AN ASSESSMENT OF STRATEGIES USED IN TEACHING WITH THE INTEGRATION OF KNOWLEDGE AND SKILLS USING TECHNOLOGY

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Abstract

Achieving a harmonious alignment between pedagogy and content is imperative for the meaningful integration of technology within an educational context. The present study conducted at Quezon City University during the Academic Year 2020-2021 that aims to assess the level and effectiveness of technological content knowledge among faculty members and its impact on various learning methods in the new normal. It employs the descriptive research design. A total of one hundred twelve (112) teachers, two hundred fifty-four (254) students, and nine (9) academic heads participated in this study. Data shows that the overall perceived level of teachers' technological content knowledge is somewhat confident, with a mean value of 3.32. Friedman test results indicate that there is no significant difference in the perceived levels of teachers' technological content knowledge among academic heads, teachers, and students. When it comes to the effectiveness of teachers' technological content knowledge, the overall perception is that it is effective (mean value of 3.29). Similar to the perceived levels, the Friedman test results indicate that there is no significant difference in the assessment of the effectiveness of teachers' technological content knowledge among academic heads, teachers, and students. The study shows that teachers' technological content knowledge positively influences both modular distance learning and online distance learning modalities. The study proposes collaboration tools to enhance teaching with technology integration. The study suggests that there is room for improvement in teachers' technological content knowledge, particularly in areas like technology integration, strategies and techniques, classroom management, and assessment skills.

Keywords: *Teaching Strategies, Technology Integration, TPACK, Educational Technology, Online Learning, Modular Distance Learning*

Introduction

In the modern era, technology has entrenched itself as an integral part of students' lives beyond the confines of the classroom. Its potential, both to elucidate intricate concepts and foster collaborative learning experiences among peers, is undeniable. Consequently, contemporary educational practice urges teachers to seamlessly integrate technology into their teaching methodologies (West, Swanson, & Lipscomb, 2017). However, for many educators, this remains a formidable challenge. Obstacles such as cost constraints, limited access to resources, and time constraints often hinder the adoption of technology in classrooms (Bulman & Fairlie, 2016). Another significant impediment is the dearth of knowledge regarding the most effective ways to leverage technology across diverse subject areas (Crisolo, 2018).

In addressing these challenges, Punya Mishra and Matthew J. Koehler's TPACK framework, conceived in 2006, emerges as a valuable guide (Valtonen et al. 2020). This framework centers on the triad of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). It offers a structured approach to the multifaceted issues teachers encounter when incorporating educational technology (EdTech) into their instructional practices (Kasim & Singh, 2017). The TPACK framework underscores the essential synergy between content (the subject matter being taught) and pedagogy (the manner in which instructors convey that subject matter) as the cornerstone of effective EdTech integration (Santos & Castro, 2021). This synergy is pivotal because the adopted technology must effectively convey the material while complementing the pedagogical approach to enhance students' learning experiences (Voogt & McKenney, 2016).

Within the TPACK framework, the strategic utilization of specific technological tools, including hardware, software, applications, and information literacy practices, is paramount to facilitate students' comprehensive understanding of the subject matter (Crisolo, 2018; Kurt, 2018; Ghora & Bhatti, 2016).

Achieving a harmonious alignment between pedagogy and content is imperative for the meaningful integration of technology within an educational context (Ruggiero & Mong, 2015). To realize optimal results, educators must be proficient in all three knowledge domains: technological, pedagogical, and content. Hence, conducting a comprehensive assessment of teachers' Technological Content Knowledge, especially in the context of the ongoing pandemic-induced shift from traditional teaching to technology-driven and distance-based instruction, becomes imperative (Mulyanti, Purnama, & Pawinanto, 2020). Such an evaluation will serve as a barometer to gauge teachers' readiness to adapt to the "new normal" of teaching about (Haapaniemi, Venäläinen, Malin & Palojoki, 2021). This insight is invaluable for educational leaders and policymakers, as it can inform the development of tailored programs and training initiatives aimed at enhancing teaching skills.

On the other hand, the COVID-19 pandemic has brought about profound changes in our way of life, and one of the sectors most significantly impacted is education. As countries worldwide implemented preventive measures to curb the transmission of the virus, leaders made the difficult decision to impose various forms of lockdowns. Citizens were advised to stay at home and maintain physical distance from one another. These measures had far-reaching effects on various aspects of society.

Quezon City, with its COVID-19 cases surging to 9,540 as of August 21, found itself among the hardest-hit areas in Metro Manila, as reported by Chavez (2020). Among the hardest-hit were the schools. During the community quarantine, schools were forced to close their doors, leaving students with no option but to stay home and adapt to various forms of flexible learning modalities.

The intermittent closure of classrooms and campuses due to the virus has thrust education into the spotlight over the past year. Despite the disruptions, the widespread adoption of online learning has provided both students and educators with a glimpse into the future of education while also reinforcing the key elements of effective teaching and learning (Hodges, et al. 2020).

The rapid transition to online education was the pandemic's most immediate and visible short-term impact. Achieving this transition swiftly presented a formidable challenge for many educational institutions and teachers. Throughout the epidemic, two critical factors have undergone transformation (Crawford, et al. 2020; Golden, 2020). First and foremost, pedagogical adjustments have proven to be essential, as traditional in-person teaching methods often do not translate effectively to a remote learning environment prospect (Basilaia & Kvavadze, 2020; Golden, 2020; Mulyanti, Purnama, &

Pawinanto, 2020). Second, the pandemic has reshaped how instructors allocate their time, striking a new balance between teaching, student interaction, and administrative duties (Cantiga, 2020; Golden, 2020; Zayapragassarazan, 2020).

In response to the pandemic, countries have combined high-tech and low-tech solutions to help teachers enhance student learning more effectively. As outlined in the World Bank's Platform for Successful Teachers, technology interventions should enhance teacher engagement with students by improving access to content, data, and networks, thereby enabling teachers to better support student learning.

Countries like the Philippines must incorporate the effective teaching methods developed during the remote learning phase into their regular education systems to build stronger educational systems. To fully harness the potential of remote and blended learning, it is crucial to empower educators by investing in their skill development and capacity building (Haapaniemi, Venäläinen, Malin & Palojoki, 2021). Furthermore, relieving teachers of administrative burdens, allowing them to focus on pedagogically beneficial activities, and providing them with socio-emotional support are all of paramount importance (Hodges, et al. 2020).

A dedicated study focusing on the technological content knowledge of teachers and its implications for the evolving learning modalities in the new educational landscape, is therefore a necessity (Hodges, et al. 2020). Such research can guide school administrators in crafting programs that effectively address the needs of teachers, empowering them to bolster their technological competencies and elevate the quality of education in the present context (West, Swanson, & Lipscomb, 2017).

Thus, the present study conducted at Quezon City University during the Academic Year 2020-2021 aims to assess the level and effectiveness of technological content knowledge among faculty members and its impact on various learning methods in the new normal. The research intends to serve as a foundation for the development of teaching tools that integrate technology-related knowledge.

