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A Model Framework for Enhancing Twenty-First Century Competencies in Primary School Teachers within Northeastern Thailand's Sub-Area

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Abstract. This study investigated the development of twenty-first-century competencies among primary school teachers in Thailand's sub-northeastern region. The research aimed to achieve three primary objectives: 1) assess the specific needs for enhancing teachers' twenty-first-century competencies in the sub-northeastern Thailand region; 2) construct a model designed to establish teachers' twenty-first-century competencies within this context; and 3) implement and evaluate the effectiveness of the developed model. The study's participants consisted of 390 teachers from the sub-northeastern region who were selected by a formula-based approach for the needs analysis, five experts for model evaluation selected by means of purposive sampling, and 30 teachers selected by purposive sampling for model implementation. To gather data, various instruments were employed, including a questionnaire to assess the needs for enhancing teachers' twenty-first-century competencies in the sub-northeastern Thailand region, a model evaluation form, a model for the development of teachers' twenty-first-century competencies in the sub-northeastern Thailand region, a twenty-first-century competencies evaluation form, and a satisfaction questionnaire. Data analysis involved mean scores, standard deviations, priority need indexes, medians and interquartile ranges. The results of this comprehensive study shed light on the specific competencies required by teachers in the twenty-first century, serving as a valuable resource for educators and policymakers alike in their ongoing efforts to improve education quality.

Keywords: twenty-first century; teacher competencies; model development

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1. Introduction

As the world hurtles forward into the twenty-first century, a profound transformation sweeps across every facet of our lives. Advancements in technology, shifting global landscapes and evolving societal norms have collectively reshaped the way we live, work, and communicate (Erdem, 2019; Turiman et al., 2012). Alongside these changes, the demand for new and versatile skills among learners has surged. In this ever-evolving landscape, where critical thinking, digital literacy, adaptability and problem-solving skills have taken centre stage, the role of educators has evolved significantly (Kim et al., 2019). Therefore, it becomes an increasingly pressing burden for teachers to adapt and equip themselves with the knowledge and pedagogical strategies necessary to nurture the twenty-first-century competencies of their students, ensuring they are prepared to thrive in this dynamic and rapidly changing world (Zamora & Zamora, 2022).

In accordance with the evolving demands of the twenty-first century, the Partnership for twenty-first Century Skills (2009), a national not-for-profit organisation committed to collaborating with school systems and communities, outlines key competencies across three thematic areas: life and career skills, learning and innovation skills and information, media and technology skills. These competencies encompass a range of abilities, including flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, high-order thinking and technological literacy. In parallel, the Ministry of Education (2015) has initiated the 3R8C campaign, aiming to equip Thai students with a comprehensive set of skills, spanning arithmetic, reading, writing, critical thinking, problem-solving, creativity and innovation, cross-cultural understanding, collaboration, teamwork, leadership, communication, information and media literacy, computing and IT literacy, as well as career and learning skills, and compassion. These skills are multifaceted, demanding specific competencies from educators to effectively impart knowledge and cultivate these essential skills in their students.

Scholars (e.g., Nessibayeva, 2012; Simonović, 2021; Sulaiman & Noor, 2020), have extensively examined the competencies essential for twenty-first-century teachers, which include interpersonal skills, pedagogy, content knowledge, ICT-literacy and organisational skills. As posited by Hager and Gonczi (1996), competencies encompass a wide range of attributes, such as traits, knowledge, beliefs, abilities, skills, experiences, motivation, values, attitudes, habits and self-regulation abilities, all working in tandem and interdependently to enable individuals to be active and effective in various situations. These competencies are not confined to a specific profession but hold universal relevance, including for educators. They are rooted in the educational goals that permeate all school subjects, underlining their significance as fundamental requisites for success in diverse workplaces, with teaching being no exception.

