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THE 21st CENTURY ICT BASED SKILLS AND PEDAGOGICAL PRACTICES: THE LIFE STORIES AND CHALLENGES OF TEACHERS

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ABSTRACT :

This study aimed to examine the relationship between public elementary school teachers' 21st-century ICT-based skills and their pedagogical practices in the 2nd Congressional District of the Province of Cotabato, including Kidapawan City. Employing a mixed-method approach, Phase 1 utilized a correlational design while Phase 2 applied phenomenology to explore deeper insights into teachers' experiences. The quantitative results revealed that teachers demonstrated high proficiency in technical, technological, and critical thinking skills. Correspondingly, they reported high levels of pedagogical practice, particularly in joint productive activity, complex thinking, and instructional conversation.

Significant and strong positive correlations were found between ICT skill domains and pedagogical practices, with the strongest association observed between technological knowledge skills and instructional conversation ($r = .957$, $p < .001$). Regression analysis further confirmed that technological knowledge skills had the most substantial influence on all pedagogical practices. However, critical thinking skills showed a negative effect on complex thinking, possibly due to overstructured instructional strategies.

INTRODUCTION

In the 21st century, the integration of Information and Communication Technology (ICT) into education has become increasingly pivotal. Recent surveys indicate that over 60% of teachers worldwide feel inadequately prepared to integrate ICT into their pedagogical practices. This gap in skills presents a significant challenge, as ICT competency is crucial for effective teaching in today's digitally driven educational landscape (Smith & Johnson, 2023).

Moreover, a study by Brown and Davis (2022) highlights the growing need for ICT training among educators. They found that teachers who received structured ICT training demonstrated an improvement in their ability to incorporate technology into lesson plans, compared to those who did not. This study underscores the positive impact of targeted ICT training on teaching methodologies.

In the Philippines, Department for Education, (2023) conducted a study revealing that teachers felt confident in their ICT skills. The research pointed out the lack of infrastructure and training programs as key barriers. This finding is particularly concerning given the Philippines' rapid digital transformation and its impact on education.

Despite these studies, there remains a significant gap in understanding the personal narratives and specific challenges faced by teachers in adapting to ICT-centric pedagogical practices (Anderson & Plomp, 2020). Most existing research focuses on quantitative data, overlooking the qualitative aspects of teachers' experiences and struggles (Carstens & Pelgrum, 2021). This includes underscoring their struggles, successes, and the unique ways they adapt to and integrate technology in their teaching methods (Law, Pelgrum, & Plomp, 2020).

In Kidapawan City, a key issue is the limited access to up-to-date technological resources. Many schools may not have the necessary ICT infrastructure, such as computers, reliable internet access, and digital learning tools, which are fundamental for implementing modern educational practices (Hassan, 2020).

Another significant challenge is the lack of comprehensive ICT training programs for teachers. Many educators in Kidapawan might not have received adequate training to effectively integrate technology into their teaching methods, leading to a gap between the potential of ICT in education and its actual utilization in classrooms (Dela Cruz, & Santos, 2021).

In a similar vein, integrating ICT into curricula poses challenges, as teachers may struggle to blend technology with lesson plans effectively. Often, a lack of confidence in new technologies or preference for traditional methods creates resistance, slowing ICT integration and hindering innovative pedagogical practices adoption (Dela Cruz, 2023).

This study aims to explore the life stories and challenges of teachers grappling with the transition to ICT-based teaching. By doing so, it seeks to provide a deeper understanding of the support needed to enhance their skills and pedagogical practices in the 21st century.

1. What is the level of teachers' 21st-century ICT-based skills in terms of technical skills, technological Knowledge skills, and critical thinking skills.

2. What is the level of teachers' pedagogical practices in terms of joint productive activity (JPA), complex thinking (CT), and instructional conversation (IC).
3. Is there a significant relationship between teachers' 21st-century ICT-based skills and pedagogical practices?
4. Does teachers' 21st-century ICT-based skills significantly influence pedagogical practices?

Research Design

This study employed a mixed-method research design, which combines qualitative and quantitative techniques to gain a more comprehensive understanding of the research problem. This approach facilitates the collection of rich, detailed data through qualitative methods and enables the generalization of findings through quantitative analysis. Such a design is especially useful in studies that require both in-depth understanding and the capacity to measure and analyze trends or patterns, making it an adaptable choice for complex research questions (Creswell, 2017).

