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Assessment literacy, transactional leadership styles, pedagogical innovation skills, and teachers' 21st century competencies

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Abstract

Aim: This study examined the relationships among assessment literacy, transactional leadership styles, and pedagogical innovation skills in predicting senior high school teachers' 21st-century competencies in the Philippine public school context. It also aimed to determine the structural model that best explains the development of these competencies in response to the learning challenges highlighted by the Programme for International Student Assessment (PISA) 2022.

Methodology: The study employed a predictive correlational research design using Structural Equation Modeling (SEM). Data were collected from 193 senior high school teachers from the Department of Education–Iligan City Division through proportionate stratified random sampling. Validated survey instruments measured assessment literacy, transactional leadership styles, pedagogical innovation skills, and 21st-century competencies. Data were analyzed using descriptive statistics, Pearson correlation, multiple regression analysis, and SEM.

Results: Teachers demonstrated very high levels of assessment literacy, transactional leadership practices, pedagogical innovation skills, and 21st-century competencies. Pedagogical innovation skills emerged as the strongest predictor of teachers' 21st-century competencies. Regression results showed that pedagogical innovation skills and contingent reward significantly predicted teacher competencies. The validated structural model showed excellent fit indices and confirmed that assessment literacy and transactional leadership indirectly influence 21st-century competencies through pedagogical innovation skills.

Conclusion: Pedagogical innovation functions as a key mechanism that transforms foundational assessment and leadership competencies into advanced 21st-century teaching capabilities. The findings provide an evidence-based framework for faculty development programs to strengthen critical-thinking instruction, data-informed teaching practices, and proactive leadership strategies aligned with the MATATAG Curriculum and the Philippine Professional Standards for Teachers (PPST). These initiatives may help address teacher competency gaps that contribute to low student performance in international assessments such as PISA 2022.

Keywords: *assessment literacy, transactional leadership, pedagogical innovation, 21st-century competencies, structural equation modeling, PISA 2022, senior high school teachers*

INTRODUCTION

The evolution of education in the 21st century has fundamentally transformed the competencies required of teachers. Contemporary educators are expected to possess strong professional skills, including critical thinking, creativity, communication, and collaboration (Dacles, 2024; Muchtar et al., 2025). The effectiveness of educational systems increasingly depends on teachers' ability to develop these 21st-century competencies, which enable them to design meaningful learning experiences, lead diverse classrooms, and navigate complex school environments. When teachers embody these skills, they are better positioned to cultivate the same higher-order thinking abilities in their students.

The urgency of strengthening teacher competencies was highlighted by the results of the Programme for International Student Assessment (PISA) 2022. These results served as a critical indicator for the Philippines, where Filipino students ranked near the bottom in creative thinking among all participating countries and scored well below

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Organisation for Economic Co-operation and Development averages in mathematics, reading, and science, according to a 2023 report by the OECD. These findings reveal a significant disconnect among curriculum intentions, classroom practices, and student learning outcomes. Students are not developing the critical thinking and creative problem-solving skills essential for the 21st century. As emphasized by the OECD (2023), student performance is strongly linked to teacher quality, instructional methods, and the learning environment. The challenges Filipino students face in applying concepts and thinking critically partly reflect the difficulties teachers encounter in developing and modeling these same skills.

In the Philippine Senior High School (SHS) context, teachers face the daily task of preparing students for college and careers while managing classes across diverse academic tracks. Many educators struggle to translate curriculum guides into lessons that foster higher-order thinking skills (Caparroso & Pepito, 2025; Department of Education [DepEd], 2023). Research confirms that teachers' own 21st-century competencies directly affect their capacity to develop these skills in students (Dacles, 2024; Gümüş, 2022). The Philippine government has demonstrated commitment to addressing these challenges through reforms such as the K to 12 Program and the MATATAG Curriculum. However, studies indicate that many teachers continue to face difficulties in integrating these competencies into their daily instruction (Caparroso & Pepito, 2025; DepEd, 2023). This persistent gap between policy and classroom practice necessitates a systematic examination of the factors influencing contemporary teaching effectiveness.

Assessment literacy, leadership style, and pedagogical innovation have emerged as critical areas of focus in recent research (Pastore, 2023; Risonar et al., 2023; Awang et al., 2025). Assessment literacy, the ability to design, implement, and interpret assessments to support learning, is a foundational skill. However, many teachers lack the training and confidence to use assessment data effectively to improve instruction and student outcomes (Malabo, 2024; Pastore, 2023). Transactional leadership, characterized by structured exchanges, rewards for meeting expectations, and performance monitoring, is prevalent in Philippine schools. However, some researchers argue that its effectiveness in fostering innovation is limited unless combined with other approaches (Dong, 2023; Hieng et al., 2024). Pedagogical innovation, particularly in instructional design and technology integration, is crucial for engaging students and personalizing learning, though implementation is often constrained by limited resources and uneven access to training (Awang et al., 2025; Laid & Adlaon, 2025).

