ATTARBAWIY: Malaysian Online Journal of Education
(e-ISSN: 2600-7622)

ENCHANCING STUDENTS' 21ST CENTURY THINKING SKILLS THROUGH TEACHERS' KNOWLEDGE AND INSTRUCTIONAL PRACTICES: A COLLECTIVE CASE STUDY

Pemerkasaan Kemahiran Berfikir Abad Ke-21 Murid Melalui Pengetahuan Guru dan Amalan Pengajaran: Satu Kajian Kes Kolektif

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Submited:	Accepted:	Revised:	Published:
15-Oct-2025	18-Dec-2025	22-Dec-2025	30-Dec-2025

Abstract

This research investigates teachers' conceptual understanding, instructional practices and the challenges they encounter in enacting 21st Century Learning (21CL) competencies within classroom settings. Adopting a qualitative design, data were obtained through semi-structured interviews, classroom observations and analysis of lesson plans, and subsequently cross-checked through triangulation to strengthen trustworthiness. The results show that teachers have a basic grasp of key 21CL competencies including collaboration, communication, critical and creative thinking, as well as the integration of digital tools although the depth and breadth of their understanding differ. Some teachers demonstrate clear links between 21CL and higher-order thinking skills, whereas others equate 21CL primarily with technology use. Classroom implementation shows the use of strategies such as Project-Based Learning (PBL/PjBL), group collaboration, digital platforms and authentic assessment, all of which support the development of students' cognitive and creative capacities. Nevertheless, full implementation is hindered by factors such as limited instructional time, uneven student engagement and restricted access to resources. Additional barriers include insufficient digital infrastructure, limited opportunities for continuous professional training, and wide variations in student ability and the pressure of standardized assessments. This study emphasizes that sustained professional learning, improved technological support and enabling policy structures are crucial for narrowing the gap between teachers' theoretical understanding and consistent application of 21CL practices in classrooms.

Keywords: 21st century learning, teaching practices, higher-order thinking skills, professional development, educational challenges

Abstrak

Kajian ini meneliti kefahaman konseptual guru, amalan pengajaran serta cabaran yang dihadapi dalam melaksanakan kemahiran Pembelajaran Abad ke-21 (PAK21) di bilik darjah. Menggunakan reka bentuk kualitatif, data dikumpulkan melalui temu bual separa berstruktur, pemerhatian PdP dan analisis rancangan pengajaran harian (RPH), seterusnya disahkan melalui kaedah triangulasi bagi memastikan kebolehpercayaan dapatan. Hasil kajian menunjukkan bahawa guru mempunyai asas pemahaman terhadap elemen utama PAK21 seperti kolaborasi, komunikasi, pemikiran kritis dan kreatif serta penggunaan alat digital, walaupun tahap penguasaan mereka berbeza antara satu sama lain. Sebahagian guru dapat menghubungkan PAK21 dengan pengembangan Kemahiran Berfikir Aras Tinggi (KBAT), manakala yang lain melihat PAK21 terutamanya sebagai penggunaan teknologi dalam PdP. Dalam pelaksanaan di bilik darjah, guru

menggunakan pelbagai strategi seperti Pembelajaran Berasaskan Projek / Inkuiri Projek (PBL/PjBL), aktiviti kolaboratif, platform digital dan pentaksiran autentik, yang membantu merangsang perkembangan kognitif dan kreativiti murid. Walau bagaimanapun, pelaksanaan menyeluruh sering terhalang oleh kekangan masa pengajaran, tahap penglibatan murid yang tidak konsisten serta akses yang terhad terhadap sumber. Halangan tambahan termasuk infrastruktur teknologi yang tidak mencukupi, peluang latihan profesional yang berterusan yang terhad, kepelbagaian keupayaan murid dan tekanan berkaitan pentaksiran berstandard. Kajian ini menegaskan bahawa latihan profesional secara berterusan, sokongan teknologi yang mencukupi dan dasar pendidikan yang kondusif amat penting bagi merapatkan jurang antara pengetahuan teori guru dengan pelaksanaan PAK21 secara konsisten dalam pengajaran.
***Kata kunci**: Pembelajaran Abad Ke-21, amalan pengajaran, Kemahiran Berfikir Aras Tinggi, pembangunan professional, cabaran pendidikan*