In Thailand, the quality of teachers is a pressing concern, particularly evident in public schools located in suburban and local areas where budget constraints are severely limiting (Pongsudhirak, 2020). Compounding this challenge is the fact that the majority of students come from lower-middle-income families who are

often unable to provide their children with the necessary support for curriculum enrichment, including extracurricular activities and access to online resources (UNICEF, 2014). Moreover, this issue is not limited to a specific region; it pervades the entire country, extending to the sub-northeastern part of Thailand, characterised by the lowest income per citizen in the nation (Office of the National Economic and Social Development Council, 2023). In order to elevate the overall quality of education and address these pervasive issues, it is imperative that teachers are equipped with twenty-first-century competencies. This empowerment would enable them to effectively address the unique challenges in their respective contexts and, most importantly, transfer essential twenty-first-century skills to their students, bridging the gap and fostering a brighter educational future for all.

Furthermore, previous studies offered various methods for enhancing teachers' twenty-first-century competencies (e.g., Gümüş, 2022; Kim et al., 2019; Schleicher, 2012; Selvi, 2010; Simonović, 2021; Zamora & Zamora, 2022); however, these approaches often overlook the critical step of investigating the specific contextual needs before implementation. Rather, they mostly present only the components that lead to teachers' twenty-first century competencies in a generic sense. Consequently, the development of a tailored model, focusing on the unique educational context of the sub-northeastern part of Thailand, holds significant promise for elevating the overall education quality in this region. In terms of academia, this endeavour serves as a crucial investigation into the challenges and requirements related to the development of teachers' twenty-first-century competencies within this specific context. It also assesses the potential benefits of using a customised development model to address the area's distinct educational needs. Thus, the current study delves into the underlying issues surrounding twenty-first-century competency development in the sub-northeastern part of Thailand, presents the development of a specialised model, and endeavours to implement it effectively to enhance the twenty-first-century competencies of teachers in this region, ultimately aiming to bridge educational gaps and uplift the quality of education in the area.

2. Literature Review

2.1 Teacher competencies

Competencies, within the framework of competency-based teacher education, encompass a multifaceted set of attributes that teacher-trainees must exhibit to successfully complete their teacher education programme, as articulated by Houstan (1987). These attributes comprise a combination of knowledge, skills and values crucial for future endeavours, as articulated by Katane et al. (2006), emphasising their practical manifestation in various activities. Furthermore, Gupta et al. (2007) expands the definition of competencies to encompass a comprehensive range of elements, including knowledge, skills, attitudes, values, motivations and beliefs, all of which are essential for achieving success in a given job or profession. Therefore, it can be summarised that teacher competencies refer to the comprehensive combination of knowledge, skills, values, attitudes, motivations and beliefs that teacher-trainees must possess to successfully complete their education programmes and excel in their roles as educators.

2.2 Teacher competencies in the twenty-first century

Taking into account the framework of twenty-first-century skills for learning, as outlined by the Partnership for Twenty-First Century Skills (2009) and the Ministry of Education (2015), we have identified six essential competencies tailored for teachers in Thailand. These encompass interpersonal competencies, ICT competencies, pedagogical competencies, profession learning community competencies, research competencies and evaluation and assessment competencies. The specifics of these competencies are detailed below.

2.2.1 Interpersonal Competencies

Interpersonal competencies remain crucial for teachers, facilitating effective communication, collaboration, empathy, and teacher's values and ethical principles (Febrianita & Hardjati, 2019). By fostering constructive connections with their students, educators establish an inclusive classroom atmosphere that fosters the growth of open communication and trust (Zhang, 2019). These relationships enable teachers to better understand students' needs, tailor instruction and provide emotional support, thus enhancing the overall learning experience.

2.2.2 ICT Competencies

In the digital age, Information and Communication Technology (ICT) competencies are indispensable for teachers. Proficiency in technology empowers educators to engage students with multimedia resources, online platforms and educational apps, making lessons interactive and dynamic. These competencies equip students with essential digital literacy skills, preparing them for a technology-driven world (Avdeeva et al., 2016; Gutiérrez-Martín et al., 2022).