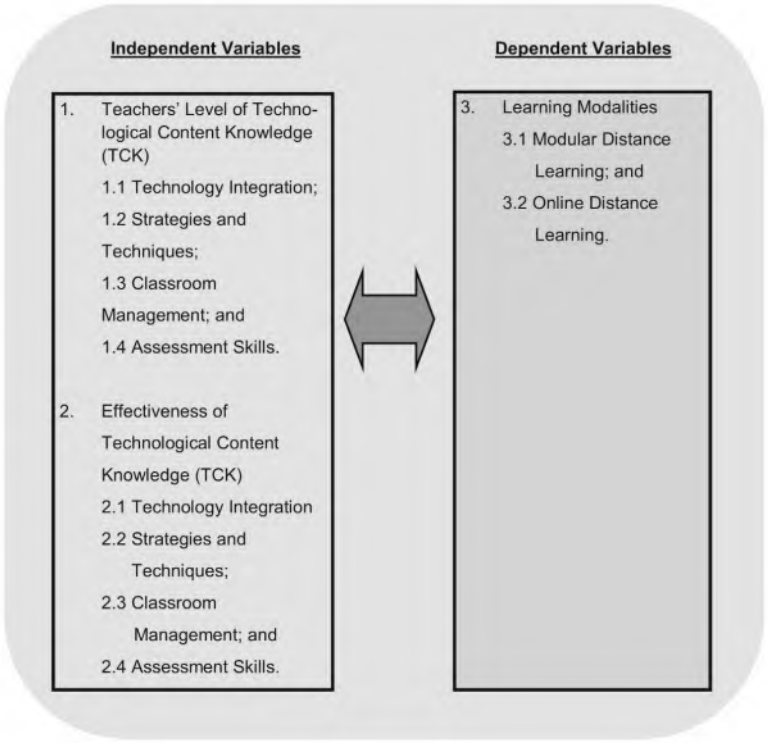
Specifically, the study has several objectives. First, it seeks to determine the perceived level of technological content knowledge among teachers in the university, focusing on areas such as technology integration, strategies and techniques, classroom management, and assessment skills. It also aims to investigate whether differences exist in the perceived levels of technological content knowledge among teachers, academic heads, and students, considering various factors. Furthermore, the research aims to understand how respondents assess the effectiveness of teachers' technological content knowledge, particularly in terms of technology integration, strategies and techniques, classroom management, and assessment skills. It also explores any variations in these assessments based on the perspective of the respondents. In addition, the study delves into the description of the learning modalities employed at Quezon City University, specifically modular distance learning and online distance learning. It seeks to understand how teachers' technological content knowledge influences these learning modalities. Finally, based on the findings of the research, the study proposes the development of teaching tools that incorporate technology-related knowledge, thus providing valuable insights for enhancing teaching practices in the context of modern education.

Research Paradigm

Mishra and Koehler of Michigan State University created the Technological Pedagogical Content Knowledge (TPACK) framework in the absence of an alternative suitable theory to describe or guide efficient Edtech integration. Since its inception in 2006, TPACK has been one of the most important concepts in Edtech and Edtech integration; both research and professional development activities heavily rely on it.

The variables addressed in the reviewed literature and experiments, on the other hand, allow for a variety of different educational situations, which is why TPACK has remained such a powerful concept for nearly a decade. Any effective use of technology in the classroom requires an awareness of the dynamic, transactional relationship that occurs between content, pedagogy, and the incoming technology - all within the contexts of various schools, classrooms, and cultures. Each case will demand a slightly different Edtech integration plan due to aspects such as the particular educator, grade level, class demographics, and more. Every context will not require a one-size-fits-all combination of material, pedagogy, and Edtech, and TPACK allows academics and practitioners to adapt its framework to different circumstances.

Figure 1
The Independent-Dependent Variable Paradigm of the Study



The Independent-Dependent Variable paradigm served as the conceptual framework of this study. As shown in Figure 1, for the researcher to come-up with the proposed collaboration tools in teaching for teachers, the Independent Variables of this study includes the level of technological content knowledge of teachers (TCK) as perceived by academic heads, teachers, and students of Quezon City University in terms of technology integration, strategies and techniques, classroom management, and assessment skills, as well as the perception of the respondents towards the effectiveness of technological content knowledge in terms of pedagogy, technology integration, strategies and techniques, classroom management, and assessment skills.

On the other hand, Dependent Variables includes the perception of the respondents towards the different learning modalities used by the university during the pandemic in terms of modular distance learning and online distance learning.

In the light of the problem of this research, the study hypothesized there is no significant difference in the perceived level of teacher's technological content knowledge based on the response made by teachers, heads, and students in terms of pedagogy, technology integration, strategies and techniques, classroom management, and assessment skills; There is no significant difference in the assessment made by the respondents towards the effectiveness of teacher's technological content knowledge in terms of pedagogy, technology integration, strategies and techniques, classroom management, and assessment skills; And there is no significant relationship between the level of teachers' technological content knowledge and its effectiveness and the different learning modalities used by Quezon City University during the pandemic.

Methodology

Research Design

The study employed the descriptive research design. The researcher used this kind of research to obtain first hand data from the respondents so as to formulate rational and sound conclusions and recommendations of the study.

Population and Sampling

The general population of this study refers to all academic heads, faculty members, and students of Quezon City University during the Academic Year 2020-2021. To determine the sample size for the teacher and student respondents, the researcher adopted the formula for sample size used by Calmorin and Calmorin in 2012. There are one hundred twenty-seven (127) faculty members who are connected in QCU during the Academic Year 2020-2021, and from this population, a total of one hundred twelve (112) teacher respondents will only be selected to participate in the survey. For student respondents, there are a total of nine thousand seven hundred twenty-seven students who are officially enrolled during the A.Y 2020-2021. Using the same formula to get the sample size (Calmorin & Calmorin, 2012), a total of two hundred fifty-four (254) students were selected to participate in the survey. For the academic heads, a total of nine (9) respondents will be included in the study since they are the only academic heads who are currently assigned in the university. To obtain the number of teacher and student respondents, this study employed a convenience non-random sampling technique. This technique was adopted due to the fact that there is an existing restriction posted by the Inter-Agency Task Force for Covid19 Pandemic (IATF) in Metro Manila. The sample refers to the students and teachers who are conveniently available during the survey, considering data privacy concerns and internet connectivity. On the other hand, purposive sampling technique was employed in selecting the academic heads due to the fact that they are the only available respondents for this study. The given sampling techniques were far more appropriate to be used in this study due to the nature of the study and present situation caused by the pandemic.

Instrument

In this study a researcher-made survey questionnaire was used. The questionnaire was developed by the research with the help of existing literature (Santos & Castro, 2021) and validated by experts in the field of education to satisfy the particular research questions presented in this study. The survey questionnaire was divided into three parts, namely: Level of Teacher's Technological Content Knowledge; Effectiveness of the Technological Content Knowledge of Teachers; and Learning Modalities. The questionnaire was made use of structured statements in a Likert format. It includes five choices for every statement, and the choices are represented with the degree of agreement, where each respondent had on the given question. Each variable consists of five (5) statements that describes technological content knowledge and learning modalities.

Validation of the Instrument

To ensure the validity of the questionnaire, the researcher asked the help of experts in the field of education to evaluate the content of the questionnaire in terms of format, language used, and whether the questions measured the desired objectives or not. Suggestions and comments of the experts were properly documented and reflected on the second version of the survey questionnaire. And in terms of reliability, a total of ten (15) respondents, who are not part of this study were asked to answer the second version of the survey questionnaire. And with the use of SPSS version 22, the Cronbach's alpha test for reliability was computed. The over-all reliability of the questionnaire was 0.902, which denotes that the questionnaire was good and therefore

reliable.

