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Science teachers' experiences on ICT integration: challenges, coping mechanisms, and opportunities

Experiências de professores de ciências na integração das TIC: desafios, mecanismos de enfrentamento e oportunidades

Experiencias de profesores de ciencias en integración de las TIC: desafíos, mecanismos de afrontamiento y oportunidades

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ABSTRACT

This study was undertaken to investigate the challenges experienced, coping mechanisms employed by, and opportunities for possible intervention schemes to help science teachers in their pedagogical integration of ICT in their classroom instruction. This study was conducted in Magsaysay North District of the Division of Davao del Sur last August through October of 2019. This was participated by 10 science teachers, 4 science coordinators, and 1 district science coordinator. Data collection was done through in-depth interviews and focus group discussions using a semi-structured interview guide questionnaire. Colaizzi's method was used for qualitative data analysis. Responses show that teachers' challenges in integrating ICT were classified as either self-level or institution-level barriers. Teachers' coping mechanisms include self-training and support, collaboration with colleagues and knowledgeable others, as well as, time management and self-organization. Opportunities for possible intervention schemes provided by the focus group include inclusive teacher training and professional development, procurement of sufficient ICT infrastructure, installation and updating of relevant educational software. Science teachers undeniably experienced challenges in their utilization of ICT in their instruction but were also able to employ strategies to circumvent such setbacks. With further significant interventions, they can be helped to improve their practice.

Keywords: ICT Integration, ICT Integration Challenges, ICT Integration Opportunities.

RESUMO

Este estudo foi realizado para investigar os desafios vivenciados, os mecanismos de enfrentamento empregados e as oportunidades para possíveis esquemas de intervenção para ajudar os professores de ciências na integração pedagógica das TIC em sua instrução em sala de aula. Este estudo foi realizado em Magsaysay Distrito Norte da Divisão de Davao del Sur de agosto a outubro de 2019. Participaram 10 professores de ciências, 4 coordenadores de ciências e 1 coordenador de ciências distrital. A coleta de dados foi feita por meio de entrevistas em profundidade e discussões em grupo focal, utilizando-se um roteiro de entrevista semiestruturado. O método de Colaizzi foi utilizado para a análise qualitativa dos dados. As respostas mostram que os desafios dos professores na integração das TIC foram classificados como barreiras de nível próprio ou de nível institucional. Os mecanismos de enfrentamento dos professores incluem autotreinamento e apoio, colaboração com colegas e outros conhecedores, bem como gerenciamento de tempo e auto-organização. As oportunidades para possíveis esquemas de intervenção fornecidos pelo grupo focal incluem treinamento inclusivo de professores e desenvolvimento profissional, aquisição de infraestrutura de TIC suficiente, instalação e atualização de software educacional relevante. Os professores de ciências inegavelmente enfrentaram desafios na utilização das TIC em seu ensino, mas também foram capazes de empregar estratégias para contornar esses contratempos. Com outras intervenções significativas, eles podem ser ajudados a melhorar sua prática.

Palavras-chave: Integração TIC, Desafios da Integração TIC, Oportunidades de Integração TIC.

RESUMEN

Este estudio se llevó a cabo para investigar los desafíos experimentados, los mecanismos de afrontamiento empleados por, y las oportunidades de posibles esquemas de intervención para ayudar a los profesores de ciencias en su integración pedagógica de las TIC en su instrucción en el aula. Este estudio se llevó a cabo en el Distrito Magsaysay Norte de la División de Davao del Sur entre agosto y octubre de 2019. En él participaron 10 profesores de ciencias, 4 coordinadores de ciencias y 1 coordinador de ciencias del distrito. La recolección de datos se realizó a través de entrevistas en profundidad y discusiones de grupos focales utilizando un cuestionario de guía de entrevista semiestructurada. Se utilizó el método de Colaizzi para el análisis de datos cualitativos. Las respuestas muestran que los retos de los profesores en la integración de las TIC se clasificaron como barreras de nivel propio o de nivel institucional. Los

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mecanismos de afrontamiento de los profesores incluyen la autoformación y el apoyo, la colaboración con colegas y otras personas con conocimientos, así como la gestión del tiempo y la autoorganización. Entre las oportunidades de posibles planes de intervención proporcionadas por el grupo de discusión se encuentran la formación y el desarrollo profesional inclusivo del profesorado, la adquisición de una infraestructura de TIC suficiente y la instalación y actualización de software educativo pertinente. Es innegable que los profesores de ciencias experimentaron desafíos en su utilización de las TIC en su instrucción, pero también fueron capaces de emplear estrategias para sortear tales contratiempos. Con más intervenciones significativas, se les puede ayudar a mejorar su práctica.

