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Technology Leadership and Technology Integration in Selected Science High Schools in the National Capital Region, Philippines: Basis for a Proposed Online Training Module

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Abstract: *This research sought to assess the extent of technology leadership of school heads and its relationship to the extent of technology integration of teachers in selected Science high schools in the National Capital Region, Philippines. The respondents of the study were six (6) school heads and two hundred seventy three (273) teachers from six (6) Science high schools: SciHS A, SciHS B, SciHS C, SciHS D, SciHS E, and SciHS F. The data were gathered through two (2) researcher-made survey questionnaires adapted and modified from the Principals Technology Leadership Assessment (PTLA) and the Levels of Teaching Innovation (LoTI) Digital Age Survey. The survey questionnaires underwent validation, pilot-testing, and reliability testing using Cronbach's Alpha. Percentage, weighted mean, Pearson product-moment correlation coefficient, chi-square, t-test for independent means, and analysis of variance were used for statistical treatment. The results of the study revealed that the school heads' extent of technology leadership across all areas ranges from partial to full implementation; and, the extent of technology integration of teachers across all areas is being implemented "most of the time." It was also found out that the profile of school heads are not associated with their technology leadership. On the other hand, only the highest educational attainment out of all profile variables was found significantly related to the teachers' extent of technology integration. Furthermore, there was no significant relationship between technology leadership of school heads and technology integration of teachers. The study also revealed that there were no significant differences among school heads when grouped according to their profile; and, there was a significant difference between teachers' assessment of and school heads' self-assessment on their technology leadership.*

Keywords: *Education 4.0, International Technology Standards, Online Training, Technology Integration, Technology Leadership*

1. INTRODUCTION

Education has already evolved from Education 1.0 to the current Education 4.0. Today, the cusp of change has put the learner at the center of the future ecosystem. According to Leapfrogging to Education 4.0: Student at the Core (2017), Education 4.0 empowers learners to structure their learning paths - characterized by personalization of the learning experience, where the learner has complete flexibility to be the architect of his or her own future and has the freedom to aspire and achieve personal goals by choice. In Education 4.0, "Dynamic Technology" envelops the learner and provides options for the learner's core decisions of what, where, when, how and why to study. This layer of dynamic technology could deliver the cognitive learning parts - instructional delivery, content, and remote learning.

This change of paradigm in Education 4.0 is a timely response to the demands and significant changes brought about by the Industrial Revolution 4.0. According to Shahroom and Hussin (2018), the fourth Industrial Revolution or IR 4.0 has changed the landscape of educational innovation and is controlled by artificial intelligence and digital physical frameworks that make human-machine interface more universal. Thus, Education 4.0 prepares graduates for future life and work achieved by IR 4.0 where more smart robots will supplant people in certain activity divisions, thereby challenging education to harness on pertinent information and abilities that could not be replaced by robots. Moreover, Fisk (2017) stipulated the trends related to Education 4.0 such as learning can be taken place anytime and anywhere. Due to this, e-learning tools offer great opportunities for remote and self-paced learning. Another trend is exposing students to more project-based learning – requiring the application of knowledge and skills in completing short term projects. Furthermore, students will be exposed to more hands-on learning through field experience such as internships and collaborative projects, where the advancement of technology enables the learning of certain domains effectively, thus making more room for acquiring skills that involve human knowledge and face-to-face interaction.

With technology playing a major role in the current educational trend, international technology standards will serve as benchmark on how front liners can effectively and efficiently integrate technology in schools. In order to continually uplift the technology standards specific to the field of education, the International Society for Technology in Education (ISTE) was created as a home to a passionate community of global educators who believe in the power of technology to transform teaching and learning, accelerate innovation and solve tough problems in education. The ISTE sets technology standards that serve as framework for students, educators, and administrators to rethink education and create innovative learning environments, thus, helping educators and education leaders worldwide re-engineer schools and classrooms for digital age learning, no matter where they are on the journey to effective educational technology integration. For education leaders such as school

heads, these foundation standards are (1) Leadership and Vision, (2) Learning and Teaching, (3) Productivity and Professional Practice, (4) Support, Management, and Operations, (5) Assessment and Evaluation, and (6) Social, Legal, and Ethical Issues.

