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From Chalkboard to Smartboards: Transforming Instruction with Technology

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Abstract **Original Research Article**

This study aimed to examine the use of technology, perceived barriers, and strategies for overcoming them among instructors at Quirino State University, to determine whether demographic factors played a role, an aspect commonly studied in educational technology research. The study was a descriptive survey conducted to collect information from 30 faculty members using a Likert-scale questionnaire. Mean differences were significantly assessed through statistical technology using means, independent sample t-tests, and one-way ANOVA in terms of gender, educational attainment, program affiliation, and subjects taught. The survey results showed that instructors' basic ICT use is common, but they have lowered their use of advanced interactive technologies. Perfected obstacles were moderate, and they were mostly associated with poor infrastructure and technical service. Teachers noted that they would proactively participate in teacher improvement and invest themselves in taking into consideration these issues. Importantly, the analyses did not always show any statistically significant differences in technology use, perceived barriers, or overcoming efforts on the basis of gender, level of education, program affiliation or subjects taught. This implies that the issues related to technology integration and mitigation approaches are partially broad on a systemic level, but not limited by the levels of specific demographic characteristics. The paper concludes that the challenges of technology integration must be put in institution-wide remedies. Among the recommendations, one can single out the improvement of digital infrastructure, the strength of technical support, and both the accessibility and high-quality instrumental professional development of all educators. Such thinking can create a fair and accepting atmosphere, which allows all the instructors to take advantage of technology to enhance the delivery of learning.

Keywords: Barriers, Education, Instruction, Perception, Technology Integration.

INTRODUCTION

The evolution of technology has significantly transformed the modern world of education in that its introduction to instruction has become a critical research field of studies between 2021 and 2025 (Kalyani, 2024; Zou et al., 2025). The studies have continuously pointed out the transformative power of digital tools and platforms to improve learning, divided by subjects and student performance in most areas of the educational sector (Bhat, 2023; Akintayo

et al., 2024; Saputra et al., 2025). It is essential because of integrating learners with the necessary skills of the 21st century that are more digital-focused than classical pedagogical methods and facilitating more dynamic and interactive forms of instructional process (Akram et al., 2022; Eden et al., 2024).

Advocacy of strategic use of technology in education, especially in higher education institutions, has been found to greatly enhance student engagement, provide individualistic learning, and increase access to educational materials resulting in equal access to education (Eden et al., 2024; Wang, 2023). Innovations like artificial intelligence, data analytics, and various educational technologies based on technologies are gradually transforming the learning process into a more inclusive and student-centered process (Saputra et al., 2025; Daniela, 2021).

Through this study, there are series of meticulous roots to pursue the diversified nature of the multiple aspect of recognizing technology in instruction, its fundamental beneficial impacts, the nature of inherent problems surrounding it as it is to be implemented, and the necessary role played by teachers in facilitating successful mediation of such digital innovations towards developing functional and fair learning environments (Panakaje et al., 2024; Fahrni et al., 2025). This research review is a synthesis of the available studies, which give depth to the current change of roles of technology in designing contemporary teaching and learning.

Purpose of the Study

The general purpose of this study is to assess the extent to which the faculty has utilized ICT tools for instructional delivery at Quirino State University.

Specifically, the study sought to:

1. determine the profile of the respondents,
2. determine the extent to which faculty utilize ICT tools for improved instructional delivery.
3. ascertain barriers encountered by faculty in utilizing ICT tools for improved instructional delivery,
4. determine the extent to which faculty attempt to overcome ICT barriers for improved instructional delivery, and
5. assess the significant difference in the profile of the respondents as to:

   a. extent of utilization of ICT tools for improved instructional delivery;

   b. barriers encountered by faculty in utilizing ICT tools for improved instructional delivery; and

   c. extent to which the faculty attempts to overcome ICT barriers for improved instructional delivery

METHODS

A descriptive survey research design was employed for this study. Descriptive survey research, according to Bakare et al. (2021), is concerned with the collection and description of data from a given population. Descriptive survey research was employed since data were collected from the faculty of Quirino State University, Maddela Campus, on which generalization is made. The population of the study comprises all 30 faculty in the campus. A purposive sampling technique was adopted to select the number of respondents. A structured questionnaire adopted from the study of Ojo et al. (2024) was used for data collection. The extent to which instructors utilize ICT tools for improved instruction delivery. was rated on a five-point rating scale ranging from Very Frequently, Frequently, Occasionally, Rarely, and Does not use. While the extent of technology utilization barriers for improved learning delivery as experienced by instructors was rated as to Very Great Extent, Great Extent, Moderate Extent, Least Extent, and Not at all. Data collected were analyzed using the mean on a decision mark of 2.5. This mean was used to answer the research questions. Hence, any response with a mean score of 2.5 and above is regarded as of great extent, while any response with a score below 2.5 is regarded as of low extent. An independent samples t-test was conducted to compare the extent to which male and female instructors utilize ICT tools for improved instruction delivery, and a one-way ANOVA was conducted to compare the instructors' extent of

technology utilization to improve learning when grouped by three parameters with three groups.

