# Empowering Science Instruction through ICT Integration: Teachers' Perceptions, Challenges, and Adaptive Practices at Valencia Colleges, Inc

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## ABSTRACT

The 21st century has witnessed a paradigm shift in education, where Information and Communication Technology (ICT) has become integral to teaching and learning. This study investigates teachers' perceptions, challenges, and coping strategies in integrating ICT tools into classroom instruction at Valencia Colleges, Inc., Bukidnon. Using a qualitative phenomenological design, twelve faculty members participated in semi-structured interviews analyzed through Colaizzi's method. Findings reveal that teachers perceive ICT as transformative, enhancing engagement, interactivity, and instructional relevance. ICT integration has shifted practices from lecture-based to learner-driven approaches, fostering blended learning, digital literacy, and collaborative environments. Teachers reported increased confidence and motivation when ICT tools were available and supported by institutional culture. Challenges include poor internet connectivity, outdated equipment, insufficient training, and inconsistent technical support. Teachers also noted resistance among colleagues and infrastructural limitations that constrain ICT adoption. Despite these barriers, respondents demonstrated resilience through adaptive strategies such as self-learning, peer collaboration, flipped classrooms, and mobile-based instruction. The study concludes that ICT integration is both empowering and demanding, requiring institutional investment and sustained professional development. Recommendations include strengthening infrastructure, establishing ICT support systems, and embedding digital pedagogy in curriculum frameworks. This research contributes to the discourse on educational technology in Philippine higher education, highlighting the need for strategic support to maximize ICT's potential in science instruction.

**Keywords**: ICT integration, teacher perceptions, science education, adaptive practices, educational technology, digital pedagogy

## INTRODUCTION

The integration of Information and Communication Technology (ICT) into education has become one of the defining features of 21st-century pedagogy. Globally, ICT has transformed traditional teaching approaches into interactive, student-centered, and inquiry-based learning environments (Tondeur et al., 2017). In science education, ICT tools such as simulations, multimedia platforms, and online resources allow teachers to visualize abstract concepts, model complex phenomena, and foster deeper conceptual understanding (Sang et al., 2018). These tools not only enhance comprehension but also encourage collaboration and critical thinking, skills that are essential in preparing learners for the demands of the modern world.

Teachers' perceptions of ICT integration play a crucial role in determining its success. Positive attitudes toward technology often lead to greater willingness to adopt ICT tools, while negative perceptions can hinder innovation (Buabeng Andoh, 2021). The Technology Acceptance Model (Davis, 1989; Teo, 2019) emphasizes that perceived usefulness and ease of use are key determinants of technology adoption. When teachers believe ICT improves their teaching effectiveness and can be used with minimal effort, they are more likely to integrate it into their practice. Rogers' Diffusion of Innovations Theory (2003) further explains how new technologies are adopted within social systems, highlighting the importance of institutional support, peer collaboration, and perceived advantages.

In the Philippine context, the Department of Education (DepEd) and the Commission on Higher Education (CHED) have strongly advocated for ICT integration to align with global education standards and the Sustainable Development Goals (Villena & Baltazar, 2020). However, the digital divide persists across public and private institutions, particularly in rural areas. Teachers face barriers such as limited infrastructure, lack of training, and insufficient institutional support (Cabansag, 2016; Bautista & Ocampo, 2021). For many Filipino educators, integrating ICT remains an aspirational goal rather than a regular classroom practice, especially in science subjects that require specialized technological tools and laboratory equipment (Mendez & Santos, 2019).

Local studies highlight the uneven readiness of teachers to adopt ICT. Villena and Baltazar (2020) observed that teachers in public schools have varying levels of ICT competence, largely due to insufficient training opportunities. Pura and Torres (2021) emphasized that during the shift to online learning, teachers demonstrated resilience by self-learning digital tools, but many still required mentoring to integrate ICT effectively. Mendez and Santos (2019) noted that while Filipino teachers acknowledge the importance of ICT, most need ongoing support to sustain its use. These findings underscore the importance of examining teachers' lived experiences in specific institutional contexts.