In the Philippines, the amendment of Republic Act No. 10533 also known as the "Enhanced Basic Education Act of 2013" gave leeway for the country to implement the K to 12 program for the augmentation of the Basic Education System by strengthening its curriculum and increasing the number of years for basic education. The K to 12 law brought new opportunities and challenges to the Philippine education, creating a functional education system that will develop productive and responsible citizens equipped with the essential competencies, skills, and values for both lifelong learning and employment. Along with the new curriculum and opportunities that the K to 12 provides, the country's education leaders are now faced with the demands of the fast-paced technology developments and how to utilize these technology advancements for the betterment of the educational system. In fact, two (2) of the salient features of the K to 12 curriculum in the Philippines are "Making the Curriculum Relevant to Learners" (Contextualization and Enhancement), and "Nurturing the Holistically Developed Filipino" (College and Livelihood Readiness and 21st Century Skills). In the first salient feature of making the curriculum relevant to learners, discussions on issues such as information and communication technology are included in the enhanced curriculum. On the other hand, the second salient feature of nurturing the holistically developed Filipino includes equipping every graduate with information, media and technology skills.

As major key players in molding educational institutions, school heads exercise command over the teachers and all other employees of the institution. Because of this, it is the duty of the school principals to be updated and knowledgeable to every trend and issue that might be affecting their institution. According to Duncan (2011), school principals need to step up and realize that engagement with technology is an important aspect of being a school leader. The school principals' attitude towards technological advancement and their strategy on how to integrate these advancements to their school's policy and curricula as well as how to empower the teachers through it are important factors as to how the whole institution will produce their students.

Aside from the principal, teachers also play a pivotal role in technology integration in their pedagogy. An Edutopia article (2007) posits that integrating technology into classroom instruction means more than teaching basic computer skills in a separate computer class. Above and beyond it, effective technology integration must happen across the curriculum in ways that deepen and enhance the learning process, supporting four (4) key components of learning: active engagement, participation in groups, frequent interaction and feedback, and connection to real-world experts.

Science high schools in the Philippines offer a specialized and relatively more challenging curriculum, and entry to these schools demand a grade requirement and passing an entrance exam. Students in these schools are generally presumed to be academically-excellent and perform above average in comparison to students from the regular public secondary schools. To accommodate these types of learners, teachers in Science high schools are also presumed to be highly-qualified, excel in their academic and work performance, and expected to be more advanced in their teaching approach, techniques and strategies - incorporating technological trends in their pedagogy in order to bridge themselves with the generation of learners born with and into technology and digital world. Consequently, as the primary mover and visionary in a school, with excellent students and excellent teachers under his or her supervision, the school head as technology leader should primarily take into consideration the needs of both teachers and students in the area of integrating technology in academics, find ways and means to actualize them in order to sustain the high educational quality expected from a Science high school.

The online training module, which served as the offshoot of this study, was intentionally proposed for school heads in order to keep up with the current educational trend in terms of delivery of content, thereby responding to their workload and tight schedule. Online learning is the answer to constraints related to time and geographical inconveniences, and has positive implications on wider access, flexibility, instilling self-discipline and accountability. The main purpose of the online training module is to develop and enhance the technology leadership knowledge and skills of the school heads by assessing their current performance, and then training them to bridge the gap between practice and adherence to international technology standards.

This study aimed to assess the technology leadership of school heads in selected Science high schools in the National Capital Region of the Republic of the Philippines and determined its relationship with technology integration of teachers. The results of this study were used in developing a proposed online training module.

Specifically, this study sought answers to the following questions:

1. What is the school head's profile in terms of:
    1.1 Age;
    1.2 Sex;
    1.3 Highest educational attainment; and,
    1.4 Years of service as school head?
2. What is the teacher's profile in terms of:
    2.1 Age;
    2.2 Sex;

2.3 Highest educational attainment; and,
2.4 Years of service in teaching?

3. What is the extent of technology leadership of school heads (a) as assessed by themselves and (b) as assessed by their teachers as to the following areas:
   3.1 Leadership and Vision;
   3.2 Learning and Teaching;
   3.3 Productivity and Professional Practice;
   3.4 Support, Management, and Operations;
   3.5 Assessment and Evaluation; and,
   3.6 Social, Legal, and Ethical Issues?
4. What is the extent of technology integration of teachers as to the following areas:
   4.1 Facilitating and Inspiring Student Learning and Creativity;
   4.2 Designing and Developing Digital Age Learning Experiences and Assessments;
   4.3 Promoting and Modelling Digital Citizenship and Responsibility; and,
   4.4 Engaging in Professional Growth and Leadership?
5. Is there a significant relationship between the school heads' self-assessment of their technology leadership and their profile?
6. Is there a significant relationship between the teachers' self-assessment of their technology integration and their profile?
7. Is there a significant relationship between the technology leadership of school heads as assessed by their teachers and their technology integration?
8. Is there a significant difference in the school heads' self-assessment when grouped according to their profile?
9. Is there a significant difference between the teachers' and school heads' self-assessment on their technology leadership?
10. What online training module may be proposed based on the results of the study?