RESULTS AND DISCUSSION

This section presents the findings and analysis of the results of the study after appropriate statistical procedures have been applied.

Profile of the Respondents

Table 1 presents the profile of 30 QSU Maddela Faculty chosen randomly using stratified random sampling in terms of sex, highest educational attainment, program affiliation, and subjects taught.

Table 1. Distribution of respondents

Profile Variable	Categories	Frequency	Percentage
Gender	Male	9	30.0
	Female	21	70.0
Highest Educational Attainment	Baccalaureate	5	16.7
	Master's	19	63.3
	Doctorate	6	20.0
Program Affiliation	Bachelor of Science in Agriculture	10	33.3
	Bachelor of Science in Hospitality Management	6	20.0
	Bachelor of Technology and Livelihood Education	14	46.7
Subjects Taught	General Education Courses	5	16.7
	Professional Education Courses	5	16.7
	Major/Specialization Courses	20	66.7

The demographic data of the sample respondents helps provide a good background on the dynamics of integration of technology in instruction. What is leading to assume that there could be a cohort of highly professional development and utilitarian pedagogical practices is the percentage of female educators (70.0) and those with Master's degrees (63.3) who are most likely to be interested in the relentless efforts at continued professional development. This is especially so because such literature stresses the importance of teacher professional growth as one of the key factors contributing to creating a successful technological learning environment (Napitupulu et al., 2024; Sanchez-Prieto et al., 2021; Kaya and Adiguzel, 2021). An increased level of education, i.e., Master's only, could predict a higher level of digital competence and a more vivid attitude to acquiring digital resources, which indirectly supports the evidence that the strong and weak features of educators demonstrate a high impact on becoming digitally competent (Guillen-Gamez et al., 2021).

The spread in program affiliations and subjects taught (e.g., a large proportion in Bachelor of Technology and Livelihood Education and Major/Specialization Courses) suggests there would be a cluster of the group that is necessarily involved in applied and specialized specializations in which technology incorporation may be a natural component of the curriculum (Wang, 2023). The present group can have particular difficulties or opportunities in using technology in comparison with General Education courses, where integration can vary (Fleur and Dlamini, 2022; Panakaje et al., 2024). That is why the knowledge of these demographic peculiarities can help to tailor the professional development programs and discuss certain obstacles to the use of technologies that can differ greatly depending on the background and theme of a particular teacher (Feng et al., 2025; Granic, 2022).

Extent of Technology Utilization among Instructors to Improve Learning

Table 2 presents the extent to which instructors utilize ICT tools for improved instruction delivery. Statements enumerated herein are lifted from the survey questionnaire administered to the respondents, to which they responded via self-assessment of their experiences with a 5-point Likert Scale with 5 as the largest and 1 as the lowest, and a descriptive scale from Very Frequently to Does Not Use.

Table 2. Extent of technology utilization among instructors for improved learning delivery

Basic Skills	Mean	SD	Qualitative Interpretation
1. I use PowerPoint to present lectures.	4.60	.563	Very Frequently
2. I use interactive Starboard/platforms for lectures.	3.70	1.088	Frequently
3. I correspond with students through online platform discussions.	3.37	.999	Occasionally
4. I adopt video conferencing for lectures.	2.77	1.223	Occasionally
5. I encourage students' usage of laptops in lecture halls to facilitate learning.	3.30	1.149	Occasionally
6. I make electronic materials/documents like PPT slides, MS Word, software, etc., available to students to facilitate further studies.	4.73	.521	Very Frequently
7. I accept assignments on electronic platforms.	3.63	.890	Frequently
8. I send lecture notes to students on electronic platforms where necessary.	4.43	.858	Very Frequently
9. I use simulations to reinforce students' retention of lectures.	3.90	.923	Frequently

10. I use MS Excel, SPSS, Genstat, etc., to explain data analysis to students/supervisees.	3.27	1.081	Occasionally
11. I use software packages like AutoCAD, MicroStation, Corel Draw, Spreadsheet, Mendeley Genstat, etc., to reach field-related skills.	2.77	1.194	Occasionally
12. I use various relevant simulations in practical classes to teach skills.	3.77	1.006	Frequently
13. I encourage students to visit YouTube to practice skill-based content of multimedia materials personally produced and uploaded.	3.67	1.155	Frequently
14. I conduct computer-based examinations in course handled (e.g. Google Forms).	2.67	1.061	Occasionally
15. I use an interactive Starboard/platform to draw figures in a practical class to arouse.	2.67	1.295	Occasionally
16. I create instructional materials using ICT (PPT, videos).	4.57	.626	Very Frequently
17. I assign students to work that calls for computer use.	3.67	1.028	Frequently
18. I ask students to produce multimedia reports/projects.	3.90	.712	Frequently
19. I encourage students to check their results online.	3.00	1.145	Occasionally
Mean	**3.60**	**.591**	**Frequently**

