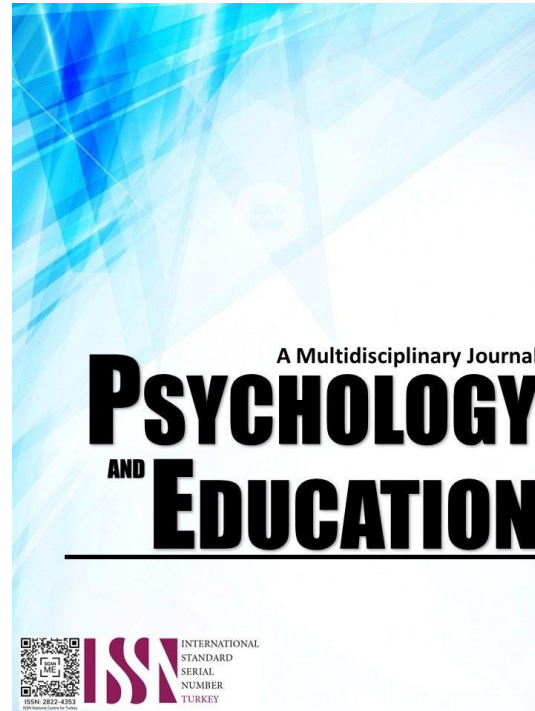


**ENHANCING INFORMATION AND COMMUNICATIONS TECHNOLOGY–  
COMPUTER SYSTEMS SERVICING (ICT-CSS) INSTRUCTION  
THROUGH GAMIFICATION: TOWARDS A LESSON  
EXEMPLAR FOR SENIOR HIGH  
SCHOOL STUDENTS**



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## Enhancing Information and Communications Technology–Computer Systems Servicing (ICT-CSS) Instruction Through Gamification: Towards A Lesson Exemplar for Senior High School Students

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### Abstract

Gamification is increasingly used in technical–vocational education, yet evidence on its effectiveness in ICT–Computer Systems Servicing (CSS) and its link to technology acceptance remains limited. This study examined the effectiveness of gamified instruction on students’ content knowledge, assessed their acceptance of gamification, and explored the relationship between acceptance and learning outcomes, with the end goal of informing a gamified lesson exemplar. A descriptive–correlational and quasi–experimental design was employed involving 116 Grade 9 ICT–CSS students selected through purposive sampling. Data were gathered using a TAM-based questionnaire and a 50-item achievement test. Statistical analyses included means, standard deviations, paired and independent-samples t-tests, and Pearson correlation, while qualitative data were analyzed thematically. The experimental group showed significantly higher gains ( $M = 23.95$  to  $36.03$ ) than the control group ( $M = 25.33$  to  $30.97$ ), with a significant posttest difference ( $t(63) = 3.07, p = .002$ ). Students reported high acceptance of gamification ( $WM = 3.58$ – $3.95$ ). However, correlations between acceptance and performance were weak ( $r = -.21$  to  $.04$ ). Gamified instruction appears to enhance engagement and learning outcomes in ICT–CSS. Findings inform the development of a scaffolded and outcome-aligned gamified lesson exemplar, emphasizing that instructional design, not acceptance alone, drives academic performance.

**Keywords:** *gamification, ICT-CSS, quasi-experimental research, high school students, computer system servicing, lesson exemplar*

### Introduction

The rapid advancement of digital technologies has significantly transformed the landscape of 21st-century education. Contemporary learners are increasingly immersed in interactive digital environments characterized by instant feedback, gamified interfaces, and immersive experiences. However, many classrooms continue to rely on traditional lecture-centered instruction, which may not sufficiently engage learners whose preferences are shaped by digital interactivity. This misalignment between instructional approaches and learner characteristics presents a critical challenge for educators and highlights the need for innovative, learner-centered pedagogies. One such approach is gamification, which integrates game design elements—such as points, badges, leaderboards, and structured challenges—into non-game contexts to enhance engagement and learning outcomes.

A growing body of literature suggests that gamification can positively influence student motivation, engagement, and academic performance when implemented effectively (Lampropoulos & Kinshuk, 2024). Empirical studies have shown that gamified learning environments can increase task participation, improve learning achievement, and foster both intrinsic and extrinsic motivation compared to traditional approaches. Similarly, meta-analyses and systematic reviews report that gamification has a generally positive effect on learners’ attitudes and performance across educational levels. However, these studies also emphasize that the effectiveness of gamification depends on context-specific design, alignment with learning objectives, and appropriate scaffolding, indicating that its impact is not universally guaranteed.

The potential of gamification is further supported by established theoretical frameworks. The Technology Acceptance Model (TAM) explains that learners’ willingness to adopt instructional innovations is influenced by perceived usefulness, perceived ease of use, and attitudes toward the technology (Davis, 1989). In parallel, constructivist learning theories argue that knowledge is actively constructed through experience, interaction, and collaboration (Piaget, 1972; Vygotsky, 1978). Gamified instruction aligns with these principles by promoting active engagement, immediate feedback, and social interaction, all of which are essential in developing both conceptual understanding and practical skills.

In the Philippine context, the need for innovative and learner-centered instruction is reinforced by national education policies. The Enhanced Basic Education Act of 2013 (Republic Act No. 10533) advocates for competency-based and student-centered learning approaches. Additionally, recent Department of Education (DepEd) initiatives recognize gamification as a viable strategy to improve learner engagement and outcomes. Despite these policy directions, empirical evidence on the effectiveness of gamification in Philippine junior high schools remains limited, particularly in technical-vocational subjects such as Information and Communication Technology–Computer Systems Servicing (ICT–CSS).