Scope and Limitations

The researcher assessed the extent of technology leadership of school heads in selected Science high schools, and its relationship to the extent of technology integration of teachers. The National Capital Region is composed of sixteen (16) cities and one (1) remaining municipality. Every city or municipality in the region has either one (1) or two (2) Science high schools. By purposive sampling, only six (6) Science high schools were selected for this study which adhered to the following criteria: deliberate inclusion of the pilot Science high school in the country; deliberate inclusion of the regional Science high school in the National Capital Region; inclusion of two (2) Science high schools from the northern part of the National Capital Region for geographical representation; inclusion of two (2) Science high schools from the southern part of the National Capital Region for geographical representation; the Science high school should have been established for not less than five (5) years to date; and, the Science high school should have already won international awards.

The study was conducted with six (6) school heads and two hundred seventy three (273) teachers from the selected Science high schools as respondents. By census, the total number of teachers from the six (6) selected Science high schools was three hundred seventy seven (377), however due to reasons of (a) refusal to participate in the study, and (b) official leave of absence, the number was reduced to two hundred seventy three (273).

The study was limited to assessing the extent of technology leadership of school heads from the selected Science high schools, as assessed by themselves and by their teachers, based on the foundation standards for education leaders set by the International Society for Technology in Education (ISTE) as stipulated in the National Educational Technology Standards for Administrators (NETS-A). Aside from the technology leadership of school heads, the extent of technology integration of teachers was also assessed by themselves. To capture the responses, two (2) sets of modified survey questionnaires were prepared by the researcher and validated by experts, based on the Principal Technology Leadership Assessment (PTLA) for the school heads and Levels of Teaching Innovation (LoTI) Digital Age Survey for the teachers. It was not the purpose of the study to assess the effect of technology integration of teachers to the academic performance of students.

Theoretical Framework

This study is anchored on Mishra and Koehler's (2006) formulation of the technological, pedagogical, and content knowledge (TPACK) framework which extended Schulman's (1986) characterization of teacher knowledge to explicitly consider the role that knowledge about technology can play in effective teaching. The three major knowledge components form the foundation of the TPACK framework which are: (1) Content knowledge (CK) which refers to any subject-matter knowledge that a teacher is responsible for teaching; (2) Pedagogical knowledge (PK) which refers to teacher knowledge about a variety of instructional practices, strategies, and methods to promote students' learning; and (3) Technology knowledge (TK) which refers to teacher knowledge about traditional and new technologies that can be integrated into curriculum. Moreover, four (4) components in the TPACK framework address how these three bodies of knowledge interact, constrain, and afford each other. The Technological Content Knowledge (TCK) refers to knowledge of the reciprocal relationship between technology and content. Disciplinary knowledge is often defined and constrained by technologies and their representational and functional capabilities. The Pedagogical Content Knowledge (PCK) is the notion of "an understanding of how particular topics, problems, or issues are organized, represented, and

adapted to the diverse interests and abilities of learners, and presented for instruction". The Technological Pedagogical Knowledge (TPK) refers to an understanding of technology can constrain and afford specific pedagogical practices. Then, Technological Pedagogical Content Knowledge (TPACK) refers to knowledge about the complex relations among technology, pedagogy, and content that enable teachers to develop appropriate and context-specific teaching strategies.

2. Review Of Related Literature

2.1 Education 4.0

Rahim (2017) illustrated how human civilization progressed during the Industrial Revolutions. The First Industrial Revolution triggered a dramatic change in the global civilization a few centuries ago. Industrial Revolution 1.0 was a remarkable shift to new manufacturing processes grounded on mechanical production driven by water and steam power. Later on, as humans learned to make use of electrical energy to greatly increase production of goods, Industrial Revolution 2.0 commenced. Computer and electronics paved way for further advancements, as people learned to use these man-made resources to enhance automation. This resulted in Industrial Revolution 3.0, and paved way for the rise of Industrial Revolution 4.0 which is based on the use of cyber physical systems. These Industrial Revolutions broadened the horizon of human civilizations by helping them fully utilize their knowledge and skills to enhance their state of living. Accordingly, as the innovations brought about by these industrial revolutions increase in quality and quantity, it has affected the education system. As technologies advanced during these Industrial Revolutions, so does human knowledge. In view of this, education can also be divided into four eras.