Despite growing research on each of these areas, few studies have examined how they collectively shape teachers' ability to develop the 21st-century skills assessed by international benchmarks such as PISA. This gap is particularly evident in local contexts such as Iligan City, where schools vary significantly in access to technology, leadership support, and training opportunities. Understanding the interplay between assessment literacy, transactional leadership, and pedagogical innovation in shaping teacher competencies is essential for designing programs that address the learning crises revealed by PISA 2022.

This study aimed to develop a growth plan that meets teachers' needs and enhances their capacity to deliver quality education by examining how these variables interact to shape teachers' 21st-century competencies. Aligned with Sustainable Development Goal (SDG) 4 and Target 4.c, which emphasizes increasing the supply of qualified teachers through professional development, this research identifies critical support areas, including assessment literacy, leadership practices, and innovative teaching methods, to inform the strategic design of professional learning programs. By strengthening teachers' 21st-century competencies, the study contributes to national priorities, including the MATATAG Curriculum, and to the broader objective of ensuring equitable access to well-prepared, effective educators (DepEd, 2025).

Review of Related Literature and Studies

PISA 2022 Results and Implications for Teacher Competencies

In PISA 2022, the Philippines ranked 77th in mathematics, 76th in science, and 75th in reading, with over 84% of students failing to reach Level 2 proficiency in mathematics (OECD, 2023). In the inaugural PISA creative thinking assessment, the country ranked 63rd out of 64 participants, scoring 14 compared to the OECD average of 33. These findings highlight teacher quality and instructional practices as critical determinants of student performance.

Assessment Literacy of Teachers

Assessment literacy is conceptualized as the knowledge and skills necessary to design, implement, and interpret assessments in ways that support learning. In the same study, moderate to high levels of assessment literacy among teachers were found to positively influence students' academic performance (Malabo, 2024). Pastore's (2023) systematic review revealed that while awareness of assessment principles has grown, many educators still struggle to translate theory into effective classroom practice. Assessment literacy comprises three core dimensions: testing literacy

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(creating valid, objective-aligned assessments), measurement literacy (understanding validity, reliability, and score interpretation), and data literacy (analyzing results to guide instruction). The PISA 2022 results underscore the importance of data literacy, as teachers must be able to analyze student performance data to identify learning gaps and adjust instruction accordingly.

Transactional Leadership of Teachers

Transactional leadership, when enacted by teachers in the classroom, involves establishing clear expectations and providing contingent rewards to shape student behavior and academic outcomes (Risonar et al., 2023). Ratna et al. (2022) found that this leadership style enhances academic performance through two key mechanisms: contingent reward (setting explicit learning targets and recognizing achievement) and management by exception (intervening when standards are not met, either actively through consistent monitoring or passively after problems arise). Together, these practices create a structured learning environment where students understand the direct link between effort and outcomes, fostering consistent engagement and performance. The importance of such structured environments is further supported by PISA 2022 findings, which highlight that classrooms characterized by clear expectations, consistent monitoring, and timely feedback are essential for developing students' foundational competencies. Such structured approaches also contribute to teacher job satisfaction and professional achievement, reinforcing the conditions that support sustained student success (Hieng et al., 2024).

Pedagogical Innovation Skills of Teachers

Pedagogical innovation skills refer to teachers' capacity to design, implement, and evaluate novel teaching strategies that enhance student learning outcomes (Awang et al., 2025). PISA 2022 results link high-performing systems to instruction emphasizing conceptual understanding, real-world application, and student-centered learning (OECD, 2023). Systematic reviews confirm that hands-on learning, technology integration, and student-centered approaches boost engagement, problem-solving, and critical thinking, though success depends on adequate training and resources (Laid & Adlaon, 2025). Similarly, Fang (2024) stresses that educators must apply methods such as problem-based learning and case studies to develop critical thinking and practical skills, while continuously updating their digital literacy and engaging in reflective practice. In this study, pedagogical innovations focused on two manifestations: instructional design (the deliberate planning and structuring of learning experiences) and technology integration (the purposeful use of digital tools to enhance teaching and learning).

