Teaching Strategies and their Effects on Competency Assessment Performance of Senior High School Students

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ABSTRACT

Computer Systems Servicing (CSS) is a vital specialization under the Senior High School Technical-Vocational-Livelihood (TVL) track, equipping students with essential technical skills for employability and industry certifications such as TESDA's National Certificate II (NC II). This study investigates the effectiveness of teaching strategies on CSS assessment performance among Senior High School students in the Schools Division of Ilocos Norte. Using a mixed-methods research design, data were collected from 13 CSS teachers and 96 student graduates, analyzed through descriptive statistics, correlation, and ANOVA. Findings reveal that Demonstration, Lecture-Based Discussions, and Laboratory-Based Learning are the most effective strategies, positively correlating with student competency outcomes. Approximately 73% of 890 assessed students achieved competency, highlighting the significance of hands-on and learner-centered approaches. Students rated strategies involving real-world applications, interactive activities, and constructive feedback highly, emphasizing their role in fostering engagement, confidence, and skill mastery. However, innovative methods such as flipped classrooms and virtual laboratories were underutilized, underscoring gaps in resource allocation and teacher training.

The study concludes that the quality and proper implementation of teaching strategies are critical to improving competency outcomes, rather than the quantity of methods employed. Recommendations include prioritizing high-impact, practical strategies, integrating modern teaching approaches, and addressing resource limitations to enhance CSS instruction. By bridging these gaps, educators can better prepare students for certifications, employment, and lifelong learning, contributing to workforce development and national progress.

Keywords: Computer Systems Servicing, teaching strategies, technical-vocational education, learner-centered approaches, TESDA NC II.

INTRODUCTION

Computer Systems Servicing (CSS) is a core specialization in the Senior High School Technical-Vocational-Livelihood (TVL) track that equips learners with competencies in computer hardware servicing, networking, and troubleshooting—skills vital for employability and for obtaining national certifications such as the NC II in CSS. As industries become more technology-driven, CSS serves as a pathway for students to acquire practical expertise that can lead to immediate employment or further technical training [21].

Despite its importance, student performance in CSS varies significantly. Some learners excel in practical assessments, while others struggle to meet competency standards. Factors contributing to these challenges include limited engagement, lack of problem-solving skills, and traditional teaching methods that emphasize rote memorization over applied learning [19]. These performance gaps highlight the need for innovative and student-centered teaching strategies.

Research increasingly supports approaches such as Problem-Based Learning (PBL) and blended learning to address these issues. PBL emphasizes real-world problem scenarios, fostering critical thinking, collaboration, and self-directed learning [13]. In vocational education, blended models that integrate PBL with e-learning have been shown to improve both technical competencies and soft skills like teamwork and communication [23]. For instance, [10]. developed and validated a PBL-based blended learning model in vocational computer engineering that significantly improved learner outcomes. Likewise, [2] found that project-based and problem-based approaches are increasingly dominant in TVET globally due to their capacity to cultivate essential 21st-century skills.

Blended learning approaches also align with current pedagogical trends in TVET, leveraging both face-to-face and digital platforms for flexible and interactive learning [11]. These strategies have been associated with increased engagement [6] and more effective skill development, particularly in technical-vocational contexts where hands-on application is critical.

Ultimately, enhancing CSS instruction through evidence-based teaching strategies supports the broader objectives of Sustainable Development Goal 4 (SDG 4), which advocates for inclusive and equitable quality education. By integrating innovative, learner-centered approaches, educators can better prepare CSS students for certification, employment, and lifelong learning, thereby contributing to both individual success and national workforce development.

RESEARCH METHODS

Research Design

This study employs mixed-methods research design, integrating both Descriptive-Correlational research to examine the impact of teaching strategies on the CSS assessment performance of senior high school students in Ilocos Norte. This enabled the researchers to investigate the matter and the related factors from multiple viewpoints; the identified data helped the researchers understand the influence of teaching strategies on the CSS assessment performance of senior high school students in Ilocos Norte.

Locale of the Study

This study was conducted within the Schools Division of Ilocos Norte (SDOIN), the largest division in the province. SDOIN comprises 13 secondary schools offering the Computer System Servicing (CSS) specialization under the Technical-Vocational-Livelihood (TVL) track. Of these schools, 12 are public secondary schools, and 1 is a private secondary school. These institutions are directly relevant to the research as they provide programs designed to equip Senior High School students with the theoretical knowledge and practical skills needed for computer system-related careers.

An integral feature of these schools is their commitment to ensuring students are prepared for industry standards. After completing the school year, students enrolled in the CSS program are given the opportunity to undergo the National Certificate II (NCII) competency assessment. This assessment evaluates their proficiency in both theoretical concepts and practical applications of computer system servicing, serving as a benchmark for their readiness to enter the workforce or pursue higher education in related fields.

The study focused on these institutions to examine the teaching strategies employed in CSS subjects and their impact on students' assessment performance, particularly in relation to their NCII competency outcomes.

Population and Sampling Procedures

The respondents of this study consisted of 13 CSS teachers and 96 Senior High School students graduates in the CSS strand under the TVL track, as shown in Table 1. The 13 teacher-respondents were selected using total enumeration, as all CSS teachers from the 13 identified schools offering the CSS specialization were included in the study. This approach ensured that every teacher actively handling the CSS subject during the time of data collection provided valuable insights into the teaching strategies and practices used in the subject.

