
Teacher Competencies	Continuous teacher training and support	3
Teacher Competencies	Teachers' motivation for using virtual education	3
Students	Students' personal characteristics and learning styles	4
Students	Technical characteristics and access to appropriate technology	3
Students	Social and communication characteristics in online classes	4
Educational Content	Quality of educational content	4
Educational Content	Content accessibility and flexibility	3
Educational Content	Interactivity and collaborative activities	3
Educational Content	Diversity and personalization of content	4
Technical Support	Technical support for students and teachers	5
Technical Support	Technical support and technological infrastructure	4
Planning and Time Management	Planning and scheduling educational activities	4
Planning and Time Management	Time management in online classes	4

Planning and Time Management	Support and coordination in time management	4
Assessment and Evaluation Process	Continuous and advanced assessment	3
Assessment and Evaluation Process	Performance- and participation-based assessment	3
Family and Parental Support	Emotional and motivational support from parents	3
Family and Parental Support	Practical and managerial parental support	3

During the selective coding stage, the identified components were grouped into more abstract categories. Following brainstorming sessions with experts, the final virtual education model for elementary school teachers in Tehran was developed (Figure 1). Consequently, 92 open

codes (indicators) were categorized into 16 axial codes (components), which were further organized into 5 selective codes (dimensions). The resulting dimensions, components, and indicators are presented in Table 3.

Table 3

Selective Coding

Dimension	Component	Number of Indicators
Individual Competencies of Stakeholders	Parents	6
Individual Competencies of Stakeholders	Teachers	12
Individual Competencies of Stakeholders	Students	9
Individual Competencies of Stakeholders	School Administrators	6
Organizational Policies	External Organizational Factors	7
Organizational Policies	Internal Organizational Factors	5
Infrastructure	Software	5
Infrastructure	Hardware	6
Infrastructure	Middleware	5
Educational Content	Quality	6
Educational Content	Accessibility	4
Educational Content	Transferability	5
Educational Content	Localization	5
Instructional Method	Synchronous Learning	4
Instructional Method	Asynchronous Learning	4
Instructional Method	Blended Learning	3

In the final stage, all identified dimensions, components, and indicators were reviewed and analyzed through a brainstorming session. Initially, the dimensions, components, and indicators were sent to the 15 experts, and their opinions were collected. The feedback was incorporated into the model and resubmitted to the experts for confirmation and final approval.

At this stage, the dimensions, components, and indicators of the virtual education model for elementary school

teachers in Tehran were organized into a conceptual model and validated by experts. The Content Validity Ratio (CVR) was calculated, and all model components were confirmed.

To further validate the identified components and indicators, an additional brainstorming session was held with five university experts. In addition to incorporating their feedback, they were asked to prioritize the dimensions and components. The results are presented in Table 4.

Table 4

Prioritization of Dimensions and Components of the Virtual Education Model for Elementary School Teachers in Tehran

Dimension Priority	Dimension	Component Priority	Component
1	Individual Competencies of Stakeholders	1	Parents
		2	Teachers
		3	Students
		4	School Administrators
2	Organizational Policies	1	External Organizational Factors
		2	Internal Organizational Factors

3	Infrastructure	1	Software
		2	Hardware
		3	Middleware
4	Educational Content	1	Quality
		2	Accessibility
		3	Transferability
		4	Localization
5	Instructional Method	1	Synchronous Learning
		2	Asynchronous Learning
		3	Blended Learning

4. Discussion and Conclusion

The findings of the present study resulted in the development of a comprehensive virtual education model for elementary school teachers in Tehran consisting of five main dimensions, sixteen components, and ninety-two indicators. The identified dimensions included stakeholders' individual competencies, organizational policies, infrastructure, educational content, and instructional methods. The prioritization process revealed that stakeholders' individual competencies constituted the most influential dimension, followed by organizational policies, infrastructure, educational content, and instructional methods. Within the dimension of individual competencies, parents, teachers, students, and school administrators emerged as key components, emphasizing that successful virtual education extends beyond technological readiness and requires the active engagement of all educational stakeholders. This finding reflects the growing recognition that virtual learning ecosystems function most effectively when they integrate human, organizational, and technological capacities simultaneously. The prominence of stakeholder competencies in the proposed model demonstrates that the success of virtual education is fundamentally dependent on the preparedness, attitudes, and collaborative capacities of individuals who participate in the educational process.