Data Gathering Procedure

To obtain necessary data and information the researcher secured a letter of approval from the Administration of Quezon City University to conduct the survey. After the approval, a week before the actual survey, the researcher sent an informed consent form to the respondents via electronic mail. And then, the survey was conducted after the respondent sent his or her conformation response or reply to the email. The link to the Survey Questionnaire (via Google Forms) was sent to the respondents and gave them enough time to answer the survey questionnaire.

Statistical Treatment of Data

After the conduct of the survey, the collected data were treated using a statistical software known as IBM SPSS Statistics Version 22 and interpreted by the researcher. Descriptive statistics such as frequency, percentage, ranking, and mean were used to describe the common response made by the respondents. To determine the significant difference between the response of the three groups on the teachers' level of technological content knowledge and on the effectiveness of teachers' technological content knowledge the researcher employed the Friedman's Two-way Analysis of Variance by Ranks (ANOVA). Lastly, to determine the influence of teacher's technological content knowledge and its effectiveness to learning modalities, the researcher used the Multiple Regression Analysis. The variables that were tested includes the teachers' level of technological content knowledge and effectiveness of teachers' technological content knowledge, and how these variables influenced the learning modalities used by the university such as modular distance learning and online distance learning.

Results

Perceived level of Technological Content Knowledge of Teachers in Quezon City University

Technology Integration

Table 1 shows the assessment of the three groups of respondents towards the perceived level of technological content knowledge of teachers in Quezon City University in terms of technology integration. Data revealed that the over-all level of teachers' technological content knowledge as perceived by the three groups is somewhat confident with computed over-all mean value of 3.32 with standard deviation of .92. Despite the over-all perception of the respondents, teachers believed that the level of their technological content knowledge in terms of technology integration is fairly confident with computed over-all mean value of 4.02 and a standard deviation of .80. However, academic heads and students said that the level of technological content knowledge of the teachers in terms of technology integration is somewhat confident with computed mean value of 3.38 and 3.01 respectively.

Table 1

Perceived level of Technological Content Knowledge of Teachers in Quezon City University in terms of Technology Integration

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	The teacher knows how maximize technology-based teaching and learning tools and facilities to fill the gap and aid the weakness of traditional teaching methods.	3.56	.53	FC	4.01	.83	FC	3.03	.82	SC	**3.34**	**.93**	SC	3
2	The teacher knows how to provide an easy access to information.	3.44	.53	FC	3.93	.78	FC	2.99	.78	SC	**3.28**	**.89**	SC	4
3	The teacher knows how to utilize available technology to store and retain information.	3.33	.50	SC	4.07	.79	FC	2.90	.81	SC	**3.26**	**.96**	SC	5
4	The teacher knows how to present information better with the use of available technology.	3.33	.50	SC	4.07	.84	FC	3.04	.84	SC	**3.35**	**.95**	SC	2
5	The teacher knows how to develop an interactive and interesting teaching and learning environment with technology integration.	3.22	.44	SC	4.02	.78	FC	3.10	.80	SC	**3.38**	**.89**	SC	1
Over-all		**3.38**	**.49**	**SC**	**4.02**	**.80**	**FC**	**3.01**	**.81**	**SC**	**3.32**	**.92**	**SC**	

Legend:

Scale	Verbal Interpretation	Abbreviation
5	Completely Confident	CC
4	Fairly Confident	FC
3	Somewhat Confident	SC
2	Slightly Confident	SIC
1	Not Confident at all	NC

Furthermore, as we glean from Table 1, respondents agreed that when it comes to the idea that the teacher knows how to develop an interactive and interesting teaching and learning environment with technology integration, the level of technological content knowledge of the teachers is somewhat confident with computed over-all mean value of 3.38 and a standard deviation of .89. However, data shows that teacher respondents believed that the level of their technological content knowledge if fairly confident with computed over-all mean value of 4.02 with standard deviation of .78. Table 1 also shows that respondents agreed that teachers are somewhat confident when it comes to the idea that they know how to present information better with the

use of available technology with computed over-all mean value of 3.35 and standard deviation of .95. Also, respondents agreed that teachers are somewhat confident when it comes to maximizing technology-based teaching and learning tools and facilities to fill the gap and aid the weakness of traditional teaching methods (X=3.34, SD=.93), providing an easy access to information (X= 3.28, SD=.89), and utilizing available technology to store and retain information (X=3.26, SD=.96).

Strategies and Techniques

Table 2 shows the assessment of the three groups of respondents towards the perceived level of technological content knowledge of teachers in Quezon City University in terms of strategies and techniques. Data revealed that the over-all level of teachers' technological content knowledge as perceived by the three groups is somewhat confident with computed over-all mean value of 3.29 with standard deviation of .93. Despite the over-all perception of the respondents, academic heads and teachers believed that the level of technological content knowledge of teachers in terms of strategies and techniques is fairly confident with computed over-all mean value of 3.49 (SD=.51) and 4.00 (SD=.83) respectively. However, students said that the level of technological content knowledge of the teachers in terms of strategies and techniques is somewhat confident with computed mean value of 2.98 with standard deviation of .81.

Table 2

Perceived level of Technological Content Knowledge of Teachers in Quezon City University in terms of Strategies and Techniques

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	The teacher knows how to increase learners' engagement.	3.78	.44	FC	3.96	.84	FC	3.04	.82	SC	3.33	.92	**SC**	1.5
2	The teacher knows how to personalize teaching and learning and able to focus on individual learners.	3.44	.53	FC	3.96	.85	FC	2.87	.78	SC	3.21	.94	**SC**	5
3	The teacher knows how to reduce repetitive tasks.	3.44	.53	FC	3.96	.81	FC	3.02	.84	SC	3.31	.93	**SC**	3
4	The teacher knows how to calibrate the course or topics for learners' specific needs.	3.44	.53	FC	4.08	.85	FC	2.94	.78	SC	3.29	.95	**SC**	4
5	The teacher knows how to reach out among learners.	3.33	.50	SC	4.04	.80	FC	3.01	.82	SC	3.33	.93	**SC**	1.5
Over-all		**3.49**	**.51**	**FC**	**4.00**	**.83**	**FC**	**2.98**	**.81**	**SC**	**3.29**	**.93**	**SC**	

Furthermore, as we glean from Table 2, respondents agreed that when it comes to the idea that the teacher knows how to increase learners' engagement and reach out among learners, the level of technological content knowledge of the teachers is

somewhat confident with computed over-all mean value of 3.33. Table 2 also shows that respondents agreed that teachers are somewhat confident when it comes to the idea that they know how to reduce repetitive tasks with computed over-all mean value of 3.31 and standard deviation of .93. Also, respondents agreed that teachers are somewhat confident when it comes to calibrating the course or topics for learners' specific needs (X=3.29, SD=.95), and personalizing the teaching and learning and able to focus on individual learners (X= 3.21, SD=.94).

Classroom Management

Table 3 shows the assessment of the three groups of respondents towards the perceived level of technological content knowledge of teachers in Quezon City University in terms of classroom management. Data revealed that the over-all level of teachers' technological content knowledge as perceived by the three groups is somewhat confident with computed over-all mean value of 3.31 with standard deviation of .91. Despite the over-all perception of the respondents, academic heads and teachers believed that the level of technological content knowledge of teachers in terms of classroom management is fairly confident with computed over-all mean value of 3.49 (SD=.51) and 3.95 (SD=.81) respectively. However, students said that the level of technological content knowledge of the teachers in terms of classroom management is somewhat confident with computed mean value of 3.02 with standard deviation of .81.

