Digital Competence and Chemistry Learning Outcomes: Assessing Their Relationship among Grade 10 Students

John Ryl B. Silacan[1], Edna B. Nabua[2], Sarah Mae P. Legasa[3], Mark Angelo P. Villena[4]

Mindanao State University- Iligan Institute of Technology, Philippines

DOI: https://doi.org/10.47772/IJRISS.2026.100600888

Received: 17 June 2026; Accepted: 22 June 2026; Published: 08 July 2026

ABSTRACT

This study aimed to examine the relationship between Grade 10 students' content proficiency in chemistry competencies and their technological proficiency at a public school in Dapitan City. Using a descriptive-correlational research design, the inquiry sought to determine whether students' effective use of digital tools correlated with their understanding of core chemistry concepts. A purposive sample of forty-five (45) Grade 10 students participated in the main investigation after research instruments were validated through pilot testing. Two verified tools were utilized: a Chemistry Questionnaire aligned with the Department of Education's Most Essential Learning Competencies (MELCs), and a 15-item Technological Proficiency Questionnaire adapted from Garma et al. (2024), which measured skills in software operation, web navigation, and online safety. Ethical standards were strictly observed throughout the study. Formal approval was secured from school authorities, and informed consent was obtained from all participants and their legal guardians. Participation was voluntary, and confidentiality and anonymity of all responses were maintained. Findings revealed that students demonstrated low chemistry content proficiency, with a mean score of 51% categorized as "Novice (Not Mastered)", while they attained a "Proficient" level of technological competence—particularly in online security practices. A weak positive correlation ($r = 0.215$) was observed between the two variables; however, this relationship was not statistically significant ($p = 0.156$), indicating that technological proficiency did not exert a significant influence on chemistry performance. These results suggest that although students possess adequate digital capabilities, such skills alone are insufficient to strengthen achievement in conceptually demanding subjects. The study recommends the integration of targeted instructional strategies—including differentiated teaching and pre-laboratory video materials—to enhance students' conceptual mastery of chemistry content.

Keywords: chemistry competencies, digital skills, educational technology, Grade 10 students, online security skills, software skills, technological proficiency, web navigation skill.

INTRODUCTION

In contemporary educational discourse, the convergence of disciplinary knowledge and technological competence has emerged as a critical determinant of student success, particularly within science education. Among the foundational scientific disciplines, chemistry is frequently characterized by its abstract theoretical constructs, symbolic representations, and cognitively demanding problem-solving processes. These characteristics often present substantial challenges to learners, thereby affecting their academic achievement and conceptual understanding. Content proficiency in chemistry serves as a crucial indicator of students' mastery of scientific principles and their capacity to apply these concepts across academic, professional, and real-world contexts (Muhali, 2026). Despite the availability of structured curricula, instructional resources, and pedagogical interventions, a significant number of students continue to experience difficulties in attaining the expected chemistry competencies due to a range of cognitive, motivational, and instructional factors.

The rapid advancement of digital technologies and their increasing integration into educational environments have prompted educators to reevaluate conventional instructional approaches. Technology-mediated learning environments offer opportunities to transform chemistry instruction through interactive visualizations, dynamic simulations, self-paced learning modules, and virtual laboratory experiences that can facilitate deeper conceptual understanding (Osorio et al., 2022). As educational technologies become more accessible and widespread, students are increasingly exposed to diverse modalities for acquiring, processing, and applying chemistry knowledge. Consequently, technological proficiency has gained recognition as a potentially influential factor in shaping students' academic performance, engagement, and learning experiences within science education (Liang et al., 2024).

Technological proficiency encompasses the knowledge, skills, and dispositions required to effectively utilize digital technologies for communication, information retrieval, collaboration, problem-solving, and content creation. Within the context of chemistry education, technological proficiency may involve the use of molecular modeling software, virtual simulations for visualizing chemical phenomena, data analysis applications for laboratory investigations, and online learning platforms that facilitate collaborative inquiry. Students who demonstrate higher levels of technological competence may possess enhanced opportunities to engage with scientific content through multiple representations and interactive learning experiences, thereby strengthening their conceptual understanding and academic performance (Purnomo et al., 2026).

Despite the documented benefits of educational technology in science instruction, the nature and extent of the relationship between students' chemistry content proficiency and technological proficiency remain insufficiently understood. Existing literature presents mixed findings regarding this association. While several studies report positive relationships between technology integration and science achievement (Bulut & Delen, 2011), other scholars argue that access to technology alone does not necessarily translate into improved learning outcomes. Rather, meaningful educational benefits depend on students' ability to utilize technological tools strategically, critically, and purposefully within the learning process (Uçar & Sahin, 2026).

Furthermore, disparities in technological proficiency may contribute to persistent inequities in educational achievement. Students with limited digital competencies or inadequate access to technological resources, including devices and reliable internet connectivity, may encounter significant barriers to participation and success in technology-enhanced learning environments (Becker & Park, 2011). Such disparities may constrain the effectiveness of digitally mediated chemistry instruction and exacerbate existing educational inequalities among learners.

