

Exploring Pedagogical Strategies & Challenges in Fostering 21st Century Competencies Among Technical and Vocational Teachers

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Abstract. This study explored the pedagogical strategies and challenges experienced by Technical-Vocational-Livelihood (TVL) teachers in fostering 21st-century competencies among learners. Anchored on Constructivist Learning Theory, the study examined how teachers design and implement instructional activities, assessment practices, and learning experiences that promote critical thinking, communication, collaboration, creativity, and digital literacy. A qualitative descriptive research design was employed, involving seven TVL teachers from selected public secondary schools. Data were gathered through semi-structured interviews and analyzed using Braun and Clarke's thematic analysis framework. The findings revealed that teachers employ a variety of learner-centered and industry-aligned pedagogical strategies, including experiential learning, scaffolded industry simulation, project-based activities, collaborative learning, and technology-supported instruction. These approaches enable students to engage in authentic workplace-related experiences while developing both technical and transferable competencies. The study further found that teachers implement differentiated instruction and competency-based assessment practices to accommodate diverse learner needs and evaluate both technical performance and workplace readiness skills. Despite these positive practices, teachers encountered several challenges, including limited instructional resources, insufficient laboratory equipment, varied levels of student readiness, technological skill disparities, administrative workload, and time constraints in balancing technical competencies with 21st-century skill development. Teachers nevertheless demonstrated adaptability and resilience in addressing these challenges through collaborative and contextualized instructional approaches. The study concluded that fostering 21st-century competencies in TVL education requires a holistic approach that integrates technical mastery, soft skills development, authentic learning experiences, and continuous teacher innovation. Strengthening institutional support, industry partnerships, resource provision, and professional development opportunities is essential to enhance the effective implementation of competency-based and learner-centered vocational education.

Introduction

The rapid advancement of technology, globalization, and industry transformation has significantly reshaped workforce expectations, placing increasing emphasis on the development of 21st-century competencies. Beyond technical expertise, employers now seek individuals who possess critical thinking, communication, collaboration, creativity, and digital literacy skills necessary to adapt to dynamic and technology-driven work environments. These competencies are particularly important in Technical and Vocational Education and Training (TVET), where the primary goal is to prepare learners for immediate employment, entrepreneurship, and lifelong learning. As industries continue to evolve under the influence of Industry 4.0 technologies, educational institutions are challenged to ensure that graduates possess not only technical proficiency but also the soft skills and adaptive capacities required in contemporary workplaces.

As technical and vocational institutions respond to Industry 4.0 demands, teachers are increasingly expected to employ pedagogical approaches that integrate technological competence, workplace simulation, and learner-centered instruction to prepare graduates for evolving labor market needs (Noh@Seth et al., 2019).

The Technical-Vocational-Livelihood (TVL) track in the Philippine Senior High School curriculum was established to equip learners with industry-relevant competencies and workplace readiness. However, studies have shown that technical competence alone is insufficient to guarantee employability. Modern industries increasingly demand workers who can communicate effectively, collaborate with diverse teams, solve complex problems, and adapt to rapidly changing work conditions. According to the World Economic Forum (2023), analytical thinking, resilience, flexibility, leadership, and technology literacy are among the most critical competencies required in the future workforce. Similarly, UNESCO (2021) emphasized that vocational education should integrate cognitive, interpersonal, and technological competencies to ensure sustainable employability and lifelong learning.

To address these demands, educational systems worldwide have shifted toward learner-centered pedagogies that promote active engagement and authentic learning experiences. Experiential learning, project-based learning, collaborative learning, and technology-enhanced instruction have emerged as effective approaches for developing 21st-century competencies among learners. Research has demonstrated that experiential learning environments improve critical thinking, problem-solving, and workplace readiness by allowing learners to apply theoretical knowledge in authentic contexts (Jalinus et al., 2020). Similarly, TVET pedagogies that emphasize collaborative and competency-based learning have been shown to strengthen learners' communication, teamwork, and workplace readiness skills (Okolie et al., 2021). The integration of digital technologies into instruction enhances learners' digital literacy, adaptability, and preparedness for Industry 4.0 workplaces (Noh@Seth et al., 2019).

Recent studies have emphasized that the development of 21st-century competencies in TVET requires pedagogical practices that promote critical thinking, communication, collaboration, creativity, and adaptability through authentic and contextualized learning experiences (Le et al., 2022).

In recent years, substantial research has examined the integration of 21st-century competencies within technical and vocational education, emphasizing curriculum reforms, competency frameworks, technology integration, and student outcomes. Existing studies have highlighted the importance of critical thinking, communication, collaboration, creativity, and digital literacy in preparing learners for increasingly complex and technology-driven work environments. Similarly, research has documented the effectiveness of learner-centered pedagogies such as experiential learning, project-based learning, collaborative learning, and competency-based instruction in promoting these competencies among vocational learners.