Table 3

Perceived level of Technological Content Knowledge of Teachers in Quezon City University in terms of Classroom Management

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	The teacher knows how to gamifies static lessons.	3.56	.53	FC	3.84	.80	FC	2.96	.80	SC	**3.24**	**.89**	**SC**	5
2	The teacher knows how to support self-directed learning.	3.67	.50	FC	3.88	.78	FC	3.11	.80	SC	**3.35**	**.86**	**SC**	1.5
3	The teacher knows how to promote and encourage collaboration.	3.33	.50	SC	4.03	.82	FC	3.05	.83	SC	**3.35**	**.93**	**SC**	1.5
4	The teacher knows how to use differentiated instruction.	3.44	.53	FC	3.90	.79	FC	3.01	.80	SC	**3.29**	**.89**	**SC**	4
5	The teacher knows how to track, monitor, and engage students in their learning effortlessly.	3.44	.53	FC	4.09	.84	FC	2.99	.82	SC	**3.33**	**.96**	**SC**	3
Over-all		**3.49**	**.51**	**FC**	**3.95**	**.81**	**FC**	**3.02**	**.81**	**SC**	**3.31**	**.91**	**SC**	

Furthermore, as we glean from Table 3, respondents agreed that when it comes to the idea that the teacher knows how to support self-directed learning and promote and encourage collaboration, the level of technological content knowledge of the teachers is somewhat confident with computed over-all mean value of 3.35. Table 5 also shows

that respondents agreed that teachers are somewhat confident when it comes to the idea that they know how to track, monitor, and engage students in their learning effortlessly with computed over-all mean value of 3.33 and standard deviation of .96. Also, respondents agreed that teachers are somewhat confident when it comes to using differentiated instruction (X=3.29, SD=.89), and gamifying static lessons (X= 3.24, SD=.89).

Assessment Skills

Table 4 shows the assessment of the three groups of respondents towards the perceived level of technological content knowledge of teachers in Quezon City University in terms of assessment skills. Data revealed that the over-all level of teachers' technological content knowledge as perceived by the three groups is somewhat confident with computed over-all mean value of 3.34 with standard deviation of .91. Despite the over-all perception of the respondents, academic heads and teachers believed that the level of technological content knowledge of teachers in terms of assessment skills is fairly confident with computed over-all mean value of 3.51 (SD=.51) and 3.99 (SD=.81) respectively. However, students said that the level of technological content knowledge of the teachers in terms of classroom management is somewhat confident with computed mean value of 3.34 with standard deviation of .91.

Table 4

Perceived level of Technological Content Knowledge of Teachers in Quezon City University in terms of Assessment Skills

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	The teacher knows how to track and assess the students, as well as their own performance in the classroom.	3.44	.53	FC	3.97	.78	FC	3.09	.82	SC	3.36	.89	SC	2
2	The teacher able to facilitate communication.	3.44	.53	FC	3.93	.80	FC	2.99	.82	SC	3.28	.91	SC	5
3	The teacher knows how to support learning across content areas.	4.00	.00	FC	4.05	.85	FC	3.11	.82	SC	3.41	.93	FC	1
4	The teacher knows how to reduce the time, resources, and disruption to learning required for the administration of paper assessments.	3.56	.53	FC	3.99	.81	FC	2.99	.82	SC	3.30	.94	SC	4
5	The teacher knows how to identify a completer and more nuanced picture of student needs.	3.11	.33	SC	4.01	.82	FC	3.06	.83	SC	3.34	.90	SC	3
Over-all		**3.51**	**.51**	**FC**	**3.99**	**.81**	**FC**	**3.05**	**.79**		**3.34**	**.91**	**SC**	

Furthermore, as we glean from Table 4, respondents agreed that when it comes to the idea that the teacher knows how to support learning across content areas, the level of technological content knowledge of the teachers is fairly confident with computed over-all mean value of 3.41. Table 4 also shows that respondents agreed that teachers are somewhat confident when it comes to the idea that they know how to track and assess the students, as well as their own performance in the classroom with computed over-all mean value of 3.36 and standard deviation of .89. Also, respondents agreed that teachers are somewhat confident when it comes to identifying a completer and more nuanced picture of student needs (X=3.34, SD=.90), reducing the time, resources, and disruption to learning required for the administration of paper assessments (X= 3.30, SD=.94), and facilitating communication (X= 3.28, SD=.91).

Table 5

Summary of the Perceived level of Technological Content Knowledge of Teachers in Quezon City University

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	Technology Integration	3.38	.49	SC	4.02	.80	FC	3.01	.81	SC	**3.32**	**.92**	**SC**	4
2	Strategies and Techniques	3.49	.51	FC	4.00	.83	FC	2.98	.81	SC	**3.29**	**.93**	**SC**	2.5
3	Classroom Management	3.49	.51	FC	3.95	.81	FC	3.02	.81	SC	**3.31**	**.91**	**SC**	1
4	Assessment Skills	3.51	.51	FC	3.99	.81	FC	3.05	.82	SC	**3.34**	**.91**	**SC**	2.5
Over-all		**3.47**	**.50**	**FC**	**3.99**	**.81**	**FC**	**3.01**	**.81**	**SC**	**3.32**	**.92**	**SC**	

Table 5 shows that summary of the perceived level of technological content knowledge of teachers in Quezon City University in terms of technology integration, strategies and techniques, classroom management, and assessment skills. It can be gleaned from the table, respondents agreed that the level of technological content knowledge of the teachers is somewhat confident with computed over-all mean value of 3.32. Particularly, the level of technological content knowledge of the teachers is somewhat confident in terms of technology integration (X=3.32, SD=.92), strategies and techniques (X=3.29, SD=.93), classroom management (X=3.31, SD=.91), and assessment skills (X=3.32, SD=.92).

Difference in the Perceived Level of Teacher's Technological Content Knowledge

One of the objectives of this study is to determine the difference in the perceived level of technological content knowledge of teachers in Quezon City University during the Academic Year 2020-2021 among the three groups of respondents. Table 6 below shows the Friedman's two-way Analysis of Variance (ANOVA) results on the perceived level of teacher's technological content knowledge of the three different groups of respondents.

Table 6

Friedman's Two-Way Analysis of Variance (ANOVA) Results on the Perceived Level of Teacher's Technological Content Knowledge of Three Different Groups of Respondents

N	df	F-test	p-value	Interpretation	Decision
3	3	1.759	0.624	Not Significant	Accept H_0

Level of significance = 0.05

The computed Friedman test value obtained is 1.759 which is insignificant at 5 percent level of confidence because this computed value is lesser than the tabular value of 7.82 with degrees of freedom of 3. This means that the teacher's technological content knowledge in Quezon City University as perceived by the academic heads, teachers, and students is almost the same. Hence the null hypothesis is accepted.