Existing local and international studies have largely focused on general education subjects or higher education contexts, with limited attention given to technical skill development in basic education. Moreover, previous research has often examined either learning

outcomes or student perceptions in isolation, with fewer studies integrating both dimensions to provide a comprehensive understanding of gamified instruction. There is also a notable lack of studies that translate empirical findings into practical instructional tools, such as lesson exemplars, that teachers can readily implement in classroom settings. These gaps highlight the need for context-specific research that examines both the effectiveness and acceptability of gamification while generating actionable outputs for educators.

In response to these gaps, this study investigates the effectiveness of gamified instruction in enhancing Grade 9 ICT–CSS students' content knowledge in computer system unit assembly and disassembly. It also examines students' acceptance of gamification using the Technology Acceptance Model and explores the relationship between acceptance and learning outcomes. Importantly, the study utilizes its findings to develop a gamified lesson exemplar grounded in empirical evidence. By integrating quantitative and qualitative insights, this research aims to contribute to the growing body of literature on gamification and provide practical guidance for improving ICT–CSS instruction in junior high school settings.

## Research Questions

This study aimed to assess the effectiveness and acceptance of gamification in the disassembly and assembly of system units among Grade 9 ICT-CSS learners of Lourdes Empinado National High School during the School Year 2025–2026 as a basis for developing an evidence-based lesson exemplar. Specifically, the study sought to answer the following questions.

1. What is the demographic profile of the respondents in terms of:
  - 1.1 age;
  - 1.2 sex;
  - 1.3 prior experience in computer hardware assembly and disassembly; and
  - 1.4 engagement with digital or educational games?
2. Is there a significant difference between the students' entry and exit levels of content knowledge in the assembly and disassembly of system units?
3. What is the level of students' acceptance of gamification in terms of:
  - 3.1 perceived usefulness of gamification (pug);
  - 3.2 perceived ease of use of gamification (PEUG);
  - 3.3 attitude toward gamification (atg); and
  - 3.4 gamification acceptance in relation to content knowledge (gack)?
4. Is there a significant relationship between students' level of gamification acceptance and their content knowledge?
5. Is there a significant difference in the posttest performance of students exposed to gamified instruction and those taught using traditional teaching methods?
6. What challenges and benefits do students report in using gamification in ICT-CSS lessons?
7. Based on the findings, what evidence-based gamified lesson exemplar can be developed for ICT-CSS instruction?

## Literature Review

### *ICT-CSS Instruction and Structured Learning Frameworks*

Structured, learner-centered instructional approaches have long been recognized as effective in promoting meaningful learning, particularly in skill-based disciplines such as Information and Communications Technology–Computer Systems Servicing (ICT-CSS). The ICY-CSS instructional framework follows a scaffolded learning progression consisting of interpretation, clarification, yielding, conceptualization, skill development, and synthesis. This structure is consistent with constructivist learning theory, which emphasizes active knowledge construction through interaction with learning experiences rather than passive information reception (Piaget, 1972; Vygotsky, 1978).

The ICY-CSS model also parallels Bloom's revised taxonomy and the 5E instructional model, both of which promote progression from basic understanding to higher-order cognitive processes (Anderson & Krathwohl, 2001; Bybee et al., 2006). Structured instructional sequencing is particularly important in technical subjects because procedural skills require gradual mastery, repeated practice, and guided application. Learners are more likely to retain and transfer knowledge when instruction is organized into clearly defined learning stages that support cognitive development and skill acquisition.

### *Gamification in Education: Concept and Theoretical Foundations*

Gamification refers to the integration of game design elements such as points, challenges, feedback mechanisms, and reward systems into learning environments to improve learner engagement and motivation (Deterding et al., 2011; Kapp, 2012). Motivational and behavioral learning theories largely explain the effectiveness of gamification.

Self-Determination Theory emphasizes that gamification can support intrinsic motivation by satisfying learners' psychological needs for autonomy, competence, and relatedness (Ryan & Deci, 2000). When learners are given meaningful choices, achievable challenges, and opportunities for social interaction, their willingness to persist in learning tasks increases.

Similarly, Flow Theory suggests that optimal learning occurs when instructional challenges are balanced with learner skills, resulting

in sustained attention and enjoyment during learning activities (Csikszentmihalyi, 1990). However, gamification effectiveness depends not merely on the presence of game elements but on how these elements are aligned with learning objectives.

### ***Effects of Gamification on Student Engagement and Motivation***

Empirical studies consistently report that gamification enhances student engagement when properly designed and implemented. Gamified learning environments encourage active participation, behavioral involvement, and positive emotional responses to learning tasks (Hamari et al., 2016; Kuo & Chuang, 2016).

Students often perceive gamified activities as more enjoyable and interactive compared to traditional instruction. This increased enjoyment contributes to sustained attention and participation. Nevertheless, motivation generated by extrinsic rewards such as points or badges may be temporary if not supported by meaningful learning experiences. Overreliance on reward-based mechanics may lead to superficial engagement rather than deep conceptual understanding (Mekler et al., 2017). Therefore, instructional design quality is a critical determinant of gamification success.

### ***Gamification and Academic Performance***

Studies examining the impact of gamification on academic performance report generally positive but context-dependent outcomes. Gamification can improve conceptual understanding, problem-solving ability, and achievement when game mechanics are directly connected to instructional goals (Su & Cheng, 2015; Sailer & Homner, 2020).