Legend: *1.00-1.80: Does not use; 1.81-2.60: Rarely; 2.61-3.40: Occasionally; 3:41-4.20: Frequently; 4.21-5.00: Very Frequently*
SD – Standard Deviation

According to Table 2, the instructors are using technology differently as a means of learning, with Frequently (Mean=3.60) as the average. Simple technologies such as PowerPoint (Mean=4.60), electronic materials (Mean=4.73), lecture notes (Mean=4.43), and ICT instructional materials (Mean=4.57) are commonly used. This is in accord with the literature that highlights the use of technology in improving learning performance and accessibility of the content (Akintayo et al., 2024; Bhat, 2023). Such practices assist with the baseline learning and the access of students (Sukmaindrayana and Yulianeu, 2022).

It is also frequently engaged in interactive platforms (Mean=3.70), simulations (Mean=3.90), electronic assignments (Mean=3.63), computer-based work (Mean=3.67), and multimedia reports (Mean=3.90). It is a manifestation of the

effectiveness of technology in terms of student engagement, active learning, and developing 21st-century skills (Martin-Somer et al., 2023; Priyakanth et al., 2021). Particularly, simulations are recognized to be helpful in promoting retention (Alharbi et al., 2024; Motejlek and Alpay, 2023).

Better tools like online platform discussions (Mean=3.37), video conferencing (Mean=2.77), special computer software (Mean=3.27, Mean=2.77), and computer-based tests (Mean=2.67) are, however, practised in the Occasionally Town. This implies possible obstacles such as technical problems or institutional assistance (Chama & Subaveerapandiyan, 2023; Cabunoc & Ubayubay, 2024). The decrease in the number of people using these high-tech tools suggests the necessity of specific professional training to go beyond the minimum content delivery and use technology to facilitate various types of equity-based learning (Napitupulu et al., 2024; Siyam et al., 2025). This will allow the instructors to take full advantage of technology.

Barriers Encountered in Utilizing Technology for Improved Learning

Table 3 presents the extent to which instructors encountered barriers in utilizing ICT tools for improved instruction delivery. Statements enumerated herein are lifted from the survey questionnaire administered to the respondents, to which they responded via self-assessment of their experiences with a 5-point Likert Scale with 5 as the largest and 1 as the lowest, and a descriptive scale from Very Great Extent to Not at All.

Table 3. Extent of technology utilization barriers for improved learning delivery as experienced by instructors

Basic Skills I encountered problem/s on…	**Mean**	**SD**	**Qualitative Interpretation**
1. Poor supply of electricity	2.50	1.137	Least Extent
2. High cost of procuring ICT tools	3.33	.959	Moderate Extent
3. Inadequate internet data connection in the lecture area	4.37	.850	Very Great Extent
4. Inadequate internet data connection in office areas	4.17	.874	Great Extent
5. Inadequate provision of internet data connection in the students' residence	3.90	1.125	Great Extent
6. Technophobia	1.83	1.020	Least Extent
7. Lecturer's computer self-efficacy	3.00	1.203	Moderate Extent
8. Technicalities involved in pinning for ICT-related instructional materials	3.00	.871	Moderate Extent
9. Lack of adequate technical assistance	2.63	1.245	Moderate Extent
10. Time constraints in teaching with simulations	2.97	.999	Moderate Extent

11. Inadequate time needed to learn using ICT gadgets, software	2.87	1.042	Moderate Extent
12. Lack of regular updating of software	2.83	1.117	Moderate Extent
13. Large number of learners/students per class	3.27	1.230	Moderate Extent
14. Resistance to change	2.47	1.432	Least Extent
Mean	**3.08**	**.674**	**Moderate Extent**

Legend: 1.00-1.80: Not at all; 1.81-2.60: Least Extent; 2.61-3.40: Moderate Extent; 3:41-4.20: Great Extent; 4.21-5.00: Very Great Extent
SD – Standard Deviation

According to Table 3, the barriers to the use of technology based on the mode of instructors include an overall estimate of moderate (Mean=3.08) of technology use barriers. The biggest impediments are infrastructural: poor internet accessibility in the lecture room (Mean=4.37, Very Great Extent), office room (Mean=4.17, Great Extent), and in the residence of students (Mean=3.90, Great Extent). Dependable connectivity is the key to successful technology integration and the remedy to an obstacle of adoption (Mdhlalose & Mlambo, 2023).