Palavras-chave: Integración de las TIC, Retos de la Integración de las TIC, Oportunidades de la Integración de las TIC

1. INTRODUCTION

Information Communications Technology (ICT) refers to the pool of technological tools and instructional resources used to communicate as well as design, develop, disseminate and manage information. Its utilization in the teaching-learning process has been the focus of research in the field of education. Integrating ICT effectively in classroom learning activities generally translates into new difficulties for school administrators and science classroom teachers.

Innovative technologies in the likes of ICT in the classroom are crucial to providing students necessary opportunities to acquire the knowledge to operate in the information age. It is confirmed that the utmost significance of integrating sufficient ICT tools in the teaching and learning process. It has been argued that conventional educational environments and traditional teaching techniques are not sufficient enough to prepare learners to be able to function in different places of work in the present technological world. Integrating ICT tools and teaching ICT skills in learning institutions prepare students to face future developments based on proper understanding. Further, integrating ICT in the teaching-learning process fosters student motivation and participation in learning important skills and concepts, allows teachers to effectively attain lesson objects as well as aids teachers to teach topics deemed to be difficult, and helps students in the inculcation of 21st Century skills (Guma, Faruque, Haolader, and Muhammad, 2013).

To effectively broaden the range of instructional opportunities that can be offered to students, and to become more efficient in dealing with everyday tasks such as communicating with parents, keeping records, doing research in their subject domain, and preparing presentations, teachers must reach and maintain a certain degree of technological competence. However, the integration of ICT in the classroom requires technical know-how for teachers to effectively convey the meaning of the lesson. A greater chance of ineffective ICT utilization looms if teachers do not know how to properly operate, navigate or even look for relevant ICT tools. Hsu (2010) reported that teachers who regard themselves as having high ability in technology integration generally do more technology integration than those who report they have lower skill levels. The question of the availability of ICT tools and pre-requisite equipment or materials for the use of ICT is also in play. Things like the absence of network connectivity and even electricity in places where utilization of ICT is supposedly needed pose real threats to the effective integration of ICT in the teaching and learning process.

Guo, Dobson, and Petrina, (2008) further stressed out that research is needed to examine the barriers for teachers, regardless of age, of effective use of emerging technologies in classroom settings, and how to remove those barriers. It is in this context the researcher intends to dive deep into the classroom experiences, coping mechanisms, and possible intervention schemes of and for science teachers in the integration of ICT in the science classroom.

Problem Statement

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The main thrust of this study was to investigate the experiences on the integration of ICT in their science classroom instruction. Moreover, this research sought to answer the following research questions:

1. What are the challenges encountered by science teachers on integrating ICT in their classroom instruction?
2. What are the best practices of science teachers employ to cope with the challenges they have experienced?
3. What intervention schemes can be done to help improve the integration of ICT in their classroom instructions?

2 THEORETICAL FOUNDATION

This study is anchored on the Technological Pedagogical Content Knowledge. Koehler and Mishra (2009) posit that a teacher depends on three domains of knowledge for the effective integration of ICT into teaching and learning. These domains are content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK).

3 METHODS

This section presents the study's design and locale, key informants and participants, the data gathering procedure, and the qualitative data analysis.

3.1 Research Design and Locale

The major methodological framework that was utilized in this research is a phenomenological study. This was to discover the experiences of people and investigate how they keep up with such experiences. The phenomenological study is believed to be appropriate because it carefully examines and clarifies the experiences of individuals as they spontaneously occur (Mack, Woodsong, McQueen, Guest, & Namey, 2005). Further, this was conducted in all public elementary and secondary schools in Magsaysay North District, Municipality of Magsaysay, Davao del Sur, Philippines.