21st-Century Competencies of Teachers

The 21st-century competencies encapsulated by the "4Cs" (critical thinking, creativity, communication, and collaboration) are fundamental goals for education. The alignment between teacher 21st-century competencies and student PISA performance is striking, as PISA measures precisely the kinds of higher-order thinking skills that the 4Cs represent. Empirical evidence confirms that teachers who exhibit high levels of these competencies, including critical thinking, creativity, collaboration, communication, and digital literacy, significantly enhance student learning outcomes, highlighting that such skills must be intentionally cultivated through teacher training programs (Dacles, 2024; Gümüş, 2022; Muchtar et al., 2025). When teachers lack these competencies themselves, they cannot effectively cultivate them in students.

Synthesis and Research Gap

The PISA 2022 results have brought into sharp focus the urgent need to strengthen teacher competencies in Philippine basic education. While the literature confirms the individual significance of assessment literacy, transactional leadership, and pedagogical innovation as contributors to teaching effectiveness, few studies have investigated how these competencies interact to shape teachers' 21st-century competencies. Existing research often employs descriptive designs, highlighting the need for more in-depth explanatory inquiry. This study addresses these gaps by examining the combined influence of these variables through Structural Equation Modeling (SEM), with explicit attention to the implications of the findings for addressing the learning crises documented in PISA 2022.

Theoretical Framework

This study is grounded in four interrelated theoretical models. The Assessment Literacy Framework (Malabo, 2024) emphasizes that teachers must be proficient in designing, administering, and interpreting assessments to make sound instructional decisions. Transactional Leadership Theory (Bass, 1985) highlights how structured leadership practices help achieve professional goals through contingent reward and management by exception. The Technological Pedagogical Content Knowledge (TPACK) Framework (Mishra & Koehler, 2006) stresses the dynamic integration of

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technology, pedagogy, and content in effective teaching. Finally, the Partnership for 21st-Century Learning (P21) Framework provides a concrete model of essential competencies through the "4Cs" (critical thinking, creativity, communication, and collaboration), which directly align with the cognitive skills assessed in PISA (Partnership for 21st-Century Skills, 2019). These theories collectively guided the research design by defining the key constructs, informing the selection and development of instruments, and shaping the interpretation of the relationships among variables.

Conceptual Framework

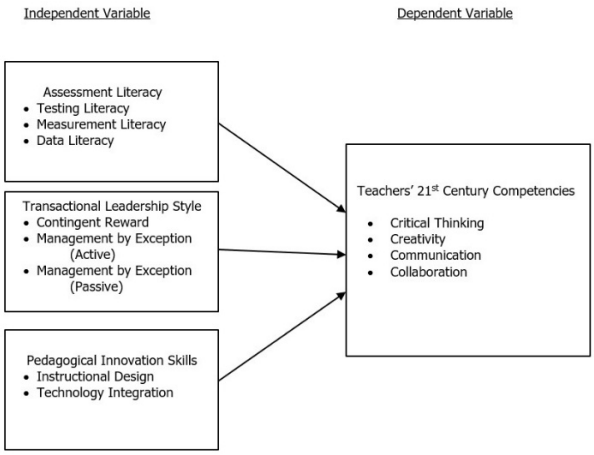

Figure 1. Research Paradigm

The conceptual framework outlined the hypothesized relationships between three independent variables: assessment literacy (testing, measurement, and data literacy), transactional leadership style (contingent reward, management by exception active, and management by exception passive), and pedagogical innovation skills (instructional design and technology integration) and their influence on one dependent variable: teachers' 21st-century competencies (critical thinking, creativity, communication, and collaboration). These competencies serve dual roles as key student learning goals and as professional attributes that teachers must embody to prepare students for the complex, real-world challenges assessed in PISA.

Statement of the Problem

The rapid transformation of education in the 21st century requires teachers to develop competencies that support higher-order thinking, creativity, collaboration, and effective communication. However, international assessments such as the Programme for International Student Assessment (PISA) 2022 have revealed significant learning gaps among Filipino students, particularly in critical thinking and creative problem-solving. These findings suggest that teachers may face challenges in translating curriculum goals into classroom practices that foster the development of these competencies.

In the Philippine Senior High School context, teachers are expected to design meaningful learning experiences while managing diverse academic tracks and integrating modern instructional approaches. Although national reforms such as the K-12 Program and the MATATAG Curriculum aim to strengthen teaching quality, many educators continue to struggle to implement instructional strategies that promote 21st-century skills. These challenges highlight the need to examine teacher-related factors that influence the development of these competencies.

Previous studies have identified assessment literacy, leadership practices, and pedagogical innovation as important factors in improving instructional effectiveness. However, many existing studies have examined these variables independently, with limited research investigating how they interact to shape teachers' 21st-century competencies. Furthermore, few studies have applied advanced statistical modeling techniques such as Structural Equation Modeling (SEM) to examine the complex relationships among these variables.