There are some other moderate barriers, such as the high cost of the ICT tool (Mean=3.33), the self-efficacy of the lecturer with computers (Mean=3.00), the technicalities involved (Mean=3.00), and poor technical support (Mean=2.63). These statements are in line with the studies that state financial limitations, instructor capabilities, and institutional backing are critical drivers of educational technology adoption (Feng et al., 2025; Granic, 2022). Teachers ought to be provided with long-term professional development platforms in order to improve their digital literacy skills and self-efficacy (Napitupulu et al., 2024; Sanchez-Prieto et al., 2021; Guillen-Gamez et al., 2021).

It is worth noting that Technophobia (Mean=1.83, Least Extent) is not a key impediment, as well as resistance towards the change (Mean=2.47, Least Extent). This implies that the instructors tend to be technology-receptive. Once all the external and systemic barriers to technology integration, such as the lack of support and infrastructure, acquire the desired nature in service provision, instead of its perceived inherent hesitation, methods to tackle these issues will resonate and result in successful integration (Feng et al., 2025; Granic, 2022). The solution of these gaps is most important to the exploitation of the educational potential of technology.

Attempt to Overcome Barriers in Technology Integration for Improved Learning

Table 4 presents the extent to which instructors attempted to overcome barriers in utilizing ICT tools for improved instruction delivery. Statements enumerated herein are lifted from the survey questionnaire administered to the respondents, to which they responded via self-assessment of their experiences with a 5-point Likert Scale with 5 as the largest and 1 as the lowest, and a descriptive scale from Very Great Extent to Not at All.

Table 4. Extent to which instructors attempted to overcome technology utilization barriers for improved learning delivery

Basic Skills	Mean	SD	Qualitative Interpretation
1. I attend retraining programs on the use of ICT in teaching.	3.67	1.295	Great Extent
2. I attend workshops on the use of ICT in research.	3.77	1.278	Great Extent
3. I respond to the students' challenges on ICT-related issues.	3.63	1.129	Great Extent
4. I conduct practical classes with the aid of simulations.	3.63	1.299	Great Extent
5. I acquire more ICT skills for data analysis.	3.77	1.194	Great Extent
6. I surf the internet daily for recent field-related articles.	4.13	.860	Great Extent
7. I liaise with technologies in the department to set up ICT gadgets in preparation for lectures.	3.57	1.223	Great Extent
8. I answer students' questions via various online platforms.	4.00	1.114	Great Extent
9. I seek knowledge from colleagues on field-related software packages.	3.93	.980	Great Extent
10. I log in to the university website to check for articles on the available e-repository.	3.47	1.137	Great Extent
11. I purchase internet data for extensive research to improve teaching.	4.13	1.008	Great Extent
12. I attempt discussions with ICT experts on how to improve computer self-efficacy.	3.57	1.223	Great Extent
13. I update software regularly.	3.73	1.143	Great Extent
14. I make use of alternative sources of electricity, like generators, when necessary.	3.50	1.253	Great Extent
Mean	**3.75**	**.957**	**Great Extent**

Legend: 1.00-1.80: Not at all; 1.81-2.60: Least Extent; 2.61-3.40: Moderate Extent; 3:41- 4.20: Great Extent; 4.21-5.00: Very Great Extent

SD – Standard Deviation

Table 4 underlines the positive involvement of the instructors in preventing the impediments of implementing technology integration, proving to a level of Great extent (overall Mean=3.75). They are dedicated in terms of professional development, such as attending re-training programs (Mean=3.67) and ICT in research workshops (Mean=3.77). The programs are direct answers to the aforementioned moderate barriers, which were lecturer computer self-efficacy and technical complexities (Feng et al., 2025; Granic, 2022). This is the importance of constant learning to increase the digital competence of teachers (Napitupulu et al., 2024; Sanchez-Prieto et al., 2021; Guillen-Gamez et al., 2021).

Another mitigation of infrastructure challenges by instructors. Is notable in their jocular buying behavior (Mode=4.13), i.e., the purchase of internet data to embark on research, and their use of alternative sources of electricity (Mode=3.50), i.e., unreliable internet connectivity and lacking infrastructure, they face head-on issues according to identified barriers that inhibit study progression and growth (Pedida and Diaz, 2023). The prohibitive price of technology, which is also mentioned as a challenge, is implicitly handled by such self-initiated initiatives (Chama & Subaveerapandiyan, 2023).

Further, faculty are also committed to assisting the students, with the students reporting that they largely address ICT-related issues (Mean=3.63) and get questions answered through online platforms (Mean=4.00). The rating of high participation in internet search of field-related articles (Mean=4.13) and seeking information with fellow employees (Mean=3.93) indicates self-directed learning. It is proactive behavior that supports the idea that instructors are mostly willing to embrace technology, suggesting that the solution to existing systemic problems is much better than the intrinsic unwillingness to adopt the use of technology (Feng et al., 2025; Granic, 2022).

Differences in the Extent of Technology Utilization among Instructors to Improve Learning when grouped by Profile

Tables 5 and 6 present the parametric test results on the extent to which instructors utilize ICT tools for improved instruction delivery when grouped by sex, highest educational attainment, program affiliation, and specialization, tested at a 95% confidence level, two-tailed test.