Despite these contributions, the current body of literature remains largely focused on competency standards, curriculum implementation, and learner achievement. Although previous studies have examined curriculum implementation, competency standards, and student outcomes, limited research has focused on how TVET teachers operationalize 21st-century pedagogies within classroom and workshop environments, particularly in contexts characterized by resource constraints and evolving industry demands (Garaba, 2023; Okolie et al., 2021). More specifically, limited qualitative research has investigated how teachers design and implement pedagogical strategies to foster 21st-century competencies, how they navigate contextual and institutional challenges, and how they perceive the role of these competencies in preparing learners for future employment and lifelong learning. Given the evolving demands of Industry 4.0 and the increasing emphasis on workforce adaptability, a deeper understanding of teachers' lived experiences is necessary to strengthen pedagogical practices and support the effective development of workplace-relevant competencies.

Anchored on Constructivist Learning Theory, which views learning as an active process of knowledge construction through experience, interaction, and reflection, this study explored the pedagogical strategies employed by Technical-Vocational-Livelihood teachers in fostering 21st-century competencies among learners. Specifically, it examined how teachers design and implement learning activities, instructional approaches, and assessment practices, the challenges they encounter in applying these strategies, and their perceptions regarding the importance of 21st-century competencies in preparing students for employment and lifelong learning. The findings contribute to the growing discourse on technical and vocational education by providing insights into instructional practices that support competency development and by identifying factors that may enhance the alignment of vocational education with contemporary workforce needs.

The findings of this study contribute to the growing body of knowledge on TVET pedagogy by providing empirical insights into the experiences of TVL teachers and identifying strategies that may enhance competency development in vocational education. The results may assist educators, school administrators, curriculum planners, and policymakers in designing interventions, professional development programs, and institutional support mechanisms that strengthen the delivery of quality TVL education and improve learner preparedness for the demands of the 21st-century workforce.

Research Questions

This study sought to explore the pedagogical strategies, instructional practices, implementation challenges, and perceptions of TVL teachers regarding the development of 21st-century competencies among learners.

1. What pedagogical strategies do TVL teachers employ to foster the development of 21st-century competencies among their students?
2. How do TVL teachers design and implement learning activities, instructional methods, and assessment techniques to promote 21st-century skills?
3. What challenges do TVL teachers encounter in adopting and applying 21st-century pedagogical strategies?
4. How do TVL teachers perceive the role of 21st-century competencies in preparing students for future employment and lifelong learning?

Methodology

Research Design

This study employed a qualitative descriptive research design to explore the pedagogical strategies and challenges experienced by Technical-Vocational-Livelihood (TVL) teachers in fostering 21st-century competencies among learners. A qualitative descriptive approach was deemed appropriate because it allows for the comprehensive exploration of participants' experiences, perspectives, and instructional practices within their natural educational contexts. The design enabled the researchers to gain in-depth insights into the pedagogical approaches, implementation strategies, challenges, and perceptions of TVL teachers regarding the development of critical thinking, communication, collaboration, creativity, and digital literacy among students.

Participants and Sampling Technique

The study involved seven (7) Technical-Vocational-Livelihood teachers from selected public secondary schools offering the TVL track. The participants represented various TVL specializations and possessed teaching experiences ranging from one to fifteen years. Their diverse professional backgrounds enabled the researchers to gather rich and varied perspectives regarding the implementation of 21st-century pedagogical practices. Data collection continued until thematic saturation was achieved, wherein no substantially new information, codes, or themes emerged from subsequent interviews. Saturation served as the basis for determining the adequacy of the participant sample.

Research Instrument

Data were collected using a researcher-developed semi-structured interview guide. Semi-structured interviews were chosen because they provide flexibility in exploring participants' experiences while ensuring that all relevant topics related to the research questions are addressed. The interview guide consisted of open-ended questions focusing on pedagogical strategies, instructional practices, assessment approaches, implementation challenges, and perceptions regarding the importance of 21st-century competencies.

To establish content validity, the interview guide was reviewed and evaluated by experts in educational research, technical-vocational education, and qualitative methodology. Their recommendations were incorporated to improve the clarity, relevance, and alignment of the interview questions with the objectives of the study. Since the instrument consisted of qualitative interview questions, reliability was established through consistency in the interview process, adherence to the interview protocol, and systematic data analysis procedures.

The interview guide consisted of four major sections corresponding to the research questions, focusing on pedagogical strategies, instructional design and assessment practices, implementation challenges, and perceptions regarding 21st-century competencies. Follow-up probing questions were utilized to clarify responses and elicit richer descriptions of participants' experiences. The interviews were conducted primarily in English and Cebuano, depending on participants' preferred language.

Data Gathering Procedure

Prior to data collection, approval to conduct the study was secured from the appropriate educational authorities and school administrators. After obtaining the necessary permissions, potential participants were identified based on the established inclusion criteria. Eligible participants were invited to participate and were provided with information regarding the purpose, procedures, and ethical considerations of the study.

