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Information and Communication Technology (ICT) Integration in Elementary Science Teaching Performance of Teachers in the New Normal

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ABSTRACT. Technology integration in education, within the context of the new normal, assists and supports Elementary Science instructors in filling gaps and assisting weaknesses of traditional teaching methodologies with digital teaching and learning tools. As a result, this study examined how 31 private school teachers in the Bogo City Division used ICT in their primary science synchronous lessons. A mixed-method sequential explanatory (QUAN qual) design was employed in this study. Pairwise Pearson Correlation coefficient revealed a significant relationship between the teachers' performance on ICT integration and their ICT skills, but its correlation was moderate.

Keywords: ICT integration; Teaching performance; Elementary science teachers; ICT during the pandemic

I.INTRODUCTION

Due to the increase in the usage of computers in schools beginning in the early 1980s, several scholars believe that Information and Communication Technologies (ICT) will be essential in the education of the future (Ghavifekr, Kunjappan, Ramasamy, & Anthony, 2016). Information and Communication Technologies (ICT) are used to improve creativity and performance in classrooms by enabling teachers to integrate the use of technology into their lesson plans (Top, Baser, Akkus, Akayoglu, & Gurer, 2021). Teaching and learning that incorporate technology are more successful than conventional methods. This is since using ICT tools and equipment fosters a much more active learning setting that benefits both teachers and students, as pupils achieve better results when lessons are structured to be more engaging and exciting (Ghavifekr & Rosdy, 2015). In addition, it is believed that almost all the subject areas, such as mathematics, science, languages, arts, and humanities, are learned better when lessons are supplemented with technological tools and devices (Jorge et al. 2003). According to Albirni (2006), ICT integration is not only limited to enhancing and improving the quality of lesson delivery but also develops skills essential for current globalization. While using technology in school settings can improve certain aspects of instruction, it has several complications and issues. This can result in lower-than-

expected outcomes, such as teachers' attitudes and beliefs, limited time, limited access, and lack of organizational support (Top, Baser, Akkus, Akayoglu, & Gurer, 2021).

Several pieces of research identified that the successful utilization of ICT in teaching and learning is strongly interrelated to the ICT competence of the teachers (Arnseth & Hatlevik, 2012; Hue & Ab Jalil, 2013; Gayeta, 2021).

In this regard, the different institutions implement professional development programs incorporating ICT into education and learning. One of the major principles governing the development of online professional growth is communities of practice, which are critical to understanding how individuals acquire information and how technological advancement can occur online (Vrasidas & Glass, 2004; Wenger, 1999). Another example of professional progress in ICT is presented in the program Supporting Teachers with Anywhere/Anytime Resources (STAR) Online. STAR-Online is a framework for teachers' continuous professional development and education centered on the idea of communities of practice. (Dede, Whitehouse, & Brown L'Bahy, 2002). School heads from districts, teachers, and specialists from an institution collaborate on the scheme, implementation, and assessment of Teaching and Learning Online (TLO), a teacher professional development training designed to equip educators to use technology and teach online classes (Vrasidas & Chamberlain, 2005).

While some established development programs exist for teachers, educational technology issues and challenges still arise. Although ICT professional development programs emphasize training teachers to utilize tools, such skills alone may not effectively educate instructors to incorporate technology (Murthy, Iyer, & Warriem, 2015). Some skills taught and acquired in varied training remain useless when not applied in a real classroom, especially when confronted with uncontrollable circumstances (Tirol, 2022). Because of the unexpected pandemic situation that put children at risk, teachers' professional training for the effective use of ICT in instruction did not apply (Guillen-Gamez et., 2020; Hong et al., 2021). Those teachers equipped with ICT skills through professional development training are not exempted from the challenges encountered during the onset of the COVID-19 pandemic. These learning obstacles include poor inter-institutional collaboration and a lack of proficiency and investment in modern technology. (Talsma et al. 2021; Akram et al., 2021). While most teachers are computer-literate and can complete online sessions, they cannot integrate ICT efficiently into their teaching practices since their abilities and productivity are not given appropriate feedback on its adoption and use (Al-Samarraie & Saeed, 2018). As a result, several researchers and academic institutions have devised various techniques to determine the way instructors perform in class discussions using the technologies available (Becker, 1999; Moersch, 1999; Allensworth, Lauen & Gladden, 2002; Barron, Kemker, Harmes & Kalydijian 2003; Hongkong Education Bureau 2005; Lim 2007). Therefore, to solve this gap, there should be a high demand for teachers' competence in ICT integration to be evaluated, such as 'how frequently they utilize a given kind of ICT tools in classrooms or how successfully teachers use a specific type of technology to complete certain tasks. (Becker 1999; Mueller et al. 2008).

This study investigated the relationship between the possession of ICT skills by teachers teaching elementary science and their performance in the actual integration of ICT during synchronous classes in private schools in Bogo City Division. The ICT skills examined focus on word processing, spreadsheets, PowerPoint presentations, video editing, search engines, interactive educational tools, graphic designing, and communicative tools.

II.METHODOLOGY

This study employed a mixed-method sequential explanatory design characterized by collecting and analyzing quantitative data in the primary phase and then qualitative data in the subsequent stage. Creswell (2013) stated that the mixed-method design is utilized to comprehend study difficulties and concerns at a higher level. In the quantitative component, teachers' level of ICT skills, their performance on ICT integration, and ICT integration practices in science class were measured using adapted and modified questionnaires. On the other hand, the qualitative component involved the depth of the experience of the teachers made through an open-ended survey questionnaire. The study was conducted at the Division of City of Bogo, Bogo City, Cebu, from March 2022-May 2022.