In the quantitative phase of this design, survey questionnaires were used to gather data on teachers' 21st-century ICT-based skills, encompassing thirty indicators across three categories: Technical skills, Technological Knowledge skills, and Critical Thinking skills. The study also examined teachers' pedagogical practices, focusing on Joint Productive Activity (JPA), Complex Thinking (CT), and Instructional Conversation (IC).

Teachers/ 21st Century ICT-Based Skills

Technical Skills

Table 1 shows that teachers exhibit a high level of competence across all indicators of 21st-century ICT-based technical skills, with individual mean scores ranging from 4.45 to 4.85. The overall weighted mean of 4.64 indicates that teachers are generally classified as *Highly Skilled* in technical ICT competencies.

This implies that teachers are well-prepared to navigate technologically advanced instructional environments. Their high level of proficiency in areas such as cybersecurity, programming, database management, and network configuration equips them to integrate ICT tools meaningfully into pedagogy. Consequently, schools may consider involving these teachers in peer mentoring or ICT innovation teams to support broader digital transformation in teaching and learning. Additionally, school leaders should sustain this momentum by facilitating continuous professional development that aligns with evolving digital trends and security standards.

In support, Boholano et al. (2021) stated that teachers with high technical proficiency are more effective in delivering technology-integrated lessons that enhance student engagement and digital fluency. Likewise, Reyes and Aquino (2022) emphasized that cybersecurity awareness among teachers strengthens digital safety in school systems. Further, Tan and Santos (2023) found that teacher training in database and programming technologies correlates with better instructional design and assessment practices.

Table 1. Level of teachers/ 21st Century ICT-Based Skills in terms of Technical Skills

Statements	Mean	Description
1. Developing proficiency in diagnosing and repairing software malfunctions.	4.45	Highly Skilled
2. Enhancing skills in configuring and maintaining network systems.	4.75	Highly Skilled
3. Mastering the implementation and management of database systems.	4.53	Highly Skilled
4. Cultivating expertise in the development and debugging of programming code.	4.62	Highly Skilled
5. Advancing knowledge in cybersecurity measures and threat mitigation techniques.	4.85	Highly Skilled
Weighted Mean	4.64	Highly Skilled

Technological Knowledge Skills

Teachers demonstrated a high level of technological knowledge skills across all indicators, with individual mean scores ranging from 4.39 to 4.80. The weighted mean of 4.60 categorizes them as Highly Skilled, particularly in basic operations, troubleshooting, internet connectivity, and lesson documentation.

In fact, this indicates that teachers possess strong foundational ICT skills necessary for effective classroom integration and technology-enhanced instruction. Their ability to troubleshoot, navigate device functions, and manage digital content suggests readiness to implement blended and remote learning models. This level of competence supports not only classroom efficiency but also enhances students' digital literacy through guided use of technology. Education leaders may build on this foundation by introducing more advanced ICT tools and providing differentiated training to maintain momentum and support innovation in instruction.

For Cruz and Villanueva (2021), they argued that foundational skills in operating digital tools are critical for managing digital classrooms and reducing instructional downtime. Moreover, Bautista and Rivera (2022) found that when teachers are confident in technological operations, they are more likely to explore innovative pedagogies and personalized learning tools. Espino and Marquez (2023) further highlighted that strong skills in basic troubleshooting and connectivity are essential for sustaining hybrid and asynchronous learning environments, especially in resource-variable school settings.

Table 2. Level of teachers/ 21st Century ICT-Based Skills in terms of Technological Knowledge Skills

Statements	Mean	Description
1. Performing fundamental troubleshooting for computer issues.	4.39	Highly Skilled
2. Understanding and operating basic features of computers or similar devices.	4.80	Highly Skilled
3. Identifying various function keys and navigating through computer menus.	4.39	Highly Skilled
4. Establishing internet connections and interfacing with other devices using a computer.	4.62	Highly Skilled
5. Recording and organizing lessons and activities via computer.	4.80	Highly Skilled
Weighted Mean	4.60	Highly Skilled