1.0 INTRODUCTION

The rapid acceleration of digitalisation, automation, and globally networked information systems has profoundly transformed economic and societal expectations, thereby redefining the purpose and function of education. Contemporary education systems are no longer expected to prioritise passive knowledge transmission; rather, they are increasingly required to cultivate learners equipped with holistic 21st-century competencies. Central to these competencies are the "4Cs", critical thinking, creativity, collaboration, and communication supplemented by digital literacy and socio-emotional competence (OECD, 2022). Collectively, these multidimensional skill sets extend beyond academic attainment, constituting essential dispositions for navigating volatile technological landscapes and increasingly complex occupational and social environments. In knowledge economies characterised by rapid technological change, individuals must demonstrate innovative problem-solving capabilities, adaptability, and a sustained capacity for lifelong learning.

At the global level, educational policy frameworks have progressively institutionalised these priorities. The OECD's Future of Education and Skills 2030/2040 initiative underscores student agency, holistic well-being, and the development of cross-disciplinary competencies as fundamental educational outcomes (OECD, 2024a). In parallel, the Programme for International Student Assessment (PISA) introduced creative thinking as a formal assessment domain in its 2022 cycle, systematically evaluating students' abilities to generate, refine, and evaluate ideas across diverse modalities (OECD, 2024b). This development reflects a paradigmatic shift away from traditional content recall toward the cultivation of adaptable, innovative, and solution-oriented learners capable of addressing authentic, real-world challenges.

The realisation of such outcomes necessitates coherent alignment among curriculum frameworks, pedagogical approaches, and assessment practices. Within the Malaysian context, this alignment requires operational coherence between macro-level policy directives and micro-level instructional enactment to ensure that students meaningfully develop the 4Cs alongside digital and socio-emotional literacies (Ministry of Education Malaysia, 2023). Systematic and sustained implementation of these competencies is expected to enhance students' preparedness to participate confidently and competitively in global contexts.

Over the past decade, international educational discourse has increasingly shifted from content-centred instruction toward competence-based learning. The inclusion of creative thinking within PISA signals a global consensus that academic

rigour must extend beyond content mastery to encompass students' capacities to conceptualise, justify, and iteratively refine ideas across disciplinary boundaries (OECD, 2024). Accordingly, OECD reports advocate for the explicit integration of creativity within curriculum structures through clearly articulated learning progressions, comprehensive instructional guidance, and aligned assessment criteria.

Malaysia's national education reform agenda, articulated in the Malaysia Education Blueprint (MEB) 2013–2025, positions 21st-Century Learning (21CL) and Higher-Order Thinking Skills (HOTs) as central drivers of educational quality enhancement. Recent Ministry of Education reports (2022; 2023) further reinforce this emphasis by prioritising teacher professional development, alignment between the KSSR and KSSM curricula, and strengthening school-based assessment systems to support instructional practices centred on the 4Cs. Despite these policy commitments, empirical evidence indicates persistent variability in implementation across schools, particularly regarding the frequency and quality of project-based learning, depth of technology integration, and use of authentic assessment practices. Such inconsistencies underscore the need for closer examination of how teachers' knowledge, beliefs, and pedagogical decision-making influence classroom enactment.

Socio-emotional competence has also gained recognition as a foundational condition for deep and sustained learning. UNESCO MGIEP (2022) proposes the 4P model (plan, prepare, practice, and proof) as a structured framework for embedding Social and Emotional Learning (SEL) within school systems. When effectively integrated into project-based and collaborative learning environments, SEL enhances psychological safety, facilitates constructive peer interaction, and creates conditions conducive to creative engagement, aligning with PISA's recognition of creativity as a core global competency.

Notwithstanding clear policy direction, recent studies suggest continuing variation in Malaysian teachers' readiness and conceptual understanding of 21CL. Constraints related to time, administrative workload, and unequal access to technological infrastructure remain significant barriers. To design and enact rigorous project-based learning experiences, teachers must strengthen their capacity to integrate technological competencies with pedagogical strategies and content knowledge. Such capacities can be developed through sustained professional learning opportunities and structured collegial collaboration. In light of these challenges, a collective multi-case study is warranted to examine how teachers enact 21CL, Technological Pedagogical Content Knowledge (TPACK), and SEL across diverse school contexts, as well as to identify contextual factors that facilitate or constrain effective implementation (Amirul, et. al, 2025).