For the student-respondents, a total of 96 students participated in the study. These students were selected from the same schools offering the CSS strand using voluntary response sampling. This method was chosen to ensure ethical compliance, particularly with respect to informed consent and the students' willingness to participate. By using voluntary sampling, the study respected the students' autonomy, allowing only those who were genuinely interested and comfortable to take part in the research. This approach also helped minimize potential bias or pressure, as participation was entirely based on the students' decision to contribute their insights and experiences. Voluntary response sampling, therefore, ensured that the data collected from student-respondents was honest, meaningful, and reflective of their true perspectives.

Additionally, the study included gradautes who underwent assessment at an accredited assessment center in the Ilocos Norte between 2021 and 2024. These students were specifically selected due to the challenges faced by assessment candidates following the 2021 updates to TESDA's Training Regulations. These updates introduced new guidelines for the Amendments of Tools, Equipment and Materials (TEM), Training Facilities (TF), and Trainers' Qualifications (TQ) across seventy-five (75) Training Regulations under various sectors. The inclusion of these students was vital to understanding the impact of these amendments on the assessment process, particularly in the CSS strand. By focusing on this group, the study aimed to capture how the changes in tools, equipment, facilities, and trainer qualifications influenced the students' competency and learning experiences during their assessment. This decision ensured that the findings reflect the challenges and adjustments faced by both students and teachers in adapting to the updated regulations.

TABLE I DEMOGRAPHIC PROFILE OF THE RESPONDENTS FROM THIRTEEN SECONDARY SCHOOLS

School	Teacher-Respondents	Student-Respondents
School A	1	8
School B	1	7
School C	1	6
School D	1	10
School E	1	9
School F	1	6
School G	1	8
School H	1	7
School I	1	6
School J	1	8
School K	1	7
School L	1	8
School M	1	6
Total	**13**	**96**

Research Instrument

The study employed a researcher-made survey questionnaire as the primary data-gathering instrument, which was developed based on an extensive review of literature to ensure alignment with the research objectives. Two separate questionnaires were created: one for CSS teachers and another for Grade 12 CSS students.

The questionnaire for teachers was divided into three parts. Part I focused on the demographic profile of the respondents, gathering basic information such as name (optional), age, gender (optional), and school name using a checklist format. Part II consisted of a checklist of various teaching strategies employed by CSS teachers in their teaching process, along with two open-ended questions to collect qualitative insights. Part III gathered data on the total number of competent and non-competent students in CSS assessment performance, providing quantitative information about student outcomes.

The questionnaire for Grade 12 CSS students was divided into two parts. Part I collected demographic information, including name (optional), age, gender (optional), and school name. Part II measured students' perceptions of teaching strategies using a 5-point Likert scale (5 - Strongly Agree, 4 - Agree, 3 - Neutral, 2 - Disagree, 1 - Strongly Disagree). This section focused on how various teaching strategies impacted the students' learning experiences and overall educational outcomes.

Additionally, interviews were conducted with students who failed the NC II assessment. These methods allowed researchers to explore deeper insights into the challenges faced by students, perceived gaps in teaching strategies, resource limitations, and suggestions for improvement. The interview guide included open-ended questions focusing on the students' experiences with CSS concepts, instructional methods, and available resources, ensuring a comprehensive understanding of their struggles and perspectives. This combination of instruments provided a robust framework to analyze both the statistical trends and the underlying reasons for competency gaps.

To ensure the integrity and validity of the research instruments, the survey questionnaire underwent rigorous content validation by a panel of experts composed of experienced educators and research professionals. Their feedback helped refine the structure, wording, and clarity of the questionnaire. Additionally, a pilot test was conducted with 20 respondents who were not part of the actual study sample, yielding a Cronbach's alpha coefficient of 0.87, which indicated high reliability and consistency of the instrument. The final version of the survey questionnaire was administered digitally using Google Forms to ensure efficient data collection and accessibility for all respondents.

Data Gathering Procedure

The researchers employed a systematic approach to gather data for the study, which aimed to examine the teaching strategies used in Computer Systems Servicing (CSS) and their impact on the performance of students who underwent assessment between 2021 and 2024. To identify the appropriate teacher-respondents, the researchers formally requested the Schools Division Office of Ilocos Norte (SDOIN) to provide a list of schools offering the CSS strand under the Technical-Vocational-Livelihood (TVL) track. A request letter was prepared, clearly outlining the study's objectives and emphasizing the importance of identifying these schools to ensure the relevance and accuracy of the research. Upon receiving the list, official correspondence was sent to the school heads of the identified institutions, requesting the names of CSS teachers actively teaching the strand. These letters explained the purpose of the study and assured the school heads and teachers of the confidentiality of their responses and the voluntary nature of their participation. This step was essential for gathering insights into the teaching strategies employed by CSS teachers, the challenges they encountered, and how these strategies influenced their students' preparation for the TESDA assessments.

In addition, the researchers included student-respondents who had undergone assessment at an accredited assessment center in the province between 2021 and 2024. These students were selected because they directly experienced the impact of TESDA's updated Training Regulations introduced in 2021, which included significant changes to Tools, Equipment, and Materials (TEM), Training Facilities (TF), and Trainers' Qualifications (TQ) (TESDA, 2021). The inclusion of these student-respondents was critical to the study, as their performance during the assessments provided direct evidence of how teaching strategies in CSS influenced their competencies and preparedness. Data were gathered on the challenges these students faced in adapting to the updated training standards and how the teaching strategies employed by their CSS teachers helped them overcome these obstacles.