Effectiveness of Teacher's Technological Content Knowledge

Technology Integration

Table 7 shows the assessment of the three groups of respondents towards the effectiveness of technological content knowledge of teachers in Quezon City University in terms of technology integration. Data revealed that the over-all effectiveness of teachers' technological content knowledge as perceived by the three groups is effective with computed over-all mean value of 3.29 with standard deviation of .93. Despite the over-all perception of the respondents, teachers believed that the effectiveness of technological content knowledge in terms of technology integration is moderately effective with computed over-all mean value of 3.96 and a standard deviation of .81. However, academic heads and students said that the effectiveness of technological content knowledge of the teachers in terms of technology integration is only effective with computed mean value of 3.36 and 3.00 respectively.

Table 7

Effectiveness of Teacher's Technological Content Knowledge in terms of Technology Integration

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	The technological content knowledge of teachers with the use of technology-based teaching and learning tools and facilities helps and assists them to fill in the gap and aid the weakness of traditional teaching methods.	3.33	.50	E	3.49	.80	ME	3.04	.82	E	**3.31**	**.91**	**E**	2

2	The technological content knowledge of teachers allows them and their students have an easy access to information.	3.22	.44	E	3.89	.80	ME	3.02	.80	E	**3.28**	**.89**	**E**	3
3	The technological content knowledge of teachers allows better retention and storage of information.	3.22	.44	E	3.98	.76	ME	2.96	.85	E	**3.27**	**.94**	**E**	4
4	The technological content knowledge of teachers enables to develop and present information better.	3.44	.53	ME	3.99	.86	ME	2.90	.82	E	**3.24**	**.97**	**E**	5
5	The technological content knowledge of teachers with the integration of technology allows the development of an interactive and interesting teaching and learning environment.	3.56	.53	ME	4.02	.83	ME	3.07	.82	E	**3.37**	**.92**	**E**	1
Over-all		**3.36**	**.48**	**E**	**3.96**	**.81**	**ME**	**3.00**	**.83**	**E**	**3.29**	**.93**	**E**	

Legend:

Scale	Verbal Interpretation	Abbreviation
5	Highly Effective	HE
4	Moderately Effective	ME
3	Effective	E
2	Somewhat Effective	SE
1	Not Effective	NE

Furthermore, as we glean from Table 7, respondents agreed that when it comes to the idea that the technological content knowledge of teachers with the integration of technology allows the development of an interactive and interesting teaching and learning environment is effective with computed over-all mean value of 3.37. Table 7 also shows that respondents agreed that technological content knowledge of teachers is effective when it comes to the use of technology-based teaching and learning tools and facilities helps and assists the teachers to fill in the gap and aid the weakness of traditional teaching methods with computed over-all mean value of 3.31 and standard deviation of .91. Also, respondents agreed that when it comes to the effectiveness of teachers' technological content knowledge on having an easy access to information (X=3.28, SD=.89), allowing better retention and storage of information (SD=3.27, SD=.94), and developing and presenting information better (X=3.24, SD=.97) is effective.

Strategies and Techniques

Table 8 shows the assessment of the three groups of respondents towards the effectiveness of technological content knowledge of teachers in Quezon City University in terms of strategies and techniques. Data revealed that the over-all effectiveness of teachers' technological content knowledge as perceived by the three groups is effective with computed over-all mean value of 3.31 with standard deviation of .91. Despite the over-all perception of the respondents, academic heads and teachers believed that the effectiveness of technological content knowledge in terms of strategies and techniques is moderately effective with computed over-all mean values of 3.49 and 3.97 respectively. However, students said that the effectiveness of technological content knowledge of the teachers in terms of strategies and techniques is only effective with computed mean value of 3.01.

Table 8

Effectiveness of Teacher's Technological Content Knowledge in terms of Strategies and Techniques

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	The technological content knowledge of teachers increases student engagement.	3.44	.53	ME	4.03	.85	ME	3.08	.79	E	**3.37**	**.93**	**E**	1
2	The technological content knowledge of teachers personalizes teaching and learning, and develop focus on individual students.	3.67	.50	ME	3.96	.83	ME	2.95	.82	E	**3.27**	**.91**	**E**	4
3	The technological content knowledge of teachers reduces repetitive tasks.	3.56	.53	ME	3.87	.83	ME	2.97	.82	E	**3.25**	**.94**	**E**	5
4	The technological content knowledge of teachers results measuring and course correction.	3.33	.50	E	4.04	.80	ME	3.01	.83	E	**3.33**	**.91**	**E**	2.5
5	The technological content knowledge of teachers allows the teacher to increase their reach among learners.	3.44	.53	ME	3.96	.85	ME	3.05	.81	E	**3.33**	**.94**	**E**	2.5
Over-all		**3.49**	**.51**	**ME**	**3.97**	**.83**	**ME**	**3.01**	**.81**	**E**	**3.31**	**.91**	**E**	

Furthermore, as we glean from Table 8, respondents agreed that when it comes to the idea that the technological content knowledge of teachers increases student engagement, technological content knowledge of teachers is effective with computed over-all mean value of 3.37 and a standard deviation of .93.

Also, Table 8 shows that respondents agreed that technological content knowledge of teachers is effective when it comes to allowing the teacher to increase their reach among learners and measuring and course correction with computed over-all mean value of 3.33. Also, respondents agreed that when it comes to the effectiveness of teachers' technological content knowledge on personalizing teaching and learning, and developing focus on individual students (X=3.27, SD=.91) and reducing repetitive tasks (X=3.25, SD=.94) is effective.

Classroom Management

Table 9 shows the assessment of the three groups of respondents towards the effectiveness of technological content knowledge of teachers in Quezon City University in terms of classroom management. Data revealed that the over-all effectiveness of teachers' technological content knowledge as perceived by the three groups is effective with computed over-all mean value of 3.32 with standard deviation of .94. Despite the over-all perception of the respondents, academic heads and teachers believed that the effectiveness of technological content knowledge in terms of classroom management is moderately effective with computed over-all mean values of 3.51 and 4.02 respectively. However, students said that the effectiveness of technological content knowledge of the teachers in terms of classroom management is only effective with computed mean value of 3.00.

Table 9

Effectiveness of Teacher's Technological Content Knowledge in terms of Classroom Management

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	The technological content knowledge of teachers gamifies static lessons.	3.44	.53	ME	4.09	.82	ME	3.04	.81	E	**3.37**	**.93**	**E**	1
2	The technological content knowledge of teachers supports self-directed learning.	3.78	.44	ME	4.06	.80	ME	2.99	.83	E	**3.33**	**.95**	**E**	2
3	The technological content knowledge of teachers encourages collaboration.	3.22	.44	E	3.94	.79	ME	3.02	.86	E	**3.30**	**.93**	**E**	4
4	The technological content knowledge of teachers enables differentiated instruction.	3.78	.44	ME	3.96	.79	ME	3.02	.84	E	**3.32**	**.93**	**E**	3

5	The technological content knowledge of teachers provides opportunity to track, monitor, and engage students in their learning effortlessly.	3.33	.50	E	4.03	.84	ME	2.94	.82	E	**3.27**	**.96**	**E**	5
Over-all		**3.51**	**.51**	**ME**	**4.02**	**.81**	**ME**	**3.00**	**.83**	**E**	**3.32**	**.94**	**E**	

Furthermore, as we glean from Table 9, respondents agreed that when it comes to the idea that the technological content knowledge of teachers gamifies static lessons is effective with computed over-all mean value of 3.37 and a standard deviation of .93. Also, Table 9 shows that respondents agreed that technological content knowledge of teachers is effective when it comes to supporting self-directed learning with computed over-all mean value of 3.33 with standard deviation of .95. Also, respondents agreed that when it comes to the effectiveness of teachers' technological content knowledge on enabling differentiated instruction (X=3.32, SD=.93), encouraging collaboration (X=3.30, SD=.93), and providing opportunity to track, monitor, and engage students in their learning effortlessly. (X=3.27, SD=.96) is effective.