2.2.3 Pedagogical Competencies

Pedagogical competencies encompass the art and science of teaching, allowing teachers to design effective lesson plans, employ diverse teaching strategies, and adapt to various learning styles (Sentürk & Zeybek, 2019). These skills enable teachers to ensure that students not only acquire knowledge but also develop critical thinking and problem-solving abilities, thus empowering them academically and beyond.

2.2.4 Professional Learning Community Competencies

Collaborative competencies within a professional learning community help teachers engage in ongoing professional development (Harris & Jones, 2010). By collaborating with peers, sharing best practices and seeking continuous improvement, teachers model a commitment to lifelong learning for their students. This fosters a culture of growth and inspires students to embrace a similar attitude towards learning (Wood, 2007).

2.2.5 Research Competencies

Research competencies equip teachers with the skills to explore and evaluate educational trends, strategies and best practices. Teachers who incorporate research into their practice can make informed decisions about instructional methods, ensuring that students benefit from evidence-based approaches that enhance their learning experiences (Ivanenko et al., 2015).

2.2.6 Evaluation and Assessment Competencies

Competency in evaluation and assessment is essential for teachers to gauge students' progress accurately. Effective assessment strategies help teachers tailor their instruction to meet individual student needs, providing timely feedback that guides students toward improvement (Amua-Sekyi, 2016; Brookhart, 2011). By cultivating these competencies, teachers can optimise the learning journey for each student, promoting growth and achievement.

2.3 Previous studies

Previous studies (Gümüş, 2022; Kim et al., 2019; Schleicher, 2012; Selvi, 2010; Simonović, 2021; Zamora & Zamora, 2022) focused on teachers' twenty-first-century competencies, primarily examining the scope of these competencies and identifying areas for teacher development. However, these studies have primarily addressed the "what" aspects of teacher competencies, resulting in a notable gap in our comprehension of the "how". This study adopts a model development approach to actively enhance teachers' twenty-first-century competencies within the sub-northeastern Thailand region. By translating the previously identified scope of teachers' twenty-first-century competencies into actionable strategies, this research aims to make a substantial contribution to the field. Therefore, the study enriches the field by bridging the gap between theory and practice, offering context-specific solutions, providing practical guidance and contributing to the empirical understanding of teachers' twenty-first-century competencies, all of which benefit educators, researchers and policymakers. The study's objectives are threefold: 1) to assess the specific needs for developing teachers' twenty-first-century competencies in the sub-northeastern Thailand region; 2) to construct a model aimed at establishing teachers' twenty-first-century competencies in this context;, and 3) to implement and evaluate the effectiveness of the developed model.

3. Methodology

3.1 Research design

The study adopted a research and development design comprising three integral phases. The initial phase involved a meticulous need analysis, delving into the unique requirements for enhancing teachers' twenty-first-century competencies within the sub-northeastern Thailand region. This comprehensive understanding of local challenges and improvement areas laid the foundation for the subsequent phase: model development. Here, a tailored framework was meticulously crafted, aligning with the region's specific context and resources. The final phase, model implementation, saw the model put into action within local educational settings. Teachers received training and support, incorporating twenty-first-century competencies through workshops, professional development and classroom applications. Continuous monitoring and evaluation ensured the model's relevance and effectiveness throughout its deployment, representing a holistic approach aimed at fostering teachers' twenty-first-century competencies in the region.