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Statistical Treatment

The data gathered underwent thorough processing to ensure accuracy and reliability. The process began with data cleansing, where the researchers reviewed all responses and removed incomplete entries or invalid submissions. After cleansing, the data were organized and tabulated using Microsoft Excel for preliminary processing. Responses were systematically arranged according to the study's variables to prepare them for more advanced statistical analysis.

The organized data were then transferred to the Statistical Package for Social Sciences (SPSS) version 26, which served as the primary software for complex statistical computations. Descriptive statistics, such as frequency counts and percentages, were used to analyze the demographic profile of the respondents and summarize key variables. Mean scores were utilized to interpret responses related to teaching strategies, student competency levels, and perceptions of instructional methods.

For the analysis of teaching strategies, frequency distributions and percentages were used to identify the most commonly employed strategies. For student competency levels, descriptive statistics summarized the number of competent and non-competent students during the assessment period.

To examine the impact of teaching strategies on student performance, one-way ANOVA was performed to determine whether variations in teaching strategies led to statistically significant differences in assessment outcomes. For the relationship between teaching strategies and student performance, the Pearson Correlation Coefficient was used to measure the strength and direction of the relationship. Additionally, multiple regression analysis was conducted to identify which teaching strategies had the strongest predictive influence on student performance.

Students' perceptions of teaching strategies were analyzed using descriptive statistics. Mean scores were interpreted using the following scale: 3.25–4.00 (Strongly Agree), 2.50–3.24 (Agree), 1.75–2.49 (Disagree), and 1.00–1.74 (Strongly Disagree). These interpretations provided insights into how students viewed the effectiveness of the teaching strategies used in their CSS classes.

Meanwhile, thematic analysis was applied to explore the insights from students who failed the competency assessment using the Braun and Clarke model [25]. This approach involved systematically categorizing student responses into themes and ranks to identify recurring challenges and actionable insights. By following the six phases of Braun and Clarke—familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report—the analysis provided a structured framework for uncovering patterns in student feedback. This method enabled a deeper understanding of the obstacles faced by students and highlighted areas for improvement in teaching strategies and curriculum design to better support their success in future competency assessments.

This systematic approach to statistical analysis ensured a comprehensive and reliable examination of the connection between teaching strategies and student performance, offering valuable insights for CSS educators and institutions.

Ethical Consideration

The study was conducted with strict adherence to ethical principles to ensure the protection of participants and the integrity of the research process. Prior to data collection, approval was obtained from the Schools Division Office of Ilocos Norte (SDOIN) and other relevant authorities. Consent letters were distributed to school heads and teacher-respondents, clearly outlining the purpose of the study, the voluntary nature of participation, and assurances of confidentiality. Similarly, student-respondents were fully informed about the study's objectives, with explicit guarantees that their responses would be treated with the utmost confidentiality and used solely for academic purposes.

Voluntary participation was emphasized throughout the study, ensuring that respondents were neither coerced nor pressured into participating. Participants were assured of their right to withdraw from the study at any point without any negative consequences. The data collection process was carefully designed to protect the privacy of respondents, with identifying information excluded from the dataset to ensure anonymity.

In addition to safeguarding participant privacy, the study adhered to ethical standards in data handling and analysis. The researchers ensured that all data were processed securely and accurately, avoiding any manipulation or bias. Findings were reported honestly and transparently, ensuring that the results accurately represented the insights gathered from respondents. Through these ethical guidelines, the researchers upheld the integrity of the study while prioritizing the rights, privacy, and well-being of all participants.

RESULTS AND DISCUSSIONS

Teaching Strategies Employed by CSS Teachers

Table II presents the teaching strategies employed by CSS teachers, ranked according to their frequency of use, revealing key insights into instructional preferences and methods.

TABLE II TEACHING STRATEGIES CURRENTLY EMPLOYED BY CSS TEACHERS

Teaching Strategies	f	%	Rank
Demonstration Method	13	100.00%	1
Lecture-based Discussions	11	84.62%	2.5
Laboratory-based Learning	11	84.62%	2.5
Collaborative Learning	8	61.54%	3
Peer-to-Peer Learning	6	46.15%	4
Project-based Learning	5	38.46%	5
Blended Learning	4	30.77%	6.5
Problem-based Learning	4	30.77%	6.5
Case Study Analysis	3	23.08%	7
Flipped Classroom	1	7.69%	8
Virtual Laboratory Method	1	7.69%	8

Note: f-frequency, %-percentage

Table II presents the teaching strategies employed by CSS teachers, ranked according to their frequency of use, along with their corresponding percentages. The data reveals key insights into instructional preferences and methods used in Computer Systems Servicing education.

The Demonstration Method, ranked first with 13 instances (100%), is the most preferred teaching strategy among CSS teachers. This indicates a strong emphasis on hands-on, practical instruction to effectively convey technical skills required in CSS. Such approaches align with competency-based training principles, which enhance technical proficiency through realistic and outcome-oriented instruction [18]. Additionally, immersive, practice-based learning has been shown to support student motivation and improve practical test performance [22].