However, research also shows mixed results across studies. Some gamification interventions produce only modest academic gains, suggesting that gamification is not inherently effective unless supported by well-structured pedagogical design (Hanus & Fox, 2015). This indicates that the success of gamification depends more on instructional integration than on the novelty of game elements.

### ***Integrating Gamification with Instructional Design Models***

Gamification is most effective when embedded within systematic instructional frameworks rather than implemented as a stand-alone strategy. Landers (2014) emphasized that game mechanics should be directly aligned with desired learning behaviors and outcomes.

When integrated with structured learning models such as ICY-CSS, gamification can support each phase of instruction. For example, challenge-based activities may enhance interpretation and clarification of concepts, while level-based progression and mastery rewards can facilitate skill development and synthesis.

Adaptive gamification design also supports differentiated instruction by adjusting task difficulty based on learner performance. Such design promotes learner autonomy and prevents cognitive overload (Deterding, 2015; Werbach & Hunter, 2015). Furthermore, gamified learning systems can generate performance data that enables formative feedback and evidence-based instructional decision-making (Sailer et al., 2017).

### ***Lesson Exemplars and Gamified Instructional Practice***

Lesson exemplars serve as practical instructional guides that translate theoretical concepts into classroom application. They help teachers align learning objectives, activities, and assessment strategies, thereby improving instructional consistency and clarity (Forster & Smeaton, 2016).

Gamified lesson exemplars provide structured models for integrating game mechanics into lessons without compromising academic rigor. When designed with clear pedagogical intent, gamified exemplars can support mastery-oriented learning, improve engagement, and enhance learner satisfaction (Abramovich et al., 2013).

### ***Challenges and Gaps in Gamified Instruction***

Despite its advantages, gamification implementation presents several challenges. Poorly designed gamification systems may cause cognitive overload, distraction, or dependence on extrinsic rewards if learning objectives are not properly aligned with game mechanics (Sailer et al., 2017).

Teacher preparedness is another important factor affecting gamification effectiveness. Successful implementation requires pedagogical planning, technological competence, and instructional design knowledge (Richter et al., 2015). In resource-constrained settings, unequal access to digital tools and internet connectivity further limits gamification adoption.

In the Philippine context, empirical studies on gamification in junior high school technical education remain limited. Local research evidence is still developing, particularly in ICT-CSS instruction. This gap highlights the need for context-specific instructional models that address learner characteristics, technological access, and classroom realities.

Overall, literature suggests that gamification can improve engagement and learning outcomes when integrated into structured instructional frameworks and supported by high-quality instructional design. However, the effectiveness of gamification varies across contexts. The present study addresses this gap by examining gamification within ICT-CSS instruction and by developing an evidence-based gamified lesson exemplar tailored to Grade 9 learners.

## Methodology

### Research Design

This study employed a mixed-methods research design, specifically an explanatory sequential mixed-methods design, integrating quantitative and qualitative approaches across two phases. In this design, quantitative data were collected and analyzed first to determine the effectiveness and acceptance of gamification, followed by qualitative data to explain and enrich the quantitative findings.

The quantitative phase consisted of descriptive, correlational, and quasi-experimental components. The descriptive component was used to analyze the demographic characteristics of the respondents and their level of gamification acceptance in terms of perceived usefulness, perceived ease of use, and attitude toward gamification. This provided baseline information for understanding learner profiles and patterns of technology acceptance.

The correlational component examined the relationship between students' gamification acceptance and their content knowledge in system unit assembly and disassembly. Establishing these relationships helped determine whether learners' perceptions of gamification are associated with their academic performance, thereby providing an empirical basis for instructional design decisions and the development of a lesson exemplar.

The quasi-experimental component utilized a single-group pretest–posttest design to measure changes in students' content knowledge before and after exposure to gamification-based instruction. This design was selected due to practical and ethical considerations within the classroom context, where assigning a control group or withholding an instructional innovation may not be feasible. While the design does not fully control for all threats to internal validity, the comparison of pretest and posttest scores allows for the assessment of learning gains associated with the intervention.

The qualitative phase involved the analysis of students' open-ended responses regarding the challenges and benefits of gamified instruction. These responses were examined using thematic analysis to identify recurring patterns and insights related to learners' experiences.

The integration of quantitative and qualitative findings occurred during the interpretation stage, where qualitative results were used to explain, validate, and provide deeper context to the statistical outcomes. This integration strengthened the overall analysis by linking measurable learning gains and acceptance levels with students' actual experiences.

Overall, the use of an explanatory sequential mixed-methods design enabled a comprehensive examination of gamification in ICT–CSS instruction. The combined findings informed the development of an evidence-based gamified lesson exemplar, ensuring that the instructional design is grounded in both empirical results and learner experiences.

### Participants

The participants of the study were Grade 9 students enrolled in the Technical-Vocational-Livelihood (TVL) track, specifically under the Information and Communications Technology (ICT) strand, at Lourdes Empinado National High School in Barili, Cebu, during the School Year 2025–2026. These students were selected because they are the direct beneficiaries of the gamification-based instruction implemented in Computer Systems Servicing (CSS) classes. Their academic performance, perceptions, and learning experiences were essential in evaluating the effectiveness and acceptance of gamification in ICT–CSS instruction.

A total population of 116 Grade 9 ICT–CSS students participated in the study and were involved in the quantitative assessments (pretest–post-test evaluation and correlational analysis) and qualitative component exploring perceived challenges and benefits of gamification. The sample size ( $n = 116$ ) is equivalent to 100% of the population, making the study a total enumeration of the target group rather than a sample of a subset.