Given these gaps, there is a need to examine how assessment literacy, transactional leadership styles, and pedagogical innovation skills collectively influence teachers' 21st-century competencies. Understanding these relationships is essential for designing professional development programs that strengthen teacher capacity and address the learning challenges highlighted by international assessments.

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Thus, this study investigates the relationships among assessment literacy, transactional leadership styles, and pedagogical innovation skills in predicting teachers' 21st-century competencies among senior high school teachers in the Department of Education - Iligan City Division.

General Objective

To determine the influence of assessment literacy, transactional leadership styles, and pedagogical innovation skills in predicting teachers' 21st-century competencies, with implications for addressing learning gaps identified in PISA 2022.

Specific Objectives

This study aimed to:

1. Determine the level of teachers' assessment literacy in terms of:
    1.1 testing literacy;
    1.2 measurement literacy, and
    1.3 data literacy
2. Determine the level of transactional leadership styles practiced by teachers in terms of:
    2.1 contingent reward;
    2.2 management by exception (active), and
    2.3 management by exception (passive)
3. Determine the level of teachers' pedagogical innovation skills in terms of:
    3.1 instructional design and
    3.2 technology integration
4. Determine the level of teachers' 21st-century competencies in terms of:
    4.1 critical thinking;
    4.2 creativity;
    4.3 communication, and
    4.4 collaboration
5. Examine the significant relationship between teachers' 21st-century competencies and their:
    5.1 assessment literacy;
    5.2 transactional leadership styles, and
    5.3 pedagogical innovation skills
6. Identify which among the independent variables significantly predict teachers' 21st-century competencies.
7. Determine the structural model that best explains teachers' 21st-century competencies.

Research Questions

This study sought to answer the following questions:

1. What is the level of teachers' assessment literacy in terms of:
    1.1 testing literacy;
    1.2 measurement literacy, and
    1.3 data literacy?
2. What is the level of transactional leadership styles practiced by teachers in terms of:
    2.1 contingent reward;
    2.2 management by exception (active), and
    2.3 management by exception (passive)?
3. What is the level of teachers' pedagogical innovation skills in terms of:
    3.1 instructional design and
    3.2 technology integration?
4. What is the level of teachers' 21st-century competencies in terms of:
    4.1 critical thinking;
    4.2 creativity;
    4.3 communication, and
    4.4 collaboration?
5. Is there a significant relationship between teachers' 21st-century competencies and their:
    5.1 assessment literacy;

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5.2 transactional leadership styles, and
5.3 pedagogical innovation skills?

6. Which among the independent variables significantly predict teachers' 21st-century competencies?
7. What structural model best explains teachers' 21st-century competencies?

Hypotheses

H_{01}: There is no significant relationship between teachers' 21st-century competencies and their assessment literacy, transactional leadership styles, and pedagogical innovation skills.
H_{02}: None of the independent variables significantly predicts teachers' 21st-century competencies.
H_{03}: There is no structural model that significantly explains teachers' 21st-century competencies.

METHODS

Research Design

This study employed a quantitative predictive correlational design with Structural Equation Modeling (SEM). The descriptive component assessed levels of key variables, while the correlational component examined their relationships and collective role in shaping teachers' 21st-century competencies. This design was suitable for identifying associations and testing the best-fitting structural model.

Population and Sampling

The participants were 193 senior high school teachers from the Department of Education – Division of Iligan City. They were selected through proportionate stratified random sampling using Yamane's formula from a total population of 372 teachers. Inclusion criteria required at least two years of teaching experience and participation in professional development programs related to assessment, leadership, or innovation. This sampling method ensured representation across different school types and teaching tracks within the division.

Research Instruments

To ensure the instrument's appropriateness, content validation and reliability testing were conducted. Three subject-matter experts—the MAEd Chairperson, a Graduate School faculty member, and a psychometrician—all holding at least a master's degree with extensive experience in educational measurement and assessment, evaluated the instrument using a 5-point validity scale, yielding a mean rating of 4.62 (very highly valid). Reliability was established through a pilot administration involving 30 senior high school teachers who were not part of the actual study sample. Cronbach's alpha coefficients were calculated for each subscale, and all constructs obtained acceptable reliability values above the recommended threshold of 0.70.

Data were collected using a 5-point Likert-scale survey questionnaire divided into five sections. The first section gathered demographic information. The second section measured assessment literacy and was adapted from Malabo (2024); it comprised 12 items for testing literacy, 12 for measurement literacy, and 16 for data literacy. The third section assessed transactional leadership styles and was adapted from the Multifactor Leadership Questionnaire (Bass & Avolio, 1995); it included 10 items for contingent reward, 10 for management by exception active, and 9 for management by exception passive. The fourth section measured pedagogical innovation skills using an instrument adapted from Schmid et al. (2020), consisting of 14 items for instructional design and 14 for technology integration. The fifth section evaluated teachers' 21st-century competencies using the instrument adapted from Mallillin et al. (2021), comprising 11 items each for critical thinking, creativity, communication, and collaboration.

