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The Role of Client-Server Network in Integration Strategies in Teaching Computer System Servicing

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ABSTRACT: This study determined the extent of integration of client-server network strategies in teaching Computer Systems Servicing (CSS) and its relationship to learners' performance. Specifically, it examined the demographic profile of the respondents, the extent of integration in terms of availability and accessibility, adaptability and flexibility, interactivity and collaboration, and scalability and security, as well as the learners' performance in system installation and configuration, troubleshooting and maintenance, and preparedness for TESDA NC II assessment. It also tested the significant differences when grouped according to profile variables and the significant relationship between integration and learners' performance. The study utilized a descriptive-correlational research design with 104 student respondents. A structured questionnaire was used to gather data, which were analyzed using frequency, percentage, mean, t-test, and Pearson correlation. Findings revealed that most respondents were 19–20 years old, male, with beginner ICT literacy level and basic prior exposure to ICT-related subjects. The extent of integration of client-server network strategies was generally rated as moderate across all indicators. Learners' performance was rated as very good in system installation and configuration and good in troubleshooting and maintenance and TESDA NC II preparedness. Significant differences were found in some profile variables such as sex, ICT literacy level, and prior ICT exposure, while no significant differences were found in others. However, no significant relationship was found between the extent of integration of client-server network strategies and learners' performance in CSS. The study concludes that while client-server network strategies are moderately integrated in instruction and learners demonstrate satisfactory performance, the integration alone does not significantly influence performance outcomes. It is recommended that instructional strategies be strengthened through hands-on activities, simulation-based learning, and competency-based training aligned with TESDA NC II standards to enhance learners' technical skills and readiness.

KEYWORDS: Client-server network, Computer Systems Servicing, ICT integration, learners' performance, TESDA NC II, instructional strategies

I. INTRODUCTION

In the 21st century, technology had become deeply embedded in the way individuals lived, worked, and learned. From communication and business to healthcare and education, technological innovations continued to transform human interaction and the delivery of services. Education, in particular, had witnessed significant changes as technology reshaped teaching and learning processes. Digital tools, online platforms, and interactive resources served as essential components in classrooms, allowing students to access vast amounts of information and develop critical skills necessary for a knowledge-driven society.

The integration of technology in Technical-Vocational-Livelihood (TVL) tracks, particularly in Computer System Servicing (CSS), had become essential in preparing learners for ICT-driven industries. The client-server network model, a foundational concept in IT, offered both instructional and operational advantages in the classroom setting enabling hands-on experiences, collaborative learning, and real-world simulation of IT environments. This study explored the role of client-server networks in enhancing integration strategies for teaching and learning CSS.

In today's digitally driven learning environment, the need for functional and efficient computer laboratories in schools had become increasingly evident. As a teacher and implementer of the Computer System Servicing (CSS) strand under the Technical-Vocational-Livelihood (TVL) track, the researcher had personally witnessed how client-server networks enhanced the learning experience. However, some public schools had outdated or standalone computers, unstable connections, and poor file-sharing systems, which limited learners' opportunities to practice ICT competency skills.

The Role of Client-Server Network in Integration Strategies in Teaching Computer System Servicing

The researcher's observations inspired her to focus on the client-server network, as this model served as a significant infrastructure in most IT industry settings. She became curious about how this network could be effectively used in schools, especially in delivering lessons in TLE/CSS. As a teacher, she often improvised when ICT tools were lacking or unorganized. By studying the use of the client-server network as a system of integration in teaching CSS, this study contributed to the development of better strategies in teaching TLE/CSS.

The purpose of this study was to analyze the role of client-server network systems in integrating strategies used by teachers for delivering lessons in Computer Systems Servicing (CSS). It aimed to explore how these networks improved teaching efficiency, supported hands-on learning, enhanced technical competencies, and identified teaching strategies that involved client-server networks in CSS.

Research Question

The Computer Systems Servicing (CSS) course under the Technical–Vocational–Livelihood track equipped learners with competencies in installation, configuration, and maintenance of systems and networks. However, opportunities for authentic practice were often limited due to a lack of equipment and laboratory access. Integrating a client-server network as a teaching strategy offered students a more realistic environment for developing technical competence, troubleshooting ability, and readiness for certification.

This study aimed to determine the relationship between the integration of client-server network strategies and the performance of learners in CSS. It further sought to compare the effectiveness of such integration when students were grouped according to their profile. Additionally, the study aimed to determine the role of the client-server network in integration strategies in teaching Computer Systems Servicing. Specifically, it sought to answer the following:

1. What is the demographic profile of the student respondents in terms of:
   1.1. age;
   1.2. sex;
   1.3. ICT literacy level;
   1.4. access to technology at home (computer, internet); and
   1.5. prior exposure to networking or related ICT subjects?
2. What is the extent of integration of client-server network strategies in teaching CSS in terms of:
   2.1. availability and accessibility;
   2.2. adaptability and flexibility;
   2.3. interactivity and collaboration; and
   2.4. scalability and security?
3. What is the level of learners' performance in CSS in terms of:
   3.1. system installation and configuration;
   3.2. troubleshooting and maintenance; and
   3.3. preparedness for TESDA NC II assessment?
4. Is there a significant difference in the extent of integration and learners' performance when grouped according to their profile?
5. Is there a significant relationship between the extent of integration of client-server network strategies and learners' performance in CSS?
6. Based on the findings of the study, what instructional strategies or innovations can be recommended to enhance the integration of client-server networks in teaching CSS?

II. SCOPE AND LIMITATION OF THE STUDY

This study focused on examining the role of client-server network integration strategies in enhancing the teaching and learning process of Computer System Servicing (CSS) under the Technical-Vocational-Livelihood (TVL) strand. It specifically investigated how client-server network setups contributed to the improvement of students' learning experiences, technical competencies, and readiness for TESDA NC II assessment.

The scope of the study covered selected senior high school students enrolled in the Computer System Servicing specialization during the School Year 2024–2025. The research was limited to analyzing the relationship between the extent of integration of client-server network strategies and the learners' performance in CSS, considering factors such as availability and accessibility, adaptability and flexibility, interactivity and collaboration, and scalability and security.

The study also included an assessment of the demographic profile of the respondents in terms of age, sex, ICT literacy level, access to technology at home (computer and internet), and prior exposure to networking or related ICT subjects. These variables provided contextual understanding of the students' capacity to engage with network-based instructional methods.

The investigation was limited to data gathered through a researcher-made survey questionnaire, which primarily measured perceptions and self-reported performance rather than actual performance-based assessments. Therefore, the study did not include direct observation of laboratory activities or practical demonstrations.

Furthermore, the study was confined to the integration of client-server networks within the context of classroom-based instruction in Computer System Servicing and did not cover other ICT-related subjects or industrial training settings. Factors such as hardware limitations, internet connectivity issues, and teacher training were acknowledged as external variables that might have affected the full implementation of the integration strategies but were not directly measured in the study.

Despite these limitations, the findings were expected to provide valuable insights into improving teaching practices, enhancing student performance, and formulating strategies and innovations that promoted effective technology integration in the delivery of Computer System Servicing instruction.