While technology delivers the content and cognitive learning, the need for experiential learning is still magnified in the context of Education 4.0 - absorbed through the interpersonal experiences with all stakeholders. Based on "Leapfrogging to Education 4.0: Student at the Core" (2017), the landscape for education has already changed across ages. Education 1.0 in ancient ages was limited to few privileged people, largely influenced by religion and governed by informal methods of teaching. In Education 2.0, with the advent of printing presses and establishment of universities, the process of teaching evolved and the concept of formal higher education focused on both academics and research developed. In Education 3.0, technology has provided a platform that has greatly expanded access to education and changed the ways of learning. The traditional setting of a lecture hall has been transformed with the integration of new tools and technologies in teaching that help students learn virtually and deliver targeted information to them effectively. Today, a cusp of change is being introduced, where the learner will be at the center of the future ecosystem in Education 4.0. Education 4.0 empowers learners to structure their learning paths. It is characterized by personalization of the learning experience, where the learner has complete flexibility to be the architect of his or her own future and has the freedom to aspire, approach and achieve personal goals by choice. Increased innovation in teaching methods and availability of better learning opportunities supported by technology have been the major impetus for this shift toward personalization.

As Montealegre (2019) points out, with Education 4.0, the focus of education is now shifted to mobile learning, individualized learning playlist, flexible and customized curriculum, and hands-on and practical application of knowledge. The brains of the internet generation are developed in terms of visual ability. It is also evident that their brain is more prepared to grasp information in bites and chunk, drastically affecting their attention span by making it on the average of eight seconds in online platforms and seven to ten minutes in the classroom. Inevitably, this poses a challenge to the teachers. The teacher education curriculum should be innovative enough to train them on the pedagogy of this generation and equip them with the "content of the future", which includes software, hardware, digital, technological, and social media. Moreover, once they are already immersed in the teaching profession, they must be provided with meaningful, technology-focused, continuing professional development programs as they experience the transition from a traditional learning model to one that is learner-centered and technology-based.

2.2 International Technology Standards

The International Society for Technology in Education (ISTE) has been consistent in conducting studies and analyses on international standards for technology for education leaders, classroom teachers, and students. In the year 2000 for instance, the ISTE provided Technology Leadership Standards which include the following: (1) Technology Operations and Concepts; (2) Planning and Designing Learning Environments and Experiences; (3) Teaching, Learning, and the Curriculum; (4) Assessment and Evaluation; (5) Productivity and Professional Practice; (6) Social, Ethical, Legal, and Human Issues; (7) Procedures, Policies, Planning, and Budgeting for Technology Environments; and, (8) Leadership and Vision. Educational technology leaders should identify and apply educational and technology-related research, the psychology of learning, and instructional design principles in guiding the use of computers and technology in education, apply strategies for and knowledge of issues related to managing the change process in schools, apply effective group process skills, lead in the development and evaluation of district technology planning and implementation, and engage in supervised field-based experiences with accomplished technology facilitators and/or directors.

Aside from education leaders or school heads, the ISTE also provides the technology standards for classroom teachers. The original five (5) standards for teachers are: (1)

learning and creativity, and how to facilitate these qualities in students using technology; (2) learning experiences and assessments via technology, while teachers assess their own progress in the development of technology-enriched learning environments; (3) model digital-age work and learning in teaching, including their work with families, and action research activities; (4) promote and model digital citizenship and responsibility through "digital-age communication and collaboration"; and, (5) professional growth and leadership, for self-renewal and for a willingness to assume leadership roles.

2.3 Principals or School Heads as Technology Leaders

"To be a principal in the 21st century school demands leadership of technology. To be a leader of technology requires a willingness to learn, flexibility, and the capacity to accept change as a constant factor. Adaptability and acceptance of ambiguity are essential. Because technology changes continuously, there is no menu of technology must dos and must haves. Instead, leaders of technology must be lifelong learners and explorers of the new, the exciting, and the useful in technology."

This statement came from one of the principals interviewed by Grady (2011) for her article, "The Principal's Role as Technology Leader." Based on the article, the principal's role as technology leader includes establishing the vision and goals for technology in the school, carrying the technology banner in the school, modelling the use of technology, supporting technology use in the school, engaging in professional development activities that focus on technology and integration of technology in student learning activities, providing professional development opportunities for teachers and staff that emphasize the use of technology and that facilitate integration of technology in student learning, securing resources to support technology use and integration in the school, advocating for technology use that supports student learning, being knowledgeable and supportive of national technology standards and promoting attainment of the standards in the school, and communicating the uses and importance of technology in enhancing student learning experiences to the school's stakeholders.

Moreover, principals who are comfortable with technology become models of technology use in schools. Principals demonstrate their ease with technology by using e-mail, web sites, preparing reports illustrated with graphs and photos embedded in presentations, using the student information system to track the day-to-day operation of the school, and using handheld devices to complete teacher appraisals. Leaders of technology encourage implementation of technology in instructional strategies.