Grounded in contemporary scholarly discourse, this study is informed by four interrelated theoretical frameworks that collectively elucidate the development of 21st-century competencies within instructional contexts. The OECD Global Competence and 21st-Century Skills Framework (2030/2040) provides the primary conceptual foundation, outlining the knowledge, skills, attitudes, and values required for learners to thrive, with particular emphasis on student agency and holistic well-being. Complementing this framework, the TPACK model explicates how the strategic integration of disciplinary knowledge, pedagogical approaches, and digital technologies enhances instructional effectiveness.

Project-Based and Problem-Based Learning (PBL/PjBL) function as instructional approaches centred on authentic tasks, collaboration, and inquiry, thereby facilitating the development of digital literacy and the 4Cs; critical thinking, communication, collaboration, and creativity. Finally, Social and Emotional Learning (SEL), operationalised through UNESCO MGIEP's 4P model, emphasises the creation of

inclusive and supportive learning environments that foster personal development and creative self-expression. Together, these frameworks position teachers as central agents in translating policy aspirations into classroom practice, enabling the simultaneous development of the 4Cs, digital literacy, and socio-emotional competence.

Despite sustained policy emphasis, a coherent, shared pedagogical understanding of 21CL remains limited. Empirical studies indicate that while teachers demonstrate baseline awareness, there is considerable variation in conceptual understanding and instructional enactment, particularly regarding integration of the 4Cs, project-based learning, and technology (Mailis & Mansor, 2024; Mazlan, Mahamod & Jamaludin, 2025). Without robust conceptual clarity, instructional practices risk remaining superficial, emphasising task completion over deep learning. Teachers' conceptual and practical understanding is therefore pivotal, as they translate policy aspirations into concrete classroom experiences. Teachers' practices vary considerably depending on school context and the level of professional development support they receive (Ministry of Education Malaysia, 2023). The integration of technology and the design of authentic learning tasks in lessons are still suboptimal in certain classrooms, while teachers' efficacy in applying the Technological Pedagogical Content Knowledge (TPACK) model differs according to their experience, training and access to resources (Ali, 2024; Mahmud, et. al, 2025).

Project-Based Learning (PBL) and Project-Based Inquiry Learning (PjBL) have been widely recognized as effective strategies for developing the 4Cs, yet the success of these approaches is highly dependent on the quality of project design and authentic assessment. Without adequate support, implementation outcomes often remain inconsistent (Safri & Jamaludin. 2023; Zhang, 2023). Moreover, the need to embed Social and Emotional Learning (SEL) alongside the 4Cs remains urgent in order to foster creativity an area emphasized in the Programme for International Student Assessment (PISA) 2022 creative thinking domain, which assesses students' ability to generate, evaluate and improve ideas across multiple contexts (OECD, 2024a, 2024b). However, systematic implementation of SEL at the school level is still far from comprehensive (UNESCO MGIEP, 2022).

Given these persistent challenges, a multiple-case study approach is warranted to explore how teachers conceptualise and apply TPACK, 21CL, and SEL across diverse school contexts. By investigating different instructional environments, the study seeks to surface enabling conditions for effective implementation and provide insights for bridging the gap between policy and practice (Adams et al., 2025). Specifically, the study aims to: (1) examine teachers' knowledge and conceptual understanding of 21CL; (2) explore classroom instructional practices in applying 21st-century pedagogical approaches; and (3) identify challenges and barriers teachers encounter in implementing 21CL in authentic classroom settings.

2.0 METHODOLOGY

2.1 Research Design and Paradigm

This study adopts a qualitative research paradigm situated within an interpretivist framework, which prioritises understanding social phenomena through participants' lived experiences and subjective meanings (Creswell & Poth, 2023). An interpretivist stance is particularly appropriate for exploring instructional practices, as it recognises that teachers' knowledge, beliefs, and classroom actions are socially constructed and context-dependent.