The creation of the division office is a significant point in the northern part of Cebu, Philippines, whose jurisdiction covers all 23 public elementary schools, 14 public secondary schools, and five private schools. The five private schools are Cebu Roosevelt Memorial Colleges, San Roque de Cebu, Child and Development School, Araneta Learning Center for Child Development, Felipe R. Verallo Foundation, and Bogo Christian Learning and Development. However, in this study, only the first four schools mentioned above participated since only these schools employ online distance learning.The respondents of this study were the private elementary teachers of the Division of the City of Bogo for the school year 2021-2022. In selecting the respondents, all teachers in private schools handling online science classes in elementary were involved.

Table 1.
Distribution of Research Respondents (N=31)

School	No. of Teacher-Respondents
Cebu Roosevelt Memorial Colleges	14
San Roque College de Cebu	7
Araneta Learning Center and Development	7
Felipe Verallo Memorial Foundation, Inc.	3

Moreover, White (2005) indicated that purposive sampling begins "on the researcher's awareness of the group." As an outcome of this knowledge, a deliberate decision is made about selecting participants to "give the most relevant information to discuss the study's objectives. Purposive sampling entails the researcher seeking to critically assess the population's characteristics and attributes and then selecting a sample accordingly. (De Vos et al., 2009). A total of 31 respondents were employed.

The table shows the demographic details of the elementary private elementary respondents.

Data were collected using the four main tools: a survey on the perceived level of teachers' ICT skills, perceived level of performance on ICT integration, and level of ICT integration practices in science class and focus group discussion.

The researcher gathered information through the questionnaire and analyzed it using the 5-point Likert scale model. To identify the frequency and proportion of the entire population, descriptive statistics were utilized about the teachers' perceived level of ICT proficiency, performance, and ICT integration in science classes. Using Minitab, data were gathered, coded, and made ready for data analysis. Each item on the survey questionnaire received a score calculated as a mean, standard deviation, frequency, and percentage. Frequency count and percent, weighted mean, and Pairwise Pearson correlation coefficient were utilized to analyze and interpret the data. They were also used to determine the relationships among the respondents' ICT skills, performance, and ICT integration in science teaching. Table 2 shows the scale to interpret teachers' performance on ICT integration, ICT skills, and status of ICT integration in science class.

Table 2

The scale used to interpret the faculty ICT skills and level of ICT integration practices and the performance of Teachers' ICT integration.

Scale	Interpretation	Mean Range	Interpretation
5	Strongly agree	4.21-5.00	Much competent/very often/extremely
4	Agree	3.41-4.20	Very competent/often very important
3	Neutral	2.61-3.40	Competent/Sometimes/Of average importance
2	Disagree	1.81-2.60	Little competence/Rarely/Little Importance
1	Strongly disagree	1.00-1.80	Not yet competent/Never/Not important at all

On the other hand, the researcher transcribed and analyzed the qualitative data collected during the open-ended questionnaire to form themes, a process called thematic analysis (Braun & Victoria, 2006). In particular, the context for theme analysis was adopted from Saldaña (2013). Three stages of coding are defined in this framework: initial coding, axial coding, and theoretical coding. The researcher disseminated the information during the initial coding and allocated codes based on observations.

III.RESULTS AND DISCUSSIONS

Perceived Level of Elementary Teachers' Performance on ICT Integration in the New Normal

This study assessed the perceived level of elementary teachers' performance on ICT integration in terms of the following: preparation, production, instruction, development, and issues.

Preparation and development. Table 3 shows the respondents' ICT integration performance in lesson preparation and development. The first two items correspond to teachers' lesson preparation using ICT, with a total mean of 3.45 interpreted as "advanced." At the same time, the succeeding indicators pertain to ICT integration in lesson development, with an actual compromise of 3.086 interpreted as "proficient."

Table 3
Respondents' performance on ICT Integration in Terms of Preparation and development

Variable	Mean	SE Mean	StDev	Interpretation
1. Use the Internet to search for information	3.419	0.152	0.848	Advanced
2. Use a computer to create lecture notes	3.484	0.146	0.811	Advanced
3. Spend time to learn and practice ICT skills	3.097	0.169	0.944	Proficient
4. Attend a conference read journals to learn about ICT integration	3.194	0.194	1.078	Proficient
5. Use an online database for professional development	3.220	0.199	1.110	Proficient
Overall	3.232	0.172	0.958	Proficient

Of the two indicators in lesson preparation, item number 2, "use a computer to create lecture notes, incurred a larger scale (M=3.484) while the other item has a mean of 3.419, equating to advanced level. This implies that the teachers are very competent in lesson preparation using ICT.

On the other hand, Table 5 revealed the respondents' performance in ICT integration in terms of professional development and self-study with an overall mean of 3.086, which fell under the level of "proficient," indicating that teachers considered themselves to have an average level of competence in this area. As shown in the table, the indicator (M=3.194), "attend a conference or read journals to learn about ICT integration," had the highest mean value, which also signifies that the teachers have a positive attitude towards attending professional development programs and activities related to ICT integration. Meanwhile, the item with the lowest mean value is number 3 (M=2.968), "use online database for professional development." This is because most teachers who attended professional development training still depend on printed modules and learning resources (Fitri & Putro, 2020). Despite this experience, teachers in the classroom still consider ICT use when situations call for it. However, the training of teachers offers another essential factor to consider (Tirol et al., 2022). Many schools, for example, are purchasing iPads; however, the functionality of iPads in learning is not always evident. Teachers become open to development programs when any technical support addresses their needs. (Johnson et al., 2016).