3.2. Research Key Informants, and Participants

This study involved ten (10) teachers who served as key informants during the conduct of an In-depth Interview (IDI) to determine the experiences of teachers in the integration of ICT in their classroom instruction. Further, the FGD participants included five (5) science school coordinators, three (3) from the secondary, one (1) from the elementary, and (1) District Science Coordinator.

3.3. Data Gathering Procedure

To provide a rich source of qualitative data, the researcher had undergone phases of gathering data. In the First Phase, the researcher asked for a copy of the list of Science teachers and Science school coordinators from the schools and personally met them to give the Inform Consent. Also, the researcher asked for the consent of the District Science Coordinator to be part of the study. The researcher made sure that the informants and participants understood well the purpose and process of the conduct of the research. After which, the researcher asked for the contact numbers of the identified informants and participants. In the Second Phase, after the consent of the informants and participants, an In-depth Interview (IDI) using a semi-structured interview questionnaire was conducted by the researcher to determine the experiences of teachers' integration of ICT in their instruction. In the Third Phase, the researcher personally asked FGD participants to undergo discussion. The researcher conducted the Focus Group Discussion (FGD) using the Guide

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Questions which were based on the data results generated from the IDI to determine the possible interventions needed to assist Science teachers in the integration of ICT in their teaching instruction.

3.4. Qualitative Data Analysis

In analyzing the data of the study gathered from the said In-depth Interview (IDI) and Focus Group Discussion (FGD), the researcher made use of Colaizzi's (1978) phenomenological method. In this method, all written transcripts were read several times to obtain an overall feeling for them. From each transcript, significant phrases or sentences that pertain directly to the lived experience on teachers' technology integration are identified. Meanings are then formulated from the important statements and words. Finally, the acquired meanings are clustered into themes, allowing for themes common to all participants' transcripts. The results are then integrated into an in-depth, exhaustive description of the phenomenon. Once descriptions and themes have been obtained, the researcher in the final step approached some participants a second time to validate the findings. All relevant that data emerged are included in the final description.

4 RESULTS AND DISCUSSION

This section presents the significant themes identified from the responses of the key informants and participants through qualitative data analysis using Colaizzi's method.

4.1 Challenges Science Teachers on the Integration of ICT in the Classroom Instruction

Important objectives of this research were to determine the barriers encountered by science teachers in integrating ICT in their science classroom instruction and to determine the coping mechanisms that science teachers employ to cope with the challenges they encountered. Based on the results of the In-Depth Interview conducted, common barriers encountered and coping mechanisms employed by science teachers in integrating ICT in their science classroom instruction are presented in the following major themes with its specific sub-themes. The major themes are the following: Self-level barriers and Institution-level barriers.

1.1 Teacher's Self-Level Barriers.

The significant role of Information and Communication Technologies (ICTs) in education is irrefutable. For decades, ICTs had changed and are continuously changing the face of education. Abbott, Heid, and Van Haitsma (2016) pointed out that school practices were revolutionized through the use of new technologies, including the introduction of teaching machines and the widespread use of televisions in schools. These developments proved to offer possible tools to help teachers perform their traditional tasks. It is abundantly clear that the development of information and communication technologies as well as their applications in education will not slow down. This forces learning and teaching to change in a variety of ways and prompts teachers, as the instructional facilitators of learning, to acclimate to these new developments in the field of education. This adaptation to new educational trends made teachers encounter setbacks towards the successful integration of ICTs. Some of these setbacks that lie within the levels of the teachers are the following: lack of ICT Skills and Competence and Lack of Time for Initial ICT Integration Preparations.

1.1.1 Lack of ICT Skills and Competence

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Although many teachers have positive attitudes toward technology, they only considered themselves able to "minimally" integrate ICT effectively into their instruction. Teacher-respondents feel unconfident in their ICT skills. Science teachers see possibilities of improvement with their skills for the future more successful pedagogical use of ICT in their teaching. Science teachers lack certain preparatory and simple troubleshooting skills when ICT is in use during classroom instructions. Teachers also lack the skills in file conversion to suit appropriate computer software for presentations. This troubleshooting mishap and inability to convert files forced teachers to discard useful supplementary tools like simulations of the lesson. More problematically, this lack of skills forced teachers to terminate the lesson for the day.