Within this paradigm, a collective case study design was employed to examine teachers' knowledge, classroom practices, and challenges in implementing 21st-Century Learning (21CL). In this study, each case represents an individual teacher situated within their specific instructional and school context. This design allows for cross-case comparison across different schools and geographic locations, enabling the identification of both enabling and inhibiting factors influencing 21CL implementation (Othman, 2022; Yin, 2022). The collective case study approach is particularly suitable for addressing "how" and "why" questions in naturalistic settings, as it facilitates an in-depth exploration of complex and contextually embedded teaching practices.

2.2 Participants and Sampling

The target population comprised primary school teachers in National Schools under the Ministry of Education Malaysia in the state of Melaka, specifically those involved in implementing 21CL in Years 1 to 3 across core subjects such as Bahasa Melayu, English Language, and Mathematics. These early primary levels were selected due to their foundational role in shaping pupils' learning dispositions and competencies aligned with 21CL.

Three information-rich teachers were selected using purposive sampling, as qualitative case study research emphasises depth of understanding rather than breadth or generalisability (Ahmad & Wilkins, 2024; Nyimbili & Nyimbili, 2024). Participants were chosen based on demonstrated engagement with 21CL instructional strategies, ensuring alignment with the study objectives. This selection strategy enhanced the relevance, credibility, and richness of the data, allowing for nuanced insights into classroom enactment of 21CL.

2.3 Data Collection Methods

Semi-structured interviews served as the primary data collection method, as they allow participants to articulate their experiences, beliefs, and challenges while providing flexibility for the researcher to probe for elaboration and clarification (Creswell & Poth, 2023; Adams, 2022). This approach was well suited to capturing teachers' reflective accounts of instructional decision-making and classroom realities.

The interview guide underwent expert review and pilot testing to enhance clarity, sequencing, and methodological rigour. Data were collected through face-to-face interviews conducted at the participants' respective schools. Each interview lasted approximately 45 to 60 minutes and was audio-recorded with participants' informed consent to ensure accuracy. All recordings were transcribed verbatim prior to analysis.

To provide a more comprehensive understanding of instructional practices, classroom observations and relevant document reviews (such as lesson plans and teaching materials) were also conducted. The integration of multiple data sources enabled methodological triangulation, strengthening the study's validity by allowing for cross-verification of findings and the identification of consistencies and discrepancies across data sets.

2.4 Instrument Validity and Trustworthiness

To ensure the validity and reliability of the interview instrument, the interview guide was reviewed by two experts in the fields of education and qualitative research. Their feedback resulted in several refinements, including rewording questions for clarity, simplifying language, and incorporating additional probing questions.

A pilot interview was subsequently conducted with a teacher who shared similar characteristics with the study participants. This pilot session served to assess question clarity, estimate interview duration, and evaluate the comprehensibility of instructions. Minor adjustments were made to the wording of selected questions based on insights gained from the pilot, thereby enhancing the overall quality of the instrument.

2.5 Data Analysis Procedures

Qualitative data derived from interviews, classroom observations, and document analysis were analysed using reflexive thematic analysis, following Braun and Clarke's (2021) six-phase approach. This analytic method was selected for its flexibility and its capacity to generate analytically robust themes that align closely with the study's objectives while foregrounding researcher reflexivity throughout the analytical process.

The analysis involved familiarisation with the data, systematic coding, theme development, review, definition, and reporting. Throughout this process, reflexivity was maintained to acknowledge the researcher's interpretive role in meaning-making. To further enhance trustworthiness, findings were triangulated across interviews, observational field notes, and documentary evidence, allowing patterns of convergence and divergence to be systematically examined. These credibility strategies were informed by contemporary qualitative evaluation methodology.

Collectively, the rigorous application of a collective case study design, purposive sampling of information-rich participants, triangulated data collection, and reflexive thematic analysis provides a robust and trustworthy methodological framework for understanding teachers' knowledge, practices, and challenges in enacting 21CL within authentic classroom contexts. The table below summarises the data analysis methods employed for each research objective.

Table 1 presents a summary of the data analysis procedures aligned with each research objective, outlining the specific data sources and analytical strategies employed to address the aims of this study.