Technological developments have a great effect in our day to day lives which also brought about significant changes. One field that receives its effect is education. Cakir (2012) stated that technological developments have found their way into every area of our lives, and it appears as if the integration of technology into education is inescapable. Given the important place that technology has come to occupy in our lives, schools have a great responsibility to educate individuals who are capable of effectively using technology.

Duncan (2011) in his dissertation, "An Assessment of Principals Technology Leadership" stated that technology in the American public school system during the late 20th century was an instructional strategy. He further added that today, there is an increasing demand and requirements to quantify the learning process that has put new pressures on administrators to understand the uses of various technologies for administrative purposes in addition to instructional purposes.

The study of Seneca (2008) revealed the importance that administrators placed upon the obtainment of leadership skills in terms of technology. Participants noted the importance of understanding how to make informed decisions based upon data analysis. Furthermore, study results indicate that administrators understand and are willing to obtain the skills necessary to lead by example in terms of technology integration. They understood the importance of having the ability to work with teachers for the proper integration of technology and recognize the importance of encouraging and supporting these efforts in the classroom.

Banoglu (2011) in his study cited that the technology leader in a school is the person who mobilizes all school components by using technological devices. Furthermore, school principals have performed "significantly" in technology leadership proficiency. In compatibility with this, Akbaba-Altun (2004) and Celikten (2002) stressed that school principals have positive perception of using computers and other educational technologies in education. However, Saban et al. (2006) addressed that technology planning does not mean only allocating a fund for technology development from school budget, but also it covers to focus on explicitly technology oriented education understanding.

In the article, "Leadership Principles in Technology" from "The Knowledge Loom: Educators Sharing and Learning Together", school leaders must articulate a shared vision of how technology will be effectively used to support teaching, learning, and school management. Many stakeholders are affected by the integration of technology in schools; therefore, it is imperative that all audiences be identified and involved in the process. Creating and communicating your vision requires that you understand how educational technology impacts each audience and why it is important to each. When the vision is expressed in ways that are meaningful, stakeholders are more likely to share in the vision.

From the advancement of technology and its effect in the school in delivering the education to the students, different studies were conducted to see whether school heads have the capacity for their duties with regards to technological leadership in schools. Alkrdem (2014) stated in his study that, the expectations of students and of parents are increasing day by day. The teaching-learning and management process is transferred into a network environment via online systems, such as e-school. In this way, teachers, students, and parents can now reach information sources easily.

Another study was conducted to prove the importance of technology in education to the school heads of different institutions. As cited from "An Assessment of Principals' Technology Leadership: A Statewide Survey" by Jeffrey Duncan 2011, improved technology skills for educational leaders, similar to improving technology skills for teachers, are a necessary component for improved technology usage in the classroom. From the same study of Duncan, technology standards in education for public school administrators are a recent requirement in our era of working under educational standards.

2.4 Technology Leadership and Technology Integration

As cited in the study, "The 21st Century Principal: A Study of Technology Leadership and Technology Integration in Texas K-12 Schools" by Fisher et. al. (2003), in the classrooms today, the plethora of resources and relationships made easily accessible via the Internet is increasingly challenging teachers to revisit their roles as educators. Studies show that principals' technology-leadership proficiencies are a critically important factor in the effective use and integration of technology by teachers and students to support learning. Instructional technology is not a new concept; rather the idea of infusing technology into the curriculum has been around for the last century. The call for teachers to integrate technology into the curriculum, provide necessary skills for the 21st century workplace, and support best teaching practices has increased over the last 30 years; however, simply adding technology to a classroom does not make it a better learning environment.

The study of Samancioglu et. al. (2015) showed a weak but positive correlation between technology leadership roles of school administrators and teachers' technology use in their courses. As cited in the study, according to Yu and Durrington (2006), school principals play a major role in determining whether educational technologies will be used effectively. Chang et al. (2008) underscores that there is a strong relationship between technology leadership roles of school principals and teachers' integrating educational technologies into their courses, and argues that technology leadership is a requirement for effective use of technology in schools. Unlike the findings of the current study, Anderson and Dexter (2005) found in their study that technology leadership was a strong predictor of technology use and technology integration in schools.

The study, "Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools" (Ghavifekr & Rosdy, 2015) showed that technology-based teaching and learning is more effective compared to traditional classroom. This is because using ICT tools and equipment will prepare an active learning environment that is more interesting and effective for both teachers and students.

In the Philippines, Placido & Lachica (2015) concluded that public secondary school teachers from both coastal and upland areas considered ICT as a form of modern technology and as a tool. Teachers from coastal rural schools view ICTs a driver for change, a conduit for learning, and as an instrument utilized for teaching and learning. As a driver for change, ICTs enable actors in classroom communication to cope with the needs and opportunities in the 21st century. It brings about intellectual development through collaborative learning that promotes creative thinking and communication among learners. ICTs changed the way teaching and learning process is done.