Assessment Skills

Table 10 shows the assessment of the three groups of respondents towards the effectiveness of technological content knowledge of teachers in Quezon City University in terms of assessment skills. Data revealed that the over-all effectiveness of teachers' technological content knowledge as perceived by the three groups is effective with computed over-all mean value of 3.31 with standard deviation of .90. Despite the over-all perception of the respondents, academic heads and teachers believed that the effectiveness of technological content knowledge in terms of assessment skills is moderately effective with computed over-all mean values of 3.47 and 3.94 respectively. However, students said that the effectiveness of technological content knowledge of the teachers in terms of assessment skills is only effective with computed mean value of 3.03.

Table 10

Effectiveness of Teacher's Technological Content Knowledge in terms of Assessment Skills

	Areas of Concern	**Heads**			**Teachers**			**Students**			**X**	**SD**	**VI**	**Rank**
		X	**SD**	**VI**	**X**	**SD**	**VI**	**X**	**SD**	**VI**				
1	The technological content knowledge of teachers tracks and assess students and teachers' performance in the classroom.	3.44	.53	ME	3.92	.75	ME	3.09	.82	E	**3.34**	**.88**	**E**	2
2	The technological content knowledge of teachers facilitate communication.	3.44	.53	ME	3.97	.85	ME	2.91	.79	E	**3.24**	**.94**	**E**	5

3	The technological content knowledge of teachers supports learning across content areas.	3.33	.50	E	3.87	.83	ME	3.06	.78	E	**3.30**	**.87**	**E**	3
4	The technological content knowledge of teachers reduces the time, resources, and disruption to learning required for the administration of paper assessments.	3.56	.53	ME	4.04	.78	ME	3.09	.79	E	**3.39**	**.89**	**E**	1
5	The technological content knowledge of teachers aids the teacher identify a completer and more nuanced picture of student needs.	3.56	.53	ME	3.90	.83	ME	3.00	.83	E	**3.28**	**.92**	**E**	4
Over-all		**3.47**	**.50**	**ME**	**3.94**	**.81**	**ME**	**3.03**	**.80**	**E**	**3.31**	**.90**	**E**	

Furthermore, as we glean from Table 10, respondents agreed that when it comes to the idea that the technological content knowledge of teachers reduces the time, resources, and disruption to learning required for the administration of paper assessments is effective with computed over-all mean value of 3.39 and a standard deviation of .89. Also, Table 10 shows that respondents agreed that technological content knowledge of teachers is effective when it comes to tracking and assessing students and teachers' performance in the classroom with computed over-all mean value of 3.34 with standard deviation of .88. Also, respondents agreed that when it comes to the effectiveness of teachers' technological content knowledge on supporting learning across content areas (X=3.30, SD=.87), identifying a completer and more nuanced picture of student needs (X=3.28, SD=.92), and facilitating communication (X=3.24, SD=.94) is effective.

Table 11

Summary of the Effectiveness of Teacher's Technological Content Knowledge

	Areas of Concern	**Heads**			**Teachers**			**Students**			**X**	**SD**	**VI**	**Rank**
		X	**SD**	**VI**	**X**	**SD**	**VI**	**X**	**SD**	**VI**				
1	Technology Integration	3.36	.48	E	3.96	.81	ME	3.00	.83	E	**3.29**	**.93**	**E**	4
2	Strategies and Techniques	3.49	.51	ME	3.97	.83	ME	3.01	.81	E	**3.31**	**.92**	**E**	2.5
3	Classroom Management	3.51	.51	ME	4.02	.81	ME	3.00	.83	E	**3.32**	**.94**	**E**	1
4	Assessment Skills	3.47	.50	ME	3.94	.81	ME	3.03	.80	E	**3.31**	**.90**	**E**	2.5
Over-all		**3.34**	**.93**	**E**	**3.65**	**.93**	**ME**	**3.01**	**.82**	**E**	**3.21**	**.90**	**E**	

Table 11 shows that summary of the perceived effectiveness of teachers' technological content knowledge in terms of technology integration, strategies and techniques, classroom management, and assessment skills. As we glean from the table, respondents agreed that the effectiveness of technological content knowledge of the teachers is effective with computed over-all mean value of 3.21. Particularly, the effectiveness of technological content knowledge of the teachers is effective in terms of technology integration (X=3.29, SD=.93), strategies and techniques (X=3.31, SD=.92), classroom management (SD=3.32, SD=.94), and assessment skills (X=3.31, SD=.90).

Difference in the Assessment of the Effectiveness of Teacher's Technological Content Knowledge

Table 12 below shows the Friedman's two-way Analysis of Variance (ANOVA) results on the effectiveness of teacher's technological content knowledge of the three different groups of respondents.

Table 12

Friedman's Two-Way Analysis of Variance (ANOVA) Results on the Effectiveness of Teacher's Technological Content Knowledge of Three Different Groups of Respondents

N	df	F-test	p-value	Interpretation	Decision
3	3	3.207	0.361	Not Significant	Accept H_0

Level of significance = 0.05

The computed Friedman test value obtained is 3.207 which is insignificant at 5 percent level of confidence because this computed value is lesser than the tabular value of 7.82 with degrees of freedom of 3. This means that the effectiveness of teacher's technological content knowledge in Quezon City University as perceived by the academic heads, teachers, and students is almost the same. Hence the null hypothesis is accepted.

Learning Modalities Used in Quezon City University as Described by the Respondents

Modular Distance Learning

Table 13 shows the views of the three groups of respondents towards the modular distance learning used by Quezon City University during the Academic Year 2020-2021. Data revealed that the over-all response of the three groups of respondents is neutral, with computed over- all mean value of 3.33 and a standard deviation of .93.

Table 13

Learning Modalities Used in Quezon City University as Described by the Respondents in terms of Modular Distance Learning

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	Modular distance learning allows the learning continues depending on the student's willingness to accept challenge.	3.56	.53	A	4.06	.84	A	3.03	.82	N	3.35	.94	N	3
2	Modular distance learning helps to make parents realize their role in educational process.	3.44	.53	A	3.93	.80	A	2.99	.78	N	3.28	.89	N	4
3	Modular distance learning allows students to learn how to value their time.	3.33	.50	N	3.98	.81	A	2.90	.81	N	3.23	.94	N	5
4	Modular distance learning teaches the students values, not specific lessons which is repetitive.	3.33	.50	N	4.21	.80	A	3.04	.84	N	3.39	.97	N	1.5
5	In modular distance learning, teachers amidst their busy schedule still find their way to challenge their selves.	3.22	.44	N	4.07	.77	A	3.10	.80	N	3.39	.90	N	1.5
Over-all		**3.38**	**.49**	**N**	**4.05**	**.81**	**A**	**3.01**	**.81**	**N**	**3.33**	**.93**	**N**	

Scale	Verbal Interpretation	Abbreviation
5	Strongly Agree	SA
4	Agree	A
3	Neutral	N
2	Disagree	D
1	Strongly Disagree	SD

As we glean from the table, respondents agreed that modular distance learning teaches the students values, not specific lessons which is repetitive, and it allows the learning continues depending on the student's willingness to accept challenge with computed over-all mean value of 3.39 and interpreted as neutral. Furthermore, Table 13 shows that modular distance learning allows the learning continues depending on the student's willingness to accept challenge (X=3.35, SD=.94), helps to make parents realize their role in educational process (X=3.28, SD=.89), and allow students to learn how to value their time (X=3.23, SD=.94).