Table 5. Independent samples t-test results comparing male and female instructors' extent of technology utilization to improve learning

Gender	N	Mean	SD	t	Sig.	Decision
Male	9	3.83	.686	1.437^{ns}	.162	Failed to reject Ho
Female	21	3.50	.532			

Legend: ns – not significant at .05 level
SD = standard deviation
Degrees of freedom = 28
N = 30

The independent samples t-test results reported in Table 5 do not provide any statistically significant (Sig. = 0.162, $p > 0.05$) difference in the level of technology use to enhance learning by male and female instructors. The investigative article, Failed to reject Ho, which means that any current difference in the application of technology between the sexes should not be caused by any flawless method but more likely to be accidental. Whereas male instructors demonstrated a higher mean

utilization (Mean=3.83, SD= 0.686) than the female instructors (Mean=3.50, SD= 0.532), their difference is statistically insignificant.

This conclusion indicates that gender is not a major factor that influences the tendency of the instructor to integrate technology. It is in line with the research that found other elements to have a stronger influence on the adoption of technologies and their use among teachers (Feng et al., 2025; Granic, 2022). Such critical factors as the digital competence of instructors (Guillen-Gamez et al., 2021; Sanchez-Prieto et al., 2021; Chama and Subaveerapandiyan, 2023), years of experience, and the presence of professional development opportunities in proposals towards technology integration (Napitupulu et al., 2024) are crucial elements. The proactive attitude of the instructors to break the identified barriers, irrespective of the gender (as it can be observed in Table 4), once again indicates that common motivation, positive environments, personal competencies, and training have a more significant impact. The attempts to increase integration of technology must consequently be strategically focused on such aspects that are universal to create a great and effective use of technology.

Table 6. Analysis of variance results comparing instructors' extent of technology utilization to improve learning when grouped by highest educational attainment, program affiliation, and specialization

Parameter	Sources of Variation	Sum of Squares	df	Mean Square	F	Sig.	Decision
Highest Educational Attainment	Bet. Groups	.731	2	.365	1.049^{ns}	.364	Failed to reject Ho
	W/ in Groups	9.398	27	.348			
	Total	10.129	29				
Program Affiliation	Bet. Groups	.439	2	.219	$.611^{ns}$	.550	Failed to reject Ho
	W/ in Groups	9.690	27	.359			
	Total	10.129	29				
Subjects Taught	Bet. Groups	1.362	2	.681	2.097^{ns}	.142	Failed to reject Ho
	W/ in Groups	8.767	27	.325			
	Total	10.129	29				

Legend: ns – not significant at .05 level
N = 30

According to the results of ANOVA being conducted in Table 6, there is no significant difference in the technology use by the instructors towards enhancing learning depending on their highest level of education (Sig. = 0.364), program affinity (Sig. = 0.550), or subject taught (Sig. = 0.142). The complete acceptance of the following parameters led to the fact that there were no statistically significant differences observed.

This implies that the academic level, course, or handout taught by an instructor does not hold any significance as far as the use of technology is concerned. This is unlike the assumption that some areas could result in a more significant technological

involvement. Rather, it concurs with the above-made deliberations in which universal aspects such as good infrastructure and good professional development are strong determinants of technology adoption (Feng et al., 2025; Granic, 2022; Mdhlalose & Mlambo, 2023).

The fact that no significant differences were observed between these groups is a hint that people should employ less demographic stratification to design the improvements in technology integration and employ more effective interventions, including inappropriate internet access and technical assistance (as reported in Table 3). Moreover, the results support the significance of promoting digital competence and offering continuous professional learning opportunities regardless of the disciplines or particular demographic attributes (Napitupulu et al., 2024; Sanchez-Prieto et al., 2021; Guillen-Gamez et al., 2021), instead of positing based on the differences in the needs. Personal preparedness, self-efficacy, and institutional support seem to have a stronger input.

Differences in the Extent of Barriers Encountered in Utilizing Technology for Improved Learning

Tables 7 and 8 present the parametric test results on the extent to which instructors encountered barriers in utilizing ICT tools for improved instruction delivery when grouped by sex, highest educational attainment, program affiliation, and specialization, tested at a 95% confidence level, two-tailed test.

Table 7. Independent samples t-test results comparing male and female instructors' extent of encountered barriers in technology utilization to improve learning

Gender	N	Mean	SD	t	Sig.	Decision
Male	9	2.95	.768	.677^{ns}	.504	Failed to reject Ho
Female	21	3.14	.642			

Legend: ns – not significant at .05 level
SD = standard deviation
Degrees of freedom = 28
N = 30

The independent samples t-test in Table 7 shows that there was no statistically significant difference between the perceptions of barriers to the methods of technology usage among male and female instructors. The null hypothesis (Failed to reject Ho) cannot be rejected because this value of 0.504 equals or exceeds 0.05 ($p > 0.05$). This implies that any perceived small difference in the perception of barriers is likely to happen due to chance, although the mean (Mean=3.14), however, according to the female instructor,s is slightly higher than in males (Mean=2.95).