3.2 Phase 1 Specifying needs for developing teachers' twenty-first-century competencies in the sub-northeastern Thailand region

In Phase 1 of the study, a sample group comprising 390 primary school teachers from the lower northeastern region of Thailand was selected using a formula-based approach due to the unavailability of precise population data. This method, set with a 95% confidence level (Z=1.96) and a 5% margin of error, initially resulted in a sample size of 384 individuals, which was then rounded up to 390. The research instrument was a structured questionnaire with three main components. The first segment consisted of a general information questionnaire, administered in a checklist format. The second part aimed to assess both the current and expected conditions of teacher competency development in the twenty-first century for primary school teachers in the sub-northeastern Thailand region, employing a scale estimation method. The aspects of investigation included interpersonal competencies, ICT competencies, pedagogical competencies, profession learning community competencies, research competencies, evaluation and assessment competencies. The third section delineated guidelines for enhancing teacher competencies in the twenty-first century and was presented in an open-ended format. Stringent content validation procedures were carried out by five experts, using Rovinelli and Hambleton's method (1977) to compute the Index of Congruence (IOC). Questions with an average IOC score between 0.50 and 1.00 were retained, with all questions achieving an IOC of 1.00. Subsequently, the questionnaire underwent pilot testing on 29 teachers outside the sample group, yielding reliable scores for both the expected conditions (60 items, r=0.47-0.89, α=0.98) and the actual conditions (57 items, r=0.23-0.84, α=0.99). Furthermore, the study integrated a document analysis and research review form to investigate existing literature, strategies and programmes related to teacher competency development. Regarding data collection, data acquisition took place between February and March 2023. The data underwent analysis employing the Priority Needs Index (PNI-modified) method (Wiratchai, 1999; Wiratchai & Wongwanich, 1998). This approach entails calculating the disparity between the reported necessity and the present state, followed by dividing this difference by the current state. If the resulting value exceeded a predefined threshold of 0.0 (a positive number), the respective indicator was considered relevant for incorporation into the model under development. Qualitative data, on the other hand, were subjected to content analysis for interpretation.

3.3 Phase 2 Developing a model for developing teachers' twenty-first-century competencies in the sub-northeastern Thailand region

In the second phase of the study, a model for enhancing teachers' twenty-first-century competencies in the sub-northeastern Thailand region was developed. This model development phase involved the active participation of five expert scholars specialising in education management and pedagogy who were selected by purposive sampling method. The model was constructed based on the data collected during Phase 1, using a model evaluation form as the primary instrument. To assess the model's effectiveness, it was subjected to evaluation using Stufflebeam's (2001) Standard-Based Assessment Framework, which comprises four critical dimensions: 1) propriety, 2) feasibility, 3) utility and 4) accuracy. Subsequently, a comprehensive analysis was conducted to determine

the model's average score, standard deviation and interquartile range. A consensus among the expert panel was considered strong if the interquartile range was less than 1.50 and the median score fell within the range of 2.51 and above.

3.4 Phase 3 The implementation of the model

During the third phase of the study, the developed model was put into action. A total of 30 primary school teachers hailing from Maha Sarakham and Yasothon provinces were purposefully selected to participate in a programme aimed at enhancing their twenty-first-century competencies within the sub-northeastern Thailand region. The programme encompassed a variety of activities, including training sessions, workshops, practical classroom implementation, research endeavours, supervision and engagement in professional learning communities. The participants' competencies were meticulously assessed through a comprehensive evaluation, focusing on four key aspects of teachers' abilities: active learning management, evaluation and assessment, proficient use of media and technology, and conducting research for learner development. Additionally, the participants' satisfaction was gauged through a questionnaire. The resulting data were analysed using mean scores and standard deviations, categorising the outcomes into the following levels: very high (4.50-5.00), high (3.50-4.49), moderate (2.50-3.49), low (1.50-2.49), and very low (1.00-1.49).