Lecture-based Discussions and Laboratory-based Learning both ranked second, with 11 instances each (84.62%). These findings reflect a balanced approach that combines theoretical knowledge dissemination through lectures and practical application via laboratory activities. In CSS education, this blending of theory and practice fosters authentic problem-solving and workplace readiness, which are essential components of effective career and technical education [22].

Collaborative Learning, ranked third with 8 instances (61.54%), underscores the importance of teamwork and peer interaction in developing problem-solving and communication skills among students. This strategy fosters communication, teamwork, and peer-supported skill development—traits critical in industry environments requiring coordinated effort [2]. Peer-to-Peer Learning, ranked fourth with 6 instances (46.15%), highlights a moderate emphasis on peer mentoring and cooperative learning.

Project-based Learning, ranked fifth with 5 instances (38.46%), indicates that while teachers use projects to simulate real-world scenarios, this strategy is less frequent than others. Problem-based and project-based methods are especially relevant in CSS, as they develop applied problem-solving abilities needed for certification and workplace tasks [2].

Blended Learning and Problem-based Learning tied at rank six, with 4 instances each (30.77%). This suggests limited integration of online and problem-solving approaches in the CSS curriculum. Problem-Based Learning (PBL) promotes higher-order thinking and applied decision-making, while Blended Learning integrates face-to-face and digital modalities, offering flexibility and personalization [5]. Their lower ranking may reflect limited access to resources or insufficient familiarity with their implementation.

Case Study Analysis, ranked seventh with 3 instances (23.08%), shows minimal use of real-world scenarios to develop analytical skills. Finally, Flipped Classroom and Virtual Laboratory Method, ranked eighth with only 1 instance each (7.69%), indicate that these innovative strategies are rarely employed. This may be due to technology and instructional resource constraints or unfamiliarity with these methods. Although such methods are designed to promote independence, critical thinking, and technology integration, their underutilization contrasts with evidence suggesting that virtual simulations can significantly enhance engagement and practical competence [22].

These findings highlight the dominance of lecture and hands-on strategies, such as demonstration and laboratory-based learning, in CSS education. This implies that teachers focus heavily on practical skills development, which is critical for technical courses like CSS. However, the limited use of innovative approaches such as flipped classrooms and virtual laboratories suggests gaps in integrating modern teaching methodologies or challenges in accessing digital resources.

These results align with research emphasizing the effectiveness of hands-on and collaborative strategies in promoting skill mastery and teamwork in technical-vocational education [18][22]. However, the minimal use of innovative strategies contrasts with contemporary educational research advocating for blended and flipped learning to enhance student engagement and flexibility in learning [5][22]. Additionally, studies indicate that while lecture-based methods remain dominant, the integration of modern teaching strategies is essential to prepare students for rapidly evolving technological environments [2].

Overall, the data suggests that while CSS teachers employ effective strategies for skill development, there is room to explore and integrate modern teaching methods to further enhance learning outcomes and adaptability to technological advancements. Institutions should consider providing training and resources to support the implementation of innovative strategies, ensuring that educators are equipped to balance traditional and modern approaches effectively.

Assessment Performance in Computer Systems Servicing

Table III presents the assessment performance results of schools offering Computer Systems Servicing (CSS) from 2021 to 2024, showcasing varying competency rates among assessed students. The data provides valuable insights into the effectiveness of each school's CSS programs and instructional strategies.

School A and School M achieved a perfect competency rate of 100.00%, with all assessed students deemed competent. These results highlight the schools' exceptional program implementation, effective teaching strategies, and rigorous preparation for assessments, positioning them as benchmarks for CSS education excellence.

School D and School L followed closely with competency rates of 94.51% and 94.12%, respectively. These schools demonstrated strong program effectiveness, reflecting their ability to align curriculum delivery with assessment standards while fostering skill development and student engagement.

TABLE III ASSESSMENT PERFORMANCE RESULTS FROM 2021-2024

Schools	**Students Assessed**	**Competent**	**Competency Rate (%)**
School A	28	28	100.00%
School B	66	60	90.91%
School C	57	34	59.65%
School D	91	86	94.51%
School E	34	16	47.06%
School F	62	53	85.48%
School G	104	78	75.00%
School H	91	81	89.01%
School I	55	41	74.55%
School J	98	79	80.61%
School K	3	0	0.00%
School L	102	96	94.12%
School M	99	99	100.00%
Overall	**895**	**696**	**77.95%**

School B and School H performed well, attaining competency rates of 90.91% and 89.01%, respectively. While slightly below the top-performing schools, these results indicate solid implementation of CSS programs and effective instructional strategies. Similarly, School F achieved a commendable competency rate of 85.48%, underscoring its effectiveness in preparing students for assessments.

Moderate competency rates were observed in School J (80.61%), School G (75.00%), and School I (74.55%). While these schools exhibit satisfactory performance, there remains room for improvement in instructional delivery, student support mechanisms, or curriculum enhancement to further boost competency outcomes.

At the lower end of the spectrum, School C (59.65%) and School E (47.06%) exhibited significantly lower competency rates. These results suggest challenges in program implementation, alignment with assessment standards, or student preparedness. Interventions such as curriculum revisions, teacher training, or additional student support services may help address these gaps.

School K, with a competency rate of 0.00%, represents the most critical performance issue among all schools. This result highlights substantial challenges requiring immediate attention, including program restructuring, resource allocation, and faculty development to address competency gaps and improve outcomes.