At Valencia Colleges, Inc. (VCI), located in Bukidnon, ICT integration has become increasingly significant in enhancing instructional delivery. As a private higher education institution in a semi-urban setting, VCI aims to strengthen its digital teaching framework. Anecdotal observations suggest that teachers' levels of ICT readiness and confidence vary considerably. Some science teachers employ interactive multimedia tools, simulations, and online resources, while others rely primarily on traditional lectures. Understanding the teachers' perceptions and challenges in integrating ICT tools within this specific institutional context is essential for designing appropriate capacity-building initiatives and improving instructional quality.

This study is anchored on the Technology Acceptance Model (Davis, 1989; Teo, 2019) and Rogers' Diffusion of Innovations Theory (2003). Together, these frameworks provide a foundation for understanding how teachers at VCI perceive and adapt to ICT in their instructional practices. The conceptual framework of this study is guided by three major constructs: teachers' perceptions, challenges in ICT integration, and coping strategies. These elements are interrelated and collectively influence the level and effectiveness of ICT integration in classroom instruction.

The significance of this study extends to multiple stakeholders. Teachers will gain deeper understanding of their own experiences, enabling self-assessment and professional growth. School administrators can use findings to design targeted ICT training programs and policies that foster technological competency. Students stand to benefit from improved instructional practices that enhance engagement and learning outcomes. Educational policymakers may use the results to strengthen ICT integration strategies in teacher education. Future researchers can build upon this study to explore comparative or longitudinal analyses on ICT adoption.

By situating the research within the broader discourse on ICT integration and grounding it in the lived experiences of teachers at VCI, this study contributes to ongoing efforts to bridge the digital divide in Philippine education. It seeks to answer three central questions: How do teachers perceive ICT integration in classroom instruction at VCI? What challenges do they encounter? How do they cope with these challenges? Addressing these questions provides valuable insights into the complex interplay of perceptions, barriers, and adaptive practices that shape ICT integration in science education.

## METHODS

This study employed a qualitative phenomenological design to explore teachers' perceptions and challenges in ICT integration. Phenomenology is appropriate as it seeks to understand lived experiences of a phenomenon—in this case, ICT integration in teaching. The study was conducted at Valencia Colleges, Inc., a private higher education institution in Bukidnon. Twelve faculty members from the Basic Education Department and College of Education were purposively selected based on teaching experience and ICT use. A semi-structured interview guide was developed, validated by experts, and piloted. It covered perceptions, challenges, and coping strategies. Permission was obtained from VCI administration. Interviews lasted 30–45 minutes, recorded and transcribed verbatim. Colaizzi's phenomenological method was used, involving significant statements, formulated

meanings, clustered themes, and synthesis. Braun and Clarke's thematic analysis supported coding and theme development. Credibility was ensured through member checking. Transferability was supported by contextual descriptions. Dependability was achieved via audit trails, and confirmability through reflective journaling. Confidentiality and anonymity were maintained. Pseudonyms were used, and participants could withdraw at any time.

## RESULTS AND DISCUSSION

The findings of this study reveal that teachers at Valencia Colleges, Inc. perceive ICT integration as a transformative force that enhances engagement, promotes interactivity, and supports modern pedagogical practices. Respondents consistently emphasized that ICT makes lessons more engaging and relevant, improves comprehension through visual learning, and shifts classrooms toward student-centered approaches. These perceptions align with Ghavifekr and Rosdy (2015) and Tondeur et al. (2017), who emphasized that teachers' positive perceptions strongly influence the success of ICT integration.

Building on these perceptions, teachers reported significant changes in their instructional practices. Many shifted from lecture-based to interactive lessons, regularly using multimedia resources, blended learning approaches, and online assessments. ICT encouraged them to design student-centered activities and incorporate digital literacy into their teaching. This transformation echoes constructivist learning theory, which emphasizes knowledge construction through engagement and collaboration (Teo, 2019). Hatlevik and Hatlevik (2018) similarly found that ICT allows teachers to become facilitators rather than sole knowledge providers, a shift that was evident in the experiences of VCI teachers.

In addition to instructional changes, confidence in using ICT varied among respondents, with most reporting moderate to high levels. Confidence was linked to prior training, exposure, and continuous practice. Some teachers expressed anxiety during technical problems, while others gained confidence through webinars and self-learning. These reflections confirm Hatlevik and Hatlevik's (2018) finding that self-efficacy improves through experience and institutional support. Within the Technology Acceptance Model (TAM), these findings illustrate how perceived ease of use is compromised by poor internet and outdated equipment, while perceived usefulness remains high. Thus, ease of use barriers directly limit adoption frequency despite positive perceptions.