Data Collection Procedure

The procedure followed three phases. Pre-implementation: The researchers obtained adviser approval, the dean's endorsement, and clearance from the Liceo de Cagayan University Research Ethics Committee. Implementation: After securing approval from the DepEd–Iligan City Division Superintendent, the researchers coordinated with school administrators. Orientation meetings were conducted with potential participants. Informed consent was obtained, and questionnaires were administered in both online and printed formats over four weeks, with a completion time of 20 to 60 minutes. Post-implementation: Collected data were compiled, coded, and analyzed quantitatively. All data were stored in password-protected digital folders for ten years per institutional policy.

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Treatment of Data

Descriptive statistics (mean and standard deviation) were used to determine the levels of assessment literacy, transactional leadership styles, pedagogical innovation skills, and 21st-century competencies.

Pearson's Correlation Coefficient (r) was used to examine the significance of relationships between the independent variables and the dependent variable.

Multiple regression analysis was employed to identify which independent variables significantly predicted teachers' 21st-century competencies.

Structural Equation Modeling (SEM) was conducted to examine structural or predictive relationships among latent variables and to identify the best-fitting structural model, using maximum likelihood estimation and evaluating model fit through multiple indices, including CMIN/DF, Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), and Root Mean Square Error of Approximation (RMSEA), based on established criteria. All statistical tests were conducted at the 0.05 level of significance.

Ethical Considerations

Ethical standards were strictly observed throughout the study. The necessary ethical bodies and school officials gave their approval. Written informed consent was secured from all participants, ensuring their voluntary participation. To maintain confidentiality, all data were anonymized and securely stored. The researchers ensured that no personally identifiable information appeared in reports or publications, in accordance with the Data Privacy Act of 2012 and institutional standards. Participants were informed of their right to withdraw at any time, and the findings were shared with the school community.

RESULTS and DISCUSSION

This section presents and discusses the study's results in relation to the research questions. Findings are interpreted in relation to learning theory and relevant empirical studies to explain observed outcomes.

1. Level of Participants' Assessment Literacy

Table 1 shows that teachers demonstrated an overall mean of 4.52 (SD = 0.445) in assessment literacy, which is interpreted as very high literacy. Among the sub-constructs, testing literacy (M = 4.54, SD = .457) and measurement literacy (M = 4.54, SD = .491) both indicated very high proficiency, while data literacy (M = 4.48, SD = .438) was the lowest domain, though still within the high literacy range. This means teachers are skilled at creating tests and applying measurement principles, important for handling the diverse tracks and large classes in Philippine senior high schools.

Table 1
Participants' Assessment Literacy Levels

Sub-constructs	Mean	SD	Interpretation
Testing Literacy	4.54	.457	Very High Literacy
Measurement Literacy	4.54	.491	Very High Literacy
Data Literacy	4.48	.438	High Literacy
Overall Mean	**4.52**	**.445**	**Very High Literacy**

However, relatively low data literacy suggests that teachers struggle to translate assessment results into instructional improvements, a pattern consistent with Malabo (2024) and Pastore (2023). Such a gap may be further exacerbated by teacher-subject mismatch (Caparroso & Pepito, 2025) and a prevailing transactional leadership culture that prioritizes compliance over data-driven instructional inquiry (Dong, 2023; Risonar et al., 2023).

For educational practice, this finding implies that professional development programs should move beyond test construction and prioritize building teachers' capacity to interpret and apply data for differentiation and remediation. Strengthening data literacy is particularly critical, as PISA 2022 results show that Filipino students' low performance highlights the need for teachers to precisely diagnose learning gaps and adjust instruction accordingly (OECD, 2023; Malabo, 2024).

2. Level of Participants' Transactional Leadership Styles

Table 2 reveals that teachers reported frequently practicing transactional leadership, with an overall mean of 4.27 (SD = 0.583). Contingent reward (M = 4.67; SD = .441) and management by exception-active (M = 4.60; SD = .439) were fully practiced, whereas management by exception-passive was lower (M = 3.54, SD = 1.26) and showed greater variability. This indicates that teachers consistently use positive reinforcement and active monitoring, and they tend to intervene before problems escalate, a practice aligned with effective classroom management.