The overall mean competency rate of 77.95% reflects satisfactory performance across schools, but the high standard deviation of 26.01% underscores significant variability in program effectiveness. These results align with existing literature emphasizing the importance of effective teaching strategies, adequate resources, and student engagement in achieving high competency rates [3], [4], [9]. Schools with lower competency rates can benefit from adopting best practices from high-performing institutions, such as hands-on learning, collaborative approaches, and rigorous assessment preparation [3], [4], [9].

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In conclusion, the assessment performance results highlight varying levels of program effectiveness across schools offering CSS. While some schools demonstrate exemplary outcomes, others face significant challenges that require targeted interventions. Educational institutions should prioritize disseminating best practices, allocating resources, and investing in faculty development to improve competency rates across all schools. Regular monitoring and evaluation of CSS programs are essential to ensure alignment with industry standards and enhance student outcomes [3], [4], [9].

Impact of Teaching Strategies on Student Performance in CSS

Table IV presents the computed impact of teaching strategies on student performance in CSS, revealing an F-value of 0.4513, which is significantly below the F-critical value of 3.97 at a 0.05 level of significance. The corresponding p-value of 0.7965 further confirms that the variation in student performance is not statistically significant. This indicates that the number of teaching strategies employed does not have a measurable impact on student proficiency in Computer Systems Servicing (CSS). The findings suggest that the quality, alignment, and delivery of instructional approaches are more critical than the mere quantity of strategies used. Research consistently supports this view, highlighting the importance of learner-centered and technology-supported strategies in improving student outcomes.

TABLE IV COMPUTED IMPACT OF TEACHING STRATEGIES ON STUDENT PERFORMANCE IN CSS

Source of Variation	**SS**	**df**	**MS**	**F-value**	**F-critical (α = 0.05)**	**p-value**	**DI**
Between Groups	3,702.5	5	740.5	0.4513	3.97	0.7965	Not Significant
Within Groups	11,491.8	7	1,641.7				
Total	15,194.3	12					

Note: SS- Sum of Squares, df-degrees of freedom, MS-Mean Square, DI-Descriptive Interpretation

For instance, blended learning models such as flipped classrooms and station-rotation approaches have been found effective in balancing theoretical knowledge with hands-on application [16]. Similarly, integrating ADDIE-designed workshop sessions with online platforms like Google Classroom enhances interaction and accessibility [11]. Embedding problem-based learning (PBL) into blended formats significantly boosts technical competencies such as requirement analysis, coding, and testing [7]. Moreover, combining PBL with workplace simulations strengthens troubleshooting skills and improves practical assessment scores [20]. Active learning strategies, including collaborative problem-solving, have also been shown to increase engagement and retention compared to traditional lecture-based delivery [1]. Collectively, these findings emphasize that instructional success in CSS depends less on the number of strategies employed and more on the intentional application of interactive, blended, and problem-based methods that directly build technical skills and workplace readiness.

In conclusion, while the present study does not establish a statistically significant relationship between the quantity of teaching strategies employed and student competency, it reinforces the understanding that the effectiveness of teaching strategies lies in their applicability, implementation, and alignment with desired learning outcomes. Teachers in technical-vocational education such as CSS should prioritize high-impact learner-centered approaches that foster technical competencies and confidence-building among students.

Correlation Between Teaching Strategies and CSS Assessment Results

Table V highlights the correlation between various teaching strategies and CSS assessment results, showcasing the effectiveness of different methods in influencing student performance. The Pearson correlation coefficients reveal that Lecture-Based Discussions and the Demonstration Method exhibit a very strong positive correlation (+0.827) with CSS assessment results, suggesting their significant impact on improving student performance. These strategies align well with the technical and practical nature of CSS education, emphasizing direct instruction and hands-on demonstration to build essential skills.

Conversely, Case Study Analysis demonstrates a very strong negative correlation (–0.827), which is statistically significant ($p < 0.001$). This indicates that while the relationship is meaningful, the increased use of Case Study Analysis correlates with lower performance in CSS assessments. This may suggest that the method, despite its value in fostering critical thinking, does not effectively align with the technical and practical competencies required for CSS education. Its negative impact could stem from a mismatch between the theoretical focus of case studies and the hands-on, skills-based nature of CSS assessments.

Laboratory-Based Learning, with a moderate positive correlation (+0.347), shows potential in enhancing technical skills, while Problem-Based Learning, with a weak positive correlation (+0.221), reflects limited but meaningful contributions to developing problem-solving abilities. Strategies like Collaborative Learning (+0.168), Project-Based Learning, Blended Learning, and Flipped Classrooms (all +0.084) exhibit very weak positive correlations, suggesting minimal impact on CSS assessment results when used independently. These methods may require more structured implementation or integration with hands-on activities to achieve better outcomes.