This result is essential because it indicates that gender is not a key factor that might explain the experience of an instructor in overcoming technology integration challenges (Awang et al., 2022). Such obstacles as poor internet connection, high prices of ICT tools, or a lack of technical support are often cited as the ineffective use of technology (Stumbriene et al., 2023; Akram et al., 2022; Pedida and Diaz, 2023). The absence of the sex difference implies that these challenges are more systemic or more infrastructural and target all the educators, raising the need to ensure a comprehensive model of support (Taroreh et al., 2023; Peled and Perzon, 2021).

Therefore, viable techniques to overcome the obstacles would work on universal enhancers. The most important is better digital infrastructure, effective technical assistance, and professional

development prospects to achieve fairness in the technological adoption and increase the power of instruction (Napitupulu et al., 2024; Eden et al., 2024; Siyam et al., 2025). Perspectives on such slightly diverse contextual and institutional circumstances that affect every educator will have a more effective impact on the use of technologies than the gendered interventions (Aljemely, 2024; Cabasan, 2024).

Table 8. Analysis of variance results comparing instructors' extent of encountered barriers in technology utilization to improve learning when grouped by highest educational attainment, program affiliation, and specialization

Parameter	Sources of Variation	Sum of Squares	df	Mean Square	F	Sig.	Decision
Highest Educational Attainment	Bet. Groups	1.766	2	.883	2.088^{ns}	.144	Failed to reject Ho
	W/ in Groups	11.418	27	.423			
	Total	13.184	29				
Program Affiliation	Bet. Groups	.479	2	.240	.509^{ns}	.607	Failed to reject Ho
	W/ in Groups	12.705	27	.471			
	Total	13.184	29				
Subjects Taught	Bet. Groups	.788	2	.394	.858^{ns}	.435	Failed to reject Ho
	W/ in Groups	12.396	27	.459			
	Total	13.184	29				

Legend: ns – not significant at .05 level
N = 30

The Analysis of Variance (Table 8) depicts that instructors do not have statistically significant differences in perception of technology barriers used when grouped based on highest educational attainment (Sig. = 0.144), program affiliation (Sig. = 0.607), and subjects taught (Sig. = 0.435). The verdict of all parameters was "Mainstreamed Ho," i.e, recorded changes are not found to be statistically significant in the population at large. This is a highly indicative implication of the fact that the level or type of technological barrier is not necessarily determined by scholarly credentials, program membership, or specialization in teaching.

The inference of such a finding is that the obstructions to effective integration of technology are probably systematic and cross-cutting across team members, regardless of demographic characteristics. It can be associated with the same research pointing to institutional support, strong infrastructure, and resources in an important role in shaping challenges (Feng et al., 2025; Granic, 2022; Mdhlalose and Mlambo, 2023). Clarifications made

regularly highlight the effects that the contextual factors observed have on teaching and learning (Pedida and Diaz, 2023).

As a result, profound, institution-wide strategies must come first in the assessment of effective approaches instead of those interventions that relate to a specific group of people with certain social demographic specificities. The all-important in the case of every instructor is robust teacher professional development programs that increase digital competence and combinations of technology training with pedagogy (Napitupulu et al., 2024; Sanchez-Prieto et al., 2021; Guillen-Gamez et al., 2021). Such programs must strive to have equal access to training and technical support so that all educators will be able to overcome typical technological challenges. Resolution of these underlying problems provides an enabling atmosphere of effective technology implementation to enhance exquisite learning execution (Eden et al., 2024).

Differences in the Extent of Overcoming Barriers Encountered in Utilizing Technology for Improved Learning

Tables 9 and 10 present the parametric test results on the extent to which instructors attempted to overcome barriers in utilizing ICT tools for improved instruction delivery when grouped by sex, highest educational attainment, program affiliation, and specialization, tested at a 95% confidence level, two-tailed test.

Table 9. Independent samples t-test results comparing male and female instructors' extent of overcoming barriers encountered in technology utilization to improve learning

Gender	N	Mean	SD	t	Sig.	Decision
Male	9	3.43	.920	1.215^{ns}	.235	Failed to reject Ho
Female	21	3.89	.960			

Legend: ns – not significant at .05 level
SD = standard deviation
Degrees of freedom = 28
N = 30

The independent samples t-test presented in Table 9 indicates that there is no statistically significant difference in efforts made by male and female instructors who are trying to conquer the barriers of technology-related utilization. The study had a significance value of 0.235 ($p > 0.05$), thus failing to reject the Ho meaning the observed variations may have been a result of random chance. The mean of female instructors (Mean=3.89) was slightly higher than that of males (Mean=3.43), although the difference was no longer significant.