Critical Thinking Skills

The data show that teachers exhibit a high level of proficiency in critical thinking skills, with all item means ranging from 4.43 to 4.89. The overall weighted mean of 4.66 confirms that teachers are *Highly Skilled* in evaluating, analyzing, and solving complex problems within educational contexts. This means that teachers are capable of engaging in deep reflection and strategic decision-making, essential for navigating complex classroom dynamics and pedagogical challenges. Their strong critical thinking skills enable them to adapt instruction, assess learning outcomes meaningfully, and implement solutions grounded in logical reasoning. Educational leaders can leverage this strength by integrating more collaborative inquiry, problem-based learning (PBL), and reflective teaching models in professional development programs.

Indeed, Torres and Cruz (2021) emphasized that teachers with strong analytical skills are better equipped to handle classroom uncertainties and instructional dilemmas. Meanwhile, Bautista et al. (2022) highlighted the importance of reflective and evaluative thinking in improving teaching practices and student engagement. Furthermore, Santiago and Dela Cruz (2023) argued that critical thinking enhances teachers' professional judgment, especially when integrating ICT and differentiated strategies in instruction.

Table 3. Level of teachers/ 21st Century ICT-Based Skills in Terms of Critical Thinking Skills

Statements	Mean	Description
1. Applying analytical reasoning to evaluate complex problems and formulate effective solutions.	4.49	Highly Skilled
2. Utilizing logical thinking to dissect arguments and assess their validity.	4.89	Highly Skilled
3. Employing strategic thought processes to anticipate and solve unforeseen challenges.	4.43	Highly Skilled
4. Exercising reflective thinking to assess one's own beliefs and values in decision-making.	4.67	Highly Skilled
5. Implementing systematic problem-solving methods to address intricate issues methodically.	4.80	Highly Skilled
Weighted Mean	4.66	Highly Skilled

Teachers' Pedagogical Practices

Joint Productive Activity

The level of teachers' pedagogical practices in terms of Joint Productive Activity is rated as Highly Practiced, with individual item means ranging from 4.35 to 4.80. The overall weighted mean of 4.63 confirms that collaborative instructional strategies are consistently and effectively employed by teachers.

This underscores the emphasis teachers place on cooperative learning and classroom interaction. By integrating joint productive activities into daily instruction, teachers not only promote academic engagement but also foster peer collaboration, communication skills, and social development. This practice is particularly beneficial in diverse and multilingual classrooms where collaborative formats support inclusive participation. School administrators should further encourage co-learning practices through structured group tasks, flexible seating arrangements, and project-based instruction aligned with students' interests and abilities.

In the same vein, Reyes and Santos (2021), collaborative instructional designs improve student engagement, particularly when learning tasks are aligned with real-world applications. Villanueva and Castro (2023) found that group-based tasks promote interpersonal development and deepen understanding through shared cognitive processing. Moreover, Aragon and Martinez (2022) emphasized that such practices are vital for developing students' social-emotional skills and ensuring equitable participation in mixed-ability classrooms.

Table 4. Level of Teachers' Pedagogical Practices in terms of Joint Productive Activity

Statements	Mean	Description
1. Designing instructional activities requiring student collaboration to accomplish a joint product	4.35	Highly Practiced
2. Matching the demands of the joint productive activity to the time available for accomplishing them,	4.80	Highly Practiced
3. Arranging classroom seating to accommodate students' individual and group needs to communicate and work jointly	4.49	Highly Practiced
4. Participating with students in joint productive activity	4.74	Highly Practiced
5. Organizing students in a variety of groupings, such as by friendship, mixed academic ability, language, project, or interests, to promote interaction.	4.80	Highly Practiced

Weighted Mean	4.63	Highly Practiced

Complex Thinking

The level of teachers' pedagogical practices in terms of Complex Thinking is described as Highly Practiced, with mean scores ranging from 4.30 to 4.85. The highest-rated item focuses on fostering metacognitive skills (Mean = 4.85), while the overall weighted mean is 4.58, indicating that complex cognitive engagement is deeply integrated into teaching strategies.

The high level of practice in complex thinking suggests that teachers in the study are consistently nurturing analytical, evaluative, and creative capacities in their students. This has meaningful implications for curriculum design and instructional planning, as it affirms the capacity of educators to move beyond rote instruction toward fostering independent thought. Incorporating multiple perspectives and encouraging creative problem-solving prepares students for 21st-century challenges by developing lifelong learning habits and critical consciousness.