Matulac (2016) concluded that the use of technology in order to attain a rich experience of learning is essential. He noted various lessons learned from utilizing technology in education such as, (a) teachers must be valued and respected - no matter how urgent change may be. Teachers should challenge themselves to move away from their comfort zones; (b) Presentation Tools are windows to how students think. Presentations can be multi-faceted and can even show the different intelligences of students; (c) Internet is a rich source of information; and, (d) the world is my classroom - a teacher must look beyond the walls of the school.

Gorra and Bhati (2016) concluded that most students in state colleges and universities of a certain Philippine region are likely to use technology in classroom for the purpose of positive consequences supporting the view that use of technology helps in enhancing learning related activities in classroom. However, the excitement of students in involving these technologies as part of their learning can cause also disruptions inside the classroom that being considered as negative consequences.

Leadership in school is very important for it helps the entire institution in their achievement. Creighton (2003) believes that technology linked to standards and learning objectives can help all students achieve and excel.

Since technology leadership is the main focus of this study, it particularly assessed the extent of technology leadership of school heads in selected Science high schools in the National Capital Region to examine how knowledgeable, skillful, and influential they are based on the standards provided by the ISTE for education leaders. Consequently, as

backed up with studies, this research further looked into the effect of technology leadership to the extent of technology integration of classroom teachers. This study may bring about innovations to technology leadership which leads to updating the knowledge and skills of teachers in relation to classroom teaching and management incorporating technology.

3. METHODOLOGY

The design of this study is quantitative – descriptive survey. According to Creswell (1994), quantitative research is explaining phenomena by collecting numerical data that are analyzed using mathematically-based methods, particularly statistics. A descriptive survey design provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population.

Furthermore, this study is both descriptive-correlational and descriptive comparative. Since this research sought to find out if there is a relationship between (a) technology leadership of school heads and their profile; (b) technology integration of teachers and their profile; and (c) technology integration of teachers and technology leadership of school heads as assessed by their teachers, hence, descriptive correlational which explores the relationship between variables using statistical analyses. According to Bordens and Abbott (2008), in correlational research, the main interest is to determine whether two or more variables covary and, if so, to establish the directions, magnitude, and form of the observed relationships.

On the other hand, since this research also sought to find out if there are significant differences between, (a) school heads' technology leadership self-assessment when grouped according to their profile, and (b) between teachers' assessment of and school heads' self-assessment on their technology leadership, hence, descriptive-comparative which essentially compares two or more groups by analyzing differences. Creswell (2012) describes comparative study as examining differences between two or more groups on a particular variable.

3.1 Respondents and Sampling Techniques

According to DePoy and Gitlin (1998), the main purpose of sampling is to select a sub-group that can accurately represent the population. For this study, respondents will come from Science high schools, where in the Philippine context, Science high schools are public high schools with a specialized science curriculum, and enrolment in these schools usually require passing an entrance exam.

Every city or municipality in the National Capital Region of the Philippines has either one (1) or two (2) Science high schools. To come up with the respondents, the researcher utilized purposive sampling to select the six (6) Science high schools. DePoy and Gitlin (1998) defines purposive sampling as involving deliberate selection of individuals based on predefined criteria, which primarily specific to this study, as being designated by the Department of Education (DepEd) as a Science high school that has the sole authority to offer and implement a specialized Science curriculum.

Furthermore, the following criteria were also considered: (1) deliberate inclusion of the pilot Science high school in the country; (2) deliberate inclusion of the regional Science high school in the National Capital Region; (3) inclusion of two (2) Science high schools from the northern part of the National Capital Region for geographical representation; (4) inclusion of two (2) Science high schools from the southern part of the National Capital Region for geographical representation; (5) the Science high school should have been established for not less than five (5) years to date; and, (6) the Science high school should have already won international awards.

Meanwhile, the total population of six (6) school heads and three hundred seventy seven (377) teachers from all selected Science high schools served as respondents. However, the total number of teacher-respondents was reduced to two hundred seventy three (273) due to reasons of (a) official leave of absence, and (b) non-participation of some teachers in the study. According to Del Siegle of the University of Connecticut, researchers are bound by rules of ethics which means that first and foremost, all research participants must give their permission to be part of a study and they must be given pertinent information to make an informed consent to participate.

3.2 Instruments

This study utilized two (2) researcher-made instruments. The first instrument was used to assess the extent of technology leadership of school heads and the second instrument was used to measure the extent of technology integration of teachers, both adapted and modified from the original sources, and validated by experts and pilot tested.