Within the Philippine educational context, the implementation of the K–12 curriculum and the increasing emphasis on twenty-first-century competencies have underscored the importance of both content mastery and digital literacy (Department of Education, 2016). Chemistry, as a fundamental component of the senior high school science curriculum, presents a unique context for cultivating students' analytical reasoning, scientific literacy, and technological competence. However, empirical investigations examining the intersection of chemistry content proficiency and technological proficiency remain relatively scarce, particularly within local educational settings.

This study seeks to address this gap in the literature by examining the level of students' content proficiency in chemistry competencies and exploring its relationship with technological proficiency across three dimensions: (a) software skills, (b) web navigation skills, and (c) online security skills. Understanding the relationship between these constructs is essential for the development of evidence-based interventions aimed at enhancing both cognitive and technological capacities among learners. Such insights may contribute to the design of instructional practices, curricular innovations, and educational policies that foster more effective, equitable, and technologically responsive science education. The study assumes particular significance within the post-pandemic educational landscape, wherein hybrid and technology-mediated learning modalities have become increasingly prevalent (Trust & Whalen, 2020).

METHODOLOGY

This study employed a descriptive-correlational research design to investigate the relationship between Grade 10 students' chemistry content proficiency and their technological proficiency. The descriptive component facilitated a comprehensive assessment of students' proficiency levels in both domains, while the correlational component examined the magnitude and direction of the association between the variables under investigation. This research design was deemed appropriate because it enabled the collection and analysis of quantifiable data regarding existing levels of student performance and technological competence without manipulating any study variables. Furthermore, it provided a systematic framework for identifying patterns and relationships that may exist between chemistry achievement and technological capability among learners.

A purposive sampling technique was utilized in selecting the study participants. Respondents were intentionally chosen based on their availability, willingness to participate, and relevance to the objectives of the investigation, specifically as Grade 10 students enrolled in a public secondary school in Dapitan City. The use of purposive sampling ensured that participants possessed the characteristics necessary to provide meaningful and relevant data concerning both chemistry content proficiency and technological proficiency. This sampling strategy was considered appropriate because it enabled the researcher to focus on a population directly aligned with the study's objectives. A total of forty-five (45) Grade 10 students participated in the main phase of the study. These students had previously been exposed to the chemistry competencies prescribed in the Grade 10 Science curriculum, thereby ensuring the relevance of their responses to the research questions.

Prior to the primary data collection phase, pilot testing was conducted to establish the validity and reliability of the research instruments. A sample of one hundred fifty (150) Grade 11 students from the same institution participated in this process. Grade 11 students were selected because they had already completed the Grade 10 Science curriculum and possessed sufficient background knowledge in chemistry to evaluate the appropriateness, clarity, and relevance of the instrument items. The findings from the pilot testing informed the refinement and validation of the instruments before their administration to the target participants.

Two research instruments were employed to gather data. The first instrument was a researcher-developed thirty-five-item multiple-choice Chemistry Content Proficiency Test designed to assess students' mastery of chemistry competencies outlined in the Grade 10 Science curriculum. The test items were aligned with the Department of Education's Most Essential Learning Competencies (MELCs) for chemistry. To ensure content validity, the instrument underwent expert review by subject-matter specialists. Subsequently, it was pilot-tested among Grade 11 students to assess reliability, clarity, and appropriateness. Based on the pilot-testing results, revisions were implemented to improve the quality of the instrument prior to its administration.

The second instrument consisted of a fifteen-item Technological Proficiency Scale adapted from Garma et al. (2024). This instrument measured students' technological proficiency across three domains: software skills, web navigation skills, and online security skills. Scores for each domain were calculated by summing and averaging responses within the corresponding subscales. Proficiency levels were categorized using a four-point scale, wherein a score of 1 indicated *Novice*, 2 represented *Developing*, 3 denoted *Proficient*, and 4 corresponded to *Advanced*. The instrument was reviewed to ensure contextual appropriateness for the target population, and minor modifications were introduced where necessary.

Data collection was conducted systematically to ensure the validity and reliability of the study findings. Prior to the administration of the instruments, formal approval was obtained from the school administration. The pilot testing phase was first undertaken using the researcher-developed Chemistry Content Proficiency Test. The instrument was administered to Grade 11 students who had completed the Grade 10 Science curriculum and were therefore qualified to evaluate the clarity and appropriateness of the test items. The pilot-testing data were subsequently analyzed to determine instrument reliability and identify areas requiring revision. Based on both statistical analyses and participant feedback, the necessary modifications were incorporated into the final version of the instrument.

Following the validation process, the finalized instruments were administered to the forty-five (45) Grade 10 participants. These included the validated Chemistry Content Proficiency Test and the Technological Proficiency Scale adapted from Garma et al. (2024). The researcher personally facilitated the administration of the instruments during regularly scheduled class sessions to ensure consistency in instructions and minimize potential distractions. Participants were provided with sufficient time to complete all assessment materials.