TABLE V CORRELATION BETWEEN TEACHING STRATEGIES AND CSS ASSESSMENT RESULTS

Teaching Strategy	**Pearson r**	**Descriptive Rating**	**p-value**	**Significance**
Lecture-based Discussions	+0.827	Very Strong Positive Correlation	< 0.001	Significant
Demonstration Method	+0.827	Very Strong Positive Correlation	< 0.001	Significant
Case Study Analysis	–0.827	Very Strong Negative Correlation	< 0.001	Significant
Laboratory-Based Learning	+0.347	Moderate Positive Correlation	0.061	Not Significant
Problem-Based Learning	+0.221	Weak Positive Correlation	0.236	Not Significant
Collaborative Learning	+0.168	Very Weak Positive Correlation	0.375	Not Significant
Project-Based Learning	+0.084	Very Weak Positive Correlation	0.664	Not Significant
Blended Learning	+0.084	Very Weak Positive Correlation	0.664	Not Significant
Flipped Classrooms	+0.084	Very Weak Positive Correlation	0.664	Not Significant
Peer-To-Peer Learning	–0.237	Weak Negative Correlation	0.206	Not Significant
Virtual Laboratory Method	–0.237	Weak Negative Correlation	0.206	Not Significant

Note: ±0.80 – 1.00-Very Strong Correlation; ±0.60 – 0.79-Strong Correlation; ±0.40 – 0.59-Moderate Correlation; ±0.20 – 0.39-Weak Correlation; ±0.01 – 0.19-Very Weak Correlation; 0-No Correlation

Interestingly, Peer-To-Peer Learning and the Virtual Laboratory Method show weak negative correlations (both –0.237), implying that these strategies may need refinement or better alignment with the technical and practical demands of CSS education. These findings align with prior research emphasizing the importance of strategy alignment with the specific requirements of technical-vocational education. For instance, learner-centered approaches such as the Demonstration Method and Laboratory-Based Learning are effective in developing troubleshooting and hands-on skills [11], [7]. However, methods like Case Study Analysis, while beneficial for critical thinking, may not directly address the technical competencies assessed in CSS [20].

Furthermore, blended models such as Flipped Classrooms and Project-Based Learning, although valuable for balancing theory and practice, may require more structured implementation to yield measurable improvements in CSS performance [16]. Collaborative and peer-based strategies, while fostering engagement and interaction, need to be complemented with direct skill-building activities to enhance their effectiveness [1].

In conclusion, the correlation data emphasizes the importance of adopting targeted instructional methods that prioritize hands-on, learner-centered approaches. Educators should focus on strategies with proven effectiveness, such as Lecture-Based Discussions, Demonstration Method, and Laboratory-Based Learning, while refining or integrating weaker strategies to better address the technical and practical requirements of CSS education.

Students' Perceptions of the Effectiveness of Different Teaching Strategies

Table VI presents the perceptions of students regarding the effectiveness of various teaching strategies employed in Computer Systems Servicing (CSS) education. The data reveals high levels of agreement across all statements, indicating that students find the teaching strategies effective in enhancing their learning experiences, engagement, and skill development.

TABLE VI STUDENTS' PERCEPTIONS OF THE EFFECTIVENESS OF DIFFERENT TEACHING STRATEGIES

Statements	**M**	**DI**
The teaching strategies used help me understand concepts more clearly and effectively.	4.56	Strongly Agree
Real-world examples and case studies make the lessons more practical and relevant to real-life applications.	4.46	Strongly Agree
Interactive activities and multimedia tools make learning more engaging and enjoyable.	4.42	Strongly Agree
Hands-on exercises and practical activities improve my technical skills and help me apply what I've learned.	4.52	Strongly Agree
Group activities and collaborative tasks allow me to learn from my classmates and develop teamwork skills.	4.27	Strongly Agree
The combination of different teaching methods keeps me motivated and confident in my ability to learn CSS.	4.54	Strongly Agree
The pacing of lessons matches my learning speed, allowing me to fully absorb the material without feeling rushed.	4.40	Strongly Agree
Lectures and discussions help me build a strong foundation of theoretical knowledge.	4.31	Strongly Agree
Problem-solving tasks and case studies challenge me to think critically and make better decisions.	4.38	Strongly Agree
Feedback and assessments guide me in improving my skills and understanding my progress.	4.56	Strongly Agree

Note: M-Mean; DI-Descriptive Interpretation

The highest-rated statements, with a mean score of 4.56, are "The teaching strategies used help me understand concepts more clearly and effectively" and "Feedback and assessments guide me in improving my skills and understanding my progress." These results suggest that students highly value teaching methods that clarify difficult concepts and provide constructive feedback to support their learning journey.

Similarly, statements such as "Hands-on exercises and practical activities improve my technical skills and help me apply what I've learned" (4.52) and "The combination of different teaching methods keeps me motivated and confident in my ability to learn CSS" (4.54) reflect strong agreement, emphasizing the importance of diverse instructional approaches and practical applications in fostering confidence and skill mastery.

Other statements, including "Real-world examples and case studies make the lessons more practical and relevant to real-life applications" (4.46) and "Interactive activities and multimedia tools make learning more engaging and enjoyable" (4.42), highlight students' appreciation for engaging and relatable teaching strategies that connect theoretical knowledge to real-world scenarios.

While all statements received high ratings, "Group activities and collaborative tasks allow me to learn from my classmates and develop teamwork skills" (4.27) and "Lectures and discussions help me build a strong foundation of theoretical knowledge" (4.31) were rated slightly lower compared to others. These results suggest that while students recognize the value of collaboration and traditional teaching methods, they may prefer more interactive and hands-on approaches.

The results align with existing literature that emphasizes the importance of active learning strategies, feedback mechanisms, and real-world applications in vocational education [1], [2], [3], [8]. For instance, Abdullah et al. [1] highlighted how active learning strategies enhance student engagement and performance, while Ahmad et al. [2] underscored the relevance of project-based learning in vocational settings.