The first instrument was adapted and modified from the Principals Technology Leadership Assessment (PTLA) survey questionnaire developed by the Center for the Advanced Study of Technology Leadership in Education (CASTLE) of the University of Kentucky, United States of America. The Principals Technology Leadership Assessment (PTLA) is intended to assess principals' technology leadership inclinations and activities based on the National Educational Technology Standards for Administrators (NETS-A) of the International Society for Technology in Education (ISTE). This instrument was distributed to both sets of respondents, school heads and teachers, for self-assessment and for teachers to assess their school heads, respectively. The instrument included the six (6) technology leadership standards for school heads namely, (1) leadership and vision; (2) learning and teaching; (3) productivity and

professional practice; (4) support, management, and operations; (5) assessment and evaluation; and, (6) social, legal, and ethical issues. The rating scale provided in the instrument are fully (4), partially (3), minimally (2), and not at all (1).

On the other hand, the second instrument was adapted and modified from the "LoTi" (Levels of Teaching Innovation) Digital Age Survey, utilized by the researcher to know the extent of technology integration of teachers. This survey questionnaire is contributory to promoting digital age teaching, learning, and leadership as defined by the Partnership for 21st Century Skills (P21) and the International Society for Technology in Education (ISTE) Standards. Partnership for 21st Century Skills is a national advocacy organization that encourages schools, districts, and states to infuse technology into education, and provides tools and resources to facilitate that effort. The LoTi Digital Age Survey is comprised of a series of questions and statements about the instructional use of technology in the classroom and within the school or district. The portion on teacher statements inquire about the specific uses and integration of digital and/or environmental resources during instruction. The teacher statements represent a wide range of uses of digital and/or environmental resources that a teacher may currently experience or support, in varying degrees of intensity. The instrument included the four (4) areas for technology integration namely, (1) facilitating and inspiring student learning and creativity; (2) designing and developing digital age learning experiences and assessment; (3) promoting and modelling digital citizenship and responsibility; and (4) engaging in professional growth and leadership. The rating scale provided in the instrument are always (4), most of the time (3), occasionally (2), and never (1).

The survey instruments were initially validated by the five (5) panel members, then further validated by five (5) experts – one (1) educational technology specialist, one (1) doctorate degree holder in Technology Education, one (1) professor of Educational Technology, one (1) former University research director, and one (1) school head.

Prior to the actual conduct of the study, the survey instruments were pilot tested in two (2) schools – the first school is a Science high school and the second school is a technological university, for the purpose of establishing its internal consistency through Cronbach's alpha. The values obtained were 0.86 and 0.75 for the survey instruments for teachers and school heads, respectively. According to Taber (2018), alpha values of 0.73 and above are acceptable values.

3.3 Data Gathering Procedure

This study commenced by seeking approval and endorsement from the Regional Director of the Department of Education – National Capital Region for the conduct of survey to school heads and teachers of selected Science high schools in the same region. The researcher then submitted the approval and endorsement to the respective Schools Division Superintendents where the Science high school is located. Upon approval of the Schools Division Superintendents, courtesy calls with the six (6) school heads transpired with the purpose of seeking permission to conduct the research and informing the school heads of the context of the study. The actual floating and retrieval of survey questionnaires were done, then the researcher tabulated and summarized the responses of school heads and teachers in the survey instruments, and the data were subjected to the Statistical Package for the Social Sciences (SPSS) for statistical treatment.

After the data analysis and guided by the "Analysis, Design, Development, Implementation, and Evaluation" (ADDIE) model as a systematic approach to instructional designing, conceptualizing the format, contents, and electronic web design of the online training module followed. Subsequently, the module contents were initially written by the researcher, and thereafter, two (2) weeks were allotted for the validation of its contents by three (3) experts – an educational technology specialist, an educational technology innovator, and a Digital Rise educator. Based on the comments and suggestions of the experts, the module was subjected to final revisions. The final version of the training module was then converted into an online web format through the assistance of an Information Technology expert.

3.4 Ethical Considerations

All reasonable efforts were made to ensure the ethical treatment of respondents and data gathered in this research. Through an informed consent form, the following were assured - respondent involvement was voluntary, and the option to withdraw any time from the research was communicated. Confidentiality of the respondents was observed with respect to their responses to the survey instruments and in the presentation of the results in this paper.

3.5 Statistical Treatment of Data

In this study, descriptive statistical tools were applied to reveal the profile of the school heads and teachers. Results were reported using tables, frequency percentages, and means. Data collected were disaggregated by four (4) profile characteristics of age, sex, highest educational attainment, and years of service as school head or years of service in teaching. Meanwhile, inferential statistics was utilized to find possible relationships and significant differences between the selected variables.