Purposive sampling was employed because participants needed to meet specific criteria relevant to the research objectives, including formal enrollment in the ICT–CSS strand and exposure to Computer Systems Servicing instruction. Selecting students from three class sections (St. Michael, St. Paul, and St. Roque) enhanced the diversity of respondents and reduced potential section-specific biases. Sampling across multiple sections improved the credibility of findings by capturing varied learning behaviors, academic abilities, and classroom experiences within the target population.

Participation in the study was voluntary. All selected students were invited to participate, and informed consent procedures were followed in accordance with ethical research standards. There were no reported participant refusals; thus, the final population consisted of all 116 students initially identified. Potential sampling limitations include the use of a single-school setting and a non-random sampling technique, which may limit generalizability beyond the study locale. These limitations were addressed by clearly defining the population scope and focusing the interpretation of results within the contextual characteristics of the participants.

### Instrument

The study utilized two primary research instruments: an adapted survey questionnaire based on the Technology Acceptance Model (TAM) and a teacher-made achievement test designed to measure ICT–CSS competency in system unit assembly and disassembly.

The first instrument was a survey questionnaire adapted from the Technology Acceptance Model (Davis, 1989) and contextualized for Grade 9 ICT-CSS learners. During the adaptation process, all core constructs of the original model were retained to maintain theoretical consistency. However, item statements were modified to ensure clarity, readability, and appropriateness for junior high school respondents. Technical terminologies were simplified, and context-specific references related to Computer Systems Servicing were incorporated.

The adapted questionnaire consisted of three parts. Part I collected demographic information, including age, sex, prior experience in computer hardware assembly and disassembly, and frequency of engagement with digital or educational games. Part II measured students' acceptance of gamification across four dimensions: Gamification Perceived Usefulness, Gamification Perceived Ease of Use, Attitude Toward Gamification, and Gamification Acceptance in Relation to Content Knowledge. Responses were recorded using a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). Part III consisted of open-ended questions exploring students' perceived challenges and benefits in using gamification for ICT-CSS learning.

Content validity of the adapted instrument was established through expert review involving subject matter specialists in ICT education and instructional design. Items were evaluated based on relevance, clarity, and alignment with research objectives. Revisions were made based on expert feedback to ensure contextual appropriateness for Grade 9 learners.

To ensure reliability, the adapted questionnaire underwent pilot testing, and internal consistency was measured using Cronbach's alpha coefficient. The instrument yielded a Cronbach's alpha value of  $\alpha = 0.89$ , indicating high internal consistency and reliability. This value exceeds the recommended threshold of  $\alpha \geq 0.70$ , confirming that the items in the questionnaire are consistently measuring the intended constructs.

The second instrument was a teacher-made achievement test consisting of 50 multiple-choice items assessing students' knowledge and skills in assembling and disassembling computer system units. The test items were aligned with ICT-CSS competency standards and were also subjected to expert validation to ensure content accuracy and construct relevance.

The reliability of the achievement test was established through pilot testing and statistical computation of internal consistency using Cronbach's alpha. Only items that contributed positively to the overall reliability coefficient were retained. This procedure ensured that the test provided a stable and consistent measurement of students' entry and exit knowledge. Overall, the combination of adapted standardized instruments and validated teacher-made assessments ensured the accuracy, reliability, and contextual relevance of data collected for the study.

## **Procedure**

Before data collection, the researchers secured permission from the Schools Division Superintendent of Cebu Province and the school principal. Informed consent was obtained from the parents or guardians of the participants, and student assent was also secured to ensure voluntary participation and adherence to ethical research standards.

After approval was granted, participants were grouped into experimental and control groups following their existing class sections. Both groups were administered a pretest to determine their baseline knowledge and skills in computer system unit assembly and disassembly.

The experimental group was exposed to gamification-based instruction integrated into ICT-CSS lessons. The gamification intervention was embedded within the ICY-CSS instructional framework and implemented using structured game mechanics such as point systems, challenge-based tasks, feedback reinforcement, and reward recognition. The intervention focused on computer system unit assembly and disassembly competencies.

The gamification strategy was implemented for a specified instructional period of four weeks, with lessons delivered during regular ICT-CSS class schedules. The instructional design followed progressive learning phases, including concept introduction, guided practice through gamified activities, performance challenges, and synthesis tasks. Digital or game-based learning tools were utilized to facilitate interactive activities, provide immediate feedback, and encourage learner participation. The control group received the same instructional content using traditional teaching methods, primarily consisting of lecture-discussion and demonstration without gamification elements. This approach ensured that content coverage between groups was comparable.

After the intervention period, both groups were administered a posttest to measure learning gains in assembly and disassembly competencies. The experimental group also answered a Technology Acceptance Model (TAM)-based questionnaire to evaluate their perceptions of gamification in terms of perceived usefulness, perceived ease of use, and attitude toward gamified learning. Additionally, participants responded to open-ended questions regarding the challenges and benefits experienced during gamified instruction. All collected quantitative and qualitative data were coded, organized, and prepared for statistical analysis.

## **Data Analysis**

The study employed appropriate quantitative and qualitative data analysis techniques to address the research objectives.

Descriptive statistics, including frequency counts and percentages, were used to summarize the demographic characteristics of the

respondents. The mean and standard deviation were computed to describe students' entry and exit knowledge scores in computer system unit assembly and disassembly to determine overall performance levels and score dispersion before and after the intervention.