Face-to-face interviews were conducted at mutually convenient schedules and locations. Before the interviews commenced, participants signed informed consent forms indicating their voluntary participation. Each interview lasted approximately 30 to 60 minutes and was audio-recorded with participants' permission to ensure accuracy in data capture. Field notes were also maintained to document observations and contextual information relevant to the study. The interviews continued until sufficient data were obtained to address the research questions.

Following each interview, audio recordings were transcribed verbatim. The transcripts were reviewed multiple times to ensure accuracy and completeness. Participants were subsequently provided opportunities to verify the accuracy of their responses through member checking.

Data Analysis Procedure

The collected data were analyzed using thematic analysis following the six-phase framework developed by Braun and Clarke (2006). The first phase involved familiarization with the data through repeated reading of interview transcripts. The second phase consisted of generating initial codes by identifying meaningful units related to the participants' experiences. In the third phase, codes were grouped into potential themes based on patterns and relationships within the data. The fourth phase involved reviewing and refining the themes to ensure coherence and alignment with the data set. The fifth phase focused on defining and naming the themes, while the final phase involved producing the report through the integration of themes, supporting quotations, and relevant literature.

To ensure trustworthiness, the study adhered to the criteria of credibility, dependability, confirmability, and transferability proposed by Lincoln and Guba (1985). Credibility was enhanced through prolonged engagement with the data and member checking, wherein participants were given opportunities to verify the accuracy of interpretations. Dependability was established through maintaining a clear audit trail documenting the research procedures and analytical decisions. Confirmability was strengthened through peer review and researcher reflexivity to minimize bias. Transferability was supported through detailed descriptions of the research context, participants, and findings, enabling readers to determine the applicability of the results to similar settings.

Ethical Considerations

Ethical principles were strictly observed throughout the conduct of the study. Participants were fully informed about the objectives, procedures, potential benefits, and voluntary nature of their participation before providing informed consent. They were informed of their right to withdraw from the study at any stage without penalty or consequence.

To ensure confidentiality and anonymity, participants were assigned pseudonyms and no identifying information was included in the transcripts, reports, or publications. Audio recordings, transcripts, and other research materials were securely stored and accessed only by the researchers. The collected data were used solely for academic and research purposes. Furthermore, the researchers exercised sensitivity and respect throughout the interview process to ensure the protection of participants' rights, dignity, and well-being. The interpretation of the data was driven entirely by human judgment, while AI tools served only a supporting role for data organization and linguistic refinement.

Results and Discussion

Research Question 1. What pedagogical strategies do TVL teachers employ to foster the development of 21st-century competencies among their students?

The analysis of interview data revealed three interconnected themes that describe the pedagogical strategies employed by Technical-Vocational-Livelihood (TVL) teachers in fostering 21st-century competencies among learners. These themes include Scaffolded Industry Simulation, Adaptive Collaborative Resilience, and Holistic Professional Formation. Table 1 presents the summary of themes, categories, and representative participant responses.

Representative Quote	Initial Code	Category	Theme
STR1: "In TVL, the main pedagogical strategy we use is experiential learning. We let students experience real activities..."	Experiential Learning Strategy	Immersive Experiential Learning	Scaffolded Industry Simulation

Representative Quote	Initial Code	Category	Theme
ATR3: "Once we proceed to the execution of skills, the strategy I use is the Direct and Explicit Instruction Approach, commonly known as 'I do, we do, you do'."	Scaffolded Modeling Technique	Immersive Experiential Learning	Scaffolded Industry Simulation
ATR1: "After the teacher's demonstration, the students perform the method themselves. This follows John Dewey's philosophy of 'learning by doing'..."	Practical Performance Focus	Immersive Experiential Learning	Scaffolded Industry Simulation
TTR2: "I integrate digital tools in Technical Drafting by using industry-standard software such as AutoCAD and SketchUp."	Digital Technology Integration	Industry Technology Integration	Scaffolded Industry Simulation
ATR3: "We also use tools like ChatGPT, online videos, and other digital platforms to stay updated and to provide students with visual learning resources."	Digital Resource Utilization	Industry Technology Integration	Scaffolded Industry Simulation
STR1: "Through collaboration and group work, faster learners can help classmates who need more support."	Peer Collaborative Learning	Collaborative Peer Engagement	Adaptive Collaborative Resilience
STR1: "Groupings and collaborations are especially effective in TVL because one of the biggest problems is the lack of tools, materials, and equipment."	Resource-Driven Collaboration	Collaborative Peer Engagement	Adaptive Collaborative Resilience
ATR1: "Lesson plans and activities must be tailored to their diverse learning needs... some learn better by watching video presentations... others through manual drawing."	Differentiated Instruction Strategy	Holistic Adaptive Instruction	Holistic Professional Formation
ATR1: "I allow them to answer in Bisaya, English, or Tagalog so they feel free to express their understanding."	Multilingual Communication Support	Holistic Adaptive Instruction	Holistic Professional Formation
STR2: "The teacher must consistently give reminders and guidance. Baking and cooking require discipline, patience, and passion..."	Behavioral Attitude Molding	Holistic Adaptive Instruction	Holistic Professional Formation
ATR3: "Even if a learner is highly skilled, if they lack proper attitude... they will still struggle... skills can be taught, but attitude is difficult to change."	Workplace Character Development	Holistic Adaptive Instruction	Holistic Professional Formation