This result supports the conclusion of Table 7 that there is no significant gender variance in earnings on perceived barriers. Combined with the other outcomes obtained, this is evidence that both the problems encountered and the remedial efforts used are in concert exactly gender neutral in this group of instructors. This is in accordance with the research stating that a successful implementation of technology requires more factors, such as the availability of resources, institutional support, and professional development opportunities,s and not the gender of an instructor (Feng et al., 2025; Granic, 2022). The literature of the relevant subject, regardless of sex, constantly emphasizes that teacher professional development and online competence add significant value (Napitupulu et al., 2024; Sanchez-Prieto et al., 2021; Guillen-Gamez et al., 2021).

Thus, the strategy should not focus on gender-specific responses but emphasize universal ones to muster the power of instructors to circumvent barriers on technology and adopt strategies like easy access to training, supportive technical assistance, and supportive infrastructure. Paying attention to these systematic and contextual scenarios, institutions will be better placed to empower all the instructors to incorporate technology in the learning delivery (Mdhlalose & Mlambo, 2023; Eden et al., 2024).

Table 10. Analysis of variance results comparing instructors' extent of overcoming barriers encountered in technology utilization to improve learning when grouped by highest educational attainment, program affiliation, and specialization

Parameter	Sources of Variation	Sum of Squares	df	Mean Square	F	Sig.	Decision
Highest Educational Attainment	Bet. Groups	1.541	2	.770	.832^{ns}	.446	Failed to reject Ho
	W/ in Groups	25.004	27	.926			
	Total	26.544	29				
Program Affiliation	Bet. Groups	.764	2	.382	.400^{ns}	.674	Failed to reject Ho
	W/ in Groups	25.780	27	.955			
	Total	26.544	29				
Subjects Taught	Bet. Groups	1.230	2	.615	.656^{ns}	.527	Failed to reject Ho
	W/ in Groups	25.314	27	.938			
	Total	26.544	29				

Legend: ns – not significant at .05 level
N = 30

The Analysis of Variance in Table 10 demonstrates that it does not have any statistically significant differences in the percentage that instructors claimed to have conquered barriers to using technology when grouped by the highest education level of instructors (Sig. = 0.446), program affiliation (Sig. = 0.674), or subject taught (Sig. = 0.527). In each of the parameters, it was decided to fail to reject Ho, which implies that all numeric differences observed might be the result of a coincidental factor and cannot represent real structural differences in the general population.

The results have supported earlier ones done in this analysis as Tables 6 and 8 also have reported similar results that the differences are not significant based on these demographic factors to technology usage and perceived barrier, respectively. A cumulative number of these non-significant conclusions strongly hides that the academic degree, or program, or individual subjects taught by an instructor, is not the main factor concerning the views of either perceived challenges by technology or anticipatory approaches to the perceived challenges.

Rather, these findings support the idea that attitude to technology integration barriers revolves more around systemic and contextual characteristics than personal demographic characteristics (Feng et

al., 2025), (Granic, 2022). Supporting anxiety through institutional means, such as the attitude of the management and organizational support, is essential in the effective use of the technology application. It has been substantially reported that effective professional development and intensive training programs could contribute to bettering digital competence and resilience (Guillen-Gamez et al., 2021; Napitupulu et al., 2024; Pedida and Diaz, 2023; Sanchez-Prieto et al., 2021). These organized educational initiatives are critical to close divides existing between technology use or access, and its effective use in the pedagogue (Aljemely, 2024; Siyam et al., 2025).

This means that in order to successfully promote high usage of technology and create the power drive for the teachers, the institutions ought to be preoccupied with making broad-based measures. These are the intensive institutional reinforcement, investment in the effective technical infrastructure, and availability of strong professional development opportunities to every teacher, irrespective of his/her particular academic profile (Eden et al., 2024; Stumbriene et al., 2023). This is a holistic solution that will provide equal support and create a robust learning environment that will see every teacher willing to use technology to enhance the delivery of learning (Cabasan, 2024).

The survey of 30 QSU Maddela faculty reveals a diverse demographic and professional profile, with most respondents being female, holding master's degrees, and affiliated with the Bachelor of Technology and Livelihood Education (BTLED) Department, primarily teaching major courses. Instructors frequently integrate ICT tools in their teaching, though there is potential to adopt more advanced and interactive technologies to enhance engagement. Challenges to technology use are generally limited to infrastructure, funding, and training, and these obstacles are experienced similarly across faculty regardless of sex, educational attainment, program affiliation, or specialization. Despite these limitations, faculty exhibit strong motivation to learn and adapt, demonstrating commitment to effective technology-enhanced and online teaching.