Overall, the data underscores the effectiveness of diverse teaching strategies in CSS education, particularly those that focus on practical applications, interactive learning, and constructive feedback. Educators should continue to prioritize these methods while addressing areas for improvement, such as enhancing collaboration and theoretical discussions. Continuous program evaluation and adaptation to student needs are essential to ensure alignment with industry standards and foster better learning outcomes [3], [4], [9].

Qualitative Insights from Students Who Failed Competency Assessment

Table VII provides a thematic analysis of the challenges and insights derived from interviews with students who failed the NC II CSS assessment. It categorizes recurring issues into four major themes: Challenges in Understanding CSS Concepts, Perceived Gaps in Teaching Strategies, Resource Limitations, and Suggestions for Improving Instruction. Each theme is further broken down into specific categories ranked based on their frequency and importance as identified during the interviews.

TABLE VII QUALITATIVE INSIGHTS FROM STUDENTS WHO FAILED COMPETENCY ASSESSMENT

Themes	**Categories**	**Rank**
Challenges in Understanding CSS Concepts	Lack of foundational knowledge in CSS basics	1
	Difficulty in troubleshooting and problem-solving	2
	Over-reliance on rote memorization rather than practical application	3
Perceived Gaps in Teaching Strategies	Insufficient hands-on activities and laboratory-based learning	1
	Lack of clear explanations during lectures	2
	Limited use of real-world examples and case scenarios	3
Resource Limitations	Outdated or inadequate equipment in laboratories	1
	Limited access to supplemental learning materials (e.g., videos, manuals)	2
	Lack of internet connectivity for virtual learning environments	3
Suggestions for Improving Instruction	Incorporate more hands-on and practical exercises	1
	Provide clearer step-by-step demonstrations	2
	Offer personalized guidance or tutoring for struggling students	3

Challenges in Understanding CSS Concepts

This theme highlights the difficulties students face in mastering CSS concepts, particularly foundational knowledge and practical application. It emphasizes the importance of establishing a strong base in technical education to support advanced skills like troubleshooting and problem-solving.

The categories under this theme include "Lack of foundational knowledge in CSS basics" (ranked first), "Difficulty in troubleshooting and problem-solving" (ranked second), and "Over-reliance on rote memorization" (ranked third). These rankings indicate that students struggle with both understanding core principles and applying them in practical scenarios, while relying heavily on memorization rather than critical thinking.

The implications of these challenges are significant. Without foundational knowledge, students are unable to build higher-order skills, such as troubleshooting, which are essential for success in practical assessments. Additionally, reliance on rote learning limits their ability to think critically and adapt their knowledge to real-world situations.

Research shows that foundational knowledge is critical for developing technical competence and higher-order thinking skills [18, 20]. Studies show that transitioning from theory to practice is a common challenge in technical fields like Computer Systems Servicing [14, 22]. Competency-based education advocates for experiential learning approaches, emphasizing hands-on activities and applied learning to bridge these gaps [5, 16].

Perceived Gaps in Teaching Strategies

This theme focuses on deficiencies in instructional methods that hinder effective learning in CSS education. It underscores the need for innovative teaching strategies that prioritize clarity, immersion, and relevance to real-world applications.

The categories under this theme include "Insufficient hands-on activities and laboratory-based learning" (ranked first), "Lack of clear explanations during lectures" (ranked second), and "Limited use of real-world examples and case scenarios" (ranked third). These rankings highlight the need for more practical, structured, and context-driven teaching approaches to enhance student engagement and understanding.

The implications of these gaps are profound. Without sufficient hands-on activities, students may struggle to develop technical proficiency and confidence in applying their skills. Poor instructional clarity can lead to confusion and misinterpretation of complex concepts, while the absence of real-world examples limits students' ability to connect theoretical knowledge to practical applications.

Studies corroborate these findings. Hands-on learning has been shown to improve technical proficiency and deepen understanding of complex concepts [1, 18]. Clear explanations during lectures are essential for conveying technical knowledge effectively [11, 22]. Incorporating real-world scenarios into teaching strategies significantly enhances problem-solving skills and prepares students for workplace challenges [2, 19].

Resource Limitations

This theme highlights barriers to effective learning caused by inadequate or outdated resources. It emphasizes the importance of providing modern tools and materials to support students' learning experiences and technical development.

The categories under this theme include "Outdated or inadequate equipment in laboratories" (ranked first), "Limited access to supplemental learning materials" (ranked second), and "Lack of internet connectivity for virtual learning environments" (ranked third). These rankings reflect the critical role of resources in enabling students to gain hands-on experience, access modern learning tools, and develop technical competencies.

The implications of these resource limitations are severe. Outdated equipment prevents students from engaging with current technologies, while limited supplemental materials hinder self-paced learning and comprehension. Poor internet connectivity restricts access to virtual tools, which are increasingly vital for modern education.

Research supports these findings. Access to modern equipment is essential for developing technical skills and confidence in practical settings [18, 23]. Supplemental materials, such as videos and manuals, improve comprehension and retention of technical concepts, especially in independent learning environments [5, 8]. Internet connectivity is crucial for integrating modern teaching methodologies, such as blended learning and virtual laboratories [13, 22].

Suggestions for Improving Instruction

This theme focuses on strategies to enhance teaching methods and address students' learning needs. It emphasizes the importance of practical, structured, and personalized approaches to improve educational outcomes and foster mastery of technical skills.