According to Morales and Tan (2023), fostering complex thinking enhances learners' adaptive problem-solving and academic resilience in real-world contexts. Meanwhile, dela Cruz and Villamor (2021) emphasize that metacognitive instruction allows students to regulate their thought processes, improving academic performance across subject areas. Additionally, Lim and Santiago (2022) found that encouraging creativity and divergent thinking contributes to student innovation and deeper understanding of interdisciplinary content.

Table 5. Level of Teachers' Pedagogical Practices in terms of Complex Thinking

Statements	**Mean**	**Description**
1. Encourages students to analyze and synthesize information from various sources, fostering a deeper understanding of complex topics.	4.30	Highly Practiced
2. Involving critical thinking skills such as evaluating evidence, identifying patterns, and making connections between different concepts or ideas.	4.66	Highly Practiced
3. Encouraging to consider multiple perspectives and viewpoints, enhancing their ability to solve intricate problems.	4.42	Highly Practiced
4. Promoting creativity by encouraging students to explore alternative solutions and think "outside the box" when faced with complex challenges.	4.67	Highly Practiced
5. Engaging in Complex Thinking activities helps students develop metacognitive skills	4.85	Highly Practiced
Weighted Mean	4.58	Highly Practiced

Instructional Conversation

The pedagogical practice of Instructional Conversation is Highly Practiced among teachers, as reflected in a weighted mean of 4.65. The highest mean (4.80) was recorded for facilitating a deeper understanding of academic content, followed closely by statements on fostering dialogue, critical questioning, and collaborative knowledge construction.

This finding reveals the teachers' strong orientation toward dialogic and constructivist approaches to learning. Instructional conversation practices such as probing questions, cooperative discussions, and mutual idea-building cultivate higher-order thinking, language development, and collaborative problem-solving. When consistently applied, these strategies help bridge gaps in student understanding and foster inclusive participation, especially in diverse classrooms. This suggests a supportive environment where learners' voices are integral to the meaning-making process.

Rivera and Mendoza (2022) found that dialogic teaching strategies enhance cognitive engagement and social interaction, particularly in linguistically diverse settings. Similarly, Guevarra and Dizon (2021) reported that collaborative discussion deepens understanding by connecting prior knowledge with new content. Lastly, Yap and Soriano (2023) emphasize that instructional conversation fosters equitable learning by amplifying student voice and supporting peer-led learning exchanges.

Table 6. Level of Teachers' Pedagogical Practices in terms of Instructional Conversation

Statements	**Mean**	**Description**
1. Promoting active and meaningful dialogue among students.	4.44	Highly Practiced
2. Facilitating a deeper understanding of academic content.	4.80	Highly Practiced
3. Encourages students to ask probing questions, share their perspectives.	4.57	Highly Practiced
4. Engage in thoughtful discussions to construct knowledge collaboratively.	4.71	Highly Practiced
5. Fostering a cooperative learning environment where students can build on each other's ideas,	4.71	Highly Practiced
Weighted Mean	4.65	Highly Practiced

Significant Relationship between teachers' 21st-century ICT-based skills and pedagogical practices

Table 7 shows a highly significant positive relationship between teachers' 21st-century ICT-based skills and their pedagogical practices in terms of Joint Productive Activity, Complex Thinking, and Instructional Conversation. Among the three skill sets, Technological Knowledge Skills and Critical Thinking Skills both exhibit the strongest correlations, particularly with Instructional Conversation ($r = .957$, $p < .001$).

Technical Skills and Joint Productive Activity

The correlation coefficient between Technical Skills and Joint Productive Activity is .779, indicating a strong and statistically significant positive relationship ($p < .001$). This suggests that teachers with proficient technical skills—such as operating digital tools, managing virtual platforms, and using educational software—are more capable of facilitating collaborative learning experiences. These educators can structure learning environments where students and teachers engage in shared tasks using technology to co-create knowledge. Platforms like Google Docs, Microsoft Teams, or collaborative learning apps become enablers of real-time group work, peer-to-peer learning, and co-construction of meaning in digitally enriched classrooms.