Online Distance Learning

Table 14 shows the views of the three groups of respondents towards the online distance learning used by Quezon City University during the Academic Year 2020-2021. Data revealed that the over-all response of the three groups of respondents is neutral, with computed over- all mean value of 3.29 and a standard deviation og .93.

Table 14

Learning Modalities Used in Quezon City University as Described by the Respondents in terms of Online Distance Learning

	Areas of Concern	Heads			Teachers			Students			X	SD	VI	Rank
		X	SD	VI	X	SD	VI	X	SD	VI				
1	Online distance learning offers teachers an efficient way to deliver lessons to students.	3.78	.44	A	3.96	.84	A	3.04	.82	N	3.33	.92	N	1.5
2	Online distance learning allows students to attend classes from any location of their choice. It also allows schools to reach out to a more extensive network of students, instead of being restricted by geographical boundaries.	3.44	.53	A	3.96	.85	A	2.87	.78	N	3.21	.94	N	3.5
3	Online distance learning reduced financial costs. Online education is far more affordable as compared to physical learning.	3.44	.53	A	3.96	.81	A	3.02	.84	N	3.31	.93	N	3.5
4	With online learning, there is a greater chance for students to be easily distracted by social media or other sites.	3.44	.53	A	4.08	.85	A	2.94	.78	N	3.29	.95	N	5
5	Without a consistent internet connection for students or teachers, there can be a lack of continuity in learning for the child. This is detrimental to the education process.	3.33	.50	N	4.04	.80	A	3.01	.82	N	3.33	.93	N	1.5
Over-all		**3.49**	**.51**	**A**	**4.00**	**.83**	**A**	**2.98**	**.81**	**N**	**3.29**	**.93**	**N**	

As we glean from the table, respondents agreed that online distance learning offers teachers an efficient way to deliver lessons to students, and without a consistent internet connection for students or teachers, there can be a lack of continuity in learning for the student, it is detrimental to the education process with computed over-all mean value of 3.32 and interpreted as neutral. Furthermore, Table 14 shows that online distance learning allows students to attend classes from any location of their choice, allows schools to reach out to a more extensive network of students, instead of being restricted by geographical boundaries, and reduced financial costs, thus it is far more

affordable as compared to physical learning (X=3.21, SD=.94), helps to make parents realize their role in educational process (X=3.28, SD=.89), and with online learning, there is a greater chance for students to be easily distracted by social media or other sites (X=3.29, SD=.95).

Influence of Teacher's Technological Content Knowledge in Learning Modalities

A multiple linear regression analysis was performed to determine how the teachers' technological content knowledge influences modular distance learning modality used in Quezon City University during the pandemic. Result show that the model is significant, R^2 =.690, Adjusted R^2 =.719, F $(_{2,372})$ = 413.123, p<.05 as shown in Table 15.

Table 15

Influence of Teacher's Technological Content Knowledge in Modular Distance Learning

Predictors	B	Std. Error	t	p	Interpre-tation	Decision
Constant	-.103	.125	-.824	.410	Significant	Reject H_0
Level of Teachers' Techno-logical Content Knowledge	.975	.070	13.890	.000		
Effectiveness of Teachers' Technological Content Knowledge	.060	.072	.843	.400		

R^2 =.690, Adjusted R^2 = .688, F $_{(2,372)}$ = 413.123, p<.05
Level of significance = 0.05

Specifically, Table 15 revealed that the level of teachers' technological content knowledge β= .975, Std. error = .070, t = 13.890, p<.05 and the effectiveness of the teachers' technological content knowledge β= .060, Std. error = .072, t = .843, p<.05 are positive predictors of learning modalities used by the Quezon City University during the time of pandemic and directly influence modular distance learning modality.

Furthermore, a multiple linear regression analysis was also performed to determine how the teachers' technological content knowledge influences online distance learning modality used in Quezon City University during the pandemic. Result show that the model is significant, R^2 =.719, Adjusted R^2 =.717, F $(_{2,372})$ = 475.869, p<.05 as shown in Table 16.

Table 16

Influence of Teacher's Technological Content Knowledge in Online Distance Learning

Predictors	B	Std. Error	t	p	Interpre-tation	Decision
Constant	-.219	.119	-1.839	.067	Significant	Reject H_0
Level of Teachers' Techno-logical Content Knowledge	.976	.067	14.624	.000		
Effectiveness of Teachers' Technological Content Knowledge	.083	.068	1.227	.221		

R^2 =.719, Adjusted R^2 = .717, F $_{(2,372)}$ = 475.869, p<.05
Level of significance = 0.05

Specifically, Table 16 revealed that the level of teachers' technological content knowledge β= .976, Std. error = .067, t = 14.624, p<.05 and the effectiveness of the teachers' technological content knowledge β= .083, Std. error = .068, t = 1.227, p<.05 are positive predictors of learning modalities used by the Quezon City University during the time of pandemic and directly influence online distance learning modality.

The data above support the assertion that providing ongoing technology integration education for teachers is a vital component of ensuring that technology has a positive impact on our students' education (Crisolo, 2018).

On the Tools in Teaching with the Integration of Knowledge in the Use of Technology

Based from the results, a Collaboration Tools in teaching with integration of knowledge in the use of technology was proposed. Collaboration tools are a broad term that refers to anything that two or more people use to work together. These tools come in a variety of shapes and sizes, but they all have the same purpose: to encourage people to interact with one another. Collaboration tools that may be used to improve both modular and online distance learning includes chat app that lets multiple people brainstorm ideas, project management app that defines tasks across a group, video conferencing tool that lets people talk face-to-face, and a file sharing program that gives many people access to collateral

Discussion

Data shows that the overall perceived level of teachers' technological content knowledge is somewhat confident, with a mean value of 3.32. However, when looking at specific aspects, there are variations in perception. In terms of technology integration, teachers believe they have fairly confident knowledge in technology integration (mean value of 4.02), while academic heads and students perceive it as somewhat confident (mean values of 3.38 and 3.01, respectively). The findings back with Crislo's findings from 2018, which showed that technology integration courses have a significant impact on instructors' attitudes about computers. Although it exists, teacher technology integration education has a weaker direct impact on students. In terms of strategies and techniques, academic heads and teachers view teachers' knowledge in this area as fairly confident (mean values of 3.49 and 4.00), while students perceive it as somewhat confident (mean value of 2.98). Educators who use instructional strategies help students to make meaningful connections between classroom topics and real-world situations, according to the findings (Kurt, 2018). They enable students to demonstrate their knowledge and make essential course corrections on their own. In terms of classroom management, similar to strategies and techniques, academic heads and teachers view teachers' knowledge in classroom management as fairly confident (mean values of 3.49 and 3.95), while students perceive it as somewhat confident (mean value of 3.02). According to recent studies, classroom management is crucial since it directly affects students' and teachers' ability to learn. Classroom management has an impact on a teacher's ability to be productive and enjoy their profession, according to the above findings. A well-managed classroom, above all, has a substantial impact on pupils' academic success (Ruggiero & Mong, 2015). And in terms of assessment skills, academic heads and teachers also view teachers' knowledge in assessment skills as fairly confident (mean values of 3.51 and 3.99), while students perceive it as somewhat confident (mean value of 3.34). As teachers and students work toward reaching curriculum targets, data show that assessment plays a continual role in influencing instruction, guiding students' next actions, and assessing progress and success (Valtonen et al., 2020). Data also back up prior claims that a teacher's technological content expertise is vital in establishing a sufficient level of critical thinking and problem-solving evaluation skills, which has a positive impact on the quality of learning outcomes. Assessment, according to studies, can be used to aid students in learning, report on student progress, and make teaching decisions (Voogt & McKenney, 2016).