The categories under this theme include "Incorporate more hands-on and practical exercises" (ranked first), "Provide clearer step-by-step demonstrations" (ranked second), and "Offer personalized guidance or tutoring for struggling students" (ranked third). These rankings highlight the need for experiential learning, detailed instructional approaches, and individualized support to address learning gaps.

The implications of these suggestions are promising. Hands-on exercises improve technical proficiency, critical thinking, and problem-solving skills, while step-by-step demonstrations enhance comprehension by reducing cognitive overload. Personalized guidance provides targeted support that builds student confidence and addresses specific learning gaps.

Research corroborates these recommendations. Experiential learning methods, such as hands-on exercises, are essential for success in technical assessments [1, 18]. Clear, structured demonstrations are particularly effective in technical courses, as they improve understanding and learning outcomes [11, 22]. Personalized instruction has been shown to foster mastery of technical skills and improve student confidence [5, 9].

CONCLUSION

The findings of this study underscore the pivotal role of practical, interactive, and well-delivered teaching strategies in enhancing student performance in Computer Systems Servicing (CSS). Demonstration, lecture-based discussions, and laboratory-based learning emerged as the most effective methods, positively influencing competency outcomes and fostering technical skill mastery. These strategies resonate strongly with students, as evidenced by their high ratings for approaches that integrate hands-on activities, real-world examples, and constructive feedback.

While the quantity of teaching strategies employed showed no significant correlation with competency rates, the quality and proper application of these methods proved to be the defining factors in student success. The study highlights the importance of aligning instructional approaches with the technical and practical demands of CSS, emphasizing learner-centered strategies that promote engagement, critical thinking, and workplace readiness.

Furthermore, the study reveals a gap in the integration of innovative methods such as flipped classrooms and virtual laboratories, which, despite their potential, are underutilized. This suggests the need for resource allocation and professional development to equip educators with the skills and tools necessary to implement modern teaching strategies effectively.

In conclusion, the study affirms that high-impact, practical teaching methods are instrumental in achieving better competency outcomes in CSS education. It recommends prioritizing hands-on and interactive strategies, leveraging student feedback in lesson planning, and fostering innovation through modern teaching approaches. By addressing these areas, educators can better prepare students for industry certifications, employment opportunities, and lifelong learning, ultimately contributing to workforce development and national progress.

LIMITATIONS OF THE STUDY

This study provides valuable insights into the effectiveness of teaching strategies in Computer Systems Servicing (CSS) education; however, several limitations must be acknowledged.

First, the study is geographically confined to the Schools Division of Ilocos Norte, which may restrict the generalizability of its findings to other regions or educational contexts with varying resources, demographics, and institutional policies. Second, the reliance on self-reported data from surveys administered to teachers and students introduces the possibility of biases, such as social desirability or limited recall, which may not fully capture the complexities of teaching strategies or their precise impact on student performance.

Additionally, the study primarily examines the correlation between teaching strategies and competency outcomes but does not account for other potential factors influencing student performance, such as socio-economic conditions, access to modern tools and equipment, or variations in teacher qualifications and experience. Furthermore, the absence of experimental or longitudinal designs limits the ability to establish causal relationships between teaching strategies and assessment results.

The study also does not fully address the challenges involved in implementing innovative teaching methods, such as flipped classrooms and virtual laboratories. These methods, while promising, face significant barriers, including resource constraints, such as limited access to technology and internet connectivity, and teacher readiness, which requires specialized training to effectively adopt these approaches. The feasibility of these methods has not been tested within the study's context, underscoring the need for pilot studies to evaluate their applicability and effectiveness in CSS education.

Addressing these limitations in future research by expanding the scope of the study, incorporating objective measures, exploring additional influencing factors, and employing experimental designs would enhance the reliability and applicability of the findings. Furthermore, investigating the challenges and feasibility of integrating innovative methods like flipped classrooms and virtual laboratories through pilot studies would provide actionable insights into their implementation and impact on student learning outcomes.

RECOMMENDATIONS

In light of the findings and conclusions, the following recommendations are offered:

Future efforts should explore the integration of innovative methods such as flipped classrooms and virtual laboratories into Computer Systems Servicing (CSS) education. Pilot studies should be conducted to test the feasibility and effectiveness of these approaches, particularly in schools with lower competency rates. Flipped classrooms, which shift lecture-based content to pre-class activities, can enhance student engagement and allow more time for hands-on learning during class sessions. Virtual laboratories, on the other hand, provide simulated environments where students can practice technical skills, even in resource-limited settings. These pilot programs should include clear evaluation metrics, such as competency rates, student feedback, and engagement levels, to assess their impact effectively.

Additionally, a framework should be developed to integrate these innovative methods with traditional teaching strategies. For example, flipped classrooms can be utilized for theory-based topics, enabling students to study independently before engaging in practical exercises. Virtual laboratories can complement demonstration-based learning, providing students with opportunities to refine their skills in both physical and simulated environments. Such a blended approach would leverage the strengths of both traditional and modern methods, ensuring flexibility and adaptability in instructional delivery.

To overcome challenges in implementation, institutions should prioritize resource allocation for infrastructure upgrades, such as internet connectivity and modern equipment, and invest in teacher training programs to build the necessary technical and pedagogical skills. Collaboration with organizations like TESDA or similar institutions can help provide resources and professional development opportunities for educators.

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