Upon completion of data collection, the responses were systematically organized and prepared for analysis. Scores from the Chemistry Content Proficiency Test were computed based on the number of correct responses

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

and subsequently converted into percentage scores. Responses from the Technological Proficiency Scale were numerically coded and averaged to determine individual proficiency levels across the identified domains. All data were then encoded, verified for accuracy, and subjected to appropriate statistical analyses to address the study's research objectives and examine the relationship between chemistry content proficiency and technological proficiency among Grade 10 students. The data were analyzed using both descriptive and inferential statistics to answer the research questions effectively.

Table 1. **Interpretation of Students' Performance in the Chemistry Test**

Percentage	**Remarks**
90-100	Passed
85-89	Passed
80-84	Passed
75-79	Passed
Below 75	Failed

(DepEd Order No. 8 s, 2015)

Table 2. Content Proficiency Scale Range and Interpretation

Level of Proficiency	**Equivalent Numerical Value**
Novice	74% and below
Developing	75-79%
Approaching Proficient	80-84%
Proficient	85-89%
Advances	90% and above

(DepEd Order No. 31 s, 2012)

Table 3. Technological Proficiency Scale Range and Interpretation

Level of Proficiency	**Equivalent Numerical Value**
Advanced	3.25-4.00
Proficient	2.50-3.24
Developing	1.75-2.49.
Novice	1.00-1.74

(Garma et al., 2024)

To investigate the relationship between students' chemistry content proficiency and technological proficiency, the **Pearson Product–Moment Correlation Coefficient (Pearson's r)** was employed. This inferential statistical technique was utilized to determine the magnitude and direction of the linear association between the two variables. Furthermore, the analysis assessed whether the observed correlation was statistically significant, thereby providing empirical evidence regarding the extent to which variations in technological proficiency are associated with differences in chemistry content proficiency. Statistical significance was evaluated using an alpha level of **0.05**.

The conduct of this study was guided by established ethical principles and research protocols governing investigations involving human participants. Prior to the commencement of data collection, the researcher obtained the requisite authorization from the school principal and coordinated with the designated science teachers to facilitate the systematic administration of the research instruments.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

Informed consent was secured from the parents or legal guardians of the participating students through duly accomplished consent forms. These documents explicitly communicated the objectives, procedures, potential benefits, and voluntary nature of participation in the study. Consequently, participants and their guardians were provided with sufficient information to make an informed decision regarding involvement in the research.

To uphold the principles of confidentiality and anonymity, stringent measures were implemented throughout the data collection and management processes. Participants were assured that all responses would be treated with the utmost confidentiality and utilized exclusively for scholarly and research purposes. No personally identifiable information was solicited or recorded, thereby safeguarding the anonymity of the respondents. Additionally, participants were informed of their right to withdraw from the study at any stage without incurring any form of academic, social, or administrative disadvantage.

Consistent with the ethical principles of beneficence and nonmaleficence, every effort was undertaken to minimize potential risks and ensure the well-being of all participants. The research procedures were non-invasive and posed no foreseeable physical, emotional, psychological, or social harm. Moreover, all stages of the investigation were conducted in accordance with the ethical standards prescribed by the Department of Education and other recognized guidelines for educational research, thereby ensuring the protection of participants' rights, dignity, and welfare throughout the duration of the study.