Production (Material production, troubleshooting, communication, and sharing). Table 4 shows the respondents' ICT integration performance in lesson production, with an overall mean of 3.14, interpreted as "proficient."

Among all the items, the indicators found to have the highest mean are items 2 and 6 (M=3.387), which state that "use presentation software and use email or MSN to communicate with students," respectively. This implies that the teachers have average competence in production using ICT. Mizoram University is one of the institutions in India that first took the initiative to fully embrace the technology-supported system during the start of the pandemic lockdown. The school used email as the primary means of communication where students raised their concerns and clarifications about their assignments, projects, and lessons (Mishra, Gupta, & Shree, 2020).

Table 4
Respondents' performance on ICT Integration in Terms of Production

Variable	Mean	SE Mean	StDev	Interpretation
Use the computer to record or edit sound	3.032	0.176	0.983	Proficient
Use presentation software	3.387	0.165	0.919	Proficient
Solve hardware problems	2.548	0.212	1.179	Basic
Spend time selecting Media that fits the lesson goals	3.323	0.149	0.832	Proficient
Use internet communication	3.355	0.177	0.985	Proficient
Use email or MSN to communicate with the students	3.387	0.200	1.116	Proficient
Use ICT to record students 'attendance	2.903	0.182	1.012	Proficient
Overall	3.14	0.180	1.004	Proficient

Apart from the reason that sending messages through email is more convenient, it has also expedited the lesson-concerning transactions since most students in schools have their email accounts and are engaged on phones, computers, and laptops most of the time. However, in the Philippines setting, although it was released by Philippine News Agency on August 24, 2020, that as per the Department of Education, 93% of public schools have devices for online learning, most of the students and teachers are using Facebook Messenger as a medium of online instruction instead of email. They found Facebook Messenger the cheapest online learning form (Lim E. J., 2021). Meanwhile, the indicator found at the bottom showing the lowest mean is item number 3, "solve hardware problems," which gave a mean of 2.548 and can be interpreted as essential.

Consequently, it can be inferred that teachers have considered this area something that needs improvement. This result was supported by similar research by Johnson et al. (2016), which showed that most public school teachers had a unique struggle to troubleshoot when confronted with computer device issues. Common

hardware problems include keys not working on a keyboard, display screen image distortion, signs of virus infection, and a blue screen. Thus, despite the good weight of this issue, it still poses a problem because teachers who manipulate the devices lack the necessary skills to diagnose and fix the problem. A computer technician is required to incorporate ICT in science education. If such a specialist is not accessible, teachers may experience significant difficulties due to a lack of technical support (Bingimlas, 2009, Tinapay et al., 2022).

As suggested by Dupin-Bryant (2004), teachers who use computers in the classroom need adequate help from computer professionals and should get familiar with various software applications and be trained to resolve common hardware issues. Teachers who use computer technologies can be encouraged and supported through peer seminars (Tirol et al., 2022) and online message boards. Thus, school professional development programs must address teachers' technical knowledge, especially in hardware troubleshooting.

Instruction (Planning, teaching, and evaluation)

Table 5 shows the respondents' performance in ICT integration in terms of education, including planning, teaching, and assessment, with an overall mean of 2.991, which can be interpreted as "proficient."

Table 5 shows the performance of teachers' ICT integration in terms of instruction. The results show that teachers have identified themselves with the proficient level, meaning they have an average competence in lesson planning, teaching, and evaluation using ICT tools. The item with the highest mean is indicator 8, "Ensure beforehand all the students have sufficient ICT resources and skills to complete the homework" (M=3.226). Gaining the lowest mean is item number 17, "Give up ICT integrated lessons for some units because of poor learning results," with a mean of 2.355, which is equivalent to the primary level. It can be interpreted that most teachers have difficulty looking for teaching alternatives whenever ICT integration does not go successfully, affecting the student's academic performance. For instance, some teachers use Kahoot as an online assessment tool; however, if this integration results in poor learning outcomes, the teacher should abandon the practice and seek any possible substitutes.

The students' learning performance is always the teachers' top priority in the classroom (Tirol, 2021). Regardless of how teachers grow accustomed to utilizing such educational software or apps when the student's academic status is at risk, teachers should stop doing so without compromising the quality of learning. One approach of teachers in the school to make learning more engaging is through game-based instruction. This learning method involves applying particular game ideas to actual circumstances to keep learners interested. Its primary purpose is to have lively and dynamic interaction between students and the educational materials (Dinscore, 2015). Examples of game-based learning platforms usually used in virtual classrooms are EdApp, Kahoot, Gametize, Centrical, and Archy Learning. However, using game-based learning as an intervention may not be the best if a student lacks enjoyment when

playing with others or technological skills. In a study, researchers investigated the effects of game-based learning on children with dyslexia. Researchers were optimistic and accurate throughout the trial about students with dyslexia since they showed improved reading comprehension. Still, it was impossible to show that they could apply their improved reading comprehension to other academic subjects like spelling and writing (Ronimus, 2019).