To determine the effectiveness of gamification-based instruction, a paired-sample t-test was conducted to examine significant differences between pretest and posttest scores within groups. This analysis evaluated whether changes in content knowledge were associated with the gamification intervention.

The Pearson product-moment correlation coefficient was used to determine the relationship between students' gamification acceptance and their content knowledge. This analysis assessed the strength and direction of association among perceived usefulness, perceived ease of use, attitude toward gamification, and learning performance. Qualitative responses from open-ended questions were analyzed using thematic analysis, following systematic coding, categorization, and theme generation to identify recurring patterns in students' reported challenges and benefits of gamification.

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS), which was used to ensure accuracy and reliability of computed results. Thematic analysis was conducted manually by the researchers through iterative review and validation of coded responses.

The combination of quantitative and qualitative analyses allowed comprehensive interpretation of gamification effectiveness, learner acceptance, and experiential feedback related to ICT-CSS instruction.

### Ethical Considerations

The study strictly adhered to ethical research standards throughout the conduct of the research. Prior to data collection, approval was obtained from the Schools Division Superintendent of Cebu Province and the school principal. In addition, informed consent was secured from parents or guardians, and student assent was obtained to ensure voluntary participation. Participants were clearly informed about the purpose of the study, research procedures, and their right to withdraw from participation at any time without academic or administrative penalty.

The research protocol and instruments underwent internal ethical review and compliance checking following institutional research guidelines. Although an external institutional ethics committee did not review the study, ethical compliance was monitored by adhering to school division research policies, informed consent procedures, and data protection standards throughout the research process.

To maintain confidentiality and anonymity, participants' responses were coded, and no personally identifiable information was collected or disclosed in any research output. Data were presented in aggregated form to ensure that individual identities could not be traced.

The gamified instructional activities used in the study were designed to be developmentally appropriate, curriculum-aligned, and free from physical, psychological, or academic harm. Participants were encouraged to provide honest responses, and their opinions were treated with respect and impartiality. Data management and analysis were conducted with integrity, accuracy, and transparency. All referenced materials were properly cited to avoid plagiarism, data fabrication, or misrepresentation of findings.

## Results and Discussion

### *The Demographic Profile of The Respondents*

This section presents the demographic characteristics of the respondents to contextualize the interpretation of their learning performance and acceptance of gamified ICT-Computer Systems Servicing (ICT-CSS) instruction.

#### *Age of the Respondents*

*Table 1. Demographic Profile of the Respondents in terms of Age.*

<i>Group</i>	<i>Age</i>	<i>Frequency</i>	<i>Percentage</i>
Experimental (n = 38)	13	4	10.53
	14	27	71.05
	15	7	18.42
Total	38	38	100
Control (n=78)	13	3	3.85
	14	60	76.92
	15	15	19.23
Total	78	78	100

The majority of students in both the experimental (71.05%) and control (76.92%) groups were 14 years old, indicating that respondents were predominantly early adolescents. This developmental stage is characterized by increased responsiveness to interactive and technology-mediated learning environments. The prevalence of this age group suggests that the learners are at an optimal stage for integrating gamified instruction, as adolescents tend to exhibit strong engagement with digital and game-based activities (Ratinho & Martins, 2023).



### Sex of the Respondents

Table 2. Demographic Profile of the Respondents in terms of Sex.

Group	Sex	Frequency	Percentage
Experimental (n = 38)	Male	17	44.74
	Female	17	44.74
	Prefer not to say	4	10.53
Total	38	38	100
Control (n=78)	Male	39	50
	Female	39	50
Total	78	78	100

Both groups demonstrated a balanced sex distribution, minimizing the potential influence of gender bias on the outcomes. This balance strengthens the internal validity of the study, as differences in performance and acceptance can be more confidently attributed to the instructional intervention rather than demographic disparities. While prior studies suggest slight differences in technology preferences between male and female learners, research also indicates that well-designed gamified environments can effectively engage both groups (Peñaflor-Espinosa, 2020; Schorr & Gorovoj, 2023). Thus, the results support the notion that gamification can function as an inclusive instructional approach when properly implemented.

### Prior Experience in Computer Hardware Assembly/Disassembly

Students’ prior experience in handling computer hardware was examined to determine how existing skills might influence their learning performance.

Table 3. Prior experience in computer hardware assembly/disassembly.

Indicator	Frequency	Percentage
With Experience	34	89.47
Without Experience	4	10.53
Total	38	100

A large proportion of students (89.47%) reported prior experience in computer hardware assembly/disassembly. This suggests that most learners entered the intervention with foundational knowledge, which may have facilitated faster adaptation to ICT–CSS tasks. From an instructional perspective, prior experience likely reduced cognitive load, allowing students to focus more on higher-order skills during gamified activities. This supports findings that prior hands-on exposure enhances technical learning efficiency and engagement (Radović et al., 2021; Chantika et al., 2022). However, it also implies that observed learning gains should be interpreted within the context of this relatively experienced cohort.

### Engagement with Digital/Educational Games

Students’ prior engagement with digital games was also examined to determine their familiarity with game-based environments.

Table 4. Engagement with digital/educational games.