Table 1. Pedagogical Strategies for Developing 21st-Century Competencies

Theme 1: Scaffolded Industry Simulation

The narratives of the TVL teachers reveal that their pedagogical strategies are deeply rooted in creating learning environments that mirror real industry settings. As they shared their stories, it became evident that experiential learning serves as the backbone of TVL instruction. One respondent described, "In TVL, the main pedagogical strategy we use is experiential learning. We let students experience real activities," emphasizing that students learn best when they engage directly with authentic tasks. Another teacher reinforced this approach by recounting how the "I do, we do, you do" method guides learners from observation to independent performance. This step-by-step modeling, as one teacher explained, helps

students gain confidence as they progress from watching demonstrations to performing skills on their own: *"After the teacher's demonstration, the students perform the method themselves... learning by doing."* These strategies are consistent with contemporary TVET pedagogies that emphasize experiential, workplace-based, and competency-oriented learning experiences designed to bridge classroom instruction and industry practice (Okolie et al., 2021; Jailani et al., 2017).

The teachers' stories collectively illustrate how scaffolded instruction through demonstrations, guided practice, digital tool integration, and hands-on engagement creates an ecosystem where students practice as though they are already part of the workplace. By blending traditional modeling with modern technological integration, TVL teachers craft a learning experience that not only simulates industry expectations but also nurtures the critical thinking, adaptability, and practical competence demanded by contemporary labor markets. As the respondents' stories show, TVL instruction becomes a lived, dynamic rehearsal of real professional life. This finding is consistent with Constructivist Learning Theory, which posits that learners construct knowledge through active engagement and meaningful experiences. The use of demonstrations, guided practice, workplace simulations, and technology-enhanced activities allows students to develop understanding through direct interaction with authentic tasks rather than passive reception of information. Through these experiences, learners actively construct competencies that mirror real industry expectations.

Theme 2: Adaptive Collaborative Resilience

The teachers' narratives also highlighted the central role of collaboration in fostering student growth, particularly under conditions of limited resources. One teacher shared, *"Through collaboration and group work, faster learners can help classmates who need more support,"* illustrating how peer interaction becomes both a learning strategy and a support system. Another recounted that groupings were designed with the school's limited tools and equipment in mind: *"Groupings and collaborations are especially effective in TVL because one of the biggest problems is the lack of tools, materials, and equipment."* These stories reveal that collaborative structures are not just pedagogical choices but adaptive responses to practical constraints in vocational settings.

Collaborative learning environments enable students to share expertise, solve problems collectively, and strengthen workplace-relevant interpersonal competencies, which are central features of effective vocational pedagogy (Okolie et al., 2021). The findings also reflect the social dimension of Constructivist Learning Theory, which emphasizes that knowledge is developed through interaction and collaboration with others. By engaging in peer learning, cooperative problem-solving, and shared task completion, students co-construct understanding while simultaneously developing communication, teamwork, and interpersonal competencies essential in workplace environments.

Theme 3: Holistic Professional Formation

Finally, the teachers' narratives emphasized the importance of nurturing both technical skills and professional character, highlighting a holistic approach to student development. One teacher noted, *"Lesson plans and activities must be tailored to their diverse learning needs... some learn better by watching video presentations... others through manual drawing,"* showing the use of differentiated instruction to accommodate varied learning styles. Another teacher described how students are encouraged to express themselves freely in multiple languages: *"I allow them to answer in Bisaya, English, or Tagalog so they feel free to express their understanding."* Beyond cognitive skills, respondents emphasized attitude and character: *"Even if a learner is highly skilled, if they lack proper attitude... they will still struggle... skills can be taught, but attitude is difficult to change."*

This finding aligns with contemporary perspectives on 21st-century competency development, which emphasize the integration of technical, cognitive, and socio-emotional skills necessary for workplace success (World Economic Forum, 2023). This finding supports recent evidence indicating that successful TVET graduates require a combination of technical competence, employability skills, and socio-emotional competencies to thrive in contemporary workplaces (Le et al., 2022). From a constructivist perspective, learning is influenced by learners' prior experiences, individual differences, and social contexts. The teachers' use of differentiated instruction, multilingual communication, and attitude formation demonstrates their role as facilitators who create learning environments that accommodate diverse learner needs while encouraging reflective and meaningful learning experiences.

Taken together, the three themes demonstrate that TVL teachers foster 21st-century competencies through constructivist-oriented pedagogies that emphasize authentic learning experiences, collaborative knowledge construction, and learner-centered instructional support. These approaches position students as active participants in the learning process, enabling them to develop both technical and transferable skills required in contemporary workplaces.