RESULTS AND DISCUSSION

Content Proficiency in Chemistry Competencies

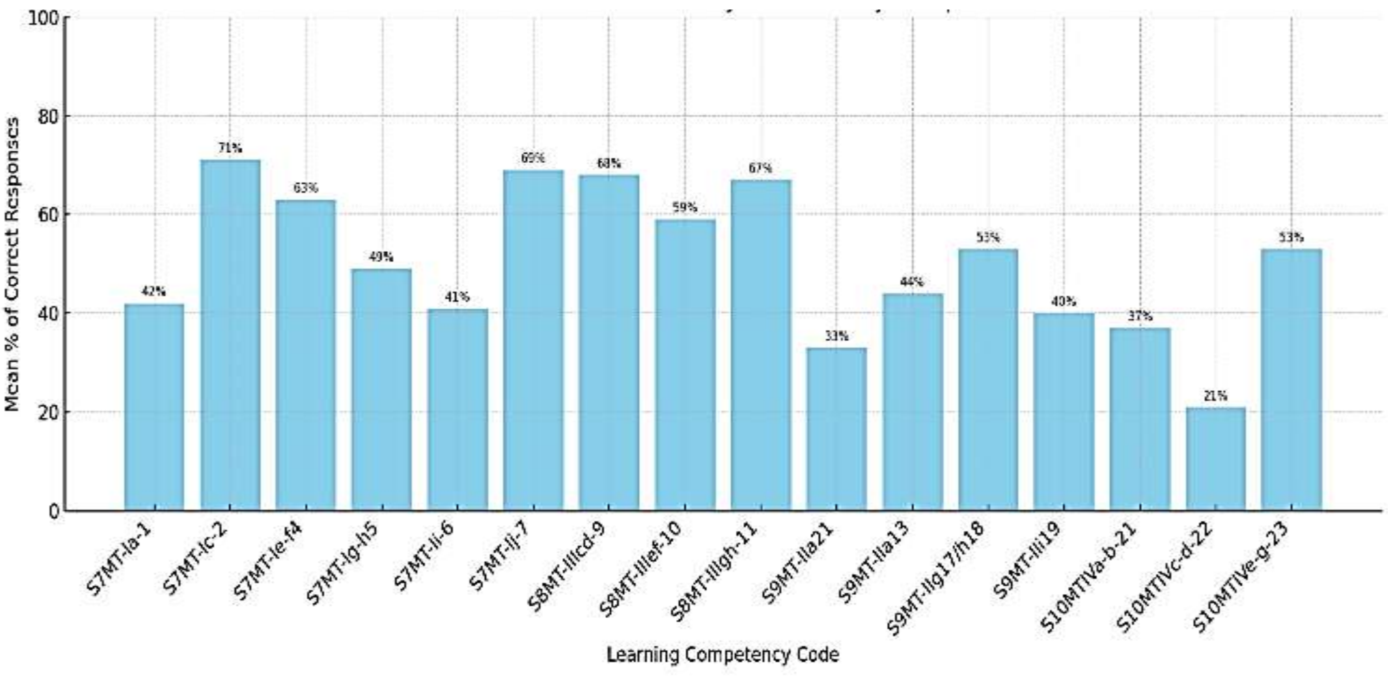


Fig. 1.

Chemistry learning competencies indicate a generally low level of content proficiency. The computed overall mean percentage score of 51% places students within the **Novice (Not Mastered)** proficiency level based on the proficiency standards stipulated in Department of Education Order No. 31, s. 2012. This finding suggests that the students have not attained the expected level of mastery in the assessed competencies and continue to experience substantial difficulties in comprehending and applying fundamental Chemistry concepts.

Analysis of the individual competencies reveals that all assessed learning areas obtained proficiency levels below the 75% mastery threshold. This pattern indicates persistent learning gaps across competencies spanning the Grade 7 to Grade 10 Chemistry curriculum. The consistently low performance suggests deficiencies not only in

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

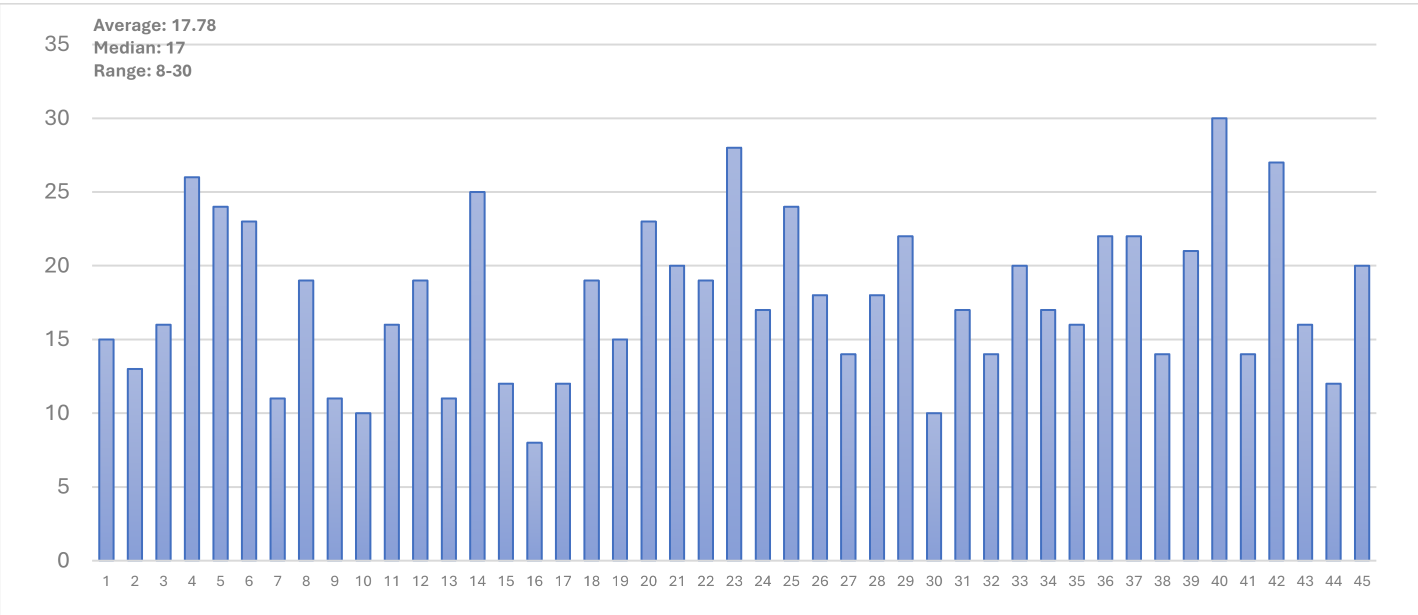
the acquisition of new knowledge but also in the retention and integration of previously learned scientific concepts.