Table 1. Data Analysis Procedures Corresponding to the Research Objectives

Research Objective	Data Analysis Method	Analysis Process
To examine teachers' knowledge and conceptual understanding of 21st Century Learning	Thematic Analysis – identifying patterns in teachers' knowledge, understanding, and perceptions of 21st-century learning	1. Data familiarisation – repeated reading of interview transcripts. 2. Generating initial codes related to concepts, strategies, and teachers' understanding. 3. Grouping codes into themes such as definitions, characteristics, and importance of 21st-century learning. 4. Reviewing and naming themes to ensure accurate representation of findings.
To explore classroom instructional practices in applying 21st century pedagogical approaches	Thematic Analysis + Data Triangulation – comparative analysis between interview data, observations, and teaching documents	5. Initial coding related to teaching strategies and activities. 6. Grouping codes into themes such as PjBL usage, collaborative approaches, digital communication, and authentic assessment. 7. 3. Data triangulation – comparing interview data with evidence from

		classroom observations and lesson plans.
To identify the challenges and barriers teachers encounter when implementing 21st century learning approaches in real classroom settings.	Thematic Analysis – identifying main challenges and influencing factors	8. Initial coding related to constraints (e.g., time limitations, resources, teacher training). 9. Grouping codes into themes such as resource limitations, digital competency issues, administrative support, and student attitudes. 10. 3. Reviewing and refining themes for in-depth analysis.

3.0 FINDINGS

The presentation of findings in this chapter is structured according to the three research objectives: (i) to examine teachers' knowledge and conceptual understanding of 21st Century Learning, (ii) to explore teachers instructional practices in applying 21st century pedagogical approaches, and (iii) to identify the challenges and constraints encountered during implementation in the classroom.

3.1 Examine teachers' knowledge and conceptual understanding of 21st Century Learning

Analysis of the interview data revealed that the participating teachers possessed a reasonably strong conceptual understanding of 21st Century Learning (21CL). They articulated core elements of 21CL including communication, collaboration, critical thinking, creativity and the integration of digital technology and generally perceived it as a learner-centred approach that promotes active student participation and engagement.

However, the depth of this understanding varied among participants. While several teachers demonstrated the ability to link 21CL with the development of Higher-Order Thinking Skills (HOTs), others predominantly associated it with the use of technological tools in teaching. Although all teachers acknowledged the importance of incorporating 21CL principles into their lesson planning, they also indicated that applying these strategies consistently across diverse classroom settings remains challenging.

This pattern reinforces the findings of Abdullah et al. (2022), who reported that practitioners often equate 21CL with technology adoption while overlooking essential pedagogical components such as collaboration and critical thinking. Likewise, Mansor and Jamaludin (2024) found that teachers who participated in structured professional development exhibited a more comprehensive understanding of 21CL, highlighting the need for continuous capacity building. Flick (2022) further argues that professional learning communities and reflective practice enhance teachers' ability to effectively embed 21CL competencies within instructional design, suggesting that improving teachers' expertise requires sustained and targeted support.

Triangulation of evidence from interviews, classroom observations and lesson plan analyses confirmed these patterns. Interview responses reflected self-reported knowledge, observations revealed partial but inconsistent implementation and lesson

plans demonstrated intended strategies. Collectively, these data sources substantiate that while teachers possess foundational knowledge of 21CL, further systematic professional development is necessary to strengthen its translation into practice (Herlinawati et al., 2024). The triangulation matrix for Objective 1 is presented in the following table.

Table 2. Triangulation Data for Objective 1 from Different Instrument

Theme / Sub-theme	Interview (Teacher Quotes)	Classroom Observation	Document Analysis (Lesson Plans)	Interpretation / Notes
Understanding of 21CL Concepts	"I know 21CL involves collaboration and critical thinking, but sometimes I just focus on ICT tools."	Lessons occasionally incorporate collaboration and critical thinking, but ICT dominates	Lesson plans mention 21CL strategies but focus heavily on technology	Teachers have foundational knowledge, but comprehension of 21CL as a broader pedagogical framework is limited
Awareness of 21st-Century Skills	"I try to design activities that improve students' creativity and communication."	Some activities promote creativity and communication, but uneven across subjects	Plans include creativity, communication, and problem-solving tasks	Knowledge of key 21st-century skills exists but integration varies across lessons
Continuous Professional Development	"I attend workshops, but more hands-on training would help."	Teacher application of new strategies is inconsistent	Lesson plans sometimes reference new methods learned in workshops	Limited or irregular professional development affects consistent application of 21CL knowledge