4. Results

4.1 Needs in developing teachers' twenty-first-century competencies

Table 1: Priority need index of developing teachers' twenty-first-century competencies

Teachers' twenty-first-century competencies	Degree of success			Importance			$PNI_{modified}$
	$\bar{X}$	SD	Level	$\bar{X}$	SD	Level	
1) Competencies in active learning management	4.19	0.54	High	4.23	0.83	High	0.15
2) ICT competencies	4.17	0.63	High	4.21	0.86	High	0.19
3) Authentic evaluation and assessment	4.23	0.57	High	4.29	0.89	High	0.17
4) Research competencies	4.02	0.66	High	4.16	0.86	High	0.57
5) Interpersonal competencies	4.63	0.50	Very High	4.23	1.06	High	-1.84
6) Professional learning community competencies	4.42	0.55	High	4.22	0.95	High	-0.90
Overall	4.28	0.48	High	4.21	0.85	High	-

The survey was distributed to 390 primary school teachers throughout the sub-northeastern region of Thailand. They were tasked with assessing items within two dimensions: the degree of success, indicating their current level and the importance, reflecting their expected outcomes for competencies. These two sets of ratings were then used to calculate the PNI for each competency. The study's findings revealed that four competencies, namely active learning management,

ICT competencies, authentic evaluation and assessment and research competencies, were incorporated into the model development. This decision was based on their PNIs exceeding 0.00, signifying a need for development beyond the current state. Conversely, interpersonal competencies and professional learning community competencies were not included in the model due to their current state not surpassing the demand for development. In summary, while all aspects were deemed important by the teachers, only four were deemed necessary for further development.

Moreover, the recommendations gained from the analysis of the qualitative data include providing practical and continuous teacher training, encouraging successful teachers to share their methods with others, establishing diverse online learning communities for knowledge exchange, ensuring ongoing professional learning communities and competency development, promoting collaborative teacher development within schools, minimising unnecessary training and administrative burdens, supporting classroom technology, fostering teachers' self-development to adapt to changes, and integrating research development with proactive learning management and ethics. The data gained from Phase 1 study were used in the development process of the model.

4.2 Model development

4.2.1 Content

The content of the developed model encompassed several key areas, including active learning management, the integration of ICT, the implementation of authentic evaluation and assessment methods, and the promotion of research skills. Within this model, participants had the opportunity to delve into each of these aspects in a comprehensive and detailed manner. In active learning management, the participants gained insights into effective strategies for actively engaging students in the learning process. This might involve exploring pedagogical approaches that encourage student participation, problem-solving, critical thinking and collaborative activities. Practical techniques for creating dynamic and interactive classroom environments were also covered. In the realm of ICT, participants learned how to leverage technology as a powerful tool for enhancing teaching and learning experiences. This included not only basic digital literacy but also the integration of digital resources, online platforms and educational software to support instruction, communication and student engagement. The model guided participants in designing and implementing assessment methods that reflect real-world skills and competencies. This approach goes beyond traditional testing and encourages educators to assess students' abilities in contexts that mirror authentic, practical situations. This could involve performance-based assessments, project-based learning and formative assessment strategies. Lastly, the model fostered research skills among participants. This involves equipping educators with the tools and methodologies needed to conduct educational research, gather data, analyse findings and make informed decisions based on evidence. Research skills are valuable not only for professional development but also for continuously improving teaching practices and student outcomes.

4.2.2 Activities

The activities within this educational programme were structured into four distinct stages, each serving a specific purpose in enhancing the participants' teaching competencies. These stages, namely training, workshops, class implementation and research, were carefully designed to provide a comprehensive and immersive learning experience.

Training

The training stage served as the foundational component of the programme. Renowned scholars in the field of education delivered lectures and informative sessions. These sessions aimed to familiarise teachers with the essential competencies required in the twenty-first century teaching landscape. During this phase, teachers actively participated in training sessions, absorbing valuable knowledge and insights.

Workshops

Following the training, participants engaged in workshops that encouraged practical application. These workshops enabled educators to apply the knowledge acquired during the training phase to the real world of teaching. Participants were tasked with developing learning management plans that incorporated twenty-first-century teaching methodologies. The programme's expert lecturers actively engaged in these workshops, providing guidance, feedback and evaluations to further refine the participants' plans.