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Table 2
Participants' Transactional Leadership Styles

Sub-constructs	Mean	SD	Interpretation
Contingent Reward	4.67	.441	Fully Practiced
Management by Exception Active	4.60	.439	Fully Practiced
Management by Exception Passive	3.54	1.26	Frequently Practiced
Overall Mean	**4.27**	**.583**	**Frequently Practiced**

This pattern aligns with Bass's (1985) transactional leadership theory, which emphasizes contingent reward and active monitoring as key dimensions. The high ratings for these dimensions show that teachers consistently use rewards and proactive monitoring to manage their classrooms, a finding that corroborates the positive influence of transactional leadership on student outcomes reported by Ratna et al. (2022). Hieng et al. (2024) and Risonar et al. (2023) similarly found that such structured practices promote orderly learning environments and strengthen classroom competencies. However, the variability in passive management also suggests that some teachers may benefit from targeted coaching on early intervention strategies to prevent minor issues from becoming significant barriers to learning.

3. Level of Participants' Pedagogical Innovation Skills

Table 3 shows that teachers reported very high innovation skills, with an overall mean of 4.58 (SD = .429). Instructional design (M = 4.59, SD = .420) and technology integration (M = 4.57, SD = .456) were both rated as very high. This finding reflects teachers' confidence in designing creative, student-centered lessons and in using digital tools to enhance learning.

Table 3
Participants' Pedagogical Innovation Skills

Sub-constructs	Mean	SD	Interpretation
Instructional Design	4.59	.420	Very High Innovation Skills
Technology Integration	4.57	.456	Very High Innovation Skills
Overall Mean	**4.58**	**.429**	**Very High Innovation Skills**

The high scores in both sub-constructs suggest that these skills are mutually reinforcing, supporting the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes integrating technology, pedagogy, and content as essential for effective teaching. The strong performance ratings reflect teachers' confidence in designing engaging lessons and using digital tools. Awang et al. (2025) found that digital competence and self-efficacy are key drivers of innovative teaching, while Laid and Adlaon (2025) highlighted that technology integration and student-centered approaches foster critical thinking skills essential for addressing the higher-order thinking gaps identified in PISA 2022. To build on these strengths, professional development should help teachers use digital tools more purposefully to deepen student learning (Laid & Adlaon, 2025).

4. Level of Participants' 21st-Century Competencies

Table 4 shows that teachers demonstrated very high levels of 21st-century competencies, with an overall mean of 4.61 (SD = .421). Communication and collaboration both scored the highest (M = 4.64, SD = .429 and .446, respectively), followed by creativity (M = 4.62, SD = .444) and critical thinking (M = 4.56, SD = .435), all within the very high competence range. This suggests that while teachers feel confident working with others, they may feel less prepared to teach students how to think critically.

Table 4
Participants' 21st-Century Competencies

Sub-constructs	Mean	SD	Interpretation
Critical Thinking	4.56	.435	Very High Competence
Creativity	4.62	.444	Very High Competence
Communication	4.64	.429	Very High Competence
Collaboration	4.64	.446	Very High Competence
Overall Mean	**4.61**	**.421**	**Very High Competence**

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This finding aligns with the results of the Philippines' PISA 2022 assessment, in which students struggled most with creative thinking and analytical reasoning (OECD, 2023). Dacles (2024) found that when teachers had stronger 21st-century skills, their students also performed better in these areas. Gümüş (2022) adds that research shows teacher skills account for as much as 75% of what schools contribute to student achievement. Together, these studies confirm that a teacher's own abilities directly affect how well students learn.

To improve student outcomes, professional development must go beyond one-time workshops. Instead, it should provide ongoing, subject-specific coaching that helps teachers learn practical ways to build critical thinking into everyday lessons. Strengthening teachers' confidence in teaching higher-order thinking, as recommended by both Dacles (2024) and Gümüş (2022), is a key step toward addressing the gaps seen in PISA and preparing students with the thinking skills they need for the future.

5. Significant Relationship between Participants' 21st-Century Competencies and their Assessment Literacy, Transactional Leadership Styles, and Pedagogical Innovation Skills

Table 5 shows that all three independent variables were significantly related to teachers' 21st-century competencies at $p < 0.01$. Pedagogical innovation skills showed the strongest correlation ($r = .903$), indicating a very strong positive relationship. Assessment literacy ($r = .566$) and transactional leadership ($r = .545$) demonstrated moderate positive relationships.