Research Question 2. How do TVL teachers design and implement learning activities, instructional methods, and assessment techniques to promote 21st-century skills?

Through thematic analysis of the interview data, four major themes emerged that illustrate how TVL teachers design and implement learning activities, instructional strategies, and assessment techniques to develop 21st-century competencies among learners. These themes are (1) compliance-driven curriculum design, (2) experiential and contextualized instruction, (3) adaptive and collaborative scaffolding, and (4) competency-based performance evaluation. Each theme highlights a unique dimension of TVL instruction, emphasizing adherence to standards, real-world application, differentiated support, and holistic assessment of both technical skills and workplace-ready competencies.

Representative Quote	Initial Code	Category	Theme
STR1: "In TVL, learning activities are pre-designed by TESDA. As teachers, our role is to implement these activities... We follow the Training Regulations (TR)."	Adopting Prescribed Standards	Anchoring on Standards	Compliance-Driven Curriculum Design
ATR2: "even the theory-based activities are designed to coincide with performance-based tasks required by TESDA... directly connected to the practical activities."	Aligning Competency Standards	Anchoring on Standards	Compliance-Driven Curriculum Design
ATR1: "I bring them to real situations inside or outside the school... Installing fluorescent lamps inside classrooms... Replacing damaged outlets."	Exposing Real Situations	Contextualizing Real-World Practice	Experiential and Contextualized Instruction
TTR1: "We use project-based learning where students create meaningful products such as the recipe book... create real-world drafting projects."	Simulating Real-World Projects	Contextualizing Real-World Practice	Experiential and Contextualized Instruction
ATR1: "Fast learners proceed to the next stage while slower learners are given more guidance... Peer-to-peer mentoring is used."	Differentiating Instructional Pace	Differentiating Instructional Support	Adaptive and Collaborative Scaffolding
ATR1: "This follows Vygotsky's scaffolding, where learners perform tasks with guidance before doing them independently."	Applying Scaffolding Strategies	Differentiating Instructional Support	Adaptive and Collaborative Scaffolding
TTR2: "Assess not only their final outputs but also their thought processes, adaptability... how they handle challenges... and how they troubleshoot errors."	Evaluating Process Adaptability	Assessing Holistic Competence	Competency-Based Performance Evaluation
ATR1: "For installation tasks, aesthetics are part of the score—the wiring should be neat... I use rubrics... so students clearly understand the criteria."	Using Transparent Rubrics	Assessing Holistic Competence	Competency-Based Performance Evaluation

Table 2. Instructional and Assessment Practices in TVL Education

Theme 1: Compliance-Driven Curriculum Design

Teachers highlighted the importance of anchoring instruction on formal TESDA competency standards. One teacher shared, "In TVL, learning activities are pre-designed by TESDA. As teachers, our role is to implement these activities... We follow the Training Regulations (TR)," emphasizing the structured guidance provided by official frameworks. Another remarked, "Even the theory-based activities are designed to coincide with performance-based tasks required by TESDA... directly connected to the practical activities," showing the deliberate alignment of theoretical knowledge with hands-on practice.

These narratives suggest that compliance with TESDA standards ensures consistency, workplace relevance, and clear learning objectives for students, creating a solid foundation for ensuring alignment between classroom instruction and industry competency requirements. Aligning instruction with competency standards remains a defining characteristic of vocational pedagogy and ensures consistency between training outcomes and workforce requirements (Jailani et al., 2017).

Theme 2: Experiential and Contextualized Instruction

Respondents described how lessons are contextualized to mirror real-world situations. One teacher recounted, *"I bring them to real situations inside or outside the school... Installing fluorescent lamps inside classrooms... Replacing damaged outlets,"* while another noted, *"We use project-based learning where students create meaningful products such as the recipe book... create real-world drafting projects."* These stories demonstrate that authentic, hands-on tasks allow students to actively engage with the content, enhancing practical skills while connecting classroom learning to workplace realities.

Authentic and contextualized learning experiences are recognized as essential pedagogical approaches in TVET because they facilitate the transfer of knowledge and skills to workplace settings (Abdul & Silor, 2024; Okolie et al., 2021).

Theme 3: Adaptive and Collaborative Scaffolding

Teachers also highlighted strategies that support diverse learners through differentiated instruction and peer collaboration. One teacher explained, *"Fast learners proceed to the next stage while slower learners are given more guidance... Peer-to-peer mentoring is used,"* while another emphasized, *"This follows Vygotsky's scaffolding, where learners perform tasks with guidance before doing them independently."*

Providing differentiated support and collaborative opportunities enables learners to progressively acquire competencies while strengthening communication and teamwork skills (Abdul & Silor, 2024).