Class Implementation

The class implementation phase represented a pivotal step in the programme. Participants were entrusted with the responsibility of putting their developed learning management plans into action within their own classrooms. This hands-on experience allowed them to apply the newly acquired concepts, teaching strategies and competencies in a real educational setting. Throughout this phase, participants maintained ongoing communication with programme supervisors, sharing their progress, successes and challenges.

Research Activity

In the final research activity, participants were tasked with conducting educational research relevant to their teaching contexts. This research involved exploring specific topics or issues related to the twenty-first-century competencies they had been learning about. Subsequently, participants were required to compile their research findings into comprehensive research reports. This phase encouraged participants to delve deeper into their chosen areas of inquiry, fostering a culture of continuous learning and evidence-based teaching practices.

Table 2: Summary of model activities

Activity	Sub-activities	Personnel
Training	- Lectures on active learning teaching technique, technology integrate teaching, assessment and evaluation, and research	- Participants - Lecturers
Workshop	- Collaborating activities - Developing learning management plans - Presentation and feedback	- Participants - Lecturers - Experts

Activity	Sub-activities	Personnel
Class implementation	- Implementing the plans - Inspecting - Supervision	- Participants - Students - Supervisors
Research	- Conducting research - Writing research reports	- Participants - Students - Supervisors

4.2.3 Model Evaluation

Table 3: Summary of the model evaluation

Aspect of evaluation	Mean	SD	Level	Q_3	Q_1	Mdn	IR
Propriety	4.85	0.37	Very high	5	4	5.00	1.00
Feasibility	4.92	0.28	Very high	5	4	5.00	1.00
Utility	4.68	0.47	Very high	5	4	5.00	1.00
Accuracy	4.68	0.48	Very high	5	4	5.00	1.00
Overall	4.78	0.42	Very high				

The results indicate that the model was evaluated with a consistently high level of overall quality ($\bar{x}$ = 4.78, S.D = 0.42). Specifically, all evaluation aspects received very high ratings ($\bar{x}$ = 4.68-4.85, S.D = 0.28-0.48). Additionally, the interquartile range, which signifies consensus among the experts, remained below 1.50. Furthermore, the median score did not fall within the range of 2.51, affirming the model's strong performance in the assessment.

4.3 The implementation of the model

The model was implemented with 30 primary school teachers in the sub-northeastern Thailand region. After the implementation of the model, the results of the study are shown below.

Table 4: Evaluation of twenty-first century competencies after implementation of the model

twenty-first century competencies	$\bar{X}$	SD	Level
1) Competencies in active learning management	4.66	0.49	Very high
2) ICT competencies	4.60	0.70	Very high
3) Authentic evaluation and assessment	4.61	0.49	Very high
4) Research competencies	4.38	0.52	High
Overall	4.56	0.57	Very high

The assessment reveals that teachers' competency levels in the twenty-first century, as self-evaluated after undergoing development, are exceptionally high overall ($\bar{x}$ = 4.56, S.D = 0.57). When examining specific competencies, three of them are notably at a very high level, as indicated by the following means: active learning management ($\bar{x}$ = 4.66, S.D = 0.49), ICT competencies ($\bar{x}$ = 4.60, S.D = 0.70), and authentic evaluation and assessment ($\bar{x}$ = 4.61, S.D = 0.49). In contrast, research competencies were observed at a high level ($\bar{x}$ = 4.38, S.D = 0.52). The results affirm the positive impact of the development initiatives on teachers' abilities to effectively adapt to the demands of twenty-first-century education.

Table 5: Participants' satisfaction with the model

Aspect	$\bar{x}$	SD	Level
Benefits	4.72	0.48	Very high
Feasibility for implementation	4.69	0.47	Very high
Process of model development	4.69	0.46	Very high
Efficiency of the model	4.71	0.46	Very high
Overall	**4.70**	**0.47**	**Very high**

The results indicate that participants expressed an exceptionally high level of overall satisfaction with the model ($\bar{x}$ = 4.70, S.D = 0.47). They reported being highly satisfied with various aspects of the model, including its benefits ($\bar{x}$ = 4.72, S.D = 0.48), feasibility for implementation ($\bar{x}$ = 4.69, S.D = 0.47), the process of model development ($\bar{x}$ = 4.69, S.D = 0.46), and its efficiency ($\bar{x}$ = 4.71, S.D = 0.46). These findings suggest that participants had a highly positive and gratifying experience with the model, perceiving it as a beneficial, feasible and effective approach that was developed through a well-structured process to enhance their twenty-first-century competencies.