Table 5
Respondents' performance on ICT Integration in Terms of Instruction

Variable	Mean	SE Mean	StDev	Interpretation
Analyze students' learning progress in group activities	3.194	0.176	0.98	Proficient
Devise proper ways to track students' progress	3.097	0.176	0.978	Proficient
Design different evaluation criteria	3.000	0.18	1.000	Proficient
Divide students into groups while teaching ICT lessons	2.645	0.22	1.226	Proficient
Arrange time in class to provide additional ICT lesson	2.839	0.197	1.098	Proficient
Design different ICT learning activities for students	2.806	0.199	1.108	Proficient
Try new strategies to increase students' level of concentration	3.161	0.18	1.003	Proficient
Ensure all the students have sufficient ICT resources	3.226	0.184	1.023	Proficient
Manage students' behavior and learning in class	2.935	0.202	1.124	Proficient
Discuss with other teachers about students' learning	3.000	0.167	0.931	Proficient
Assign students' grades by including students' IT performance	3.065	0.196	1.093	Proficient
Review my own ICT Integrated units and strategies	3.161	0.168	0.934	Proficient
Ask students to use ICT tools for collecting information	3.000	0.185	1.033	Proficient
Try to use ICT tools to teach remedial lessons	3.097	0.182	1.012	Proficient
Provide worksheets when requiring the use of web information	3.129	0.184	1.024	Proficient
Instruct students on how to search for useful resources	3.129	0.178	0.991	Proficient
Give up ICT-integrated lessons for some units because of poor learning results	2.355	0.23	1.279	Basic
Overall	2.991	0.188	1.049	Proficient

Respondents' Perceived ICT Skills

This research assessed the perceived ICT skills of the teachers in terms of the following: basic hardware operations and ICT utilization for teaching. Technological adoption in the classroom is becoming increasingly important because it assists students in developing transferable skills such as personal communication, critical thinking, self-sufficiency, personal accountability, reasoning skills, and the ability to initiate. These are all fundamental goals that students must attain in a stimulating classroom environment conducive to learning (Ghavifekr et al., 2014).

Table 6
Respondents' ICT skills in Terms of Basic Hardware Operations

Variable	Mean	SE Mean	StDev	Interpretation
I can operate spreadsheet program	3.871	0.19	1.056	Agree
I can install a new software program	3.71	0.162	0.902	Agree
I can operate a database program	3.00	0.174	0.966	Neutral
I can search the WWW to access information.	4.194	0.142	0.792	Agree
I can solve simple problems in operating computers.	3.774	0.145	0.805	Agree
I can operate the graphic program and organize them into folders.	3.71	0.168	0.938	Agree
I can remove computer viruses	2.903	0.199	1.106	Neutral
Overall	3.595	0.169	0.938	Agree

Basic hardware operations. Table 6 shows the respondents' ICT skills in basic hardware operations, with an overall mean of 3.594 interpreted as "agree." The top item rank is indicator number 4, "I can search the WWW to access Basic hardware operations. Table 9 showed the respondents' ICT skills in basic hardware operations, which obtained an overall mean of 3.594, interpreted as "agree." The top rank among the items is indicator number 4, "I can search the WWW to access information" (M= 4.194), while in the bottom rank, having a mean of 3.00 and 2.903 are items number 3 and7, respectively which states "I can operate database program" and "I can remove computer viruses." This specifies that the teachers in this study are competent enough to access varied websites to gather information for teaching but have less inclination towards solving simple technical computer issues. The data was congruent with Subaveerapandiyan & Nandhakumar's (2021) research, which surveyed the teachers' ICT skills and ICT integration in online teaching during the pandemic situation in India. Most teachers perceived database operation and resolving issues on computer viruses as skills they fully did not possess, resulting in fear of ICT integration.

In this study, some respondents highlighted difficulties after a computer virus deleted their vital records, including grade reports, school forms, and student profiles. While it might be challenging to manage virus identification and prevention in busy schools with numerous users spread out around the campus, teachers should at least be trained with minimal computer virus remediation through understanding its warning signs and ways to avoid such issues.

Respondents' level of ICT skills and their performance on ICT integration in a synchronous class

Table 7 shows respondents' ICT integration performance and ICT proficiency level. It is observed that teachers' level of ICT skills has a significant relationship with their performance on ICT integration (p=0.016).

Table 7
Relationship between respondents' level of ICT skills and their performance in ICT integration

Sample 1	Sample 2	N	Correlation	95% CI for ρ	P-Value
IS_Mean	PTI_Mean	31	0.430	(0.089, 0.0681)	0.016

As the level of teachers' ICT skills increases, their performance on ICT integration also improves. In other words, teachers with higher ICT-related skills are more likely to integrate ICT successfully in their synchronous classes.

The correlation between the teachers' ICT skills and their performance on ICT integration is found to be "medium" or "moderate" (r=0.430). This means there are still other determinants to achieving good performance on ICT integration in the class apart from possessing ICT skills. These include the type of available technological resources, attendance in professional development programs, and teachers' attitude toward ICT integration. Likewise, it suggests an essential factor to consider in producing a reliable outcome by increasing the sample size.

According to a similar study, educators' philosophies, views, and trust levels have a role in adopting new technologies in their pedagogical practices. A good attitude toward technology influences its inclination to employ such technology in the classroom. Positive attitudes play a significant role in whether or not newer technology integration is accepted (Harman et al., 2019). With that correlation, it also infers that having ICT skills impact the teachers' ICT integration practice. The study of Alazam et al. (2012) supported this result when teachers in Malaysia who had above-average actual ICT integration in their classrooms were teachers who also possessed ICT skills.