Moreover, teachers also lack the skill to facilitate supplementary learning through social media sites like Facebook and cloud technology. Teachers had seen the important role of the use of social media and cloud technology for lesson supplementation. Teachers believe that social media tools could afford them and students with varied opportunities to improve learning methods. Despite this acknowledgment, teachers are not able to tap this ICT-driven educational resource due to a lack of skills and inability to utilize features like file sharing.

1.1.2 Lack of Time for Initial ICT Integration Preparations

In lesson preparation, especially lessons that require the use of ICT tools and other ICT-related materials necessitate sufficient time. One of the factors that hindered teachers' adaptation of ICT integration identified in this research is the lack of time for initial preparations for lessons that require ICT tools or other ICT-related materials. This was made pronounced by the need of science teachers for more time to explore ICT materials they are going to use during the actual class discussions. This is primarily fueled by the teachers' need to familiarize salient concepts and features embedded in the ICT materials before they relay these concepts correctly and sufficiently to their students. Also, time constraints became more pronounced because of the extra-instructional functions of the teachers themselves. Teachers found lesson preparations for lessons with ICT integration, as time-consuming as it is, being interfered with by frequent additional paperwork required by the school or by the educational agency.

This result confirms that the problem of lack of time exists for teachers in many aspects of their work as it affects their ability to complete tasks, with some of the participant teachers specifically stating which aspects of ICT require more time. These include the time needed to locate Internet advice, prepare lessons, explore and practice using the technology, deal with technical problems, and receive adequate training. Further, lack of time is an important factor affecting the application of new technologies in science education. It is a barrier affecting the application of ICT because of busy schedules. It was further indicated that because both teachers and students have a limited number of hours during the day to work on integrating ICT into science education. Similarly, teachers take much more time to design projects that include the use of new ICT than to prepare traditional lessons (Osborne and Hennessy, 2003).

1.2 Institution-Level Barriers

The adoption of information and communications technologies in the school and classroom settings also depends on the institutional policies of the national, local and school-based educational agencies. This means that teacher-level factors about the utilization of ICT for classroom instruction, like teacher skills in navigating and using ICT tools as well as lack of adequate time for lesson preparations for lessons requiring usage of ICT materials, is only one factor that is intertwined with the crucial role educational institutions play in ICT utilization in the classroom. Some factors or lack of these factors may hinder the use of ICT in the classroom by science

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teachers. These factors are identified as lack of access to ICT tools; and appropriate resources and lack of skills training and technical support.

1.2.1 Lack of Access to ICT Tools and Appropriate Resources.

Appropriate and sufficient use of ICT in the classroom requires teachers to be able to access up-to-date hardware and software ICT resources. This means that for science teachers to fully and efficiently integrate information and communications technology in their classroom instruction, they must be afforded easy-to-access hardware and software resources for lecture, demonstration, use of computer-generated simulations as well as hands-on manipulation. Accessible hardware resources refer to readily available physical information and communication tools for use in classroom instruction. These materials include but are not limited to fully functioning computers, overhead projectors, monitors, speakers, earphones or headsets, microphones, computer-connected sensors, and cameras. Additionally, available software resources pertain to the availability of educational computer programs that coordinates ICT hardware for the actual educational experience.

Science teachers however pronounced that access to sufficient information and communications technology hardware and software is often minimal and that their utilization of ICT in the science classrooms is also trifling. Common sentiments are about the lack of overhead projectors. Before the actual classroom use, teachers need to book for the projectors which usually are fully booked for use by other teachers upon their time request. Teachers were then forced to only use their laptops with very small screen dimensions and almost inaudible sound speakers during their actual classroom instruction. Additionally, teachers are also prompted by the problem of the lack of sufficient software materials. Unavailable supplementary materials from links provided by textbooks and printed learning materials are commonplace. Teachers sometimes are required for a paid subscription to be able to access the materials provided by the teacher guides. When materials are available, these materials are simply inappropriate for the lesson. Available materials are deemed by science teachers to be either overly above or under the required competency. Further, science teachers also faced the lack of the most important commodity to access ICT resources online, the lack of network connectivity. Lack of network connectivity hinders teachers to access and download important ICT materials for instructional use.