The identification of stakeholders' individual competencies as the most important dimension is consistent with contemporary educational research emphasizing the central role of human capital in digital transformation initiatives. Teachers remain the primary agents responsible for translating technological opportunities into meaningful learning experiences. Research has demonstrated that teachers' technological knowledge, pedagogical expertise, and confidence in using digital tools significantly influence the effectiveness of virtual instruction (Jung et al., 2024; Persada & Sobandi, 2023). The prominence of teachers within the model also aligns with studies highlighting the

importance of professional development programs that strengthen teachers' digital competencies and instructional adaptability (Meletiyou-Mavrotheris & Paparistodemou, 2024; Teemant et al., 2024). Furthermore, the inclusion of parents as the highest-priority component within this dimension underscores the unique nature of elementary education, where students often depend on family support to engage successfully in online learning activities. Previous investigations have similarly reported that parental involvement is a critical determinant of virtual learning success, particularly among younger learners who require supervision, motivation, and assistance with educational technologies (Hidayah, 2023; Shayeb et al., 2023). The inclusion of students and school administrators within the same dimension further supports the notion that virtual education should be viewed as a collective enterprise rather than an individual instructional activity.

Another important finding concerns the significance of organizational policies as the second-ranked dimension. The model distinguishes between external and internal organizational factors, suggesting that virtual education effectiveness depends on both educational system policies and school-level administrative practices. This finding is supported by previous research demonstrating that institutional support, leadership practices, and organizational culture substantially influence teachers' willingness and capacity to implement innovative educational approaches (Hayes et al., 2024). Organizational policies establish the structural conditions under which virtual education occurs, including resource allocation, professional development opportunities, accountability mechanisms, and technological support systems. Studies conducted in various educational contexts have shown that successful digital transformation requires coherent policy frameworks capable of aligning technological investments with pedagogical objectives (Singh, 2023; Szűts et al., 2023). The distinction between internal and external organizational factors identified in the present study further reflects the complexity of educational systems, where

macro-level policies interact with local school practices to shape educational outcomes. The findings therefore suggest that improving virtual education requires coordinated efforts among policymakers, educational authorities, and school leaders.

The infrastructure dimension emerged as the third most important component of the model and consisted of software, hardware, and middleware elements. This finding is unsurprising given that virtual education depends fundamentally on technological infrastructure capable of supporting communication, content delivery, assessment, and collaboration. However, the prioritization of software over hardware and middleware provides an important insight into contemporary educational needs. While access to devices remains essential, educational stakeholders increasingly require sophisticated software platforms that facilitate interaction, content management, and instructional flexibility. Previous studies have highlighted the importance of learning management systems as foundational tools for effective blended and virtual learning environments (Zainil et al., 2024). Similarly, research examining teachers' technological competencies has demonstrated that the availability of appropriate software significantly influences instructional quality and learner engagement (Putri et al., 2023). The identification of middleware as a separate component also reflects a sophisticated understanding of digital ecosystems, recognizing the importance of integration mechanisms that connect different educational technologies and facilitate seamless learning experiences. These findings support contemporary perspectives that view technological infrastructure not merely as equipment but as a comprehensive ecosystem supporting educational processes.

The educational content dimension consisted of quality, accessibility, transferability, and localization. The prioritization of content quality as the most important component within this dimension highlights the central role of pedagogical substance in virtual education. Technological innovations alone cannot guarantee meaningful learning outcomes if educational materials fail to engage students or support instructional objectives. Previous research has consistently emphasized that effective digital learning environments require high-quality content characterized by clarity, relevance, interactivity, and pedagogical alignment (Bercasio, 2024; Noviana et al., 2023). The emphasis on accessibility reflects growing concerns regarding educational equity and the need to ensure that all learners can benefit from virtual learning opportunities regardless of

their technological or socioeconomic circumstances. This finding aligns with recent studies addressing digital inclusion and efforts to reduce barriers associated with the digital divide (Henriquez et al., 2026). The inclusion of transferability and localization further demonstrates the necessity of adapting educational content to specific contexts while maintaining relevance across diverse learning situations. Such findings are consistent with research suggesting that effective virtual education requires content that is both contextually meaningful and adaptable to changing educational needs (Persada & Sobandi, 2023; Szűts et al., 2023).