Particularly noteworthy are the competencies that registered the lowest mean percentages of correct responses. Competency S10MTIVc-d-22, which pertains to biomolecules, yielded a mean correctness rate of only 21%, identifying it as a critical area requiring immediate instructional intervention. Similarly, competencies S9MT-IIa-21 (Electronic Structure of Matter) and S10MTIVa-b-21 (Gas Laws) demonstrated markedly low performance levels, highlighting significant conceptual difficulties among students. These findings imply that learners may struggle with abstract and microscopic representations of matter, as well as with the mathematical and analytical demands associated with chemical principles. Furthermore, the low performance observed in S9MT-IIa-13 (Chemical Bonding) corroborates the findings of Al-Rawi et al. (2021), who reported similarly limited levels of student understanding in this topic. The consistency of these findings across studies suggests that chemical bonding remains a persistent area of difficulty in Chemistry education.

Despite the generally low level of achievement, several competencies exhibited comparatively higher mean percentages of correct responses. Competency S7MT-Ic-2 (Solutions) attained a mean correctness rate of 71%, while S7MT-Ij-7 (Metals, Nonmetals, and Metalloids) obtained 69%. Although these scores remain within the Novice proficiency category, they indicate relatively stronger conceptual understanding in these areas compared with other competencies assessed. Such findings may reflect greater familiarity with these topics due to their relevance to everyday experiences or the effectiveness of instructional strategies previously employed in teaching these concepts.

Overall, the prevalence of low proficiency levels across the majority of competencies underscores the need for comprehensive instructional enhancement and targeted academic interventions. The findings suggest that students would benefit from differentiated instruction, structured remediation programs, and the integration of technology-enhanced and inquiry-based learning approaches designed to promote deeper conceptual understanding. Moreover, the results highlight the importance of revisiting curriculum implementation practices, assessment methodologies, and pedagogical strategies to address persistent learning deficiencies. Consequently, educators, curriculum planners, and policymakers may consider developing evidence-based interventions aimed at strengthening Chemistry content proficiency and improving students' overall achievement in science education.

Fig. 2. Total Points Distribution



The assessment results obtained from the 45 Grade 10 student participants reveal a generally low level of Chemistry content proficiency. The class attained an overall mean score of 17.78, corresponding to a mean

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

percentage score of 51%, which is classified under the **Failed** category based on the established performance standards. This finding indicates that, as a group, the students were unable to demonstrate the expected level of mastery of the Chemistry competencies assessed.

An examination of individual performance data further demonstrates the extent of the learning deficiency. Only three students (ST 23, ST 40, and ST 42) achieved scores that met or exceeded the prescribed passing criterion of 76%, obtaining percentage scores of 80%, 86%, and 77%, respectively. These students represent only 6.7% of the total sample population. Conversely, 42 students, comprising 93.3% of the respondents, failed to attain the minimum proficiency benchmark. This distribution of scores suggests that the majority of learners experience considerable difficulty in acquiring and applying essential Chemistry concepts and principles.

Moreover, several students obtained exceptionally low scores, with percentage ratings ranging from 23% to 29%. Such performance levels indicate substantial conceptual gaps and limited understanding of foundational Chemistry content. The prevalence of low achievement across the cohort may be attributed to a combination of factors, including inadequate prior knowledge, misconceptions regarding key scientific concepts, insufficient opportunities for meaningful learning experiences, or challenges associated with instructional delivery and assessment practices.

Collectively, the findings underscore a critical need for targeted educational interventions aimed at improving students' Chemistry content proficiency. Strategic measures may include the implementation of differentiated instructional approaches, structured remediation programs, formative assessment practices, and technology-enhanced learning experiences designed to foster deeper conceptual understanding. Furthermore, the results highlight the importance of continuously evaluating pedagogical strategies and curriculum implementation to address learning deficiencies and promote improved academic achievement in Chemistry

Grade 10 Students' Technological Proficiency

Table 4. Students' level of technological proficiency in terms of software skills

Indicators	Mean	Interpretation
I can prepare and give presentations using PowerPoint, Google Slides, Prezi, etc.	2.82	Proficient
I can utilize Canva and other editing apps in making and submitting my learning task.	2.64	Proficient
I can work collaboratively on a shared online document using Google Docs, Google Slides, etc.	2.73	Proficient
I can create a report using Excel and spreadsheets for my assigned learning tasks.	2.58	Developing
I can compose my assignments and other learning tasks using Microsoft Word, Google Docs, etc.	2.78	Proficient
Total Mean	**2.71**	Proficient

Table 4 presents the students' level of technological proficiency with respect to software-related competencies. The results indicate an overall mean score of 2.71, suggesting that the respondents generally demonstrate a relatively high level of confidence in utilizing productivity and presentation software applications, including Microsoft Word, PowerPoint, Google Slides, and Canva. This finding implies that students possess foundational digital competencies necessary for creating academic outputs, communicating information, and engaging in technology-supported learning activities.

Among the assessed competencies, the highest mean rating was recorded for students' ability to prepare and deliver presentations, reflecting a strong degree of familiarity with presentation software and digital communication tools. In contrast, the lowest mean rating was obtained for the competency involving the creation of reports using Microsoft Excel and other spreadsheet applications (M = 2.58), which was classified under the Developing proficiency level. Although students exhibit competence in presentation design and document preparation, their comparatively lower proficiency in spreadsheet-related tasks suggests limitations in their ability to manage, organize, analyze, and interpret quantitative data using digital tools.