In consonance, Bingimlas (2009) stated that lack of access to resources, including home access, is another complex barrier that discourages teachers from integrating new technologies into education and particularly into science education. It was further stated that barriers were insufficient numbers of computers, insufficient peripherals, insufficient numbers of copies of the software, and insufficient simultaneous Internet access. However, overcoming such hardware barriers does not, in itself, ensure ICT will be used successfully. The accessibility of ICT resources does not guarantee its successful implementation in teaching, and this is not merely because of the lack of ICT infrastructure but also because of other barriers such as lack of high-quality hardware, suitable educational software, and access to ICT resources. It was asserted that poor choices of hardware and software and a lack of consideration of what is suitable for classroom teaching are problems facing many teachers. Also, the majority of teachers agreed that insufficient ICT resources in the school and insufficient time to review software prevent teachers from using ICT.

1.2.2 Lack of ICT Skills Training and Technical Support

Science teachers commented on the lack of skills training and technical support that has been provided by the school, division, or by the national educational agency. Often, science teachers who are directly involved in the daily instructional activities were not able to participate in sponsored training and seminars. They remarked that whenever skills training is scheduled, they were not

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selected to participate. Science coordinators or some master teachers were sent to participate in the said training. The insufficiency caused by the lack of training made teachers hesitant to utilize available hardware and software materials available in the school

These findings echoed the claim that teachers have not been sufficiently trained in the pedagogical use of ICT. Further, another issue that has to be raised is the teachers' confidence in using ICT to help them teach effectively. The lack of confidence is a problem linked to the previous two issues: the lack of access to resources and the lack of teacher competence. Regarding the availability of ICT resources, the perceived ability to use ICT and have the basic skills to operate it may increase teachers' satisfaction with modern technologies, which may motivate teachers to integrate ICT in education. However, we should not overlook the provision of training, enough time, and technical support (Reynolds, Treharne, and Tripp, 2003).

4.2 Teacher's Coping Mechanisms

Despite the problems and difficulties experienced in the utilization of information and communications technology in science classroom instruction, Science teachers have also shared positive experiences and feedback with regards to their coping abilities in the use of ICT resources and materials in helping students learn important scientific facts and concepts. These good practices and coping mechanisms used by teachers are presented in the following sub-themes: self-training and support, collaboration with colleagues and knowledgeable others, and time management and self-organization. Figure 4 shows the schematic diagram for the coping mechanisms employed by science teachers in integrating ICT in the science classroom instruction.

2.1 Self-Training and Support.

Science teachers purported that for them to be able to learn using new educational technology themselves, they use video streaming platforms like YouTube for step-by-step video tutorials. Pre-exploration of the ICT material is also an option. Science teachers added that even without initial or previous knowledge about the use of certain ICT material, they explore the material until they can operate such material for classroom use. Additionally, science teachers said that trying or navigating the material before actual classroom instruction would help them operate the ICT material successfully. Moreover, due to the lack of certain information and communications technology utilities for classroom use, science teachers opted to exploit personal financial resources to procure ICT utilities. Science teachers buy their projectors, printers, and speakers to be used for their classroom instruction. Further, in terms of network connectivity, teachers also spent their own money for their internet connection which undeniably is quite expensive. This finding is in congruence with the statement of Assude (2017) that when faced with challenges in the pedagogical integration of information and communications technology in their classroom instruction, teachers opted out to be resourceful and self-supportive. Baskin and Williams (2016) further stated that teachers can sufficiently acquire the most basic but significant skill-set for proper utilization of information technology, to improve student learning, through self-education and exploration.