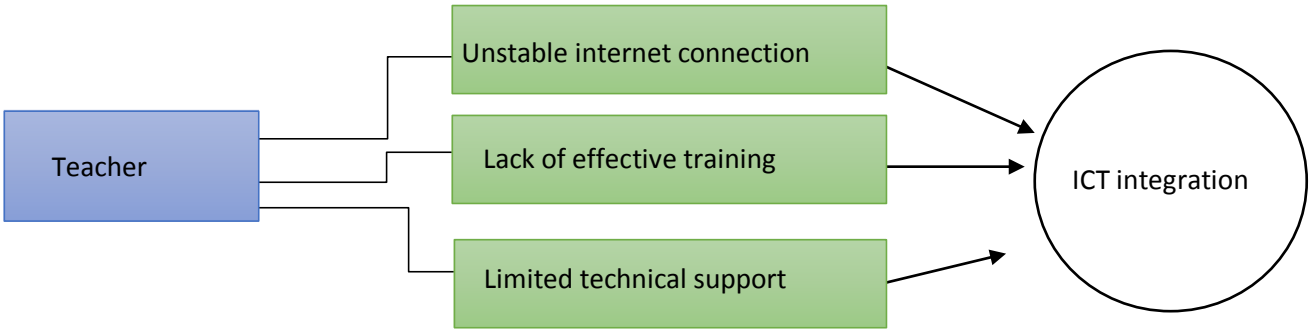
Challenges and Opportunities of teachers on ICT integration in the New Normal

Themes were drawn out from the qualitative data gathered in the open-ended survey questionnaire. Using the key questions, teacher participants described the challenges and opportunities they encountered during ICT integration into the new normal (Tinapay & Tirol, 2021). This study examined challenges and opportunities through their claims and experiences in integrating ICT into their online science classes.

Thus, one way of exploring their experiences in ICT integration is by identifying the impacts of ICT tools in their pedagogical approaches using one of the questions covered in the key questions. Teacher informants in the study regarded ICT integration as a potential approach in the process of instruction and learning. When asked to assess the beneficial effect of ICT involvement in science instruction and learning, they gave affirmative responses. The researcher axially coded the teacher responses and presented the result in a thematic network. The themes obtained through open coding identified the basic theme and classified it into an organizing and global article that came out in the analysis (Tirol, 2021).

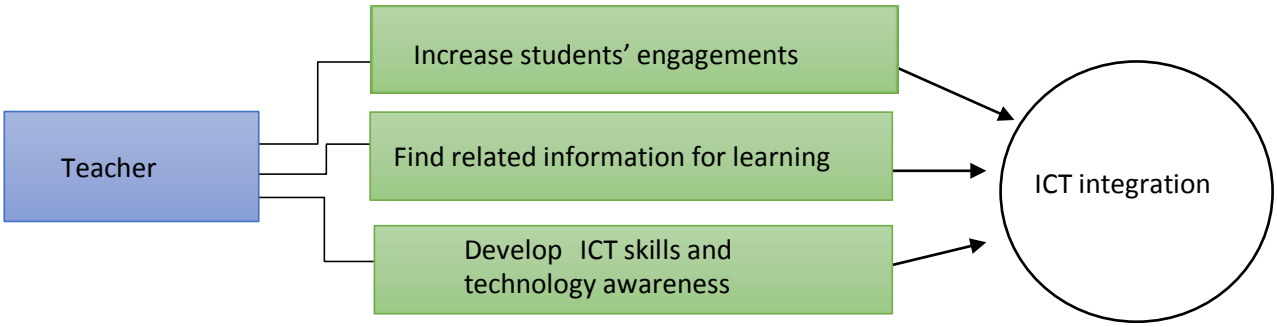
Challenges of Teachers on ICT Integration

The first global theme relates to the challenges faced by teachers in integrating technology into online science teaching. This has three organizing themes: unstable internet connection, lack of practical training, and limited technical support. Figure 2 shows the themes collected from the interview transcripts.



Thematic network for challenges of teachers on ICT integration

Opportunities for Teachers on ICT Integration. In this study, opportunities refer to the advantageous effects of ICT integration in the context of instruction and learning. The key informants responded to the two main questions about the opportunities they consider when integrating ICT. The informants drew differing views since some teachers anchored the results to the teachers while some pointed to the students. Figure 3 shows the thematic network of opportunities for teachers on ICT integration.



Thematic network of opportunities for teachers on ICT integration

IV. CONCLUSIONS

Educators enter the advancements with insufficient ICT skills and knowledge, making it challenging to execute the instructional approaches comprehensively required for employing ICT tools in the process (Somera, 2018). The results of this research study contribute to the body of knowledge about the complex issues educators face when technology is integrated into their online schools and provide new intuitions into a comprehensive method of transformation. From the study, it was evident that the teachers' level of ICT skills is directly proportional to the teachers' performance on actual ICT integration in the classroom. Still, other intervening factors may also contribute to the improved version of the teachers. The lessons learned, challenges, and best practices in the field, especially in the context of elementary science teaching in the locale of this study, inform the existing body of literature about the experiences of science teachers in actual classroom settings. This study found that ICT integration performance is linked with their skills. The findings in this study have implications for school management policy and teaching practice. Since ICT integration has the potential to transform learning in varied ways, concerned individuals and personnel must implement some existing methods that are found to be effective.

V.REFERENCES

AlAmmary, J. (2012). Educational Technology: A Way to Enhance Student Achievement at the University of Bahrain. *Procedia - Social and Behavioral Sciences, 55*.