Indicator	Frequency	Percentage
Rarely	11	28.95
Sometimes	20	52.63
Often	7	18.42
Very Often	0	0
Total	38	100

Most students reported moderate exposure to digital games, with 52.63% indicating they “sometimes” engage in such activities. This suggests partial familiarity with game mechanics, which may have contributed to their generally high acceptance of gamification. Importantly, this level of exposure indicates that while students are not novice users, they are also not highly experienced gamers. This reinforces the need for guided implementation of gamified instruction, ensuring that game mechanics are clearly explained and aligned with learning objectives (Nadi-Ravandi & Batooli, 2022).

### Entry and Exit Level of Students’ Content Knowledge

To determine the effectiveness of the gamified instructional strategy, students’ content knowledge was measured using pretests and posttests focusing on system unit assembly and disassembly.

Table 5. Entry and Exit Level of Content Knowledge.

Group		t Stat	p-value	Variance	R	Df	Mean	SD
Experimental (n = 38)	Pre-test	-13.27	6.10E-16	52.00	0.77	37	23.947	7.21
	Post-test			76.35			36.026	8.74
Control (n = 78)	Pre-test	-7.07	3.04E-10	39.06	0.48	77	25.33	6.25
	Post-test			54.39			30.97	7.37



Both groups demonstrated statistically significant improvements from pre-test to post-test. However, the experimental group exhibited substantially higher gains compared to the control group. Rather than simply indicating improvement, this result suggests that gamified instruction may enhance the efficiency of learning, enabling students to achieve greater knowledge gains within the same instructional period. This aligns with research indicating that gamification promotes active engagement and sustained attention, which are critical for cognitive processing (Hamari et al., 2014; Costello, 2020). However, it is important to note that improvement in both groups indicates that traditional instruction remains effective, and gamification should be viewed as an enhancement rather than a replacement.

**Level of Students’ Acceptance of Gamification**

Students’ acceptance of gamification in ICT–Computer Systems Servicing (ICT–CSS) instruction was examined using four constructs derived from the Technology Acceptance Model (TAM): Gamification Perceived Usefulness (GPU), Gamification Perceived Ease of Use (GPEU), Attitude Toward Using Gamification (ATUG), and Gamification Acceptance in Relation to Content Knowledge (GACK).

Table 6. Gamification perceived usefulness (GPU)

Indicator	Weighted mean	Verbal Interpretation
Usefulness		
1. Gamified activities make ICT–CSS lessons more interesting.	4.50	Very High Acceptance
2. Gamification helps me understand lesson content better.	4.03	High Acceptance
3. I learn ICT–CSS topics faster through gamified lessons.	3.68	High Acceptance
4. Using games helps me remember key concepts longer.	3.71	High Acceptance
5. Gamified lessons motivate me to complete learning tasks.	3.95	High Acceptance
6. I become more active when the lesson involves games.	3.71	High Acceptance
7. Gamified learning helps me achieve higher scores in ICT–CSS.	3.74	High Acceptance
8. Gamified lessons improve my classroom participation.	4.00	High Acceptance
9. Gamification increases my confidence in performing ICT–CSS tasks.	3.63	High Acceptance
10. I believe gamification improves my learning performance.	3.95	High Acceptance

Legends: 5 – Strongly Agree, 4 – Agree, 3 – Neutral, 2 – Disagree, 1 – Strongly Disagree

Students reported high acceptance of gamification in terms of usefulness (WM = 3.89). The strongest agreement centered on increased interest and engagement, suggesting that gamification effectively captures learners’ attention. Beyond motivation, the findings indicate that students perceive gamification as supporting comprehension and participation.

This supports the Technology Acceptance Model (TAM), where perceived usefulness directly influences adoption of instructional innovations. However, while students believe gamification improves performance, later findings (correlation results) suggest that perceived usefulness does not always directly translate into measurable academic outcomes, highlighting a gap between perception and actual performance.

Table 7. Gamification perceived ease of use (GPEU)

Indicator	Weighted mean	Verbal Interpretation
Ease of Use		
1. It is easy for me to use gamified learning activities in ICT–CSS.	3.82	High Acceptance
2. The instructions in gamified lessons are easy to understand.	3.55	High Acceptance
3. I can participate in gamified lessons without much guidance.	3.37	Moderate Acceptance
4. I quickly learned how to use the digital tools used in gamification.	3.68	High Acceptance
5. The layout of gamified activities is simple to follow.	3.66	High Acceptance
6. I do not experience difficulty using gamified applications.	3.37	Moderate Acceptance
7. I can easily navigate gamified lessons on my own device.	3.58	High Acceptance
8. Gamified learning requires only minimal effort from me to use.	3.50	High Acceptance
9. I find gamified activities user-friendly and accessible.	3.53	High Acceptance
10. Overall, gamified learning is easy to use in ICT–CSS.	3.71	High Acceptance

Legends: 5 – Strongly Agree, 4 – Agree, 3 – Neutral, 2 – Disagree, 1 – Strongly Disagree

Gamification was generally perceived as easy to use (WM = 3.58), although some students required guidance. This indicates that while the platform is accessible, ease of use is not uniform across learners, particularly for those with lower digital proficiency.

This finding reinforces TAM assumptions that usability influences acceptance, but also highlights the role of instructional scaffolding. Without adequate support, the benefits of gamification may not be fully realized. Prior studies confirm that poorly designed interfaces or unclear instructions can increase cognitive load and hinder learning (Hamari et al., 2019).