Motivation to integrate ICT also emerged as a critical factor, stemming from both intrinsic and extrinsic sources such as student engagement, administrative encouragement, ease of lesson delivery, and personal interest in technology. This dual motivation reflects Self-Determination Theory (Deci & Ryan, 2000), where autonomy and competence foster persistence. From the perspective of Diffusion of Innovations Theory, institutional support functions as a moderator: administrators' encouragement and training opportunities accelerate adoption, enabling teachers to transform challenges into creative practices such as flipped classrooms and digital simulations. Conversely, limited support slows diffusion, leaving some faculty hesitant or reliant on traditional methods.

Despite these positive perceptions and motivational drivers, teachers encountered persistent challenges. Poor internet connectivity, outdated equipment, insufficient training, and inconsistent technical support were frequently cited. These limitations mirror the findings of Cabansag (2016) and Buabeng-Andoh (2021), who highlighted resource inadequacy and insufficient technical support as recurring problems in schools. Resistance among older or less tech-savvy colleagues was also noted, though training and encouragement from administrators gradually improved acceptance (Villena & Baltazar, 2020). Importantly, the private funding structure of VCI uniquely shaped these challenges. Unlike public schools, where ICT barriers often stem from bureaucratic procurement and centralized resource allocation, VCI's reliance on tuition and limited private capital created uneven investment patterns. Infrastructure upgrades were contingent on enrollment stability and administrative prioritization, explaining why some classrooms benefited from modern facilities while others remained under-resourced. Bautista and Ocampo (2021) observed that learning environments influence teachers' readiness and enthusiasm for digital pedagogy, and at VCI, infrastructural disparities underscore the unique challenges of private institutions.

In response to these barriers, teachers employed diverse coping strategies to sustain ICT integration. These

included preparing backup lessons, seeking help from colleagues, attending training and webinars, using mobile data when Wi-Fi failed, and adapting tasks to available tools. Respondents also demonstrated creativity through personal innovations such as using YouTube and simulations in science demonstrations, creating digital quizzes with Google Forms, developing video lessons, and applying flipped classroom approaches. These adaptive practices highlight professional resilience and commitment to quality instruction despite limitations. Pura and Torres (2021) emphasized adaptability as a key characteristic of teachers effectively managing technological barriers, and the experiences of VCI teachers illustrate how institutional support moderates the relationship between challenges and coping strategies, consistent with Rogers' Diffusion of Innovations framework.

Taken together, the findings underscore a complex interplay between positive perceptions, persistent challenges, and adaptive strategies. Teachers at VCI view ICT as essential for modern instruction, yet their ability to integrate it fully is constrained by infrastructural and institutional factors. The results highlight the importance of sustained support, training, and investment to maximize ICT's potential in science education, while also showing how private funding structures uniquely shape the trajectory of ICT adoption compared to public sector contexts.

## CONCLUSION AND RECOMMENDATION

The findings of this study underscore the transformative potential of Information and Communication Technology (ICT) integration in science instruction at Valencia Colleges, Inc., a privately funded provincial institution. Teachers consistently described ICT as a powerful pedagogical tool that fosters student engagement, enhances collaboration, and stimulates innovation in classroom practices. By shifting from traditional lecture-based approaches to interactive and student-centered methods, ICT has enabled the creation of dynamic learning environments that reflect the realities of 21st-century education. This transformation is particularly evident in science subjects, where simulations, multimedia resources, and online platforms allow learners to visualize abstract concepts, conduct virtual experiments, and connect theoretical knowledge to real-world applications.

At the same time, persistent challenges hinder the full realization of ICT's potential. Infrastructural limitations such as poor internet connectivity, outdated equipment, and insufficient technical support remain significant barriers. Unlike public schools, where bureaucratic procurement often delays ICT adoption, VCI's reliance on tuition and limited private capital produces uneven investment patterns, resulting in disparities across classrooms. Teachers also reported gaps in training and professional development, which affect their confidence and ability to maximize ICT tools. Resistance among some colleagues, particularly those less familiar with technology, further complicates integration efforts. These challenges highlight the importance of institutional support in sustaining ICT adoption. Within the Technology Acceptance Model, poor connectivity and outdated equipment directly undermine perceived ease of use, while perceived usefulness remains high. From the perspective of Diffusion of Innovations Theory, institutional support acts as a moderator, enabling teachers to transform barriers into creative practices when encouragement and training are present.