FRAMEWORK

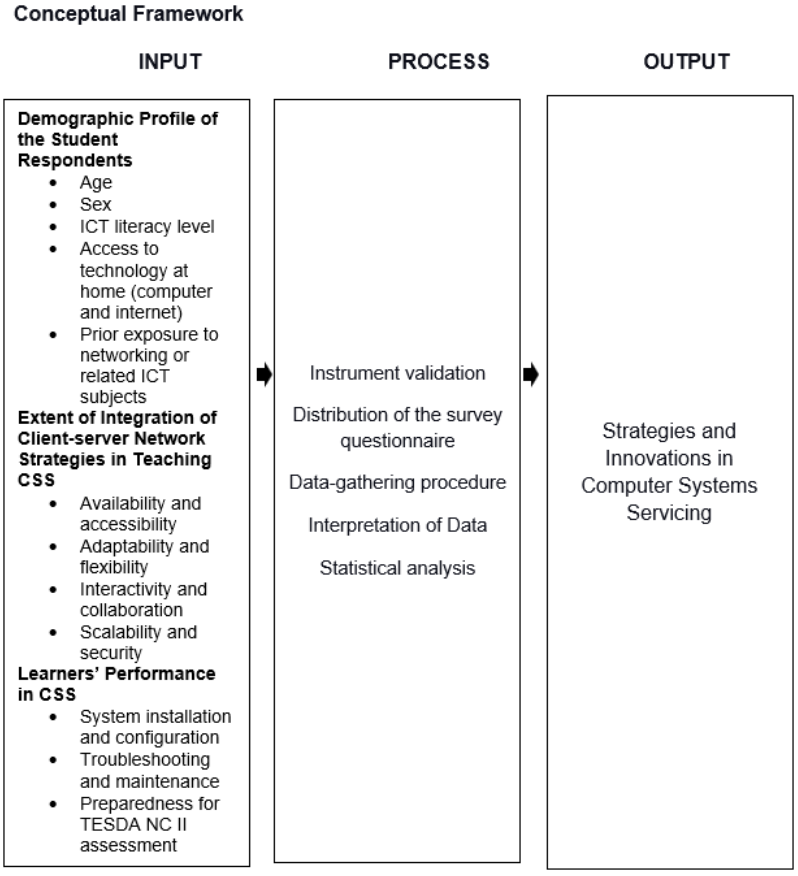


Figure 1. *Research Paradigm*

This study was anchored on the Input–Process–Output (IPO) framework, which served as the structural guide in identifying the flow of the investigation. The framework illustrated the flow and relationship of variables in the study, showing how inputs were transformed through systematic processes to produce the intended outputs that addressed the study's objectives. Specifically, it aimed to determine the role of the client-server network in the integration strategies used in teaching Computer System Servicing (CSS).

The input phase involved the essential components that influenced the study. It included the demographic profile of the student respondents, which covered age, sex, ICT literacy level, access to technology at home such as computers and internet connection, and prior exposure to networking or related ICT subjects. These characteristics were important in understanding the learners' background and capacity to engage with technology-integrated instruction.

The next part of the input focused on the extent of integration of client-server network strategies in teaching CSS. This aspect was assessed in terms of availability and accessibility, adaptability and flexibility, interactivity and collaboration, and scalability

and security. These dimensions determined how effectively the client-server network was utilized as an instructional tool and how it supported teaching and learning processes in CSS.

The final part of the input pertained to the learners' performance in Computer System Servicing, which was measured through their competencies in system installation and configuration, troubleshooting and maintenance, and preparedness for TESDA NC II assessment. These indicators reflected the practical skills and readiness of students to meet industry standards.

The process represented the sequence of research activities undertaken to obtain and analyze data. This included instrument validation to ensure the reliability and accuracy of the research tool, distribution of the survey questionnaire to gather responses from participants, data-gathering procedures that adhered to ethical standards, interpretation of data based on analyzed findings, and statistical analysis using appropriate descriptive and inferential tools. These steps ensured that the data collected were systematically processed to generate valid and reliable results.

The output of the study was the development of strategies and innovations in teaching Computer System Servicing through the integration of client-server network systems. The findings served as the basis for designing instructional approaches that enhanced learners' engagement, improved practical performance, and promoted technological competence aligned with TESDA standards.

In summary, the IPO framework guided the study in establishing a clear connection among the inputs (demographic profile, integration extent, and learners' performance), the processes (data collection and analysis), and the outputs (proposed strategies and innovations). This systematic flow ensured that the study's objectives were achieved and that the findings contributed to the improvement of ICT-based instruction in the TVL strand, specifically in Computer System Servicing.

Research Design

The study employed a quantitative approach, specifically a descriptive research design, which was appropriate as it involved the gathering, organization, and tabulation of data, as well as the comparison of results through the use of a survey questionnaire. This study adopted a descriptive-quantitative research design to examine the effectiveness of the client-server network as an integration strategy for teachers in the computer laboratory. Descriptive research was appropriate for this study as it aimed to describe variables without establishing causal relationships or comparisons with other variables (McCombes, 2023).

Research Instrument

The primary research instrument used in this study was a structured survey questionnaire. The questionnaire was designed to gather data on the respondents' demographic profile (age, sex, educational attainment, and years of teaching experience) as well as their assessment of the effectiveness of using a client-server network in teaching TLE/CSS in terms of availability, accessibility, scalability, security, adaptability, interactivity, and flexibility.

The items in the instrument were framed using a five-point Likert scale, ranging from Strongly Disagree to Strongly Agree.

Data Gathering

Prior to data collection, a letter of request for permission to conduct the study was submitted to the Schools Division Superintendent of Pasig City. Upon approval, the researcher personally distributed the survey questionnaires to the identified respondents with the assistance of school principals. Respondents were given one week to complete the instrument.

After retrieval, the responses were checked, tallied, and encoded for analysis. The researcher ensured confidentiality and voluntary participation, adhering to ethical standards of research.

Statistical Treatment

The data gathered from the respondents were organized, tabulated, and statistically analyzed to determine the relationship between the extent of integration of client-server network strategies and learners' performance in Computer System Servicing. The following statistical tools were utilized:

Frequency and Percentage Distribution

These were used to describe the demographic profile of the respondents in terms of age, sex, ICT literacy level, access to technology at home, and prior exposure to networking or related ICT subjects. This helped identify the general characteristics of the participants.

Weighted Mean

The weighted mean was applied to determine the extent of integration of client-server network strategies in teaching CSS in terms of availability and accessibility, adaptability and flexibility, interactivity and collaboration, and scalability and security. It was also used to assess the level of learners' performance in system installation and configuration, troubleshooting and maintenance, and preparedness for TESDA NC II assessment.

III. RESULTS

This chapter systematically presents the collected data, analyzes key findings, and interprets the results in relation to the study's objectives. The data were carefully organized and presented using statistical tables to clearly illustrate significant trends, patterns, and relationships among the variables under investigation.

1. **What is the demographic profile of the student respondents in terms of:**

Table 1.1 *Demographic profile of the student respondents in terms of Age*

Age	Frequency	Percentage
16 – 18 years old	27	26.0
19 – 20 years old	59	56.7
21 – 23 years old	16	15.4
24 years old and above	2	1.9
Total	**104**	**100**

Table 1 presents the demographic profile of the student respondents in terms of age. Out of 104 respondents, the majority (59 or 56.7%) are aged 19–20 years old. This is followed by students aged 16–18 years old with 27 respondents (26.0%). Meanwhile, 21–23 years old students account for 16 respondents (15.4%), and only 2 respondents (1.9%) are 24 years old and above.

The data indicate that most of the respondents fall within the 19–20 age range, suggesting that the sample is largely composed of students in their early college years. The relatively smaller percentage of respondents aged 21 and above implies that fewer participants are in the later stages of their academic programs or may represent irregular or returning students. The presence of respondents aged 16–18 also suggests the inclusion of younger students, possibly early college entrants.

The dominance of respondents aged 19–20 years old implies that the findings of the study will largely reflect the perspectives, experiences, and behaviors typical of students in this developmental stage. Since this age group is often associated with adjustment to higher education, identity formation, and increasing independence, the results may be influenced by these factors. Additionally, the limited representation of older students (21 years old and above) suggests that the study may not fully capture the viewpoints of more mature or experienced learners. Future studies may consider balancing age groups to ensure broader generalizability of findings.

This finding is supported by Arnett (2022), who explains that individuals aged 18 to 25 belong to the stage of emerging adulthood, a developmental period characterized by identity exploration, instability, and increasing independence. This stage is particularly relevant to college students as they navigate important decisions related to education, career paths, and personal relationships. The predominance of respondents aged 19–20 years old in the study aligns with this developmental stage, suggesting that their responses may reflect characteristics such as adaptability, self-discovery, and evolving responsibilities.

Table 1.2 *Demographic profile of the student respondents in terms of Sex*

Sex	Frequency	Percentage
Male	93	89.4
Female	11	10.6
Total	**104**	**100**

Table 1.2 presents the demographic profile of the student respondents in terms of sex. Out of 104 respondents, the majority are male, with 93 respondents (89.4%), while only 11 respondents (10.6%) are female.

The data indicate a significant imbalance in the distribution of respondents by sex, with males comprising the overwhelming majority. This suggests that the sample is heavily male-dominated, while female respondents are underrepresented. Such disparity may reflect the actual population of the group being studied or may be influenced by sampling limitations.

The predominance of male respondents implies that the findings of the study will largely reflect male perspectives, experiences, and behaviors. Consequently, the insights derived from the study may not fully represent the viewpoints of female students. This imbalance may affect the generalizability of the results, particularly in contexts where sex differences are relevant. Future studies may consider achieving a more balanced representation to ensure inclusivity and broader applicability of findings. This finding is supported by Hyde (2014), who emphasized that gender differences and similarities can influence behavior, cognition, and experiences in educational settings. A skewed sex distribution in research samples may therefore shape the interpretation of results and limit the ability to compare perspectives across groups.