On the difference in perceived levels, the Friedman test results indicate that there is no significant difference in the perceived levels of teachers' technological content knowledge among academic heads, teachers, and students. This suggests that all three groups have relatively similar perceptions of teachers' knowledge.

When it comes to the effectiveness of teachers' technological content knowledge, the overall perception is that it is effective (mean value of 3.29). However, there are variations in perception among the groups. In terms of Technology Integration, teachers perceive it as moderately effective (mean value of 3.96), while academic heads and students see it as effective (mean values of 3.36 and 3.00, respectively). The foregoing findings support prior research findings indicating the capacity to use a computer for personal use and with students in the classroom is commonly acknowledged in the literature as an important component of successful teacher preparation (Bulman & Fairlie, 2016; Crisolo, 2018; Garcárcel & Mena, 2016). Additionally, the findings suggested that teachers who have learned to incorporate technology into contemporary curricula may teach in a different way than those who have not. As a result of the differences in classroom approach and increased usage of technology, teachers and students' attitudes about information technology should improve (Bulman & Fairlie, 2016). In terms of Strategies and Techniques, academic heads and teachers believe it is moderately effective (mean values of 3.49 and 3.97), while students perceive it as effective (mean value of 3.01). Teaching methods, according to the above findings, are approaches for supporting students in learning needed course content and setting attainable future goals (Ghora & Bhatti, 2016). Furthermore, data suggests that teaching strategies discover several possible learning approaches in order to develop the optimal plan for dealing with the target group (Ghora & Bhatti, 2016). Furthermore, the most visible application of technology is that it no longer restricts lesson time to the four walls of the classroom, allowing for true home-schooling. Technology can be used by students to research topics, communicate ideas, and learn specialized skills (Kurt, 2018). In terms of Classroom Management: Academic heads and teachers view it as moderately effective (mean values of 3.51 and 4.02), while students see it as effective (mean value of 3.00). The findings support previous research that suggests a good classroom management system can help instructors avoid burnout by lowering the need for yelling, scolding, and other stressful discipline approaches that lead to teacher-student conflict. This type of environment encourages both intellectual and social/emotional development (Santos, 2017). Furthermore, the findings support previous research that suggests that because technology manages the learning material, the facilitator has more time to engage actively with the students and attend to their unique needs. By developing interesting and interactive lessons, facilitators strive to better engage learners (Valtonen et al., 2020). And in terms of Assessment Skills: Academic heads and teachers also consider it moderately effective (mean values of 3.47 and 3.94), while students perceive it as effective (mean value of 3.03). The findings back up Voogt and McKenney's (2016) argument that teachers who are skilled at using assessment data for formative purposes can provide students with relevant feedback on their progress and adjust their instruction to match their needs. Furthermore, statistics supported the premise that technology may be used for quick evaluation in a variety of ways, including tracking student improvement over time, according to research (Valtonen et al., 2020). Furthermore, technology can assist teachers in measuring and evaluating the performance of their students (as well as their own) in the classroom. It can also be used to improve communication between students and instructors, as well as to create digital records of student progress and development that can be easily passed down from grade to grade (Valtonen et al., 2020).

Similar to the perceived levels, the Friedman test results indicate that there is no significant difference in the assessment of the effectiveness of teachers' technological content knowledge among academic heads, teachers, and students.

The study shows that teachers' technological content knowledge positively

influences both modular distance learning and online distance learning modalities. The level and effectiveness of teachers' technological content knowledge have a significant impact on these learning modalities during the pandemic. For modular distance learning, both the level and effectiveness of teachers' technological content knowledge are positive predictors. Scholars say that modular degrees provide students with several benefits in terms of flexibility, choice, access, and mobility, which Dta backs up (Basilaia & Kvavadze, 2020; Golden, 2020; Mulyanti, Purnama, & Pawinanto, 2020). The findings further support the notion that modular frameworks may assist universities by allowing them to respond to business needs, expand student markets, provide more efficient resource utilization, and increase curricula breadth prospects (Basilaia & Kvavadze, 2020; Golden, 2020; Mulyanti, Purnama, & Pawinanto, 2020). However, it is also stated that modularization has the potential to fracture and disintegrate the educational experience, resulting in poor learning outcomes and raising epistemological, structural, and pedagogical concerns (Mulyanti, Purnama, & Pawinanto, 2020). For online distance learning, again, both the level and effectiveness of teachers' technological content knowledge are positive predictors. The assertions that online distance learning allows students to get a degree without having to live near a college campus are backed up by data. Online classes allow you to complete coursework on your own time, allowing you to prioritize your career, family, and other responsibilities (Golden, 2020). However, the findings reveal that, in addition to its advantages, online distance learning has its own set of disadvantages (Crawford, et al. 2020). Difficulties staying motivated, talking with teachers, mingling with classmates, being connected at all times, obtaining rapid feedback, and completing all courses for certification are just a few of the downsides (Crawford, et al. 2020).

The study proposes collaboration tools to enhance teaching with technology integration. These tools include chat apps for brainstorming, project management apps for task assignment, video conferencing for face-to-face interaction, and file sharing programs for easy access to educational materials. The aim is to promote interaction and collaboration among teachers and students, whether in modular or online distance learning settings.

The study suggests that there is room for improvement in teachers' technological content knowledge, particularly in areas like technology integration, strategies and techniques, classroom management, and assessment skills. However, it also highlights the effectiveness of teachers' knowledge in facilitating different learning modalities during the pandemic and proposes collaboration tools to enhance technology-integrated teaching practices. Furthermore, the study provides insights into the level and effectiveness of teachers' technological content knowledge, as well as their views on learning modalities and suggests practical tools to improve technology-integrated teaching practices. Based on the key findings and conclusion of this study, it is recommended to create an environment that encourages teachers to continuously develop their technological skills. Arrange workshops within the school conducted by colleagues or proficient students who have mastered technology. Give students the chance to showcase their technological skills by offering roles as Digital Leaders. While integrating technology, ensure that it complements pedagogy and content knowledge. Foster opportunities for staff to come together and discuss their experiences with technology. Encourage the sharing of best practices and insights. Create a set of essential applications that all faculty members can use proficiently. And implement collaboration tools in teaching that integrate technology and knowledge. Consider tools such as chat apps for brainstorming, project management apps for group tasks, video conferencing for face-to-face interaction, and file sharing programs for easy access to educational materials. These recommendations aim to foster a culture of continuous learning, empower both teachers and students, strike a balance between technology and pedagogy, and leverage collaboration tools to improve teaching practices in both modular and online distance learning settings.

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