Table 5
Relationship between Participants' 21st-Century Competencies and their Assessment Literacy, Transactional Leadership Styles, and Pedagogical Innovation Skills

Variables	N	R	P-value	Interpretation
Testing Literacy	193	.446	.000	Significant
Measurement Literacy	193	.521	.000	Significant
Data Literacy	193	.672	.000	Significant
Overall Literacy	193	**.566**	.000	**Significant**
Contingent Reward	193	.732	.000	Significant
Management by Exception Active	193	.659	.000	Significant
Management by Exception Passive	193	.270	.000	Significant
Overall Transactional Leadership Styles	193	**.545**	.000	**Significant**
Instructional Design	193	.883	.000	Significant
Technology Integration	193	.886	.000	Significant
Overall Pedagogical Innovation Skills	**193**	**.903**	**.000**	**Significant**

Legend: p<.05 is significant and p>.05 is not significant

These findings aligned with Dacles (2024), who established a strong link between 21st-century teaching competencies and learning skills, and with Laid and Adlaon (2025), whose study confirmed that student-centered, hands-on, and technology-integrated strategies directly foster critical thinking and collaboration. The exceptionally strong correlation between pedagogical innovation and 21st-century competencies suggests that teachers adept at designing creative, technology-integrated lessons are also those who most confidently demonstrate the 4Cs—skills that PISA 2022 found Filipino students lacking (OECD, 2023).

However, Dong (2023) cautions that overreliance on transactional leadership may constrain innovation, indicating that its moderate correlation warrants a balanced application. Malabo (2024) adds that foundational assessment literacy serves as a distinct yet supporting competency, consistent with the moderate relationship observed. Collectively, the results affirm that strengthening pedagogical innovation should remain the central focus, with assessment literacy and transactional leadership developed as supporting factors rather than key levers of 21st-century competencies.

6. Predictor of Participants' 21st Century Competencies from Literacy, Transactional Leadership Style Practice, and Pedagogical Innovative Skills

Table 6 presents the multiple regression results indicating that the model significantly predicted teachers' 21st-century competencies, explaining 85.8% of the variance. Among the predictors, pedagogical innovation skills emerged as the strongest positive predictor ($\beta = .596$, $p < .001$), followed by contingent reward ($\beta = .398$, $p < .001$). Testing literacy ($\beta = -.346$, $p < .001$) and management by exception-active ($\beta = -.324$, $p < .001$) were significant negative predictors.

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Table 6
Multiple Regression Analysis Results

Predictors	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Interpretation
	B	Std. Error	Beta			
(Constant)	.561	.149		3.75	.000	Significant
Testing Literacy	-.318	.084	-.346	-3.78	.000	Significant
Measurement Literacy	.267	.090	.312	2.96	.003	Significant
Data Literacy	.077	.070	.080	1.10	.271	Not Significant
Contingent Reward	.379	.067	.398	5.69	.000	Significant
Management by Exception Active	-.311	.072	-.324	-4.28	.000	Significant
Management by Exception Passive	.026	.011	.077	2	.021	Significant
Instructional Design	.181	.148	.180	1.22	.223	Not Significant
Overall Pedagogical Innovation Skills	.584	.139	.596	4.19	.000	Significant
R=.927	**R^2=.858**	**F (8, 184) =139.51**		**P-value=.000**		

The strong influence of pedagogical innovation skills was supported by Awang et al. (2025) and Dacles (2024), who found that digital skills and confidence are key to 21st-century competencies. Contingent reward also has a positive effect, consistent with studies showing that supportive leadership practices improve teaching (Hieng et al., 2024; Risonar et al., 2023). In contrast, the negative effect of testing literacy suggests that overemphasizing test creation can detract from creative teaching (Fang, 2024; Malabo, 2024). Likewise, constant management by exception active may limit teachers' ability to try new, student-centered approaches (Dong, 2023).

This finding holds particular significance in the context of the Philippine Senior High School, where the MATATAG Curriculum aims to build 21st-century skills. However, teachers face pressures from college entrance exams and subject mismatches (Caparroso & Pepito, 2025). Professional development should therefore focus on strengthening pedagogical innovation skills while ensuring that testing literacy and management by exception provides active support rather than hindering this goal (Muchtar et al., 2025).

7. Structural Model Best Fitting Participants' 21st-Century Competencies

Figure 2 shows the validated structural model demonstrated excellent fit indices (CMIN/DF = 1.57, CFI = .997, RMSEA = .050, NFI = .992, TLI = .990, GFI = .978). Assessment literacy had a negative direct effect on competencies (β = -.223), while transactional leadership had a strong positive direct effect (β = .906). Critically, the model confirmed that assessment literacy and transactional leadership indirectly influence 21st-century competencies through pedagogical innovation, establishing pedagogical innovation as the essential mediating mechanism.