Table 1.3. *Demographic profile of the student respondents in terms of ICT Literacy Level*

ICT Literacy Level	Frequency	Percentage
Beginner	104	100.0
Intermediate	0	0.0
Advanced	0	0.0
Total	**104**	**100**

Table 1.3 presents the demographic profile of the student respondents in terms of ICT literacy level. All respondents (104 or 100.0%) are classified as beginners, while none fall under the intermediate or advanced categories (0.0%). This indicates a completely uniform distribution of ICT literacy levels across the sample.

The data reveal that all respondents possess only a basic level of ICT literacy, suggesting limited exposure to or experience with more advanced digital tools and technologies. The absence of respondents in the intermediate and advanced levels implies that the group may not yet have developed higher-order digital competencies, such as critical evaluation of online information, advanced software use, or technical problem-solving skills.

This uniformity has important implications for the study, as the findings will largely reflect the perspectives and capabilities of individuals with beginner-level ICT skills. It may also suggest a need for enhanced training or educational interventions to improve students' digital competencies. Furthermore, the lack of variation in ICT literacy levels may limit comparative analysis across different proficiency groups. Future research may consider including respondents with diverse ICT skill levels to provide a more comprehensive understanding of how ICT literacy influences outcomes.

This finding is supported by UNESCO (2023), which emphasizes that foundational ICT skills are essential but must be developed into higher levels of digital competence to enable effective participation in education and the modern workforce. The absence of intermediate and advanced skills highlights the need for structured digital literacy programs to bridge this gap.

Table 1.4. *Demographic profile of the student respondents in terms of Access to Technology at Home (Computer, Internet)*

Access to Technology at Home	Frequency	Percentage
Computer/Laptop	18	17.3
Internet Connection	86	82.7
Total	**104**	**100**

Table 1.4 presents the demographic profile of the student respondents in terms of access to technology at home. Out of 104 respondents, a majority of 86 (82.7%) reported having access to an internet connection, while only 18 respondents (17.3%) have access to a computer or laptop. The data reveal a notable disparity between internet connectivity and device availability. While most students are able to access the internet, the relatively low percentage of those with computers or laptops suggests that many rely primarily on mobile devices such as smartphones. Although smartphones enable basic online access, they may not adequately support more complex academic tasks that require larger screens, specialized software, or multitasking capabilities.

This gap has important implications for the study, as it suggests that students' digital engagement and academic performance may be constrained by limited access to appropriate technological tools. Despite being connected, students without computers or laptops may face challenges in completing assignments, participating in online learning activities, and developing higher-level ICT skills. Consequently, the findings of the study may reflect these limitations in access and capability. Addressing this imbalance through institutional support or targeted interventions—such as providing device access or enhancing school-based resources—could improve learning outcomes and digital competence.

This observation is supported by International Telecommunication Union (2023), which emphasizes that meaningful digital participation depends not only on internet connectivity but also on access to appropriate devices. The persistence of device inequality continues to shape the quality and effectiveness of technology use, particularly in educational contexts.

Table 1.5 *Demographic profile of the student respondents in terms of Prior Exposure to Networking or Related Ict Subjects?*

Prior Exposure to Networking or Related ICT Subjects	Frequency	Percentage
None	0	0.0
Basic	104	100.0
Moderate	0	0.0
High	0	0.0
Total	**104**	**100**

Table 1.5 presents the demographic profile of the student respondents in terms of prior exposure to networking or related ICT subjects. All respondents (104 or 100.0%) reported having basic exposure, while none indicated having no exposure (0.0%), moderate exposure (0.0%), or high exposure (0.0%). This reflects a completely uniform level of prior experience among the participants.

The data suggest that all respondents possess only foundational knowledge in networking or related ICT subjects. This indicates that while students are not entirely unfamiliar with the topic, their understanding is likely limited to introductory concepts rather than more advanced or applied skills. The absence of respondents with moderate or high exposure further implies that deeper engagement or specialization in networking has not yet been achieved within this group.

This uniformity has significant implications for the study, as the results will primarily reflect the perspectives and capabilities of students with basic-level knowledge. It may also indicate a need for more advanced instruction or opportunities for skill development in networking and ICT-related areas. Additionally, the lack of variation in exposure levels limits the ability to compare responses across different levels of experience. Future studies may benefit from including participants with diverse levels of exposure to better assess how prior knowledge influences learning outcomes.

This finding is supported by UNESCO (2023), which highlights that foundational ICT knowledge serves as a starting point for developing more advanced digital competencies. However, without progression beyond basic exposure, learners may struggle to meet the demands of increasingly technology-driven educational and professional environments.

2. What is the extent of integration of client-server network strategies in teaching CSS in terms of:

Table 2.1 *Extent of integration of client-server network strategies in teaching CSS in terms of Availability and Accessibility*

Indicators	Mean	VI
1. Server and client machines are always available for practice.	2.78	ME
2. The computer laboratory is accessible for extended practice.	2.71	ME
3. Adequate number of workstations are provided.	2.46	LE
4. The client-server setup is functional and ready during class.	2.73	ME
5. Technical support is available when problems occur.	3.21	ME
6. Students have individual access to client machines.	2.89	ME
7. Server resources (files, applications) are accessible during tasks.	2.70	ME
8. Students can revisit the setup for review or projects.	2.70	ME
9. Materials and guides are available for practice.	2.89	ME
10. Access to client-server practice is fairly distributed to all students.	2.87	ME
General Assessment	**2.80**	**ME**

Legend:
3.25 – 4.00 High Extent (HE) *2.50 – 3.24 Moderate Extent (ME)*
1.75 – 2.49 Low Extent (LE) *1.00 – 1.74 Very Low Extent (VLE)*

Table presents the extent of integration of client-server network strategies in teaching CSS in terms of availability and accessibility. The indicators obtained a general assessment mean of 2.80, interpreted as a Moderate Extent (ME). Among the indicators, “Technical support is available when problems occur” obtained the highest mean (3.21, ME), while “Adequate number of workstations are provided” obtained the lowest mean (2.46, LE). Other indicators, such as availability of server and client machines (2.78), accessibility of the laboratory (2.71), functionality of the setup (2.73), and access to server resources (2.70), were all rated at a moderate extent.

The results suggest that the availability and accessibility of client-server network resources in teaching CSS are generally adequate but not fully optimal. While students experience reasonable access to functional systems and technical assistance, limitations are evident in the number of available workstations, which was rated low. This indicates that overcrowding or insufficient hardware may be affecting the quality and efficiency of hands-on learning experiences. However, the presence of

accessible technical support and moderately available resources shows that the institution has basic systems in place to support ICT-based instruction.

These findings imply that although client-server integration is being implemented in CSS instruction, there is still room for improvement in infrastructure and resource allocation. Enhancing the number of workstations and ensuring consistent accessibility of laboratory facilities may further strengthen students' practical engagement and learning outcomes. Improving these areas could also lead to more efficient use of client-server systems and better skill development in computer systems servicing. This observation is supported by UNESCO (2023), which emphasizes that effective ICT integration in education depends not only on the presence of digital infrastructure but also on equitable access, sufficient resources, and reliable technical support to ensure meaningful learning experiences.

Table 2.2. *Extent of integration of client-server network strategies in teaching CSS in terms Adaptability and Flexibility*

Indicators	Mean	VI
1. Activities adapt to my pace of learning.	2.89	ME
2. Lessons adjust for students with varying ICT backgrounds.	3.13	ME
3. Different methods (demo, practice, discussion) are used.	2.80	ME
4. The setup can be adjusted for small or large groups.	2.90	ME
5. Tasks can be modified to match real-world scenarios.	2.87	ME
6. Students can choose tasks suited to their skills.	2.59	ME
7. The client-server setup allows experimentation.	3.13	ME
8. Activities allow me to learn at different difficulty levels.	2.85	ME
9. Teachers adjust activities when technical issues arise.	3.07	ME
10. Lessons integrate new technologies when relevant.	3.13	ME
General Assessment	**2.93**	**ME**

Legend:
3.25 – 4.00 High Extent (HE) *2.50 – 3.24 Moderate Extent (ME)*
1.75 – 2.49 Low Extent (LE) *1.00 – 1.74 Very Low Extent (VLE)*

Table 2.2 presents the extent of integration of client-server network strategies in teaching CSS in terms of adaptability and flexibility. The indicators obtained a general assessment mean of 2.93, interpreted as a Moderate Extent (ME). Among the indicators, several items such as "Lessons adjust for students with varying ICT backgrounds," "The client-server setup allows experimentation," and "Lessons integrate new technologies when relevant" obtained the highest mean of 3.13 (ME). On the other hand, "Students can choose tasks suited to their skills" obtained the lowest mean (2.59, ME). All other indicators also fall under the moderate extent category.