2.2 Collaboration with Colleagues and Knowledgeable Others.

Science teachers assert that during the installation as well as during troubleshooting certain ICT problems, they ask assistance from their school ICT coordinator. Additionally, they also maintain channels of communication with each other, sharing significant knowledge to help themselves in terms of utilizing certain ICT tools for pedagogical use, locating ICT materials online as well as on navigating ICT simulations for certain science lessons. Further, science teachers also acknowledge the importance of the input of other people for the development of their skills in

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utilizing ICT pedagogically. Science teachers consult IT professionals for software installations, hardware repairs, and even for training on the use of ICT resources. In the school setting, teachers sometimes ask their students for help during lesson preparation when they find navigating ICT material difficult. This is in conjunction with the assertions of Castro-Silva, Amante, and Morgado, (2017) that teacher collaboration allows teachers to work together and have a positive impact on each other which can contribute naturally to students' learning improvement. Specific types of teacher collaboration include working together in teams, sharing responsibilities, providing feedback, and building trust.

2.3 Self-Organization and Time Management.

Another skill that science teachers asserted that they should have to be able to best integrate ICT in the classroom setting is time management. Science teachers claimed that to be able to successfully integrate information and communications technology in their instruction, they strategize through time management in such a way that they can still explore, during the vacant time during duty hours, available ICT materials before bringing them to the classroom for actual pedagogical use. Additionally, science teachers extended preparation time at their respective homes, preparing ICT integration lessons at night. Further, science teachers plan ICT lesson integration through setting goals and task prioritization.

This result is after the statements of Sahito, Khawaja, Panhwar, Siddiqui, and Saeed (2016) that process of using time effectively to achieve maximum productivity involves managing work schedules and engaging in planning, organizing, and implementation to achieve the instructional objectives. They further assert that by making a schedule, the tasks that need to be completed are set out and that the teacher is aware of what lesson preparation needs to be done. Scheduling instructional tasks allow teachers to understand when a task needs to be completed and the amount of time necessary to finish the task. Effective setting out of instructional priorities also allows for time not to be wasted wondering which task should be completed and also ensures that tasks are not forgotten. Moreover, effective utilization of time can make procrastination by making teachers less likely to put off tasks. Accountability to the daily tasks helps teachers to finish instructional and preparatory plans in a timelier manner.

4.3 Opportunities

Based on the results of the focus group discussion conducted, the possible opportunities are inclusive teacher training, procurement of sufficient ICT infrastructure, installation and updating of relevant educational software.

3.1 Inclusive Teacher Training and Professional Development.

For Science teachers to be effective in the utilization of information and communications technology in their classroom instruction, they should be encouraged to continue professional development. Training and seminars may be initiated by the national, regional, division, and district levels to help Science teachers expandability in teaching and expertise in the various disciplines in the Science subjects. Further, teachers should be personally motivated to participate in some seminars and workshops. They should push themselves to do self-review and research on the topics they are struggling.

This finding is in congruence with the claims of Bhattacharjee and Deb (2016) teachers should use ICT for their professional development. Using ICT in class demands teachers to have technical skills and knowledge besides their content subject knowledge. Teachers must have a range of technical and pedagogical skills, with continuous up-dating to match advances in the technology

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and modes of use. Thus, teachers who use ICT in class have more duty; mastering their content subject, learning and always updating their technological skills.

3.2 Procurement of Sufficient ICT Infrastructure

The need for enough instructional hardware ICT materials among schools is very important for the success of the integration of information and communications technology in teaching Science. Sufficient fund allocation should be available for the procurement of effective and working internet infrastructure to help the teacher reach the internet with ease during lesson preparation or in an actual classroom, instruction as necessary. Alternatively, the school heads may utilize funds for the production of enough ICT materials for Science teachers and students to lessen their burdens in science instruction.

This is in congruence with the statement of Prensky (2010) that ICT equipment and access provided by the school is a key factor in ICT integration. It has been found that laptop and tablet computers and mobile phones are increasingly considered useful in education. Further, Lu, Tsai, and Wu, D. (2015) stated that the availability and types of digital instruction facilities are the most important indicator that could predict the utilization of multi-media classrooms and the proportion of ICT-aided courses in schools.

3.3. Installation and Updating of Relevant Educational Software.

Other important information and communications technology material that should be provided to teachers to help them better integrate ICT in their instruction are pre-installed and fully updated instructional, assessment, and pedagogical software. This software is necessary for teachers during lesson preparation particularly on preparing lessons with ICT integration. Some software is also important during actual lesson instructions. Some software is necessary to be run when using science simulations during classroom discussions.