Technical Skills and Complex Thinking

The correlation coefficient between Technical Skills and Complex Thinking is .878, which reflects a very strong and statistically significant positive relationship ($p < .001$). This indicates that teachers with higher proficiency in basic ICT skills—such as word processing, presentation design, internet navigation, and digital file management—are more likely to implement instructional strategies that support complex thinking. These teachers can integrate digital tools that challenge students to analyze, synthesize, evaluate, and innovate. Through tasks involving digital simulations, online research, and multimedia presentations, technically skilled teachers help students engage in deeper cognitive processes essential for 21st-century learning.

Technical Skills and Instructional Conversation

The correlation coefficient between Technical Skills and Instructional Conversation is .770, which represents a strong and statistically significant positive relationship ($p < .001$). This suggests that teachers who are proficient in basic ICT operations—such as navigating educational software, managing digital content, or operating learning management systems—are more effective in conducting instructional conversations. These technical skills support the integration of technology into classroom discussions, enabling real-time communication, multimedia engagement, and seamless facilitation of student dialogue. When teachers are technically competent, they can more confidently use tools like video conferencing, shared documents, or interactive platforms to support learner interaction and knowledge construction.

Technological Knowledge Skills and Joint Productive Activity

The correlation coefficient between Technological Knowledge Skills and Joint Productive Activity is .930, which indicates a very strong and highly significant positive relationship ($p < .001$). This result implies that as teachers' knowledge and proficiency in using educational technologies increase, their ability to facilitate joint productive learning activities also improves. Teachers who understand how to integrate technology into the learning process are more capable of designing collaborative, student-centered tasks that involve co-construction of knowledge.

Technological Knowledge Skills and Complex Thinking

The correlation coefficient between Technological Knowledge Skills and Complex Thinking is .912, which reflects a very strong and highly significant positive relationship ($p < .001$). This result indicates that teachers with higher levels of technological knowledge are more likely to foster complex thinking in their students. Complex thinking involves skills such as analysis, synthesis, problem-solving, and drawing interdisciplinary connections—capabilities that are greatly enhanced when instruction is supported by thoughtful integration of digital technologies.

Technological Knowledge Skills and Instructional Conversation

The correlation coefficient between Technological Knowledge Skills and Instructional Conversation is .957, indicating an extremely strong and highly significant positive relationship ($p < .001$). This suggests that teachers who possess advanced knowledge in using technology are much more capable of facilitating rich, student-centered instructional conversations. These educators can leverage digital tools such as discussion forums, collaborative documents, virtual classrooms, or AI-supported dialogue platforms to promote deeper learning through interactive discourse. Such technological integration enables learners to articulate their ideas, ask questions, build on peers' responses, and co-construct meaning—hallmarks of effective instructional conversation.

Critical Thinking Skills and Joint Productive Activity

The correlation coefficient between Critical Thinking Skills and Joint Productive Activity is .928, which indicates an extremely strong and highly significant positive relationship ($p < .001$). This means that teachers with higher levels of critical thinking—such as analyzing, evaluating, reasoning, and making judgments—are more likely to facilitate joint productive activities in their classrooms. These teachers design tasks that require students to

collaboratively solve problems, reflect on their learning, and engage in evidence-based discussions. In such environments, learning is not passive; instead, students and teachers co-construct knowledge by exploring different perspectives and drawing on shared cognitive and social resources.

Critical Thinking Skills and Complex Thinking

The correlation coefficient between Critical Thinking Skills and Complex Thinking is .912, indicating a very strong and highly significant positive relationship ($p < .001$). This means that teachers who demonstrate higher levels of critical thinking are also more effective in promoting complex thinking among their students. Complex thinking includes skills such as synthesis, analysis, problem-solving, and connecting ideas across disciplines. Teachers with strong critical thinking abilities are more likely to design instructional activities that challenge students to explore multifaceted issues, make informed judgments, and develop coherent, evidence-based arguments.