The findings underscore a disparity between students' proficiency in content creation applications and their competency in data-processing technologies. This distinction is particularly significant given the increasing importance of spreadsheet literacy in both academic and professional contexts. As noted by Haleem et al. (2022), proficiency in Microsoft Excel constitutes a valuable employability skill that enhances individuals' capacity to perform data-driven tasks across various disciplines and occupational settings. Consequently, limited proficiency in spreadsheet applications may constrain students' readiness for higher education and future workforce demands.

Furthermore, spreadsheet software plays a critical role in science education, particularly in Chemistry, where quantitative analysis forms an essential component of laboratory and research activities. Applications such as Microsoft Excel facilitate the computation of descriptive and inferential statistics, including means, standard deviations, and regression analyses, thereby enabling students to evaluate experimental accuracy, identify trends, and interpret scientific data more effectively. Given these considerations, the results suggest the need for targeted instructional interventions that strengthen students' spreadsheet and data-analysis competencies. Integrating technology-enhanced learning activities that require data organization, visualization, and statistical interpretation may contribute to the development of more comprehensive technological proficiency and support improved performance in science-related disciplines.

Table 5. Students level of technological proficiency in terms of web navigation skills

Indicators	Mean	Interpretation
I can navigate and conduct research using Google Scholar and other online search engines.	2.67	Proficient
I can easily find primary sources of information for my learning task.	2.69	Proficient
I can keep track on the sites and information I have searched using online bookmarks.	2.73	Proficient
I can recognize false information available online.	2.60	Proficient
I can identify if a website is safe to navigate.	2.80	Proficient
Total Mean	**2.70**	**Proficient**

Table 5 presents the students' level of technological proficiency in relation to web navigation and online information-seeking competencies. The results indicate an overall mean score of 2.70, which is interpreted as Proficient. This finding suggests that the respondents generally possess the digital skills necessary to navigate online environments effectively and utilize internet-based resources for academic purposes. Specifically, students demonstrated competence in employing search engines, locating relevant and credible sources of information, and utilizing bookmarking tools to organize and retrieve digital resources efficiently.

Despite the generally favorable level of proficiency, a comparatively lower mean score was obtained for the competency related to recognizing false or misleading information online ($M = 2.60$). Although this rating remains within the proficient category, it represents an area requiring further development. The finding suggests that students may encounter challenges when evaluating the accuracy, credibility, and trustworthiness of information obtained from digital platforms. As contemporary learning environments increasingly rely on online information sources, the ability to critically assess digital content has become an essential component of technological literacy.

The observed result is consistent with the findings of Abojon et al. (2023), who reported that students often experience difficulty in evaluating the credibility of online information. Rather than engaging in systematic verification processes, learners frequently rely on superficial indicators such as website appearance, domain extensions, or presentation quality when determining the reliability of information sources. Such practices may increase susceptibility to misinformation and hinder the development of evidence-based reasoning skills.

The importance of information evaluation is particularly evident in the context of Chemistry education, a discipline grounded in empirical evidence, scientific accuracy, and systematic inquiry. Effective learning in Chemistry requires students to interpret data, evaluate scientific claims, and apply established theoretical principles to explain observable phenomena. Consequently, the ability to distinguish credible scientific information from inaccurate or misleading content is critical for developing scientific literacy. Moreover, the cognitive processes involved in identifying misinformation closely parallel those employed in scientific investigation, including critical analysis, hypothesis evaluation, evidence verification, and logical reasoning.

Given these considerations, the findings underscore the need for instructional initiatives that strengthen students' critical thinking, information literacy, and media literacy competencies. Integrating activities that require source evaluation, factchecking, evidence appraisal, and critical analysis of digital content may enhance students' ability to make informed judgments regarding the reliability of online information. Such interventions may not only improve technological proficiency but also contribute to the development of higher-order thinking skills essential for academic success and scientific inquiry.

Table 6. Students level of technological proficiency in terms of online security skills

Indicators	*Mean*	*Interpretation*
I am fully aware of the risk of spam and phishing attempts when utilizing social media.	2.78	Proficient
I always reconsider the pros and cons before joining as a participating member of an online community.	2.78	Proficient
I am knowledgeable about the ambiguous copyright and intellectual property issues rampant social media	2.71	Proficient
I conduct fact-checking on the information I share on social media.	2.78	Proficient
I always make sure that my post online will not go against the community guidelines.	2.80	Proficient
Total Mean	**2.77**	Proficient

Table 6 presents the students' level of technological proficiency in relation to online security competencies. Among the three technological domains assessed, online security skills obtained the highest overall mean score (M = 2.77), corresponding to the **Proficient** level. This finding suggests that the respondents possess a relatively strong understanding of digital safety practices and demonstrate awareness of the ethical and responsible use of online technologies. The consistently favorable ratings across all indicators indicate that students are generally knowledgeable about potential online risks and are capable of engaging in secure and responsible digital behavior.