3.2 Exploring classroom instructional practices in applying 21st century pedagogical approaches

Analysis of data from interviews, classroom observations and lesson plan reviews revealed that teachers actively implemented a range of 21st-century instructional strategies designed to cultivate students' thinking skills. Project-Based and Inquiry-Based Learning (PBL/PjBL) emerged as a commonly applied method, whereby students collaboratively engaged in authentic problem-solving tasks that encouraged creativity, critical thinking and independent inquiry. Collaborative learning activities, including structured group discussions and peer interaction, were frequently incorporated to foster communication and teamwork. Teachers also integrated digital communication tools such as learning applications, online platforms and interactive software, to extend engagement beyond the classroom and facilitate continuous feedback. In addition, authentic assessment practices, which included project evaluations, presentations and student portfolios, were used to assess higher-order thinking skills more holistically. Despite these efforts, teachers reported several constraints, including limited instructional time, varying student readiness levels and inconsistent access to digital resources.

These findings correspond with recent empirical evidence supporting the effectiveness of 21st-century instructional approaches in strengthening students' cognitive skills. Zhang (2023) highlights that PBL significantly enhances critical thinking and problem-solving ability by immersing learners in real-world tasks. In parallel,

Nguyen and Oanh (2025) reports that collaborative learning structures increase student engagement and motivation, thereby deepening the learning process. The integration of digital communication tools has similarly reshaped classroom practices by enabling personalised learning and immediate, continuous feedback (Amirul et al., 2024). Moreover, authentic assessments have been found to capture higher-order thinking skills more accurately than traditional examinations (Safri & Jamaludin, 2022). However, literature also emphasises that effective implementation requires structured planning, ongoing professional development and sufficient resource allocation.

Triangulated analysis of interview responses, observation field notes and lesson plans further confirmed that while teachers recognise the value of practices such as PBL/PjBL, collaborative learning, digital communication and authentic assessment, their implementation remains uneven. Interview data revealed that teachers expressed strong beliefs in the effectiveness of these approaches, but acknowledged limitations arising from time pressure, digital access issues and diverse student abilities. Classroom observations showed partial enactment of these strategies, while some students participated actively in group work, others were passive or disengaged. Lesson plan documents reflected an intention to embed activities that encourage critical thinking and collaboration; nonetheless, modifications were often made during teaching to address real-time classroom conditions. These outcomes align with Safri and Jamaludin (2022) and Herlinawati et al., (2024), who similarly found that teachers possess theoretical awareness of best practices for developing higher-order thinking skills, yet logistical and contextual barriers constrain full implementation.

Overall, the triangulation of the three data sources provides a holistic picture of current teaching practices and underscores the need for continued professional support, improved access to resources and enhanced lesson planning to strengthen the integration of 21st-century learning in classrooms. The triangulation table for Objective 2 is presented below.

Table 3. Triangulation Data for Objective 2 from Different Instrument

Theme / Teaching Practice	Interview (Teacher Quotes)	Classroom Observation	Document Analysis (Lesson Plans)	Interpretation / Notes
Project-Based Learning (PBL/PjBL)	"I try to implement projects, but time constraints make it difficult."	Students engaged in small projects; full PBL rarely executed	Lesson plans include project ideas, but often simplified or shortened	PBL is partially implemented due to logistical challenges
Collaborative Activities	"Group work helps students think critically, but some students dominate."	Group activities observed, varying levels of participation	Plans show group tasks; instructions sometimes generic	Collaborative practices exist but student participation and management need improvement
Digital Communication	"I encourage students to present online, but limited devices are a barrier."	Use of digital tools observed in some lessons only	Lesson plans mention digital tasks, conditional on resource availability	Teachers attempt to use technology, but access limits consistent practice

Authentic Assessment	"I assess students through presentations and reflections, not just tests."	Some authentic assessment methods seen; formal tests still dominate	Plans include presentations, reflections, peer assessment	Teachers recognize authentic assessment, but standardized testing pressures remain strong

3.3 Identify the challenges and constraints encountered during implementation in the classroom.

Thematic findings based on interviews, classroom observations, and analysis of lesson plans indicate several key challenges that hinder the implementation of 21st century learning (21CL) practices. Teachers highlighted that insufficient instructional time limits their ability to conduct extended activities such as project-based tasks and collaborative learning. Limited availability of digital devices and unstable internet connectivity further impede the integration of technology into lessons. Several teachers expressed that the lack of continuous professional development restricts their mastery of 21CL pedagogical approaches, while variations in students' learning readiness complicate lesson planning and differentiation. Moreover, the emphasis on standardized examinations and academic performance reduces opportunities for more student-centred, inquiry-based instructional methods.