Administrators are advised to improve internet infrastructure, increase investment in educational technologies, provide targeted ICT training, and create collaborative and practical learning spaces. Redistribution of tasks and supportive policies can further facilitate technology integration. Faculty members are encouraged to explore advanced ICT tools and foster collaboration in their use. Future research should focus on the impact of ICT on student performance, the reasons behind the underutilization of certain tools, institutional support effectiveness, and strategies to diversify and optimize ICT use in teaching and learning.

REFERENCES

Akintayo, O. T., Eden, C. A., Ayeni, O. O., et al. (2024). Evaluating the impact of educational technology on learning outcomes in the higher education sector: a systematic review.

Alshammary, F. M., & Alhalafawy, W. S. (2023). Digital platforms and the improvement of learning outcomes: Evidence extracted from meta-analysis.

Bhat, R. A. (2023). The impact of technology integration on student learning outcomes: A comparative study.

Chukwudum, C. P., Ekwealor, O. U., Ikenna, U. C., et al. (2024). Technology's role in the classroom and its implication on students' learning.

Criollo-C, S., Moscoso-Zea, O., Guerrero-Arias, A., et al. (2021). Mobile learning as the key to higher education innovation: A systematic mapping.

Daniela, L. (2021). Smart pedagogy as a driving wheel for technology-enhanced learning.

Donham, C., Pohan, C. A., Menke, E., et al. (2022). Increasing student engagement through course attributes, community, and classroom technology: Lessons from the pandemic.

Eden, C. A., Chisom, O. N., & Adeniyi, I. S. (2024). Harnessing technology integration in

education: Strategies for enhancing learning outcomes and equity.

Fahrni, D. D., Iten, G., Prasse, D., et al. (2025). Teachers' practices in the use of digital technology to promote students' self-regulated learning and metacognition: A systematic review.

Feng, J., Yu, B., Tan, W. H., et al. (2025). Key factors influencing educational technology adoption in higher education: A systematic review.

Fleur, J. L., & Dlamini, R. (2022). Towards learner-centric pedagogies: Technology-enhanced teaching and learning in the 21st century classroom.

Godsk, M., & Møller, K. L. (2024). Engaging students in higher education with educational technology.

Granić, A. (2022). Educational technology adoption: A systematic review.

Guillén-Gámez, F. D., Cabero Almenara, J., Llorente Cejudo, M. C., et al. (2021). Differential analysis of the years of experience of higher education teachers, their digital competence and use of digital resources: Comparative research methods.

Heilporn, G., Lakhal, S., & Bélisle, M. (2021). An examination of teachers' strategies to foster student engagement in blended learning in higher education.

Hennessey, S., D'Angelo, S., McIntyre, N., et al. (2021). Technology, teacher professional development and low- and middle-income countries: Technical report on systematic mapping review.

Kalyani, L. K. (2024). The role of technology in education: Enhancing learning outcomes and 21st century skills.

Kaya, M. H., & Adıgüzel, T. (2021). Technology integration through evidence-based multimodal reflective professional training.

Kusumo, B., Sutrisman, H., Simanjuntak, R., et al. (2024). The impact of technology-based learning on student engagement and achievement in the digital era.

Lázaro, G. R., & Duart, J. M. (2023). You can handle, you can teach it: Systematic review on the use of extended reality and artificial intelligence technologies for online higher education.

Liang, Y., Chen, S., Abeysekera, R., et al. (2024). Examining the adoption of Technology-Enhanced learning in universities and its effects on student performance, satisfaction, and motivation.

Mdhlalose, D., & Mlambo, G. (2023). Integration of technology in education and its impact on learning and teaching.

Napitupulu, M. H., Muddin, A., Bagiya, B., et al. (2024). Teacher professional development in the digital age: Strategies for integrating technology and pedagogy.

Nkomo, L. M., Daniel, B. K., & Butson, R. (2021). Synthesis of student engagement with digital technologies: a systematic review of the literature.

Panakaje, N., Rahiman, H. U., Parvin, S. M. R., et al. (2024). Revolutionizing pedagogy: navigating the integration of technology in higher education for teacher learning and performance enhancement.

Pozo, J. I., Cabellos, B., & Pérez Echeverría, M. d. P. (2024). Has the educational use of digital technologies changed after the pandemic? A longitudinal study.

Sánchez-Prieto, J., Trujillo Torres, J. M., Gómez García, M., et al. (2021). Incident factors in the sustainable development of digital teaching competence in dual vocational education and training teachers.

Sharma, R., & Sharma, D. (2021). Digital learning for enhancing learning experience.

Stefanovic, S., & Klochkova, E. (2021). Digitalisation of teaching and learning as a tool for increasing students' satisfaction and educational efficiency: Using smart platforms in EFL.

Wang, L. (2023). Adoption of the PICRAT model to guide the integration of innovative technologies in the teaching of a linguistics course.

Wang, X., Niu, J., Fang, B., et al. (2025). Empowering teachers' professional development with LLMs: An empirical study of developing teachers' competency for instructional design in blended learning.