Alazam, A.-O., Bakar, A. R., & Hamzah, R. (2013). Teachers' ICT Skills and ICT Integration in the Classroom: The Case of Vocational and Technical Teachers in Malaysia. *Creative Education, 3*(8).

Alazam, Abu-Obaidah, & R., B. A. (2012). Teachers' ICT Skills and ICT Integration in the Classroom:. *Creative Education*.

Aldoobie, N. (2015). Technology Integration and Learning Theory. *American International Journal of Contemporary Research, 5*(6).

Ali, W. (2020). *Online and Remote Learning in Higher Education Institutes: A Necessity in light of COVID-19 Pandemic* (Vol. 10). Higher Education Studies.

Amir, L. R., Tanti, I., & Maharani, D. A. (2020). Student perspective of classroom and distance learning during COVID-19 pandemic. *BMC Medical Education*.

Bingimlas, K. (2009). Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature. *Eurasia Journal of Mathematics, Science and*.

Brain, M., & Fenlon, W. (2022). *Google*. Retrieved from https://computer.howstuffworks.com.

Brown, A. (2014). Implementing Active Learning in an Online Teacher Education Course. *American Journal of Distance Education, 28*(3).

C.N, B. (2017). Attitude Towards, and Awareness of Using ICT in classrooms: A. *Journal of Education and Practice, 8*(1).

Champa, R. A., Rochsantiningsih, D., & Kristiana, D. (2019). *TEACHERS' CHALLENGES TO INTEGRATE ICT IN EFL TEACHING AND LEARNING ACTIVITIES.* English Language and Literature International Conference. .

Colleen Marzilli1, J. D. (2014). FACULTY ATTITUDES TOWARDS INTEGRATINGTECHNOLOGY AND INNOVATION. *International Journal on Integrating Technology in Education, 3*(1).

Corpuz and Salandanan, 2. (2011). *The 21st Century Skills and Job Performance of Teachers* . Journal of Education and Practice.

Dincer, Alanazy, & Alrusaiyes. (2021). Technology Integration in Higher Education During COVID-19: An Assessment of Online Teaching Competencies Through Technological Pedagogical Content Knowledge Model. *Educational Psychology*.

Dinscore, A. P. (2015). Game-Based Learning. *Association of College Research and Library*.

Dupin-Bryant, P. A. (2004). Teaching Styles of Interactive Television Instructors: A Descriptive Study. *American Journal of Distance Education, 18*(1).

E, A. U. (2021). *Integration of technology to learning-teaching processes and google workspace tools: A literature review* (Vol. 1). Sustainability (Switzerland).

Eisenberg, N., TL, S., & N, E. (n.d.). *Mental Health, Academic Self-Efficacy and Study Progress Among College Students – The SHoT Study, Norway.*

Fitri, Y. (2021). *EFL Teachers' Perception of the Effectiveness of ICT-ELT Integration During the COVID-19.* Proceedings of the International Conference on Educational Sciences and Teacher Profession (ICETeP 2020)Copyright © 2021 The Authors. Published by Atlantis Press SARL.This is an open access article distributed under the CC BY-NC 4.0 license -http://creati.

Gayeta, M. G. (n.d.). ONLINE INTERNATIONAL CONFERENCE ON MULTIDISCIPLINARY RESEARCH & DEVELOPMENT FACULTY ATTITUDES, COMPUTER SKILLS, AND LEVEL OF USE OF EDUCATIONAL TECHNOLOGY TOWARD ICT INTEGRATION IN HIGHER EDUCATION MANILA, PHILIPPINES.

Govindasamy, T. (2002). Successful implementation of e-learning: Pedagogical considerations. *The Internet and Higher Education, 4*(4).

Gunuc, S. (2015). Implementation and evaluation of technology mentoring program developed for teacher educators: A 6M-Framework. *Qualitative Research in Education, 4*(2), 164-191.

Hall, O. (2013). Assessing Faculty Attitudes Toward Technological Change in Graduate Management Education. *Merlot Journal of Online Learning and Teaching, 9*(1).

Harbi, M. A. (2016). Faculty Attitudes Toward and Motivation for Virtual Learning Environments (VLE) for language Studies: A cross-National Study in Saudi Arabian Universities. *Journal of Psychology and Behavioral Science, 4*(2).

Hue, L. T., & Jalil, H. A. (2013). Attitudes towards ICT integration into Curriculum and Usage among Universities Lecturers in Vietnam. *International Journal of Instruction, 6*(2).

ICT in Assessment: A Backbone for Teaching and Learning Process (Vol. 1). (2020). IJRT | United International Journal for Research & Technology |.

J, V. A. (2021). *Teaching and Learning Modalities in Higher Education During the Pandemic: Responses to Coronavirus Disease 2019 From Spain* (Vol. 12). Frontiers in Psychology.

Joaquin, J. J. (2020). *The Philippine Higher Education Sector in the Time of COVID-19* (Vol. 5). Frontiers in Education.

Johnson, A. M., & Jacovina, M. E. (2016). Challenges and solutions when using technologies in the classroom . *Adaptive educational technologies for literacy instruction*.

Jorge, C. H. (2003). Use of the ICTs and the Perception of E-learning among University Students: a Differential Perspective according to Gender and Degree Year Group. *Interactive Educational Multimedia, 7*.

Jude, L., Kajura, M., & Birevu, M. (2014). Adoption of the SAMR Model to Asses ICT Pedagogical Adoption: A Case of Makerere University. *International Journal of e-Education, e-Business, e-Management and e-Learning, 4*(2).