Table 4. Triangulation Data for Objective 3 from Different Instrument

Theme / Challenge	Interview (Teacher Quotes)	Classroom Observation	Document Analysis (Lesson Plans)	Interpretation / Notes
Time Constraints	"Group activities require more time than the schedule allows."	Collaborative and project-based tasks are often rushed	Minimal time allocated for PBL or group work	Limited instructional time hinders implementation of collaborative and PBL tasks
Limited Technology Access	"We have outdated computers and unstable internet connections."	Minimal use of digital tools; some lessons skipped technology integration	Technology use is conditional or limited	Inadequate digital infrastructure restricts ICT integration
Insufficient Training	"We need more workshops on 21CL strategies."	Teachers struggled to facilitate student-centered lessons	Lesson plans show tentative use of 21CL strategies	Lack of professional development reduces effectiveness of 21CL implementation
Diverse Student Levels	"Students have varying abilities, making it difficult to cater to all."	Mixed engagement observed; some students disengaged	Minimal differentiation for diverse learners	Student diversity challenges differentiated instruction
Curriculum Pressure	"The focus is more on exam results than on student-centered learning."	Teacher-centered teaching observed during exam-focused sessions	Assessment plans emphasize tests and quizzes	Focus on academic achievement limits adoption of student-centered practices

These results are consistent with prior research documenting persistent barriers to implementing 21CL strategies. Time constraints have been identified as a major factor affecting teachers' ability to facilitate collaborative and project-oriented learning (Safri & Jamaludin, 2022). Similarly, insufficient technological infrastructure particularly in rural or resource-limited schools limits effective digital integration (Herlinawati et al., 2024). Professional development gaps continue to inhibit teachers from applying 21CL strategies confidently (Mansor & Jamaludin, 2024). Differences in students' abilities further demand differentiated instruction, which many teachers find challenging to execute. In addition, the prioritisation of exam-driven outcomes tends to overshadow efforts to incorporate authentic and student-centred learning approaches (Ali, 2024). Addressing these barriers requires structured and continuous professional support, improved technological facilities and policy alignment that encourages innovative teaching alongside curriculum standards.

To enhance the credibility and trustworthiness of the findings, data triangulation was employed by integrating multiple sources of evidence, namely interviews, direct classroom observations, and lesson plan documentation. The use of multiple data sources enabled systematic cross-validation and provided a more robust interpretation of the instructional challenges encountered in authentic classroom contexts (Creswell & Poth, 2023; Tracy, 2020). Interviews offered insights into teachers' perceptions and experiences, classroom observations captured real-time instructional constraints, while lesson plans revealed the alignment and discrepancies between intended pedagogical strategies and actual classroom practices. The convergence of these data sources strengthens the reliability of the findings and helps to identify specific areas requiring targeted intervention to support effective implementation of 21st Century Learning (21CL).

4.0 DISCUSSION

The findings indicate that teachers generally demonstrate a sound foundational understanding of 21st century learning (21CL), particularly in relation to key elements such as communication, collaboration, critical thinking, creativity, and the integration of digital technologies (OECD, 2023). However, the depth of this understanding is not consistent across all participants. While some teachers are able to meaningfully associate 21CL with the development of higher-order thinking skills, others adopt a more limited interpretation, placing disproportionate emphasis on the use of digital tools rather than on pedagogical transformation (UNESCO, 2023; OECD, 2023). Although 21CL elements were evident in lesson planning, their enactment in classroom practice remained uneven. This disparity highlights the need for sustained and targeted professional development to support teachers in translating conceptual understanding into effective instructional practices (Flick, 2022).