5. Discussion

5.1 Twenty-first century competencies for teachers

The findings of this study align with previous research (Gümüş, 2022; Kim et al., 2019; Schleicher, 2012; Selvi, 2010; Simonović, 2021; Zamora & Zamora, 2022) that highlighted certain competencies as essential for twenty-first-century teachers. Specifically, pedagogical skills, ICT competencies, interpersonal relationship abilities and collaboration skills emerged as key competencies in both our study and previous research. Pedagogical skills are crucial because they empower teachers to employ effective teaching strategies, adapt to diverse learning needs, and foster student engagement and understanding. ICT competencies are essential in our technology-driven era, enabling educators to integrate digital tools for enriched learning experiences (Avdeeva et al., 2016). According to Febrianita and Hardjati (2019), interpersonal relationship skills emphasise the importance of creating a supportive and inclusive classroom environment, where teachers can connect with their students on a personal level, promoting trust and motivation. Collaboration skills as used in professional learning community, on the other hand, prepare teachers to work effectively with colleagues and encourage collaborative learning among students (Musanti & Pence, 2010). Additionally, our study identified competencies in conducting research to develop students as an important twenty-first-century skill. This competency is beneficial because it equips teachers with the ability to critically analyse educational practices, implement evidence-based teaching strategies and continually improve the learning outcomes of their students. Engaging in classroom research not only benefits teachers but also enhances the twenty-first-century skills of students. It fosters critical thinking, problem-solving and data-driven decision-making, which are all vital components of twenty-first-century learning .

5.2 The benefits of the model in developing teachers' twenty-first century competencies

The results reveal that the participants perceived significant improvements in their competencies after engaging in the model. This positive transformation can be attributed to the well-structured activities embedded within the model, which include training, workshops, classroom implementation and research development. Training sessions, in the form of lectures, provide teachers with the necessary theoretical foundation and knowledge to understand the core concepts of twenty-first-century competencies. These sessions lay the groundwork for subsequent activities by equipping educators with the essential information and insights they need. Workshops, characterised by collaborative learning and the development of learning management plans, promote hands-on, interactive experiences (Musanti & Pence, 2010). By working together, teachers can exchange ideas, strategies and best practices related to twenty-first-century teaching methods. This collaborative approach fosters creativity, adaptability and problem-solving skills – all vital components of twenty-first-century competencies. The classroom implementation phase allows teachers to apply what they have learned in real educational settings. This practical experience is crucial for honing their pedagogical skills, ICT competencies and interpersonal relationships. It bridges the gap between theory and practice, enabling educators to adapt their teaching methods to meet the evolving needs of their students effectively. Research development activities encourage teachers to engage in classroom research to improve student learning outcomes continually. According to Ivanenko et al. (2015), conducting research cultivates teachers' competencies and empowers them to make evidence-based decisions in their teaching practices. It also instils a sense of curiosity and lifelong learning, which are integral to twenty-first-century competencies. The combination of training, workshops, classroom implementation and research development in the model contributes to the holistic development of twenty-first-century competencies among teachers. These activities provide a comprehensive and effective approach that bridges the gap between theory and practice, empowering educators to thrive in the ever-evolving landscape of twenty-first-century education.