5 CONCLUSION

The integration of information and communications technology (ICT) in teaching Science is faced with negative experiences. Teachers experienced self-Level and institution-level barriers which hamper their successful ICT integration in their lessons. Self-level barriers include lack of ICT skills and competence and lack of time for initial preparations of lessons with ICT integration. Institution-level barriers meanwhile include teachers' lack of access to sufficient ICT tools and appropriate ICT resources as well as the lack of the availability of comprehensive ICT skills training and technical support. These factors hinder the utilization of ICT in the classroom by science teachers.

Also, despite the problems and challenges experienced by Science teachers in the integration of ICT in teaching Science, they still display coping mechanisms which are seen to help address existing problems. They have seen the possibilities of improvement with their skills for future more successful pedagogical use. Science teachers opted to augment their ICT skills through self-training and self-support. Teachers also ensure that they constantly collaborate with their colleagues especially in planning, goal setting, and evaluation to acquire sufficient skills in the pedagogical use of ICT in classroom instruction. Moreover, teachers also viewed efficient task organization and time management as another important mechanism that they can implore to successfully integrate ICT in their instruction.

Finally, to contribute to the success of the integration of ICT in teaching Science under the K to 12 curriculum, certain development opportunities were suggested to support teachers' pedagogy and develop Science teachers' ICT skills and literacy. Science teachers need to immerse

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themselves in continuous professional development by engaging in related training and seminars as well as continuing masters or doctoral degrees. Further, sufficient ICT infrastructure in schools inclusive of salient hardware and software developments must also be considered to address the insufficiency of appropriate ICT materials and network instability which are among the factors that hamper science teachers' successful integration of ICT in their instruction.

REFERENCES

Abbott, K. M., Heid, A. R., & Van Haitsma, K. (2016). "We Can't Provide Season Tickets to the Opera": Staff Perceptions of Providing Preference-Based, Person-Centered Care. Clinical Gerontologist, 39(3), 190-209.

Assude, T. (2017). Teachers' practices and degree of ICT integration. In Proceedings of the fifth congress of the European Society for Research in Mathematics Education (pp. 1339-1348).

Baskin, C., & Williams, M. (2016). ICT integration in schools: Where are we now and what comes next? Australasian Journal of Educational Technology, 22(4).

Bhattacharjee, B. and Deb, K. 2016. Role of ICT in 21st Century's Teacher Education. International Journal of Education and Information Studies.

Colaizzi, P. F. (1978). Psychological research as the phenomenologist views it.

Guo, R. X., Dobson, T., & Petrina, S. (2008). Digital natives, digital immigrants: An analysis of age and ICT competency in teacher education. Journal of educational computing research, 38(3), 235-254.

Guma, A., Faruque, A. H., & Khushi, M. (2013). The role of ICT to make teaching-learning effective in higher institutions of learning in Uganda.

Hsu, S. (2010). The Relationship between Teacher's Technology Integration Ability and Usage. Journal of Educational Computing Research, 43(3), 309–325. doi10.2190ec.43.3.c

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? Contemporary Issues in Technology and Teacher Education, 9(1), 60-70.

Lu, C., Tsai, C. C., & Wu, D. (2015). The role of ICT infrastructure in its application to classrooms: A large scale survey for middle and primary schools in China. Journal of Educational Technology & Society, 18(2), 249-261.

Mack, N., Woodsong, C., Macqueen, K., & Guest, G. E. Namey (2005): Qualitative Research Methods: A Data Collector's Field Guide. Research Triangle Park North Carolina: Family Health International.

Osborne, J., & Hennessy, S. (2003). Literature review in science education and the role of ICT: Promise, problems and future directions (Vol. 6). London, United Kingdom: Futurelab.

Prensky, M. R. (2010). Teaching digital natives: Partnering for real learning. Corwin press.

Rafeedali, E. (2009). Computer-based technology and its pedagogical utility. Edutracks, 9(2), 38.

Reynolds, D., Treharne, D., & Tripp, H. (2003). ICT—the hopes and the reality. British journal of educational technology, 34(2), 151-167.