The results indicate that the client-server network strategies used in teaching CSS are moderately adaptable and flexible in supporting student learning. Instructional activities are generally responsive to students' varying ICT backgrounds and allow some level of experimentation and adjustment. This suggests that teachers are able to modify lessons and incorporate different approaches to accommodate learner needs and technological developments. However, the relatively lower mean on student autonomy in selecting tasks implies that flexibility from the learner's perspective is somewhat limited.

These findings imply that while the instructional environment supports adaptability in teaching practices, there is still room to enhance learner-centered flexibility. Increasing opportunities for students to choose tasks based on their skill levels and further differentiating activities could improve engagement and individualized learning. Strengthening these aspects may also enhance students' confidence and competence in handling ICT-related tasks within a client-serverenvironment.

This is supported by UNESCO (2023), which emphasizes that effective ICT-integrated learning environments should be flexible, learner-centered, and adaptive to diverse student needs in order to maximize engagement and digital skill development.

Table 2.3. *Extent of integration of client-server network strategies in teaching CSS in terms Interactivity and Collaboration*

Indicators	Mean	VI
1. Activities encourage working with classmates.	2.74	ME
2. I interact with peers to solve client-server tasks.	2.78	ME
3. Group projects involve use of the client-serversetup.	2.96	ME
4. Teachers facilitate interactive sessions with the setup.	3.14	ME
5. The setup helps me learn from classmates' experiences.	2.87	ME
6. I share tasks and outputs with others using the network.	2.74	ME
7. The setup promotes teamwork in troubleshooting.	2.70	ME
8. Discussions during activities enhance my understanding.	3.22	ME
9. Teacher feedback is immediate during activities.	2.90	ME
10. Activities simulate collaborative work environments.	3.11	ME
General Assessment	**2.92**	**ME**

Legend:
3.25 – 4.00 High Extent (HE) *2.50 – 3.24 Moderate Extent (ME)*
1.75 – 2.49 Low Extent (LE) *1.00 – 1.74 Very Low Extent (VLE)*

Table 2.3 presents the extent of integration of client-server network strategies in teaching CSS in terms of interactivity and collaboration. The indicators obtained a general assessment mean of 2.92, interpreted as a Moderate Extent (ME). Among the indicators, "Discussions during activities enhance my understanding" obtained the highest mean (3.22, ME), followed by "Teachers facilitate interactive sessions with the setup" (3.14, ME) and "Activities simulate collaborative work environments" (3.11, ME). Meanwhile, the lowest means were observed in "Activities encourage working with classmates" (2.74, ME), "I share tasks and outputs with others using the network" (2.74, ME), and "The setup promotes teamwork in troubleshooting" (2.70, ME).

The results suggest that the client-server network strategies moderately support interactivity and collaboration in CSS instruction. Students generally engage in group-based learning activities and benefit from discussions and teacher-facilitated sessions, which enhance understanding of lessons. The presence of collaborative tasks and simulation of real-world work environments also indicates that the setup helps develop teamwork-oriented skills. However, slightly lower ratings in peer sharing and collaborative troubleshooting suggest that interaction among students may still be limited in practice.

These findings imply that while collaboration is present in the learning environment, there is still potential to strengthen student-to-student interaction and shared problem-solving using the client-serversetup. Enhancing structured collaborative tasks, increasing peer-assisted troubleshooting activities, and promoting more network-based sharing of outputs may further improve engagement and teamwork skills. Strengthening these aspects would better align instruction with real-world ICT workplace practices where collaboration is essential.

This is supported by UNESCO (2023), which highlights that collaborative and interactive learning environments supported by digital technologies are essential in developing 21st-century skills such as communication, teamwork, and problem-solving in ICT education.

Table 2.4 *Extent of integration of client-server network strategies in teaching CSS in terms Scalability and Security*

Indicators	Mean	VI
1. The setup allows multiple users to connect simultaneously.	2.85	ME
2. I experienced adding more clients to the server.	3.71	ME
3. Security features (passwords, permissions) were taught.	2.90	ME
4. I was able to configure user access in the server.	3.01	ME
5. I learned how to manage accounts and privileges.	2.99	ME
6. The server was protected against unauthorized access.	2.99	ME
7. I practiced setting security rules for clients.	2.92	ME
8. Lessons included safe practices in network use.	2.88	ME
9. Expansion of the network was demonstrated.	2.68	ME
10. I understood how scalability and security apply in real life.	2.88	ME
General Assessment	**2.98**	**ME**

Legend:
3.25 – 4.00 High Extent (HE) *2.50 – 3.24 Moderate Extent (ME)*
1.75 – 2.49 Low Extent (LE) *1.00 – 1.74 Very Low Extent (VLE)*

Table 2.4 presents the extent of integration of client-server network strategies in teaching CSS in terms of scalability and security. The indicators obtained a general assessment mean of 2.98, interpreted as a Moderate Extent (ME). Among the indicators, "I experienced adding more clients to the server" obtained the highest mean (3.71, ME), while "Expansion of the network was demonstrated" obtained the lowest mean (2.68, ME). Other indicators, such as configuring user access (3.01), managing accounts and privileges (2.99), server protection against unauthorized access (2.99), and security features (2.90), were all rated at a moderate extent.

The results indicate that students are moderately exposed to scalability and security concepts within the client-servernetwork setup. The high rating for adding more clients to the server suggests that learners are given hands-on experience in expanding network usage, which is essential in understanding scalability. Likewise, the moderate ratings across security-related indicators imply that students are introduced to basic network protection practices such as user permissions, passwords, and access control. However, the relatively lower mean for network expansion demonstrations suggests limited exposure to more advanced or complex scalability applications.

These findings imply that while students are developing foundational knowledge and practical skills in scalability and security, there is still room for deeper and more advanced training. Strengthening instruction on large-scale network expansion and enhancing real-world security simulations may improve students' technical competence. Providing more complex scenarios could also better prepare learners for industry-level network administration tasks where scalability and cybersecurity are critical.

This is supported by International Telecommunication Union (2023), which emphasizes that modern ICT education must include strong foundations in cybersecurity and scalable network systems to prepare learners for increasingly complex and interconnected digital environments.

3. **What is the level of learners' performance in CSS in terms of:**

Table 3.1. *Level of learners' performance in CSS in terms of System Installation and Configuration*

Indicators	Mean	VI
1. I can install operating systems in a client–server environment.	3.42	VG
2. I can configure IP addresses for client machines.	3.63	VG
3. I can install and configure server roles (e.g., file sharing).	3.48	VG
4. I can set up a print server accessible to clients.	3.60	VG
5. I can configure user accounts in the server.	3.43	VG
6. I can connect client workstations to a server.	3.48	VG
7. I can configure shared folders and permissions.	2.54	G
8. I can test connectivity between server and clients.	2.80	G
9. I can document the installation and configuration process.	2.72	G
10. I can follow safety procedures during installation.	3.61	VG
General Assessment	**3.27**	**VG**

Legend:
3.25 – 4.00 Very Good (VG) *2.50 – 3.24 Good (G)*
1.75 – 2.49 Fair (F) *1.00 – 1.74 Poor (P)*

Table 3.1 presents the level of students' skills in system installation and configuration in a client–server environment. The indicators obtained a general assessment mean of 3.27, interpreted as Very Good (VG). Among the indicators, "I can configure IP addresses for client machines" obtained the highest mean (3.63, VG), followed by "I can follow safety procedures during installation" (3.61, VG) and "I can set up a print server accessible to clients" (3.60, VG). On the other hand, lower ratings were observed in "I can configure shared folders and permissions" (2.54, Good), "I can document the installation and configuration process" (2.72, Good), and "I can test connectivity between server and clients" (2.80, Good).

The results indicate that students demonstrate a strong level of competence in system installation and configuration within a client–server environment. They are particularly proficient in core technical tasks such as configuring IP addresses, installing server roles, and setting up network services, which are essential skills in computer systems servicing. However, slightly lower ratings in tasks related to documentation, connectivity testing, and permission configuration suggest that procedural accuracy and technical refinement still need improvement.