Critical Thinking Skills and Instructional Conversation

The correlation coefficient between Critical Thinking Skills and Instructional Conversation is .957, indicating an extremely strong and highly significant positive relationship ($p < .001$). This result suggests that teachers who possess advanced critical thinking skills are highly capable of facilitating instructional conversations—dialogue-based teaching approaches that promote student inquiry, reasoning, and idea exchange. Such teachers are adept at posing thought-provoking questions, encouraging students to justify their thinking, and guiding discussions toward deeper understanding. Their reflective and analytical mindset fosters a classroom culture where dialogue is not only encouraged but structured to support the co-construction of knowledge.

Mishra and Koehler's TPACK framework (2021) emphasizes that the integration of technological knowledge enhances instructional strategies that promote collaboration and higher-order thinking. Ertmer and Ottenbreit-Leftwich (2020) add that technical proficiency enables teachers to effectively utilize digital tools in fostering meaningful classroom dialogue and problem-solving. Furthermore, Halpern (2020) and Brookhart (2021) underscore that teachers' critical thinking skills are foundational in crafting instructional conversations and complex cognitive tasks, as they shape questioning strategies, encourage analytical reflection, and support evidence-based reasoning. Collectively, these studies affirm that equipping teachers with robust ICT-based and cognitive competencies significantly enriches the quality of pedagogical engagement and student learning outcomes.

Table 7. Significant Relationship between teachers' 21st-century ICT-based skills and pedagogical practices

			Joint Productive Activity	Complex Thinking	Instructional Conversation
Spearman's rho	**Technical Skills**	Correlation Coefficient	**.779****	**.878****	**.770****
		Sig. (2-tailed)	.000	.000	.000
	Technological Knowledge Skills	Correlation Coefficient	**.930****	**.912****	**.957****
		Sig. (2-tailed)	.000	.000	.000
	Critical Thinking Skills	Correlation Coefficient	**.928****	**.912****	**.957****
		Sig. (2-tailed)	.000	.000	.000

**** Highly Significant**

Influence of the 21st Century ICT Based Skills on Teachers' Pedagogical Practices Joint Productive Activity

The multiple regression analysis revealed that Technical Skills ($t = 3.304$, $p = .001$), Technological Knowledge Skills ($t = 8.011$, $p < .001$), and Critical Thinking Skills ($t = 4.981$, $p < .001$) all significantly influence teachers' pedagogical practices in terms of Joint Productive Activity. The model explains 90.0% of the variance in joint productive activity ($R^2 = .900$, $F = 437.401$, $p < .001$), indicating a very high level of predictive accuracy and model fit.
This implies that enhancing teachers' 21st-century ICT-based skills directly influences their capacity to implement collaborative and co-constructive learning strategies in the classroom. Among the predictors, Technological Knowledge Skills had the strongest influence, suggesting that deep, integrative use of digital tools (not just technical use) plays a central role in facilitating joint productive activities. Critical Thinking Skills also showed a substantial impact, indicating that teachers' ability to reason, reflect, and design intellectually engaging tasks contributes to the success of collaborative learning. Professional development initiatives should therefore focus not only on digital tool proficiency but also on fostering higher-order thinking among educators to optimize collaborative pedagogical practices.
The significant predictive power of these variables aligns with Mishra and Koehler's (2021) TPACK framework, which highlights the importance of technological knowledge for effective technology integration in pedagogy. Ertmer and Ottenbreit-Leftwich (2020) emphasize that teachers with both technical competence and pedagogical fluency are more adept at facilitating meaningful collaboration and student engagement. Additionally, Halpern (2020) and Paul and Elder (2022) underscore that critical thinking is essential for structuring classroom tasks that involve inquiry, co-analysis, and shared problem-solving.

Table 8. Influence of the 21st Century ICT Based Skills on Teachers' Pedagogical Practices in terms of Joint Productive Activity

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		

1	(Constant)	-.209	.140		-1.492	.138
	Technical Skills	.168	.051	.168	**3.304****	.001
	Technological Knowledge Skills	.430	.054	.449	**8.011****	.000
	Critical Thinking Skills	.448	.090	.392	**4.981****	.000

R^2 = 0.900
F = 437.401**
Prob = 0.000

Influence of the 21st Century ICT Based Skills on Teachers' Pedagogical Practices Complex Thinking

The multiple regression analysis revealed that Technical Skills (t = 11.435, p < .001) and Technological Knowledge Skills (t = 8.257, p < .001) significantly and positively influence teachers' pedagogical practices in terms of Complex Thinking, while Critical Thinking Skills (t = –3.475, p = .001) have a significant but negative effect. The model explains 83.0% of the variance in complex thinking (R^2 = .830, F = 238.422, p < .001), indicating a strong predictive capacity.