Table 8. Attitude toward using gamification (ATUG)

Indicator	Weighted mean	Verbal Interpretation
Attitude		
1. I enjoy using games as part of my ICT–CSS lessons.	4.29	Very High Acceptance
2. I feel excited when our teacher uses gamification in class.	4.03	High Acceptance
3. I look forward to lessons that use game-based learning.	3.74	High Acceptance
4. Gamified lessons make learning fun and engaging.	3.89	High Acceptance



5. I prefer lessons that include interactive challenges or quizzes.	3.37	Moderate Acceptance
6. I feel more motivated to study because of gamified activities.	3.66	High Acceptance
7. Gamification makes the classroom atmosphere more enjoyable.	3.95	High Acceptance
8. Gamified lessons reduce boredom during class.	3.79	High Acceptance
9. Gamified lessons encourage teamwork and collaboration.	4.13	High Acceptance
10. I would recommend gamified learning to my classmates.	3.92	High Acceptance

Legends: 5 – Strongly Agree, 4 – Agree, 3 – Neutral, 2 – Disagree, 1 – Strongly Disagree

Students demonstrated a positive attitude toward gamification (WM = 3.88), particularly in terms of enjoyment and classroom atmosphere. This suggests that gamification contributes significantly to affective engagement, making learning more enjoyable and less monotonous. However, the moderate rating for certain activities (e.g., competitive challenges) indicates that not all gamified elements are equally effective. This finding emphasizes the importance of balancing competition with collaboration and ensuring that activities cater to diverse learner preferences (Subhash & Cudney, 2018).

Table 9. Gamification acceptance in relation to content knowledge (GACK)

Indicator	Weighted mean	Verbal Interpretation
<i>Acceptance</i>		
1. Gamified lessons help me master ICT–CSS skills more effectively.	3.76	High Acceptance
2. I can apply what I learn from gamified lessons to real tasks.	3.79	High Acceptance
3. I easily recall ICT–CSS concepts learned through games.	3.58	High Acceptance
4. Gamified lessons enhance my understanding of technical terms.	3.79	High Acceptance
5. I feel confident performing system-related tasks after gamified activities.	3.82	High Acceptance
6. Gamification helps me connect new lessons with prior knowledge.	3.97	High Acceptance
7. I can identify and correct mistakes faster during gamified learning.	3.61	High Acceptance
8. I gain a deeper understanding through repeated game-based practice.	3.87	High Acceptance
9. Gamified lessons help me assess my learning progress effectively.	3.68	High Acceptance
10. I find gamification effective in improving my ICT–CSS performance.	3.71	High Acceptance

Legends: 5 – Strongly Agree, 4 – Agree, 3 – Neutral, 2 – Disagree, 1 – Strongly Disagree

Students perceived gamification as beneficial for understanding and applying ICT–CSS concepts (WM = 3.76). The strongest effect was observed in connecting new knowledge with prior learning, supporting constructivist principles (Piaget, 1972; Vygotsky, 1978).

This suggests that gamification facilitates meaningful learning rather than rote memorization, particularly through interactive and repetitive practice. However, slightly lower ratings for recall and error correction indicate that gamification alone may not fully support metacognitive skills, highlighting the need for structured feedback and reflection.

**Relationship Between Gamification Acceptance and Content Knowledge.**

Table 10. Pearson Correlation Coefficient.

	GPU	GPEU	ATUG	GACK	Posttest
GPU	1.000	0.361	0.393	0.391	-0.116
GPEU	0.361	1.000	0.616	0.704	0.032
ATUG	0.393	0.616	1.000	0.541	0.036
GACK	0.391	0.704	0.541	1.000	-0.205
Posttest	-0.116	0.032	0.036	-0.205	1.000

Correlation results revealed weak and non-significant relationships between gamification acceptance and post-test performance. This finding is critical because it challenges the assumption that positive perceptions automatically lead to improved academic outcomes. While students may enjoy and accept gamification, learning effectiveness depends more on instructional alignment than on perception alone.

This aligns with previous studies showing that gamification primarily enhances motivation, while its impact on achievement is mediated by instructional design quality (Hamari et al., 2016). Thus, gamification should be viewed as a supportive tool rather than a direct determinant of performance.

The independent-samples t-test revealed a statistically significant difference in post-test scores, with the experimental group outperforming the control group,  $t(63) = 3.07, p = 0.002$ . This result provides empirical evidence that gamified instruction can enhance learning outcomes in ICT–CSS. The higher mean score of the experimental group suggests that gamification may improve cognitive engagement, task persistence, and knowledge retention.

However, the observed variance also indicates that gamification may benefit students differently, potentially amplifying individual differences in motivation and learning strategies. This suggests that gamification is most effective when combined with differentiated instruction. These findings are consistent with prior research demonstrating that gamification enhances performance when aligned with learning objectives and supported by appropriate feedback mechanisms (Dichev & Dicheva, 2017; Nadi-Ravandi & Batooli, 2022).



**Post-Test Performance of Students in the Control and Experimental Groups**

Table 11. Descriptive Statistics of the entry and exit levels of students' knowledge.

Group		Mean	SD	Min	Max	Kurtosis	Skewness
Experimental (n = 38)	Pre-test	23.95	7.21	7	37	-0.07	-0.65
	Post-test	36.03	8.74	14	49	-0.03	-0.87
Control (n = 78)	Pre-test	25.33	6.25	10	39	0.03	-0.65
	Post-test	30.97	7.37	13	45	-0.29	0.12

Table 12. Independent sample t-test of exit knowledge results between the treated and untreated groups.