Theme 4: Competency-Based Performance Evaluation

Assessment practices in TVL extend beyond grading final outputs, focusing on students' processes, adaptability, and adherence to professional standards. One teacher shared, *"Assess not only their final outputs but also their thought processes, adaptability... how they handle challenges... and how they troubleshoot errors,"* while another stated, *"For installation tasks, aesthetics are part of the score the wiring should be neat... I use rubrics... so students clearly understand the criteria."*

These accounts reveal that performance-based evaluation and transparent rubrics ensure holistic assessment, fostering both technical mastery and professional attitudes. These findings highlight the importance of authentic assessment approaches that evaluate both technical proficiency and workplace-relevant competencies.

Research Question 3. What challenges do TVL teachers encounter in adopting and applying 21st-century pedagogical strategies?

Through thematic analysis of the interview data, three major themes emerged that illustrate these obstacles: (1) Resource Scarcity as a Barrier to Experiential Learning, (2) The Teacher as a Mediator of Student Readiness Gaps, and (3) Institutional Friction versus Pedagogical Innovation. Each theme reflects a distinct aspect of the difficulties teachers navigate while trying to foster skills such as collaboration, problem-solving, and adaptability.

Representative Quote	Initial Code	Category	Theme
STR1: <i>"The biggest challenge is the lack or insufficiency of materials, tools, and equipment in laboratories."</i>	Scarce Laboratory Resources	Lacking Material Resources	Resource Scarcity as a Barrier to Experiential Learning
STR2: <i>"A major challenge is ingredients the school cannot provide everything because some are very expensive."</i>	Prohibitive Ingredient Costs	Lacking Material Resources	Resource Scarcity as a Barrier to Experiential Learning
TTR1: <i>"Limited access to updated industry-standard tools and equipment... becomes a challenge for both teachers and students."</i>	Obsolete Tool Availability	Lacking Material Resources	Resource Scarcity as a Barrier to Experiential Learning

Representative Quote	Initial Code	Category	Theme
STR2: "Some students only took the strand because of their friends... At first, they show little interest and lack focus."	Peer-Driven Enrollment	Student Readiness Deficits	The Teacher as a Mediator of Student Readiness Gaps
ATR1: "One barrier is students with weak reading comprehension... lack of comprehension slows down the lesson and becomes a safety hazard."	Weak Reading Comprehension	Student Readiness Deficits	The Teacher as a Mediator of Student Readiness Gaps
TTR2: "One challenge I encounter is the varying level of students' technological skills. Some students adapt quickly, while others need more time and support."	Uneven Tech Proficiency	Student Readiness Deficits	The Teacher as a Mediator of Student Readiness Gaps
TTR1: "Many teachers are experts in their trade, but they receive limited professional development in innovative instructional strategies."	Inadequate Pedagogical Training	Systemic Instructional Barriers	Institutional Friction versus Pedagogical Innovation
TTR1: "The administrative tasks required from teachers can be overwhelming and may affect instructional preparation."	Excessive Administrative Burden	Systemic Instructional Barriers	Institutional Friction versus Pedagogical Innovation
TTR2: "Another challenge is balancing the development of 21st-century skills with the need to cover all required technical competencies within the limited class time."	Curriculum Time Constraints	Systemic Instructional Barriers	Institutional Friction versus Pedagogical Innovation

Table 3. Challenges in Implementing 21st-Century Pedagogies

Theme 1: Resource Scarcity as a Barrier to Experiential Learning

Teachers frequently shared that a lack of materials, tools, and equipment limits their ability to provide authentic, hands-on learning experiences. One teacher recounted, "The biggest challenge is the lack or insufficiency of materials, tools, and equipment in laboratories," while another explained, "A major challenge is ingredients the school cannot provide everything because some are very expensive." Another reflected on outdated tools: "Limited access to updated industry-standard tools and equipment... becomes a challenge for both teachers and students."

Resource limitations continue to challenge the effective implementation of authentic vocational learning experiences and remain a significant concern across many technical institutions (Garaba, 2023).

Theme 2: The Teacher as a Mediator of Student Readiness Gaps

Teachers also described navigating student-related challenges, including differences in motivation, focus, and prior knowledge. One teacher shared, "Some students only took the strand because of their friends... At first, they show little interest and lack focus." Weak reading comprehension was also cited as a barrier: "One barrier is students with weak reading comprehension... lack of comprehension slows down the lesson and becomes a safety hazard." Varying technological skills added another layer of complexity: "One challenge I encounter is the varying level of students' technological skills. Some students adapt quickly, while others need more time and support."

These stories illustrate the crucial role of teachers in adapting instruction and providing appropriate learning support to address differences in learner readiness and skill levels (Vygotsky, 1978).