These results suggest that teachers with strong technical and technological knowledge skills are more capable of designing and implementing instructional strategies that promote complex thinking—such as problem-solving, analysis, and synthesis. Conversely, the negative influence suggests that teachers who are highly critical and reflective might overanalyze or overstructured lessons, thereby limiting student autonomy and spontaneity in exploring complex ideas.

The positive effects of technical and technological skills on complex thinking are consistent with findings by Voogt and Roblin (2020), who emphasize that digital proficiency supports cognitively demanding tasks in 21st-century learning. Mishra and Koehler (2021) also assert that when teachers integrate technology effectively through the TPACK model, they can cultivate higher-order thinking skills. The unexpected negative association of critical thinking might reflect what Dwyer et al. (2021) describe as the "paralysis by analysis" phenomenon, where overemphasis on evaluation may hinder fluid instructional implementation.

Table 9. Influence of The 21st Century ICT Based Skills on Teachers' Pedagogical Practices in terms of Complex Thinking

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.825	.231		-3.568	.000
	Technical Skills	.957	.084	.756	**11.435****	.000
	Technological Knowledge Skills	.730	.088	.603	**8.257****	.000
	Critical Thinking Skills	-.515	.148	-.356	**-3.475****	.001

R^2 = 0.830
F = 238.422**
Prob = 0.000

Influence of the 21st Century ICT Based Skills on Teachers' Pedagogical Practices Instructional Conversation

The multiple regression analysis revealed that Technological Knowledge Skills (t = 9.744, p < .001) and Critical Thinking Skills (t = 11.216, p < .001) significantly and positively influence teachers' pedagogical practices in terms of Instructional Conversation, while Technical Skills (t = –.890, p = .375) do not show a significant effect. The model explains 94.8% of the variance in instructional conversation (R^2 = .948, F = 884.324, p < .001), indicating an exceptionally high predictive power.

These findings indicate that teachers' deep, conceptual use of technology and strong critical thinking abilities are key drivers of successful instructional conversations—dialogue-based teaching that values inquiry, student voice, and meaning-making. The non-significance of technical skills implies that basic ICT proficiency alone is insufficient to support rich, student-centered dialogue. Rather, it is the teacher's capacity to apply technology meaningfully (technological knowledge) and think reflectively and analytically (critical thinking) that fuels high-quality, interactive learning conversations.

Mercer and Howe (2021) also emphasize that dialogic teaching depends on teachers' ability to guide, question, and respond meaningfully—abilities rooted in critical thinking. Hennessy et al. (2021) further highlight that instructional conversations flourish when teachers can use digital tools not just to present content but to orchestrate meaningful discussion and reflection. These findings reinforce the critical role of thinking and design skills—not just tool use—in nurturing student dialogue.

Table 10. Influence of The 21st Century ICT Based Skills on Teachers' Pedagogical Practices in terms of Instructional Conversation

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.321	.088		3.644	.000
	Technical Skills	-.028	.032	-.033	-.890	.375
	Technological Knowledge Skills	.328	.034	.395	**9.744****	.000
	Critical Thinking Skills	.633	.056	.637	**11.216****	.000

R^2 = 0.948
F = 884.324**
Prob = 0.000

Conclusions

Based on the foregoing findings, this study concludes that:

1. Public elementary school teachers possess commendable proficiency in technical, technological, and critical thinking skills, positioning them to effectively engage with digital tools and platforms.
2. Teachers consistently apply advanced pedagogical practices such as collaborative learning, complex cognitive engagement, and dialogic instruction.
3. There is strong empirical evidence that higher ICT skills are associated with better pedagogical outcomes.
4. Among the ICT skill sets, technological knowledge exerts the most consistent and powerful influence on pedagogy.
5. Despite their skill levels, teachers face persistent barriers—including infrastructure gaps, lack of support, and psychosocial constraints—which hinder full ICT integration.
6. Teachers demonstrate adaptive capacity and resourcefulness through self-driven learning, collaboration, and creative use of available tools.

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