These findings imply that students are generally well-prepared in practical installation tasks but may require further reinforcement in areas involving system management, documentation, and network troubleshooting. Strengthening these competencies is important to ensure that learners not only perform technical setups but also understand proper documentation practices and secure configuration procedures, which are critical in real-world ICT environments.

This is supported by Cisco Systems (2023), which emphasizes that effective network professionals must combine hands-on technical skills with strong configuration, documentation, and troubleshooting abilities to ensure efficient and secure network operations in modern IT environments.

Table 3.2. *Level of learners' performance in CSS in terms of Troubleshooting and Maintenance*

Indicators	Mean	VI
1. I can identify server hardware issues.	2.72	G
2. I can identify client-side hardware/software issues.	2.68	G
3. I can troubleshoot connectivity problems.	2.64	G
4. I can resolve user login and account issues.	2.70	G
5. I can restore system backups.	2.72	G
6. I can update and maintain software.	2.72	G
7. I can check server logs for errors.	2.62	G
8. I can apply preventive maintenance for servers.	2.25	G
9. I can maintain client workstations in a network.	2.71	G
10. I can follow troubleshooting flowcharts effectively.	2.52	G
General Assessment	**2.63**	**G**

Legend:
3.25 – 4.00 Very Good (VG) *2.50 – 3.24 Good (G)*
1.75 – 2.49 Fair (F) *1.00 – 1.74 Poor (P)*

Table 3.2 presents the level of students' skills in troubleshooting and maintenance in a client–server environment. The indicators obtained a general assessment mean of 2.63, interpreted as Good (G). Among the indicators, "I can identify server hardware issues" and "I can restore system backups" obtained the highest mean (2.72, Good), followed by "I can update and maintain software" (2.72, Good) and "I can maintain client workstations in a network" (2.71, Good). On the other hand, the lowest means were observed in "I can apply preventive maintenance for servers" (2.25, Good) and "I can follow troubleshooting flowcharts effectively" (2.52, Good).

The results indicate that students demonstrate a functional but developing level of competence in troubleshooting and maintenance tasks. They are generally capable of identifying common hardware and software issues, performing basic recovery procedures, and maintaining systems within a network. However, the relatively lower ratings in preventive maintenance and structured troubleshooting processes suggest limitations in applying systematic and proactive approaches to network maintenance.

These findings imply that while students possess essential troubleshooting skills, there is still a need to strengthen their ability to perform preventive maintenance and follow standardized diagnostic procedures. Enhancing these areas through more structured practice, simulation-based activities, and real-world problem-solving scenarios may improve their overall technical proficiency and readiness for industry-related tasks.

This is supported by CompTIA (2023), which emphasizes that effective IT support professionals must not only resolve technical issues but also apply preventive maintenance strategies and structured troubleshooting methodologies to ensure system reliability and minimize downtime in network environments.

Table 3.3. *Level of learners' performance in CSS in terms of Preparedness for Tesda NC II Assessment*

Indicators	Mean	VI
1. I can perform tasks aligned with TESDA CSS NC II standards.	3.39	VG
2. I feel confident in hands-on assessments.	3.50	VG
3. I can complete CSS tasks under time pressure.	3.85	VG
4. I can meet safety and OHS requirements during tasks.	2.79	G
5. I can demonstrate network setup independently.	2.74	G
6. I can troubleshoot without teacher supervision.	2.80	G
7. I believe the client-serversetup prepared me well.	3.01	G
8. I feel ready to take the TESDA NC II assessment.	3.01	G
9. I can apply 5S and safety standards consistently.	3.01	G
10. I can demonstrate competence in both theory and practice.	3.01	G
General Assessment	**3.02**	**G**

Legend:
3.25 – 4.00 Very Good (VG) *2.50 – 3.24 Good (G)*
1.75 – 2.49 Fair (F) *1.00 – 1.74 Poor (P)*

Table 3.3 presents the level of students' preparedness for the TESDA NC II assessment in Computer Systems Servicing (CSS). The indicators obtained a general assessment mean of 3.02, interpreted as Good (G). Among the indicators, "I can complete CSS tasks under time pressure" obtained the highest mean (3.85, Very Good), followed by "I feel confident in hands-on assessments" (3.50, Very Good) and "I can perform tasks aligned with TESDA CSS NC II standards" (3.39, Very Good). On the other hand, lower ratings were observed in "I can demonstrate network setup independently" (2.74, Good), "I can meet safety and OHS requirements during tasks" (2.79, Good), and "I can troubleshoot without teacher supervision" (2.80, Good).

The results indicate that students have a generally positive level of preparedness for TESDA NC II assessment, particularly in performing tasks under time pressure and demonstrating confidence in hands-on activities. This suggests that their practical exposure to client-serverand CSS-related tasks has helped build essential competencies aligned with national certification standards. However, slightly lower ratings in independent task performance, troubleshooting without supervision, and compliance with safety standards indicate areas where further reinforcement is needed.

These findings imply that while students are generally ready for certification-level assessment, continued training is necessary to strengthen autonomy, problem-solving skills, and adherence to occupational safety and health (OHS) standards. Enhancing independent practice and simulation-based assessments may further improve their readiness and confidence in actual TESDA NC II examination settings.

This is supported by Technical Education and Skills Development Authority (2023), which emphasizes that competency-based assessment requires not only technical proficiency but also independence, safety compliance, and the ability to perform tasks under realistic workplace conditions to ensure full occupational readiness.

4. Is there a significant difference in the extent of integration and learners' performance when grouped according to their profile?

Table 4.1. *Significant difference in the extent of integration and learners' performance when grouped according to their profile in terms of Age*

Demographic Profile	Integration of Client-serverNetwork Strategies in Teaching CSS	t-value	N	P-value	Remarks	Decision
Age	Availability and Accessibility	0.295	103	0.829	Not Significant	Accept the Ho
	Adaptability and Flexibility	0.778	103	0.509	Not Significant	Accept the Ho
	Interactivity and Collaboration	0.566	103	0.639	Not Significant	Accept the Ho
	Scalability and Security	1.008	103	0.393	Not Significant	Accept the Ho

Table 4 presents the test of significant difference in the extent of integration of client-server network strategies in teaching CSS when grouped according to age. The results show that for availability and accessibility (t = 0.295, p = 0.829), adaptability and flexibility (t = 0.778, p = 0.509), interactivity and collaboration (t = 0.566, p = 0.639), and scalability and security (t = 1.008, p = 0.393), all obtained p-values greater than the 0.05 level of significance. As a result, all variables were interpreted as not significant, leading to the acceptance of the null hypothesis.

The findings indicate that there is no significant difference in the perceived extent of integration of client-server network strategies in teaching CSS when respondents are grouped according to age. This suggests that students, regardless of age differences, share similar perceptions regarding the availability, adaptability, interactivity, and scalability of the client-server network setup used in their learning environment. It implies that age does not influence how students experience or evaluate the integration of these instructional strategies.

This result implies that the implementation of client-server network strategies in CSS is consistently experienced across different age groups, indicating uniformity in instructional delivery and learning exposure. It further suggests that the teaching strategies and learning environment are designed in a way that is equally accessible and understandable to students of varying ages. Therefore, age is not a determining factor in how students perceive the integration of ICT-based instructional methods in this context.

Overall, the findings suggest that instructional design and technology integration in CSS are effectively standardized, ensuring equal learning opportunities regardless of age differences.

Table 4.2. *Significant difference in the extent of integration and learners' performance when grouped according to their profile in terms of Sex*

Demographic Profile	Integration of Client-server Network Strategies in Teaching CSS	t-value	N	P-value	Remarks	Decision
Sex	Availability and Accessibility	3.007	103	0.003	Significant	Reject the Ho
	Adaptability and Flexibility	0.360	103	0.719	Not Significant	Accept the Ho
	Interactivity and Collaboration	-0.033	103	0.973	Not Significant	Accept the Ho
	Scalability and Security	3.062	103	0.003	Significant	Reject the Ho

Table presents the test of significant difference in the extent of integration of client-server network strategies in teaching CSS when grouped according to sex. The results show that availability and accessibility (t = 3.007, p = 0.003) and scalability and security (t = 3.062, p = 0.003) are significant, leading to the rejection of the null hypothesis. Meanwhile, adaptability and flexibility (t = 0.360, p = 0.719) and interactivity and collaboration (t = -0.033, p = 0.973) obtained p-values greater than 0.05, indicating no significant difference, thus the null hypothesis is accepted for these variables.