Theme 3: Institutional Friction versus Pedagogical Innovation

Finally, systemic and institutional challenges create friction in implementing innovative strategies. Teachers noted the limited professional development opportunities: *"Many teachers are experts in their trade, but they receive limited professional development in innovative instructional strategies."* Administrative demands were another concern: *"The administrative tasks required from teachers can be overwhelming and may affect instructional preparation."* Teachers also described the tension between covering required technical competencies and fostering 21st-century skills: *"Another challenge is balancing the development of 21st-century skills with the need to cover all required technical competencies within the limited class time."*

These accounts reveal that institutional pressures often hinder teachers' ability to fully implement innovative instructional practices despite their commitment to developing workplace-ready learners (Darling-Hammond et al., 2020). Garaba (2023) similarly noted that institutional barriers, inadequate facilities, and insufficient pedagogical support often constrain teachers' capacity to implement innovative instructional practices.

Research Question 4. How do TVL teachers perceive the role of 21st-century competencies in preparing students for future employment and lifelong learning?

Through thematic analysis of the interview data, three major themes emerged: (1) Workplace Readiness and Employability, (2) Lifelong Learning and Adaptability, and (3) Integrating Soft Skills with Technical Mastery. Each theme reflects teachers' perceptions of how combining technical skills with broader competencies equips learners for both the demands of the industry and personal professional growth.

Representative Quote	Initial Code	Category	Theme
ATR1: <i>"Even if a student is very skillful, but has a bad attitude, they will struggle in the workplace."</i>	Attitude Over Skill	Holistic Professional Formation	Workplace Readiness and Employability
TTR2: <i>"Technical skills alone are no longer enough. Students also need critical thinking, creativity, communication... to succeed in modern workplaces."</i>	Beyond Technical Skills	Holistic Professional Formation	Workplace Readiness and Employability
STR2: <i>"We aim to develop both their skills and behavior so they can become effective professionals in the future."</i>	Holistic Professional Development	Holistic Professional Formation	Workplace Readiness and Employability
STR1: <i>"Teachers act as catalysts of knowledge; to provide students with 21st-century skills, we must first master those skills ourselves."</i>	Modeling Teacher Competence	Foundational Teacher Competence	Teacher Mastery and Competency Development
STR1: <i>"Being well-equipped as teachers directly benefits students, enabling them to learn and apply the skills effectively in the modern world."</i>	Enabling Skill Application	Foundational Teacher Competence	Teacher Mastery and Competency Development
ATR3: <i>"These 21st-century skills help them become employable and capable of starting their own businesses even without attending college."</i>	Entrepreneurial Independence Capability	Sustainable Career Pathways	Lifelong Learning and Adaptability
TTR1: <i>"They ensure that TVL students are prepared not only for their first job but also for the continuous learning required throughout their careers."</i>	Lifelong Learning Readiness	Sustainable Career Pathways	Lifelong Learning and Adaptability

Representative Quote	Initial Code	Category	Theme
ATR3: <i>"They are digitally literate they know how to use social media for marketing... and post their products online."</i>	Digital Business Literacy	Sustainable Career Pathways	Lifelong Learning and Adaptability

Table 4. Teachers' Perceptions of 21st-Century Competencies

Theme 1: Workplace Readiness and Employability

Teachers frequently highlighted that 21st-century competencies make students more prepared and attractive for employment. One teacher shared, *"21st-century skills help students become more employable; they learn how to communicate, collaborate, and solve problems, which employers value."* Another added, *"I try to prepare them for real work situations by giving them projects that simulate actual industry problems."*

These narratives reinforce the importance of communication, collaboration, and problem-solving competencies in preparing students for contemporary employment environments (World Economic Forum, 2023). The development of employability competencies remains a primary objective of technical and vocational education programs (Le et al., 2022).

Theme 2: Teacher Mastery and Competency Development

Finally, teachers stressed that 21st-century competencies go hand in hand with technical skills, creating well-rounded professionals. One teacher shared, *"It's not enough to teach just technical skills; students must also develop teamwork, critical thinking, and ethical responsibility."* Another stated, *"Assessments are not just about correct answers; I also look at how students handle challenges and interact with others."*

These insights reveal that teachers intentionally combine technical instruction with the cultivation of soft skills like communication, critical thinking, collaboration, and ethics to ensure that learners are prepared for both the technical and interpersonal demands of modern workplaces (Binkley et al., 2012). Recent TVET studies further emphasize that technical competence alone is insufficient for career success without complementary communication, collaboration, and problem-solving skills (Okolie et al., 2021).

Theme 3: Lifelong Learning and Adaptability

Teachers also emphasized the importance of adaptability and continuous learning in an ever-changing industry landscape. One respondent explained, *"I emphasize adaptability because industries are always changing... students need to learn how to adjust and keep learning."* Another noted, *"Encouraging students to explore new tools and technologies keeps them curious and ready to learn beyond school."*

These accounts highlight the importance of adaptability and continuous learning in preparing students for evolving workplace demands (UNESCO, 2021).

Figure 1 presents the constructivist-based conceptual model generated from the study. The model illustrates how TVL teachers employ pedagogical strategies characterized by Scaffolded Industry Simulation, Adaptive Collaborative Resilience, and Holistic Professional Formation to facilitate the development of 21st-century competencies among learners. Anchored on Constructivist Learning Theory, the model emphasizes active engagement, collaboration, authentic learning experiences, and learner-centered instruction as foundations for competency development. The resulting competencies—critical thinking, communication, collaboration, creativity, and digital literacy—contribute to workforce readiness and lifelong learning. The model further recognizes that the implementation and effectiveness of these pedagogical strategies are influenced by contextual challenges, including resource scarcity, student readiness gaps, and institutional friction.