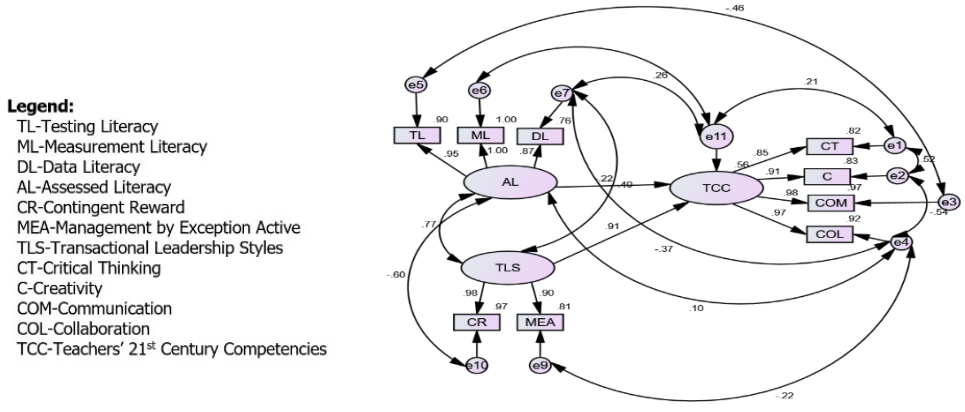

Figure 2. Structural Model-3 of Teachers' 21st Century Competencies

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This mediation reveals the crucial insight that knowing how to assess students is not sufficient; assessment knowledge must instead actively fuel creative lesson design. Likewise, transactional leadership practices such as contingent reward and active monitoring support 21st-century competencies primarily by creating the structured conditions under which pedagogical innovation can flourish. In other words, strong assessment skills and effective classroom management lead to advanced 21st-century teaching only when teachers use these foundational competencies to create innovative, adaptable lessons.

For educational practice, this model offers an evidence-based framework for faculty development. It aligns directly with DepEd's policy framework: assessment literacy corresponds to the Philippine Professional Standards for Teachers (PPST) Domain 5 (Assessment and Reporting); transactional leadership aligns with the Results-Based Performance Management System (RPMS); and the 4Cs are the explicit goals of the K to 12 Program and the MATATAG Curriculum. Professional development must therefore intentionally connect assessment and leadership practices to pedagogical innovation, ensuring that teachers do not simply acquire isolated skills but learn to integrate them in ways that transform classroom practice (Pastore, 2023; Awang et al., 2025).

Conclusions

This study found that SHS teachers in Iligan City have very high assessment literacy, except for data literacy, which needs strengthening; they fully practice contingent reward and active leadership, show very high pedagogical innovation skills, and demonstrate very high 21st-century competencies. All these factors are significantly connected. Pedagogical innovation is the strongest predictor; a teacher's ability to design creative lessons and use technology well is what most determines their capacity to teach critical thinking, creativity, communication, and collaboration. The structural model confirms that assessment literacy and transactional leadership enhance 21st-century skills only when embedded in pedagogical innovation. Knowing how to assess and manage a classroom only transforms into teaching modern skills when it leads to creative, adaptable lesson design. These findings directly address the challenge highlighted by the Philippines' performance in international assessments. The relative weakness in critical-thinking instruction among teachers suggests they need more support in crafting lessons that enable students to explore, imagine, and solve problems rather than merely memorize. Strengthening teachers' pedagogical innovation skills, particularly in fostering critical thinking, is the most strategic investment to improve student outcomes.

Recommendations

Based on the study's conclusions, the following recommendations are offered.

1. Educational institutions and policymakers may implement a targeted program to institutionalize critical-thinking pedagogy across learning areas as part of the MATATAG Curriculum rollout. This program may be embedded within ongoing training, providing subject-specific Learning Action Cells (LACs) for each senior high school track to model lesson design with authentic problems and assessments that demand analysis, directly addressing the cognitive skills where Filipino students struggled most in PISA 2022.
2. School administrators and educational leaders may launch hands-on, data-informed instructional coaching initiatives to deepen the application of PPST Domain 5 (Assessment and Reporting), integrated into school-based In-Service Training (INSET) and RPMS coaching cycles to address learning gaps contributing to low international assessment performance.
3. Senior high school teachers may create curated technology integration labs focused on pedagogical problems through enhanced LACs, ensuring purposeful technology use that supports the National ICT Competency Standards for Teachers (NICS), critical for improving capacities underlying student PISA performance.
4. Teachers may implement structured peer observation protocols within professional learning communities to exchange effective classroom management and instructional strategies, aligned with the school's Child Protection Policy and Positive Behavioral Interventions and Supports (PBIS) framework, to foster supportive environments and strengthen students' 21st-century competencies.
5. Future researchers may conduct longitudinal follow-up studies examining the direct correlation between teachers' demonstrated 21st-century competencies and measurable student academic performance outcomes, such as the National Achievement Test (NAT) and future PISA cycles, as well as explore why testing literacy was negatively related to these competencies and how assessment practices might be reformed to support deeper learning.

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