Kandell, J. (1998). Internet Addiction on Campus: The Vulnerability of College Students. *CyberPsychology & Behavior*.

Karahan, E. (2015). Integration of Media Design Processes in Science, Technology, Engineering and Mathematics (STEM). *Eurasian Journal of Educational Research*(60).

Kassim, H., & Hassan, W. (2021). The Application of Virtual Learning Environment (VLE) in Malaysian Schools. *Stagnancy Issues and Change Initiatives for Global Education in the Digital Age*.

L, O. B. (2015). *ICT and Teachers' Performance in Terms of Lesson Preparation and Delivery in Primary Schools in Ogoja Education Zone of Cross River State, Nigeria* (Vol. 15). Global Journal of Educational Research.

Lachica, F., & Placido, L. (2015). Classroom Communication And Ict Integration: Public High School Teachers' Notions. *International Journal on Integrating Technology in Education, 4*(2).

Leon, J. R. (2018). Evaluating Educational Technology.

Li, M., & Yu, Z. (2022). Teachers' Satisfaction, Role, and Digital Literacy during the COVID-19 Pandemic. *Multidisciplinary Digital Publishing Institute*.

Lim, C. P., & Chai, C. S. (2004). An activity-theoretical approach to research of ICT integration in Singapore schools: Orienting activities and learner autonomy. *Computers and Education, 43*(3).

Lim, E. J. (2021). Acceptability of Facebook Messenger as a Medium of Online Instruction during the COVID – 19 Pandemic as Perceived by Filipino Students in the Countryside. *World Wide Journal of Multidisciplinary Research and Development*.

Liu, X., Toki, E. I., & Pange, J. (2014). The Use of ICT in Preschool Education in Greece and China: A Comparative Study. *Procedia - Social and Behavioral Sciences, 112*.

Luhamya, A., & Bakkabulindi, F. P. (2017). Integration of ICT in teaching and learning: a review of theories. *Makerere Journal of Higher Education*.

Madlela, B. (2015). ICT opportunities and threats in implementing teaching practice programmes. *Universal Journal of Educational Research, 6*(3).

Majid, I. (2020). *IJRT | United International Journal for Research & Technology |*. IJRT | United International Journal for Research & Technology |.

Manco-Chavez, J. A. (2020). *Integration of icts and digital skills in times of the pandemic COVID-19* (Vol. 9). International Journal of Higher Education.

Mangkhang, C., & Kaewpanya, N. (2021). The Digital Etiquette Enhancing to Global Citizenship of Social. *Canadian Center of Science and Education*.

Markauskaite, & Valanides, A. &. (2007;2009). Examining the technological pedagogical content knowledge of Singapore pre-service teachers with a large-scale survey. *Journal of Computer Assisted Learning*.

Mccannon, M., & Crews, T. B. (2000). *Assessing the Technology Training Needs of Elementary School Teachers.* Journal of Technology and Teacher Education .

McLoughlin, C. a. (2007). *Social Software and Participatory Learning: Pedagogical Choices with Technology Affordances in the Web 2.0 Era.* Journal of Computer and Communications.

Mdlongwa, T. (2012). Information and Communication Technology (ICT) as a Means of Enhancing Education in Schools in South Africa:Challenges, Benefits and Recommendations. *Africa Institute of South Africa*.

Mishra, L., Gupta, T., & Shree, A. (2020). Online Teaching-Learning in Higher Education during Lockdown Period of COVID-19 Pandemic. *International Journal of Educational Research Open*.

Mohd, Mohamed, N. A., & Solehan, H. M. (2021). Knowledge, acceptance and perception on COVID-19 vaccine among Malaysians: A web-based survey. *PLOS ONE*.

Mueller, J., & Wood, E. (2012). Patterns of Beliefs, Attitudes, and Characteristics of Teachers That Influence Computer Integration. *Education Research International*.

Mulenga, E. M. (2019). TEACHERS' ICT SKILLS, BELIEFS AND ATTITUDES TOWARDS ICT INTEGRATION IN THE TEACHING AND LEARNING OF MATHEMATICS. A LOCAL STUDY IN KABWE DISTRICT IN ZAMBIA.

Nandhakumar, R. (2020). *A Study of Teacher Educators' Skill and ICT Integration in Online A Study of Teacher Educators' Skill and ICT Integration in Online Teaching during the Pandemic Situation in India Teaching during the Pandemic Situation in India A Study of Teacher Educator.* Library Philosophy and Practice (e-journal) .

Nawaz, A. (2010). "Using eLearning as a tool for education for all' in developing states. *International Journal of Science and Technology Education Research*.

Ndibalema, P. (2014). Teachers' Attitudes towards the Use of Information Communication Technology. *International Journal of Education and Research, 2*(2).

Ndibalema, P. (2015). Teacher Readiness and Information and Communications Technology (ICT) Use in Classrooms: A South African Case Study. *Creative Education, 6*(18).

Neverkovich, S. D., Bubnova, I. S., & Kosarenko, N. N. (2018). Students' Internet Addiction: Study and Prevention. *EURASIA Journal of Mathematics, Science and Technology Education*.

Niess, M. (2005). *Preparing teachers to teach science and mathematics.* Department of Science and Mathematics Education.

Obaydullah, A. K. (2019). Use_of_ICT_for_Primary_science. *Ministry of Primary and Mass Education*.

Oztok, M., Zingaro, & Brett. (2013). Exploring asynchronous and synchronous tool use in online courses. *Computers and Education*.