The findings indicate that sex significantly influences students' perceptions of the availability and accessibility of client-server network strategies, as well as scalability and security. This suggests that male and female students may experience or evaluate these aspects differently, possibly due to variations in exposure, confidence, or engagement with technical and infrastructure-related ICT tasks. However, both sexes show similar perceptions in terms of adaptability, flexibility, interactivity, and collaboration, implying that these instructional dimensions are experienced more uniformly.

These results imply that while collaborative and instructional aspects of ICT integration are perceived similarly by male and female students, differences emerge in more technical and resource-based components. This highlights the importance of ensuring equitable access to ICT resources and hands-on technical exposure to minimize perception gaps between sexes in technology-enhanced learning environments.

Recent studies support these findings, showing that gender can influence ICT-related experiences, confidence, and engagement in educational settings, particularly in technical and system-oriented tasks. For instance, research on ICT integration in education has reported that gender-based differences may affect learners' confidence and interaction with digital systems, even when learning outcomes are similar across groups. Similarly, recent studies in ICT learning environments highlight that gender differences can emerge in usability perceptions, motivation, and engagement depending on task type and technological complexity. These findings reinforce the need for inclusive and balanced ICT instruction to ensure equal learning opportunities for all students regardless of sex.

Table 4.3. *Significant difference in the extent of integration and learners' performance when grouped according to their profile in terms of ICT Literacy Level*

Demographic Profile	Integration of Client-server Network Strategies in Teaching CSS	t-value	N	P-value	Remarks	Decision
ICT Literacy Level	Availability and Accessibility	-64.155	103	0.000	Significant	Reject the Ho
	Adaptability and Flexibility	-123.812	103	0.000	Significant	Reject the Ho
	Interactivity and Collaboration	-101.985	103	0.000	Significant	Reject the Ho
	Scalability and Security	-116.011	103	0.000	Significant	Reject the Ho

Table presents the test of significant difference in the extent of integration of client-server network strategies in teaching CSS when grouped according to ICT literacy level. The results show that availability and accessibility (t = -64.155, p = 0.000), adaptability and flexibility (t = -123.812, p = 0.000), interactivity and collaboration (t = -101.985, p = 0.000), and scalability and security (t = -116.011, p = 0.000) are all statistically significant. Since all p-values are lower than the 0.05 level of significance, the null hypothesis is rejected for all variables.

The findings indicate that ICT literacy level significantly affects students' perceptions of the integration of client-server network strategies in CSS instruction across all dimensions. This suggests that students with different levels of ICT literacy differ in how they experience and evaluate availability and accessibility, adaptability and flexibility, interactivity and collaboration, and scalability and security. Learners with higher ICT literacy are more likely to engage effectively with client-server environments, understand system processes, and maximize available resources, while those with lower literacy may perceive greater difficulty in utilizing these systems.

These results imply that ICT literacy plays a critical role in shaping students' learning experiences in technology-enhanced environments. The significant differences highlight the importance of strengthening foundational ICT skills to ensure that all learners can fully benefit from client-server network-based instruction. Enhancing digital literacy through structured training, guided practice, and continuous exposure to ICT tools may help reduce disparities in learning experiences and improve overall engagement and competence in CSS-related tasks.

This finding is supported by recent research emphasizing that ICT literacy is a key determinant of effective engagement in digital learning environments. Studies show that students with higher digital literacy levels demonstrate stronger performance, better interaction with learning technologies, and improved adaptability in ICT-integrated instruction (UNESCO, 2023). Similarly, digital competence frameworks highlight that ICT literacy directly influences learners' ability to effectively participate in technology-rich educational settings, reinforcing the need for continuous skill development in education systems.

Table 4.4. *Significant difference in the extent of integration and learners' performance when grouped according to their profile in terms of Access to Technology at Home*

Demographic Profile	Integration of Client-server Network Strategies in Teaching CSS	t-value	N	P-value	Remarks	Decision
Access to Technology at Home	Availability and Accessibility	-0.283	103	0.777	Not Significant	Accept the Ho
	Adaptability and Flexibility	-1.178	103	0.241	Not Significant	Accept the Ho
	Interactivity and Collaboration	0.682	103	0.497	Not Significant	Accept the Ho
	Scalability and Security	0.610	103	0.543	Not Significant	Accept the Ho

Table presents the test of significant difference in the extent of integration of client-server network strategies in teaching CSS when grouped according to access to technology at home. The results show that availability and accessibility (t = -0.283, p = 0.777), adaptability and flexibility (t = -1.178, p = 0.241), interactivity and collaboration (t = 0.682, p = 0.497), and scalability and security

(t = 0.610, p = 0.543) all obtained p-values greater than 0.05. Hence, all variables are interpreted as not significant, leading to the acceptance of the null hypothesis.

The findings indicate that access to technology at home does not significantly influence students' perceptions of the integration of client-server network strategies in CSS instruction. This suggests that whether students have access to computers, laptops, or internet connectivity at home, their experiences and evaluations of availability, adaptability, interactivity, and scalability in the classroom setting remain generally similar. It implies that school-based ICT resources and learning experiences may play a more dominant role than home access in shaping students' perceptions.

These results imply that institutional provision of ICT facilities, such as computer laboratories and client-server setups, helps ensure a relatively equal learning experience among students regardless of their home technology access. Even if students differ in terms of personal access to devices at home, the school environment appears to provide sufficient exposure and opportunities for engagement with ICT-based instruction. This highlights the importance of school infrastructure in bridging digital access gaps among learners.

This finding aligns with recent discussions in digital education research, which emphasize that equitable access to school-based ICT infrastructure can reduce the impact of the digital divide on learning experiences. Studies have shown that when educational institutions provide consistent access to technology, disparities in home resources become less influential in shaping student engagement and outcomes in ICT-integrated learning environments (International Telecommunication Union, 2023).

Table 4.5. *Significant difference in the extent of integration and learners' performance when grouped according to their profile in terms of Prior Exposure to Networking or Related ICT Subjects*

Demographic Profile	Integration of Client-server Network Strategies in Teaching CSS	t-value	N	P-value	Remarks	Decision
Prior Exposure to Networking or Related ICT Subjects	Availability and Accessibility	-28.418	103	0.000	Significant	Reject the Ho
	Adaptability and Flexibility	-59.814	103	0.000	Significant	Reject the Ho
	Interactivity and Collaboration	-48.767	103	0.000	Significant	Reject the Ho
	Scalability and Security	-57.499	103	0.000	Significant	Reject the Ho

Table presents the test of significant difference in the extent of integration of client-server network strategies in teaching CSS when grouped according to prior exposure to networking or related ICT subjects. The results show that availability and accessibility (t = -28.418, p = 0.000), adaptability and flexibility (t = -59.814, p = 0.000), interactivity and collaboration (t = -48.767, p = 0.000), and scalability and security (t = -57.499, p = 0.000) are all statistically significant. Since all p-values are lower than the 0.05 level of significance, the null hypothesis is rejected across all variables.

The findings indicate that prior exposure to networking or ICT-related subjects significantly influences students' perceptions of client-server network integration in CSS instruction. This suggests that students with prior knowledge or experience in ICT concepts are more capable of understanding, engaging with, and evaluating the availability of resources, adaptability of instruction, collaborative activities, and system scalability and security. In contrast, students with limited or basic exposure may perceive greater difficulty in fully utilizing or appreciating these network-based learning strategies.

These results imply that foundational knowledge in networking plays a critical role in shaping how students experience and benefit from server–client-based instruction. Prior exposure enhances learners' readiness, confidence, and engagement in technical tasks, leading to more positive and informed perceptions of ICT integration. Therefore, strengthening early exposure to networking concepts can significantly improve students' ability to maximize learning opportunities in CSS.

This is supported by recent educational research emphasizing that prior ICT experience is a strong predictor of students' performance and engagement in technology-rich learning environments. Studies show that learners with earlier exposure to computer networking and digital systems demonstrate higher adaptability, better problem-solving skills, and stronger engagement in ICT-based instruction compared to those without such background (UNESCO, 2023).

5. Is there a significant relationship between the extent of integration of client-server network strategies and learners' performance in CSS?