Group		t Stat	p-value	Variance	Df	Mean	SD	n
Experimental	Post-test	3.07	0.002	76.35	63	36.03	8.74	38
Control	Post-test			54.39		30.97	7.37	78

An independent-samples t-test was conducted to compare the post-test performance of students in the experimental and control groups. Results revealed a statistically significant difference,  $t(63) = 3.07, p = 0.002$ , indicating that students who experienced gamified ICT–CSS instruction performed significantly better than those who received traditional instruction.

The experimental group obtained a higher mean post-test score ( $M = 36.03, SD = 8.74$ ) compared with the control group ( $M = 30.97, SD = 7.37$ ). This result suggests that the integration of gamified elements such as points, challenges, interactive tasks, and rewards may enhance students' cognitive engagement and learning performance.

These findings support previous studies indicating that gamification can improve student motivation, engagement, and academic achievement when aligned with instructional objectives. Gamified learning environments encourage active participation and immediate feedback, which contribute to deeper understanding and improved technical skills in technology-related subjects (Subhash & Cudney, 2018; Dichev & Dicheva, 2017; Nadi-Ravandi & Batooli, 2022; Ojonuba et al., 2025).

**Students' Perceived Benefits and Challenges of Gamification**

Understanding students' experiences with gamification in ICT–CSS lessons provides insight into the real-world impact of game-based instruction. Beyond test scores and survey data, qualitative feedback reveals how gamified learning influences motivation, behavior, and engagement. This section presents learners' perceptions, analyzes emerging themes, and interprets how gamification supports or hinders classroom learning (Table 13).

Table 13. Challenges and benefits students experience in using gamification.

	Indication	Frequency	Percentage
Perceived Benefits	Enjoy while learning, which makes it easy to learn	12	31.58
	Increased collaboration in learning	3	7.89
	Improved retention because of gamified learning activities; reduces boredom; more fun in class; engaging in quizzes/puzzles	15	39.47
	Increased engagement and motivation through gamified activities, such as earning points and badges	8	21.05
	The activities were quite challenging	10	26.32
Challenges	Difficult	1	2.63
	No difficulties in learning if everyone cooperates	5	13.16
	Difficulty in identifying and memorizing the steps and components of computer systems	7	18.42
	Internet connection problem	15	39.47

**Perceived Benefits and Challenges**

Qualitative feedback revealed several benefits of gamified learning. Students reported that gamification made lessons more enjoyable, improved retention of information, and increased motivation to participate in classroom activities. Collaborative game mechanics also encouraged teamwork and peer interaction, which supported cooperative learning.

Despite these advantages, students also identified several challenges. The most common issue reported was internet connectivity problems, which affected participation in online activities. Some students also noted that certain tasks were difficult or required additional guidance, particularly when memorizing system components and procedures.

These findings highlight the importance of designing gamified lessons that balance challenge and accessibility. Teachers should provide scaffolding, offer offline alternatives when possible, and ensure that game mechanics align with learning objectives. Previous research similarly emphasizes that effective gamification requires thoughtful instructional design and appropriate technological support (Costello, 2020; Ratinho & Martins, 2023).

Overall, the integrated results indicate that gamified instruction significantly improves students' learning outcomes, engagement, and motivation in ICT–CSS classes. While students demonstrated high acceptance of gamification, its impact on academic performance depends largely on instructional design, scaffolding, and alignment with learning objectives. When implemented effectively,

gamification can transform ICT–CSS lessons into interactive and meaningful learning experiences that support both cognitive development and practical skill acquisition.

## Conclusions

This study provides empirical evidence that gamified instruction can enhance learning outcomes in ICT–Computer Systems Servicing (ICT–CSS), particularly in improving Grade 9 students’ content knowledge and practical skills in system unit assembly and disassembly. While both traditional and gamified approaches resulted in learning gains, the significantly higher post-test performance of the experimental group demonstrates that gamification, when properly aligned with instructional objectives, can serve as a more effective pedagogical strategy. Beyond performance outcomes, the study also contributes to the literature by showing that students exhibit high levels of acceptance of gamification in terms of perceived usefulness, ease of use, and attitude. However, a key insight is that positive perceptions do not necessarily translate into improved academic achievement, as reflected in the weak relationship between acceptance variables and post-test scores. This highlights the critical role of instructional design, emphasizing that engagement alone is insufficient without alignment to cognitive learning processes and clearly defined learning goals.

Another significant contribution of this study is the development of an evidence-based gamified lesson exemplar grounded in both quantitative and qualitative findings. The exemplar incorporates structured challenges, immediate feedback, and scaffolded progression to address identified learning gaps and enhance student understanding and skill acquisition. This provides a practical framework for educators, particularly in technical-vocational education, by bridging theory and classroom application. Despite these contributions, several limitations must be acknowledged. The study was conducted in a single school using purposive sampling, which limits the generalizability of the findings. The relatively short duration of the intervention also restricts conclusions about long-term retention, while external factors such as internet connectivity issues and varying levels of digital literacy may have influenced the implementation and outcomes of gamified activities.

Given these findings, it is recommended that educators integrate gamification strategically by aligning game elements with instructional objectives, providing sufficient scaffolding, and balancing competitive and collaborative activities to support diverse learners. Schools and policymakers should also support the implementation of gamified instruction through professional development and improved technological infrastructure. Future research should consider larger and more diverse samples, longitudinal designs to examine long-term effects, and comparative analyses of different gamification approaches. Overall, this study affirms that gamification is not merely a tool for increasing engagement but a potentially transformative instructional approach when thoughtfully designed, contributing to meaningful learning, skill development, and improved teaching practices in ICT–CSS education.

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