Pawar, S. (2012). ICT Integration in Science Education.

Petrie. (2020). COVID-19 Impacts on Teaching and Learning: A Collaborative Autoethnography by Two Higher Education Lecturers. *Educational Psychology*.

Polly, D., & Binns, I. (2018). Elementary education candidates' integration of technology in science units. *Contemporary Issues in Technology and Teacher Education,, 4*.

Rogers, C. F. (2011). FACULTY PERCEPTIONS ABOUT E-CHEATING DURING ONLINE TESTING. *CCSC: Southeastern Conference*.

Ronimus, M. (2019). Supporting struggling readers with digital game-based learning. *Educational Technology Research and Development*.

Seemiller, C., & Grace, M. (2017). Generation Z: Educating and Engaging the Next Generation of Students. *Wiley Online Library*.

Seven Trends:The Transformation of the Teaching Force. (2014). *CONSORTIUM FOR POLICY RESEARCH IN EDUCATION*.

Sife, A., & Lwoga, E. (2007). New technologies for teaching and learning: Challenges for higher learning institutions in developing countries. *International Journal of Education and Development using Information and Communication Technology*.

Smidt, E., Mcdye, B., Bunk, J., Li, R., & Gatenby, T. (2014). Faculty Attitudes about Distance Education. *IAFOR Journal of Education, 2*(2).

SO, W. W.-M. (2002). Constructivist Teaching in Primary Science. *Asia-Pacific Forum on Science Learning and Teaching, 3*(1).

Sullivan, E. T. (2020). *With weeks of e-learning ahead, be flexible and forget perfection.* Retrieved from Edsurge: https://www.edsurge.com/news/202003-19-with-weeks-of-e-learning-ahead-be-flexible-and-forget-perfection

Surry, D. W. (1997). *Diffusion Theory and Instructional Technology.* Instructional Research Technology Online.

Syahid, A. A. (2019). ICT training curriculum for primary school teachers. *Journal of Physics: Conference Series*.

Talidong, K. J. (2020). Philippine Teachers' Practices to Deal with Anxiety amid COVID-19. *Journal of Loss and Trauma* .

Tawafak, R. M. (2021). Impact of Technologies During COVID-19 Pandemic for Improving Behavior Intention to Use E-learning. *International Journals of Interactive Mobile Technologies*.

Thanh Hue, L., & Ab Jalil, H. (2013). Attitudes towards ICT Integration into Curriculum and Usage among University Lecturers in Vietnam. *International Journal of Instruction, 6*(2).

Tinapay, A.O. & Tirol, S. L. (2022). "Social Cognitive Development on the Implementation of Student Manual in a Higher Education Institution: A Literature Review," International Journal of Science and Management Studies (IJSMS), Volume: 5 Issue: 4, pp. 54-63, 2022. DOI: 10.51386/25815946/ijsms-v5i4p106

Tinapay, A. O., & Tirol, S. L. (2021). Teachers' Primary Roles in the New Normal: Through the E-Learning Perspective. International Journal of Innovative Science and Research Technology, 6(10), 90-91.

Tirol, S. L. (2022). Spiral Progression Approach in the K to 12 Science Curriculum: A Literature Review. International Journal of Education (IJE), 10(4), 29-44. DOI:10.5121/ije.2022.10403

Tirol, S., Cortes, S., Tinapay, A., & Samillano, J. (2022). A teacher training program on designing participatory educational action research proposal. Ho Chi Minh City Open

University Journal of Science – Social Sciences, 12(1), 23-40. https://doi.org/10.46223/hcmcoujs.soci.en.12.1.2214.2022

Tirol, S. L. (2021). "Spiral Progression of Biology Content in the Philippine K to 12 Science Curriculum," International Journal of Multidisciplinary Research and Publications (IJMRAP), 4(6), 20-27.

Toquero, C. M. (2021). *Socio-educational implications of technology use during COVID-19: A case study in General Santos City, Philippines.* Human Behavior and Emerging Technologies.

Tsao, S. F., & Chen, H. (2020). What social media told us in the time of COVID19: a scoping review. *ScienceDirect*.

Tschannen-Moran, & Hoy, W. (2001). *Teacher Efficacy: Capturing an Elusive Construct.* Review of Educational Research.

Tupas, F. P., & Noderama, R. P. (2020). Looking into In-Service Training for Teachers in thePhilippines: Are They Gearing towards Education 4.0? *Universal Journal of Educational Research*.

UMORU, B. (2017). IMPACT OF INTEGRATING ICT ON STUDENTS' ACADEMIC PERFORMANCE.

Vaughan, W. (2002). *Effects of Cooperative Learning on Achievement and Attitude Among Students of Color.* The Journal of Educational Research .

Vongkulluksn, V. W., & Xie, K. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers & Education*.

W, W. M. (2020). *Integration of ICT in teaching and learning in schools Integration of ICT in teaching and learning in schools View project Integration of ICT in teaching and learning in schools.*

Wab, A. (2020). *Online and Remote Learning in Higher Education Institutes: A Necessity in light of COVID-19 Pandemic* (Vol. 10). Higher Education Studies.

Wied, Mirahmadizadeh, A., & Ranjbar, K. (2020). *Evaluation of students' attitude and emotions towards the sudden closure of schools during the COVID-19 pandemic: a cross-sectional study.* BMC Psychology.

Wood, & Specht, J. W. (2008). The Relationship between Teacher's Technology Integration Ability and Usage. *Journal of Educational Computing and Research*.