Regarding classroom practice, teachers incorporated various instructional strategies aligned with 21CL, such as Project-Based Learning (PBL/PjBL), collaborative group work, digital communication platforms and authentic assessments (Zhang, 2023; Nguyen & Oanh, 2025; Amirul et al., 2024). These methods are recognised for fostering creativity, critical thinking and teamwork. However, observations revealed that these strategies were often only partially executed due to constraints such as insufficient time, inconsistent student participation and limited access to instructional resources (Safri & Jamaludin, 2022; Penang Institute, 2025). Although lesson plans reflected teachers' awareness of best practices, adjustments were frequently made to accommodate real classroom challenges (Herlinawati et al., 2024). This indicates

that teachers recognise the value of 21CL pedagogies, but consistent implementation requires systematic planning, resource availability and continuous professional guidance (Mailis & Mansor, 2024).

The study also identifies several barriers that impede effective integration of 21CL in daily instruction. Limited instructional time restricts teachers' ability to carry out inquiry-based and project-driven lessons (Safri & Jamaludin, 2022). Challenges related to digital infrastructure such as inadequate devices and unstable internet connectivity, further limit technology-enabled teaching and learning (Penang Institute, 2025; Herlinawati et al., 2024). In addition, the lack of sustained professional development opportunities constrains teachers' confidence and competence in applying innovative 21CL pedagogies, while students' diverse learning needs make differentiated instruction difficult to execute (Mansor & Jamaludin, 2025; Mazlan et al., 2025). Furthermore, the pressure to meet standardized assessment requirements often diverts instructional focus away from student-centered and authentic learning experiences (Ali, 2024). Overcoming these barriers requires comprehensive support measures, including structured professional training, improved access to technological resources and policy initiatives that encourage the integration of 21CL while aligning with curriculum expectations (Frontiers in Education, 2025; Mahmud et al., 2025).

5.0 CONCLUSION

This study provides comprehensive insights into teachers' knowledge, classroom practices and the challenges encountered in implementing 21st century learning (21CL) in primary schools. Overall, the findings indicate that teachers possess a fundamental awareness of 21CL principles; however, the extent to which they translate this understanding into student-centred instructional practices varies considerably. Strategies such as project-based learning, collaborative activities and authentic assessments were evident, yet their implementation was influenced by several constraints. Limited access to technological resources, unstable internet connectivity and demanding administrative responsibilities were among the primary factors hindering consistent and effective integration of 21CL. These findings underscore the importance of adopting sustainable and holistic support mechanisms to empower teachers in delivering meaningful and future-oriented learning experiences. Providing adequate resources, cultivating a supportive learning environment and prioritising continuous professional development are critical to ensuring that students develop the competencies required to thrive in the 21st century (Mahmud et al., 2023; UNESCO, 2024).

To further strengthen in the 21CL implementation, several strategic recommendations are proposed. First, ongoing and well-structured professional development initiatives should focus on enhancing teachers' digital competency, innovative pedagogical knowledge and assessment literacy (Ramlan et al., 2024). Second, schools should be equipped with reliable technological infrastructure and sufficient digital resources to ensure equitable learning opportunities for all students, including those in under-resourced or rural contexts (MOE Malaysia, 2024). In addition, reducing teachers' administrative workloads would enable them to allocate more time to planning and executing interactive and high-impact learning experiences (Tahim Bael et al., 2021). Strengthening Professional Learning Communities (PLCs) is also recommended to foster collaboration, knowledge-sharing and reflective practice among teachers (MOE, 2024). Future research may expand the sample and adopt mixed-method designs to deepen the understanding of how 21CL influences

student learning outcomes (Frontiers in Education, 2025). Through these concerted efforts, the education system will be better positioned to nurture learners who are equipped with critical thinking, collaboration, creativity and problem-solving skills essential for the demands of the 21st century.

6.0 ACKNOWLEDGEMENTS

The writing of this article is part of the graduation requirement stipulated by the Institute of Graduate Studies (IPS), Sultan Idris Education University, Tanjong Malim, Perak, Malaysia for the Doctor of Philosophy (Pedagogy Education) programme, which mandates students to submit an article for publication. Sincere appreciation is extended to the main supervisor, Associate Professor Dr. Rosnidar binti Mansor, who is also a senior lecturer at the Faculty of Human Development, for her guidance and mentorship throughout the completion of this research writing. Gratitude is also conveyed to the school authorities for granting permission to conduct data collection smoothly. Not to be forgotten, heartfelt thanks to the teachers involved in the data collection process for their kind cooperation during the interviews.

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