Table 5.1. *Significant relationship between the extent of integration of client-server network strategies and learners' performance in CSS in terms of Availability and Accessibility*

Integration of Client-server Network Strategies in Teaching CSS	Level of Learners' Performance in CSS	R-value	N	P-value	Remarks	Decision
Availability and Accessibility	System Installation and Configuration	-0.088	104	0.375	Not Significant	Accept the Ho
	Troubleshooting and Maintenance	0.031	104	0.752	Not Significant	Accept the Ho
	Preparedness for TESDA NC II Assessment	0.063	104	0.527	Not Significant	Accept the Ho

Table presents the relationship between the extent of integration of client-server network strategies in teaching CSS and learners' performance in terms of system installation and configuration, troubleshooting and maintenance, and preparedness for TESDA NC II assessment. The results show that availability and accessibility is not significantly related to system installation and configuration ($r = -0.088$, $p = 0.375$), troubleshooting and maintenance ($r = 0.031$, $p = 0.752$), and preparedness for TESDA NC II assessment ($r = 0.063$, $p = 0.527$). Since all p-values are greater than 0.05, the null hypothesis is accepted.

The findings indicate that there is no significant relationship between the extent of integration of client-server network strategies and learners' performance in CSS. This suggests that regardless of how students perceive the availability and accessibility of client-server systems, their performance in system installation, troubleshooting, and NC II preparedness remains statistically similar. It implies that other factors beyond the perceived integration of client-server strategies may have a stronger influence on learners' performance outcomes, such as prior knowledge, individual effort, or hands-on practice.

These results imply that while client-server network strategies are an important component of instruction; their perceived level of integration alone does not directly translate into measurable improvements in student performance. This may indicate that students' competencies in CSS are more strongly influenced by direct skill practice, competency-based training, and experiential learning rather than perceptions of system availability or accessibility.

This finding aligns with recent educational studies suggesting that technology integration does not automatically lead to improved learning outcomes unless it is paired with effective pedagogy, sufficient practice, and structured competency development. Research emphasizes that meaningful learning gains in ICT-related subjects depend on how technology is used in instruction rather than its mere presence or perceived extent of integration (UNESCO, 2023).

Table 5.2. *Significant relationship between the extent of integration of client-server network strategies and learners' performance in CSS in terms of Adaptability and Flexibility*

Integration of Client-server Network Strategies in Teaching CSS	Level of Learners' Performance in CSS	R-value	N	P-value	Remarks	Decision
Adaptability and Flexibility	System Installation and Configuration	-0.036	104	0.714	Not Significant	Accept the Ho
	Troubleshooting and Maintenance	0.065	104	0.510	Not Significant	Accept the Ho
	Preparedness for TESDA NC II Assessment	0.046	104	0.645	Not Significant	Accept the Ho

Table presents the relationship between the extent of integration of client-server network strategies in teaching CSS and learners' performance in terms of system installation and configuration, troubleshooting and maintenance, and preparedness for TESDA NC II assessment, specifically in terms of adaptability and flexibility. The results show that adaptability and flexibility has no significant relationship with system installation and configuration ($r = -0.036$, $p = 0.714$), troubleshooting and maintenance ($r = 0.065$, $p = 0.510$), and preparedness for TESDA NC II assessment ($r = 0.046$, $p = 0.645$). Since all p-values are greater than 0.05, the null hypothesis is accepted.

The findings indicate that the adaptability and flexibility of client-server network strategies in teaching CSS do not significantly influence learners' performance in the identified areas. This suggests that even if instructional activities are perceived as flexible or adaptable to student needs, this does not directly translate into improved outcomes in system installation, troubleshooting, or

assessment readiness. It implies that students' performance may be more dependent on actual hands-on practice, skill mastery, and technical exposure rather than the perceived flexibility of instructional delivery.

These results further imply that while adaptable and flexible teaching strategies are important for creating an inclusive and responsive learning environment, they are not sufficient on their own to enhance measurable technical performance. Effective skill development in CSS may require more structured practice, repeated laboratory exposure, and competency-based training to ensure mastery of required tasks and NC II standards.

This finding is supported by recent educational research which emphasizes that technology-enhanced learning environments improve student outcomes only when adaptability is combined with consistent practice, guided instruction, and competency-based assessment. Studies highlight that instructional flexibility alone does not guarantee performance improvement unless it is supported by structured skill development activities and hands-on engagement (UNESCO, 2023).

Table 5.3. *Significant relationship between the extent of integration of client-server network strategies and learners' performance in CSS in terms of Interactivity and Collaboration*

Integration of Client-server Network Strategies in Teaching CSS	Level of Learners' Performance in CSS	R-value	N	P-value	Remarks	Decision
Interactivity and Collaboration	System Installation and Configuration	0.056	104	0.572	Not Significant	Accept the Ho
	Troubleshooting and Maintenance	0.072	104	0.466	Not Significant	Accept the Ho
	Preparedness for TESDA NC II Assessment	0.128	104	0.195	Not Significant	Accept the Ho

Table presents the relationship between the extent of integration of client-server network strategies in teaching CSS and learners' performance in terms of system installation and configuration, troubleshooting and maintenance, and preparedness for TESDA NC II assessment, specifically in terms of interactivity and collaboration. The results show that interactivity and collaboration has no significant relationship with system installation and configuration ($r = 0.056$, $p = 0.572$), troubleshooting and maintenance ($r = 0.072$, $p = 0.466$), and preparedness for TESDA NC II assessment ($r = 0.128$, $p = 0.195$). Since all p-values are greater than 0.05, the null hypothesis is accepted.

The findings indicate that interactivity and collaboration in the integration of client-server network strategies do not significantly influence learners' performance in CSS. This suggests that although students may engage in group activities, discussions, and collaborative tasks during instruction, these experiences do not directly translate into measurable improvements in system installation skills, troubleshooting ability, or NC II assessment readiness. It implies that collaborative learning alone is not sufficient to enhance technical performance outcomes in a competency-based ICT subject.

These results further imply that while interactivity and collaboration are important for engagement, communication, and social learning, they must be complemented by intensive hands-on practice and individual skill application to effectively improve technical competencies. In CSS instruction, mastery of skills such as system configuration and troubleshooting may require more direct practice and task repetition rather than relying mainly on collaborative learning experiences.

This finding is supported by recent educational literature emphasizing that collaborative learning enhances engagement and understanding but does not always directly improve technical performance unless combined with structured practice and competency-based training. Research highlights that in ICT and technical-vocational education, skill mastery is more strongly influenced by hands-on performance tasks and guided practical exercises than by interaction alone (UNESCO, 2023).

Table 5.4. *Significant relationship between the extent of integration of client-server network strategies and learners' performance in CSS in terms of Scalability and Security*

Integration of Client-server Network Strategies in Teaching CSS	Level of Learners' Performance in CSS	R-value	N	P-value	Remarks	Decision
Scalability and Security	System Installation and Configuration	-0.027	104	0.785	Not Significant	Accept the Ho
	Troubleshooting and Maintenance	-0.073	104	0.459	Not Significant	Accept the Ho
	Preparedness for TESDA NC II Assessment	0.033	104	0.739	Not Significant	Accept the Ho

Table presents the relationship between the extent of integration of client-server network strategies in teaching CSS and learners' performance in terms of system installation and configuration, troubleshooting and maintenance, and preparedness for TESDA NC II assessment, specifically in terms of scalability and security. The results show that scalability and security has no significant relationship with system installation and configuration ($r = -0.027$, $p = 0.785$), troubleshooting and maintenance ($r = -0.073$, $p = 0.459$), and preparedness for TESDA NC II assessment ($r = 0.033$, $p = 0.739$). Since all p-values are greater than 0.05, the null hypothesis is accepted.

The findings indicate that scalability and security in the integration of client-server network strategies do not significantly influence learners' performance in CSS. This suggests that even if students are exposed to concepts such as network expansion, user management, and basic security measures, these do not directly translate into improved performance in system installation, troubleshooting, or preparedness for TESDA NC II assessment. It implies that learners' technical performance is not strongly dependent on their perceived exposure to scalability and security features alone.

These results further imply that while scalability and security are essential components of network systems, their impact on student performance may only become significant when combined with deeper, hands-on application and real-world simulation. Students may understand these concepts theoretically, but without consistent practical engagement, such knowledge may not significantly enhance their competency outcomes in CSS tasks.

This finding is supported by recent ICT education research emphasizing that cybersecurity awareness and system scalability concepts contribute to learner understanding, but measurable performance improvements depend more on practical application and experiential learning. Studies highlight that in technical-vocational education, competency development is strongly influenced by hands-on training, simulation activities, and performance-based assessment rather than conceptual exposure alone (UNESCO, 2023).