The results further reveal that students exhibit competence in adhering to community guidelines, practicing responsible online conduct, verifying information through factchecking, and recognizing issues related to copyright and intellectual property rights. Such competencies are increasingly important in contemporary digital environments, where the widespread availability of information and user-generated content necessitates heightened awareness of ethical, legal, and security-related concerns. The demonstrated proficiency in these areas suggests that students have developed foundational digital citizenship skills that enable them to participate responsibly in online communities and learning environments.

Overall, the findings indicate that Grade 10 students possess a generally proficient level of technological competence across the three assessed domains: software skills, web navigation skills, and online security skills. The mean scores for these domains ranged from 2.70 to 2.77, all of which fall within the **Proficient** category based on the established proficiency scale. These results suggest that students are reasonably capable of utilizing digital technologies to support learning, communication, information retrieval, and responsible online engagement.

Despite the generally positive outcomes, the analysis also identifies specific areas that warrant further instructional attention. In particular, lower proficiency levels were observed in competencies related to spreadsheet utilization and the identification of false or misleading online information. These findings indicate that although students demonstrate confidence in common digital tasks and online interactions, they may require additional support in areas that demand higher-order analytical, evaluative, and data-management skills. Given the increasing importance of data literacy and critical information evaluation in academic and professional contexts, targeted interventions designed to strengthen these competencies may be beneficial.

Consequently, educators may consider integrating technology-enhanced instructional strategies that emphasize spreadsheet applications, data analysis, digital literacy, and media evaluation skills. Such initiatives could further enhance students' technological proficiency and better prepare them to navigate the complex demands of an increasingly digital and information-driven society. Moreover, strengthening these competencies may contribute to improved academic performance, particularly in disciplines such as Chemistry that require the interpretation of quantitative data and the critical evaluation of scientific information

Relationship between Content and Technological Proficiency of Grade 10 Students

Table 7. *Relationship between Content and Technological Proficiency of Grade 10 students*

Variable	r coefficient	p-value	Remarks
Content Knowledge	0.215	0.156	Not Significant
Technological Knowledge			

The correlation analysis conducted to determine the relationship between Grade 10 students' Chemistry content proficiency and technological proficiency yielded a Pearson correlation coefficient of **r = 0.215**, indicating a weak positive association between the two variables. This result suggests that higher levels of technological proficiency tend to be accompanied by slightly higher levels of Chemistry content proficiency; however, the magnitude of the relationship is minimal.

Further examination of the statistical significance of the correlation revealed a **p-value of 0.156**, which exceeds the predetermined alpha level of 0.05. Consequently, the observed relationship was not statistically significant. This finding indicates that the weak positive correlation identified in the analysis may have occurred by chance and does not provide sufficient empirical evidence to support the existence of a meaningful relationship between students' technological proficiency and their Chemistry content proficiency.

Based on these results, the null hypothesis stating that there is no significant relationship between Chemistry content proficiency and technological proficiency among Grade 10 students was retained. The findings suggest that variations in students' technological proficiency, as measured across the domains of software skills, web navigation skills, and online security skills, were not significantly associated with differences in their Chemistry achievement.

The absence of a statistically significant relationship implies that technological proficiency alone may not be a determining factor in students' mastery of Chemistry content. Although students generally demonstrated proficient levels of technological competence, these skills did not necessarily translate into higher academic performance in Chemistry. This outcome suggests that other factors, such as prior scientific knowledge, cognitive ability, learning motivation, instructional quality, study habits, and classroom learning experiences, may exert a more substantial influence on students' content proficiency.

Therefore, while technological proficiency remains an important competency in contemporary education, the findings indicate that its contribution to Chemistry achievement may be indirect rather than causal. Future investigations may consider examining additional mediating or moderating variables to better understand the complex interplay between technological competence and academic performance in science education.

CONCLUSION AND RECOMMENDATIONS

The findings of this study indicate that Grade 10 students generally possess a proficient level of technological proficiency across the domains of software skills, web navigation skills, and online security skills. Students demonstrated competence in the use of presentation and productivity applications, internet-based information retrieval, and responsible digital practices. These results suggest that the respondents have acquired the foundational technological competencies necessary to participate effectively in contemporary digital learning environments.

Despite this relatively high level of technological proficiency, the results revealed a generally low level of Chemistry content proficiency. Students' performance across the assessed Chemistry competencies remained within the novice or non-mastery level, indicating substantial difficulties in understanding and applying fundamental scientific concepts. Furthermore, the correlation analysis demonstrated a weak positive but statistically insignificant relationship between technological proficiency and Chemistry content proficiency. Consequently, the study failed to establish empirical evidence that technological proficiency significantly contributes to students' achievement in Chemistry.

These findings suggest that the possession of technological skills alone does not guarantee improved academic performance in science education. While technological competence may facilitate access to information and support learning processes, its effectiveness in enhancing content mastery appears to depend on how such skills are integrated into meaningful instructional experiences. The persistent deficiencies in Chemistry proficiency further indicate the need for pedagogical approaches that promote conceptual understanding, scientific reasoning, and the application of knowledge in authentic learning contexts. Overall, the findings underscore the complexity of academic achievement and suggest that factors beyond technological proficiency may exert a more substantial influence on students' learning outcomes in Chemistry.