The final dimension, instructional methods, comprised synchronous learning, asynchronous learning, and blended learning. The prioritization of synchronous instruction suggests that experts continue to value real-time interaction between teachers and students, particularly within elementary education. This preference likely reflects the developmental needs of younger learners, who often benefit from immediate feedback, social interaction, and structured learning environments. Previous research has demonstrated that synchronous learning can enhance engagement, motivation, and communication among students and teachers (McCormick & Guilbault, 2023). However, the inclusion of asynchronous and blended learning approaches indicates recognition of the flexibility and personalization opportunities afforded by contemporary educational technologies. Studies examining digital transformation in education have emphasized that blended learning models often provide the most effective balance between flexibility and interaction, allowing learners to benefit from both self-paced and collaborative experiences (Szűts et al., 2023; Zainil et al., 2024). Consequently, the findings suggest that effective virtual education should not rely exclusively on a single instructional approach but instead integrate multiple methods according to educational objectives and learner characteristics.

The overall structure of the proposed model demonstrates considerable alignment with contemporary theoretical and empirical literature concerning teacher professional development, digital literacy, and educational innovation. The findings support TPACK-related perspectives emphasizing the integration of technological, pedagogical, and content knowledge as a prerequisite for effective digital instruction (Aprilia et al., 2023; Patalinghug & Arnado, 2022). The prominence of teacher competencies within the model also reflects research demonstrating that sustained professional development initiatives contribute significantly

to educational innovation and instructional quality (Meletiyou-Mavrotheris & Paparistodemou, 2024; Teemant et al., 2024). Moreover, the inclusion of stakeholder collaboration, organizational support, and technological infrastructure suggests that virtual education should be conceptualized as a systemic process rather than a purely technological intervention. This perspective is supported by studies highlighting the interconnected nature of educational ecosystems and the importance of aligning human, organizational, and technological resources (Bercasio, 2024; Hayes et al., 2024).

An additional contribution of the present study lies in its contextualization of virtual education within the elementary school environment. Much of the existing literature focuses on higher education or general educational settings, whereas elementary education presents distinctive challenges related to student developmental characteristics, parental involvement, and instructional design. The inclusion of parents as a high-priority component demonstrates a nuanced understanding of these contextual realities and extends previous findings concerning stakeholder engagement in digital learning environments (Hidayah, 2023). Similarly, the emphasis on localized content and organizational policies reflects the importance of adapting virtual education models to specific educational contexts rather than adopting universal solutions. Such findings contribute to the growing body of literature advocating context-sensitive approaches to educational innovation (Theodosaki et al., 2025; Yang, 2025).

Overall, the findings indicate that effective virtual education for elementary school teachers requires a holistic framework integrating stakeholder competencies, supportive organizational policies, robust technological infrastructure, high-quality educational content, and diverse instructional methods. The model developed in this study offers a comprehensive perspective that extends beyond technology-centered approaches and recognizes the multidimensional nature of educational transformation. By integrating insights from educational management, teacher professional development, digital literacy, and instructional design, the proposed model provides a theoretically grounded and practically relevant framework capable of guiding future virtual education initiatives in elementary schools.

One limitation of the present study is that the model was developed based on the perspectives of a relatively small group of experts from a specific geographical and educational context. Although theoretical saturation was achieved, the findings may not fully represent the views of

all stakeholders involved in elementary education. Furthermore, the study employed a qualitative methodology, which provides rich and in-depth insights but does not permit statistical generalization. The model was validated theoretically by experts; however, its practical implementation and effectiveness were not empirically tested in actual school settings.

Future research should focus on quantitatively validating the proposed model through large-scale surveys involving teachers, school administrators, students, and parents. Researchers may also examine the causal relationships among the identified dimensions and components using structural equation modeling. Comparative studies across different regions, educational levels, and cultural contexts would contribute to assessing the model's generalizability. Additionally, future investigations could evaluate the effectiveness of the model through intervention-based studies and explore the impact of emerging technologies such as artificial intelligence, virtual reality, and learning analytics on virtual education quality.

From a practical perspective, educational authorities should invest in comprehensive professional development programs that enhance teachers' digital and pedagogical competencies. Schools should establish supportive organizational policies that encourage innovation, collaboration, and continuous improvement in virtual learning environments. Educational planners should prioritize the development of high-quality and accessible digital content while ensuring adequate technological infrastructure. Particular attention should be devoted to strengthening partnerships among teachers, parents, students, and school administrators, as stakeholder collaboration emerged as a critical factor in the success of virtual education. Finally, schools should adopt flexible instructional approaches that combine synchronous, asynchronous, and blended learning strategies to address diverse learner needs and maximize educational effectiveness.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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