6. Based on the findings of the study, what instructional strategies or innovations can be recommended to enhance the integration of client-server networks in teaching CSS?

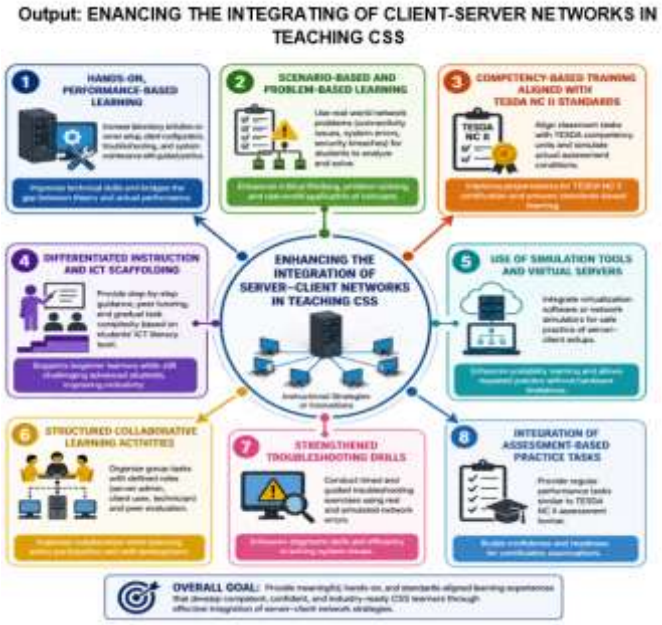
Rationale

The diagram presents a synthesized framework of instructional strategies and innovations designed to enhance the integration of client-server networks in teaching Computer Systems Servicing (CSS). It visually organizes eight key approaches—namely hands-on performance-based learning, scenario-based and problem-based learning, competency-based training aligned with TESDA NC II standards, differentiated instruction and ICT scaffolding, use of simulation tools and virtual servers, structured collaborative learning activities, strengthened troubleshooting drills, and integration of assessment-based practice tasks—around a central goal of improving learners' technical competence and readiness.

The rationale behind this framework is anchored on the findings of the study, which revealed that while the integration of client-server network strategies is generally at a moderate to very good extent, learners' performance is not always significantly influenced by perceived integration alone. This suggests that effective learning in CSS is not achieved merely through exposure to ICT infrastructure, but through well-structured, experiential, and competency-based instructional approaches that actively engage learners in real-world tasks.

Each strategy in the framework addresses a specific gap identified in the study. For instance, hands-on and simulation-based learning respond to the need for stronger practical application of skills, while scenario-based and troubleshooting activities enhance critical thinking and problem-solving abilities. Competency-based training aligned with TESDA NC II ensures that instruction is standards-driven, while collaborative and differentiated approaches promote inclusivity and active participation among learners with varying ICT literacy levels. Additionally, assessment-based practice tasks reinforce readiness for certification and workplace application.

Overall, the framework emphasizes that meaningful integration of client-server network strategies requires a balance between technology availability and pedagogical effectiveness. It highlights that improved learner performance in CSS is best achieved when instructional strategies are intentionally designed to be practical, adaptive, and aligned with both industry standards and competency-based assessment requirements.



Based on the results of the study, the following findings revealed.

1. The demographic profile of the respondents showed that most are aged 19–20 years old (56.7%), predominantly male (89.4%), with all respondents classified as beginners in ICT literacy (100%). In terms of access to technology, most have internet connection (82.7%), while fewer have computer/laptop access (17.3%). All respondents also reported only basic prior exposure to networking or related ICT subjects (100%).
2. The extent of integration of client-server network strategies in teaching CSS in terms of availability and accessibility, adaptability and flexibility, interactivity and collaboration, and scalability and security was generally interpreted as Moderate Extent (ME), with a general assessment mean ranging from 2.80 to 2.98.
3. The level of learners' performance in CSS showed that:
   - System installation and configuration was rated Very Good (VG) (3.27)
   - Troubleshooting and maintenance was rated Good (G) (2.63)
   - Preparedness for TESDA NC II assessment was rated Good (G) (3.02)
4. When grouped according to profile:
   - Age showed no significant difference in all integration dimensions.
   - Sex showed significant differences in availability and accessibility and scalability and security.
   - ICT literacy level showed significant differences across all integration dimensions.
   - Access to technology at home showed no significant differences.
   - Prior exposure to ICT subjects showed significant differences across all dimensions.
5. In terms of relationship between integration and learners' performance:
   - Availability and accessibility showed no significant relationship with performance.
   - Adaptability and flexibility showed no significant relationship with performance.
   - Interactivity and collaboration showed no significant relationship with performance.
   - Scalability and security showed no significant relationship with performance.
6. The proposed instructional strategies include strengthening hands-on, performance-based learning; scenario-based and problem-based learning; competency-based training aligned with TESDA NC II standards; differentiated instruction and ICT scaffolding; the use of simulation tools and virtual servers; structured collaborative learning activities; strengthened troubleshooting drills; and the integration of assessment-based practice tasks.

CONCLUSIONS

Based on the findings of the study, the researchers drew the following conclusions regarding the integration of client-server network strategies in teaching Computer Systems Servicing (CSS). The conclusions highlight the respondents' characteristics, the extent of implementation of client-server network strategies, learners' performance in CSS competencies, the influence of selected demographic factors, and the implications of the findings for improving technology-integrated instruction. The following conclusions were formulated based on the results of the study:

1. The respondents are mostly young male beginner-level ICT learners with limited prior exposure to advanced networking concepts.
2. The integration of client-server network strategies in CSS instruction is moderately implemented, indicating that ICT resources and strategies are present but still need enhancement.
3. Students demonstrate good to very good performance in CSS competencies, particularly in system installation and configuration, but require further improvement in troubleshooting and NC II preparedness.
4. Demographic factors such as ICT literacy level and prior exposure significantly influence perceptions of integration, while age and access to technology at home do not.
5. The integration of client-server network strategies does not significantly influence learners' performance, suggesting that performance is more dependent on actual hands-on practice and skill mastery.
6. A structured and practical instructional framework is necessary to improve the effectiveness of client-server network integration in teaching CSS.

1. **For Teachers.** TLE/CSS teachers are encouraged to strengthen hands-on, laboratory-based, simulation-based, and scenario-driven activities to provide students with authentic client-server experiences. These activities should include troubleshooting exercises, problem-based tasks, and performance-based activities that develop students' technical competencies, critical thinking, and problem-solving skills.

2. **For Teachers and Students.** Teachers are encouraged to provide differentiated ICT literacy activities, including step-by-step demonstrations, guided practice, peer tutoring, and scaffolded tasks, to accommodate learners with varying levels of ICT proficiency. This may help reduce skill gaps and provide beginner learners with greater opportunities to develop their technical skills.

3. **For Teachers and Curriculum Developers.** Classroom instruction should be more closely aligned with TESDA NC II competency standards to ensure that learning activities, performance tasks, and assessments reflect the competencies required in Computer Systems Servicing. This alignment may improve students' preparedness for competency assessment and future industry-related tasks.

4. **For School Administrators.** School administrators are encouraged to improve access to functional computer laboratories, workstations, networking equipment, and simulation tools. Adequate and functional resources are necessary to support effective hands-on learning and maximize the use of client-server networks as an instructional resource.

5. **For Teachers.** Structured collaborative learning strategies should be integrated into CSS instruction by assigning learners specific roles, such as server administrator, client user, and technician. This approach may strengthen teamwork, communication, peer learning, and active participation while developing students' technical competencies.

6. **For Teachers.** Continuous professional development programs should be provided to enhance teachers' competencies in advanced client-server network instruction, simulation tools, troubleshooting techniques, and ICT-integrated teaching strategies. This may enable teachers to implement technology-driven and industry-relevant instructional practices more effectively.

7. **For School Administrators and Curriculum Developers.** The findings may be used as a basis for developing or enhancing instructional programs that integrate client-server networks, simulation technologies, competency-based training, and other innovative ICT strategies into CSS instruction. Such initiatives should remain responsive to current industry practices and the competency requirements of learners.

8. **For Future Researchers.** Further studies are recommended to examine other factors that may influence students' performance in Computer Systems Servicing beyond the perceived integration of client-server networks. Future research may consider variables such as ICT literacy, availability of resources, teacher competency, learning motivation, learning environment, and students' prior technical experience.

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