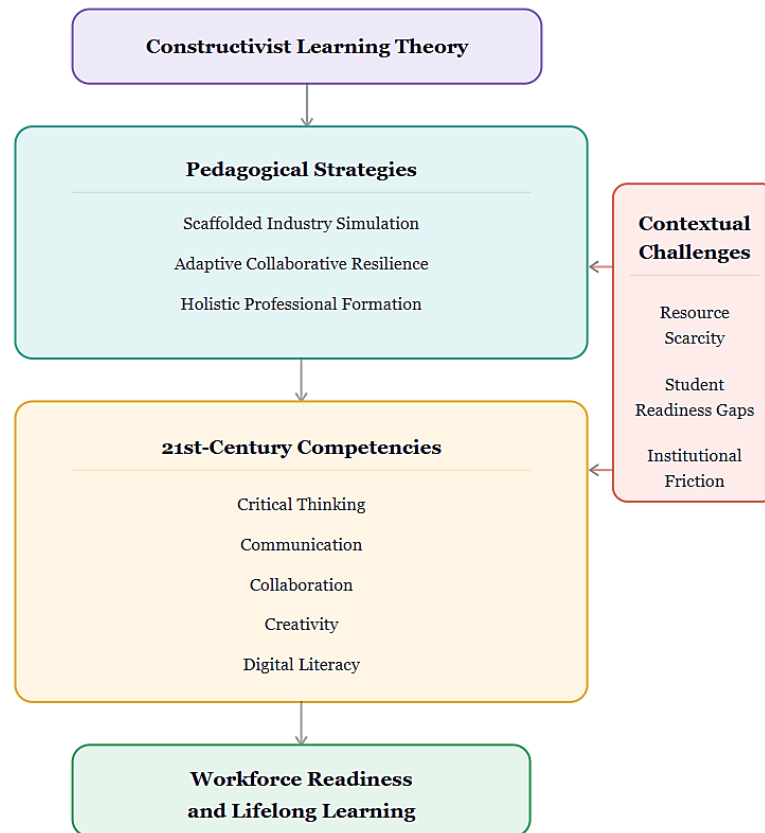


Figure 1. Constructivist-Based Model of Competency Development

Conclusion and Implications

This study contributes to the growing body of knowledge on technical and vocational education by providing an in-depth understanding of how Technical-Vocational-Livelihood (TVL) teachers foster 21st-century competencies among learners. The findings demonstrate that competency development is best achieved through the integration of experiential and industry-aligned learning experiences, collaborative instructional approaches, and holistic learner development. Beyond technical skill acquisition, TVL teachers play a critical role in cultivating critical thinking, communication, collaboration, creativity, digital literacy, work ethics, and adaptability—competencies that are increasingly valued in contemporary workplaces.

The study further highlights the adaptive capacity of TVL teachers in responding to instructional challenges. Despite limitations related to resources, instructional materials, technology access, and diverse learner needs, teachers continuously modify their pedagogical practices to create meaningful and authentic learning experiences. These findings reinforce the view that effective vocational education requires not only technical expertise but also innovative, learner-centered teaching approaches that bridge classroom learning and workplace expectations.

The results have important implications for educational practice and policy. Educational institutions and school administrators should strengthen support mechanisms for TVL programs through the provision of updated equipment, instructional technologies, and industry-standard learning resources. Continuous professional development opportunities should likewise be prioritized to enhance teachers' pedagogical, technological, and industry-related competencies. At the policy level, greater investment in industry partnerships, workplace simulation programs, and competency-based instructional initiatives may further strengthen the alignment between vocational education and labor market demands.

From a broader educational perspective, the findings affirm the importance of integrating technical competencies with soft skills and lifelong learning attributes. Preparing learners for future employment requires a balanced approach that develops both occupational expertise and the adaptive competencies necessary to thrive in rapidly changing work

environments. Consequently, curriculum planners and educational leaders should continue to promote instructional practices that support experiential, collaborative, and technology-enhanced learning. The findings further support Constructivist Learning Theory by demonstrating that meaningful learning occurs when students actively engage in authentic tasks, collaborate with peers, and participate in learner-centered experiences that connect classroom instruction with workplace realities.

Future research may explore the perspectives of students, school administrators, and industry partners to provide a more comprehensive understanding of 21st-century competency development in vocational education. Comparative studies across different vocational disciplines and educational contexts may also provide further insights into effective pedagogical practices and institutional support systems that contribute to workforce readiness and lifelong learning.

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Competing Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study; all data used were obtained from previously published sources as cited in the reference list.

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Appendices

No appendices are attached to this study.