Nevertheless, the resilience demonstrated by teachers at Valencia Colleges, Inc. is noteworthy. Respondents employed adaptive strategies such as preparing backup lessons, collaborating with peers, self-learning through online tutorials, and experimenting with blended learning approaches. The creativity evident in practices such as flipped classrooms, digital quizzes, and mobile-based activities illustrates how teachers can harness ICT to enrich learning experiences even in resource-constrained environments. These coping mechanisms reflect a strong commitment to quality instruction and exemplify how institutional support can accelerate diffusion and strengthen adoption.

Based on these findings, several recommendations are proposed to strengthen ICT integration at Valencia Colleges, Inc. First, the institution should prioritize investment in infrastructure, ensuring reliable internet connectivity, updated equipment, and consistent technical support. Second, continuous professional development programs must be established, focusing not only on technical skills but also on pedagogical strategies for effective ICT use. Mentoring and peer support initiatives can further enhance teachers' confidence and encourage collaborative innovation. Third, ICT pedagogy should be embedded into curriculum frameworks, ensuring that technology use is aligned with learning objectives and assessment practices. Diversifying assessment methods to include digital outputs such as multimedia projects, online presentations, and collaborative platforms will allow students to demonstrate their understanding in ways that reflect modern learning environments. Finally, fostering a culture of

collaboration among faculty is essential. By sharing best practices, co-developing digital resources, and engaging in reflective dialogue, teachers can collectively advance ICT integration across disciplines.

Future research should extend beyond science instruction to explore ICT integration in other subject areas and institutional contexts. Comparative studies across public and private schools, as well as longitudinal investigations of teachers' evolving practices, would provide deeper insights into the sustainability of ICT adoption. Such research will contribute to a broader understanding of digital pedagogy in Philippine higher education and inform policies that support equitable and effective technology integration.

In conclusion, ICT integration at Valencia Colleges, Inc. is both empowering and demanding. It offers transformative opportunities for teaching and learning, yet requires sustained institutional commitment to overcome persistent challenges. By situating this case study within TAM and Diffusion of Innovations Theory, the findings highlight how private funding structures, infrastructural realities, and institutional support collectively shape ICT adoption. With strategic investment in infrastructure, professional development, curriculum alignment, and collaborative innovation, educational institutions can ensure that ICT fulfills its promise of enhancing student engagement, fostering collaboration, and driving innovation in science education and beyond.

## REFERENCES

1. Bautista, M., & Ocampo, J. (2021). ICT integration in Philippine classrooms. Philippine Journal of Education, 99(1), 45–61.
2. Buabeng-Andoh, C. (2021). Teachers' attitudes toward ICT integration: A review of literature. International Journal of Education and Development, 9(6), 54–65.
3. Cabansag, M. (2016). Barriers to ICT adoption in rural schools: A Philippine perspective. Asian Education Review, 27(2), 123–138.
4. Deci, E. L., & Ryan, R. M. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68–78.
5. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.
6. Ghavifekr, S., & Rosdy, W. A. (2015). Teaching with technology: Strategies for ICT integration in the classroom. International Journal of Research in Education, 41(6), 843–861.
7. Hatlevik, O. E., & Hatlevik, I. K. R. (2018). Examining the relationship between teachers' ICT self-efficacy and ICT use. Computers & Education, 123, 1–13.
8. Mendez, R., & Santos, J. (2019). ICT adoption in Philippine science classrooms: Challenges and opportunities. Philippine Journal of Science Education, 52(2), 123–139.
9. Pura, J., & Torres, M. (2021). Resilience and adaptability of Filipino teachers in ICT integration during online learning. Philippine Journal of Teacher Education, 52(2), 145–162.
10. Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.
11. Sang, G., Valcke, M., van Braak, J., & Tondeur, J. (2018). Exploring the impact of ICT in science education: Teachers' perspectives. Journal of Science Education, 43(10), 1459–1478.
12. Teo, T. (2019). Factors influencing teachers' intention to use technology: An extension of the Technology Acceptance Model. Educational Technology Research and Development, 67(3), 555–569.
13. Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education. Computers & Education, 67(1), 1–10.