In light of the foregoing conclusions, several recommendations are proposed to enhance students' Chemistry content proficiency and maximize the educational value of technological resources.

First, educators may implement differentiated instructional strategies and targeted remediation programs designed to address identified learning gaps in Chemistry. Instructional interventions should focus particularly on competencies that exhibited the lowest proficiency levels, ensuring that students receive adequate opportunities to develop conceptual understanding and scientific problem-solving skills.

Second, teachers are encouraged to adopt learner-centered and technology-enhanced pedagogical approaches that promote active engagement and deeper learning. Strategies such as flipped classroom instruction, pre-laboratory video demonstrations, inquiry-based learning activities, and interactive simulations may facilitate improved comprehension of abstract Chemistry concepts and foster greater student participation in the learning process.

Third, schools may strengthen the integration of data analysis and quantitative reasoning tools, such as Microsoft Excel and other spreadsheet applications, within science instruction. Enhancing students' competency in data management, visualization, and interpretation may support the development of analytical skills that are essential for scientific inquiry and evidence-based decision-making.

Fourth, greater emphasis may be placed on cultivating critical thinking, information literacy, and media literacy competencies. Given the increasing prevalence of digital information sources, students should be provided with opportunities to evaluate the credibility, accuracy, and reliability of online content. Such competencies are fundamental not only to responsible digital citizenship but also to the development of scientific literacy and evidence-based reasoning.

Finally, future researchers are encouraged to investigate additional variables that may influence students' achievement in Chemistry. Factors such as learning motivation, self-efficacy, study habits, instructional quality, socioeconomic conditions, parental support, and access to educational resources may provide a more comprehensive understanding of the determinants of academic performance. Further research involving larger samples and diverse educational contexts is likewise recommended to enhance the generalizability of the findings and contribute to the advancement of Chemistry education research.

REFERENCES

1. Abojon , J. A., Derasin, L. C., Canque, M. S., Cordero, L. S., & Trinidad, G. A. (2023). Technological skills of senior high school students in state-run basic education institutions in the Philippines. European Chemical Bulletin, pp. 12510-12518. https://www.scihorizon.com/cdn/pdf/1685357340_a201a0c49032731586c4.pdf
2. Al-Rawi, A., Hameed, I., & Mahmoud, S. (2021). Assessing conceptual understanding of chemical bonding among secondary students using visual tools. Journal of Science Education and Technology, 30(2), 215–228. https://doi.org/10.1007/s10956-021-09908-7
3. Becker, K., & Park, K. (2011). Effects of integrative approaches among science, technology, engineering, and mathematics (STEM) subjects on students' learning: A preliminary meta-analysis. Journal of STEM Education, 12(5/6), 23–37.
4. Bulut, O., & Delen, E. (2011). The relationship between students' exposure to technology and their achievement in science and math. The Turkish Online Journal of Educational Technology, 10(3), 311–317.
5. Department of Education [DepEd]. (2016). K to 12 Curriculum Guide: Science (Grades 7–10). Department of Education, Republic of the Philippines. Retrieved from https://www.deped.gov.ph
6. Garma, J., Ihalon, E., & Gador, S. (2024). Technological Proficiency of Senior High School Students in the Lens of Digital Education. 26. 41-46. 10.5281/zenodo.13886189.
7. Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. Sustainable Operations and Computers, 3, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004
8. Liang, Y., Chen, S., Abeysekera, R., O'Sullivan, H., Bray, J., & Keevill-Savage, I. (2024). Examining the adoption of technology-enhanced learning in universities and its effects on student performance, satisfaction, and motivation. Computers and Education Open, 7, 100223. https://doi.org/10.1016/j.caeo.2024.100223
9. Muhali, M. A. (2026). Conceptual problem-based learning model: Promising intervention to enhance prospective science teachers' critical thinking skills. Social Sciences & Humanities Open, 13, 102509. https://doi.org/10.1016/j.ssaho.2026.102509
10. Osorio, R., & Aliazas, J. V. (2022). Integrating Android-Based Applications in Teaching Chemistry for Improved Experiential Learning. International Journal of Science Technology Engineering and Mathematics, (Vol. 2, Issue 4, p. 132). https://doi.org/10.53378/352943
11. Purnomo, F. S., Kharisma, S., & Rahmawan, S. (2026). Enhancing chemistry learning outcomes through interactive learning media to support sustainable development goals (SDGs): A systematic literature review. ASEAN Journal for Science Education, 5(1), 77–86. https://doi.org/10.17509/ajse.v5i1
12. Trust, T., & Whalen, J. (2020). Should teachers be trained in emergency remote teaching? Lessons learned from the COVID-19 pandemic. Journal of Technology and Teacher Education, 28(2), 189–199.
13. Uçar, M.B., Sahin, E. Science Teachers' Technology Integration through TPACK-P: Proficiency and Component Interactions. J Sci Educ Technol (2026). https://doi.org/10.1007/s10956-026-10331-7