5.3 Participants' satisfaction with the model

Lastly, the participants' satisfaction with the model as shown by the research results can be attributed to the enriching learning experiences they encountered throughout the programme. These experiences played a pivotal role in their overall contentment and positive perception of the model. The model emphasised an interactive and participatory approach to learning. Through collaborative workshops, hands-on classroom implementation and engaging research projects, participants actively applied their newly acquired knowledge and competencies. This hands-on involvement not only deepened their understanding but also empowered them to feel more confident in their teaching abilities. Moreover, the model fostered a sense of professional community and support among the participants. By encouraging teachers to work together, share insights and learn from one another, the model created a supportive network of educators. This sense of camaraderie and shared learning experiences contributed to a more satisfying and fulfilling professional journey. The participants also appreciated the model's emphasis on real-world applicability. The practical skills and

strategies they acquired were directly applicable to their daily teaching practices, making the learning experience immediately relevant and valuable (Lieberman & Miller, 1990). This connection between theory and practice enhanced their job satisfaction and self-efficacy as educators. Furthermore, the model's focus on research and evidence-based teaching allowed participants to see tangible improvements in their students' learning outcomes. Witnessing the positive impact of their efforts further reinforced their belief in the model's effectiveness and boosted their satisfaction. Therefore, the participants' satisfaction with the model can be attributed to the interactive and participatory learning experiences, the sense of professional community, the emphasis on real-world applicability, and the evidence of improved student outcomes. These elements combined to create a highly rewarding and fulfilling educational journey for the participants.

6. Conclusion

In conclusion, the study's key findings highlight the essential twenty-first-century competencies for teachers in the sub-northeastern region of Thailand. These competencies include active learning management, ICT competencies, authentic evaluation and assessment, research competencies, interpersonal competencies and professional learning community competencies. The study demonstrates that a model combining lecture-based training, collaborative workshops, real-world classroom implementation and research development effectively enhances these competencies. A significant contribution of this study is its recognition of the importance of research skills for twenty-first-century teachers. By integrating research competencies into the model, the study underscores their significance in teacher development. Furthermore, the model proposed in this study has the potential for broader applicability in settings facing similar educational challenges. It serves as a valuable resource for addressing the need to develop teachers' skills and knowledge in various contexts, extending the impact of twenty-first-century competencies in education. In essence, this study not only identifies crucial competencies but also translates them into actionable steps, making it a meaningful contribution to the field of teacher development and twenty-first-century education.

Based on the study's results, we suggest implementing a comprehensive strategy to enhance the capabilities of teachers in the sub-northeastern region of Thailand with skills relevant to the twenty-first century. Educational institutions should provide continual professional development programmes, which should include collaborative workshops, training on technology integration and teaching methodologies based on research. It is necessary to alter academic courses in order to explicitly include these competencies and prioritise practical experiences. Policymakers ought to allocate resources towards the provision of teacher training, advocate for the implementation of research-based practices, and improve the availability of technology in educational institutions. Furthermore, it is important to take into account the provision of rewards and benefits to promote continuous professional development and research endeavours, thereby fostering the advancement of instructors in these crucial skills. By applying these suggestions, we can enhance the capabilities of educators to effectively address the changing requirements of contemporary education.

Even though this study has reached its conclusion, it is crucial to acknowledge the inherent limitations that accompany it. Firstly, the research primarily relied on qualitative methods to explore the development of twenty-first-century competencies among teachers in the sub-northeastern region of Thailand. While qualitative approaches offer valuable insights, they may not fully capture the breadth and depth of these competencies. To address this, future research could consider incorporating more balanced approaches, such as systematic assessments using standardised tests or in-depth case studies, to provide a more comprehensive understanding. Furthermore, this study heavily relied on the participants' self-perceptions and reflections regarding the benefits of the model. While self-reporting is informative, it can introduce subjectivity and potential bias into the findings. The inclusion of objective and systematic assessment methods could have added rigour and objectivity to the study's outcomes. Additionally, the research was confined to a specific regional context, which may limit the generalizability of the findings to a broader educational landscape. Future studies should strive to include a more diverse and representative sample, enhancing the external validity of the research outcomes.

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7. References

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