- **Percentage**

To describe the profile of the school heads and teachers, the frequency and percentage was utilized.

$$\text{percentage (\%)of entry} = \frac{\text{frequency of entry}}{\text{total number of entries}} \times 100$$

- **Weighted Mean**

To describe both the extent of technology leadership of school heads based on the six (6) areas and the extent of technology integration of teachers based on the four (4) areas, the weighted mean was utilized.

$$\bar{x}_w = \frac{\sum_{i=1}^{n}(w_i \times x_i)}{\sum_{i=1}^{n}(w_i)}$$

- **Chi-square**

To determine if there is a significant relationship between the (a) technology leadership of school heads and their profile, and (b) technology integration of teachers and their profile, the Chi-square was used.

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

- **Pearson Product-Moment Correlation**

To know if there is a significant relationship between the technology integration of teachers and the technology leadership of school heads as assessed by their teachers, the Pearson-r was utilized:

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)}\sqrt{\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}}$$

- **T-test for Independent Means**

To determine significant differences between and among variables, the t-test for independent means and the analysis of variance (ANOVA) were used. The t-test was used to determine if there is a significant difference between teachers' assessment of and school heads' self-assessment on their technology leadership.

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}}}$$

- **Analysis of Variance**

Meanwhile, the analysis of variance (ANOVA) was used to know if there are significant differences among technology leadership and the selected profiles of the school heads.

Source of Variation	**d.f.**	**SS**	**MS**	**Fn**
Factor A (between groups)	$a-1$	$SSA = \sum_{i=1}^{a} n_i(\bar{y}_i - \bar{y}_{...})^2$	$MSA = \frac{SSA}{(a-1)}$	$\frac{MSA}{MSE}$
Factor B (between groups)	$b-1$	$SSB = \sum_{j=1}^{b} n_j(\bar{y}_j - \bar{y}_{...})^2$	$MSB = \frac{SSB}{(a-1)}$	$\frac{MSB}{MSE}$
Error (within groups)	$(a-1)(b-1)$	$SSE = SST - SSA - SSB$	$MSE = \frac{SSE}{(a-1)(}$	
Total	$N-1$	$SST = \sum_{i=1}^{a} n_i \sum_{j=1}^{n} n_i (\bar{y}_{ij} - \bar{y}_{...})^2$		

4. RESULTS

Table 1. Frequency and Percentage Distribution of the School Heads According to Age

Age	f	%
30-39 years old	2	33.3
40-49 years old	3	50.0
50-59 years old	1	16.7
Total	6	100%

Table 1 shows the distribution of school heads according to age. Three (3) or 50% belong to the 40-49 years old age bracket, followed by two (2) or 33.3% who belong to the 30-39 years old age bracket. Only one (1) school head or 16.7% fall in the 50-59 years old age bracket.

Based on foreign perspective, the data from the present study affirm the results of the study of Hill, et. al. (2016) that the change in average age over time of school heads was significant within the public and private schools in the United States setting. The average age of public school principals increased from 46.8 years in 1987 to 1988, to 49.3 years in 1999 to 2000, but then decreased to 48.0 years in 2011 to 2012.

It can also be noted from the table that two (2) principals are relatively younger. According to Akman (2019), a growing number of young principals are bringing

enthusiasm, optimism, energy, and new skills to their schools. They have landed school headship after making their mark as teachers, climbing the ranks through principal-training programs, or finding themselves in the right place at the right time. Millennial principals respond to the traits of educational leaders needed in this technology age - idealistic, collaborative, socially active, highly driven, and technologically-savvy - those who understand digital content and can traverse the digital environment.

Table 2. Frequency and Percentage Distribution of the School Heads According to Sex

Sex	f	%
Male	2	33.3
Female	4	66.7
Total	6	100%

As to the distribution of school heads according to sex, table 2 shows that four (4) or 66.7% are females and only two (2) or 33.3% are males.

These data from the present study affirm the study of Guiab and Ganal (2014) which reveals that 57.14% (12) are female principals and only 42.86% (9) are male principals in the elementary schools in Alicia, Isabela, Philippines. On the other hand, the current data oppose the percentage distribution in secondary public schools in the same vicinity, wherein only 33.33% (1) is a female principal while 66.7% (2) are male principals. However, looking at the combined number of principals from the elementary and secondary schools in the locale, the total number of school heads implies that there are still more female principals than males.

Table 3. Frequency and Percentage Distribution of the School Heads According to Highest Educational Attainment

Highest Educational Attainment	f	%
With Master's units	2	33.3
Master's degree	1	16.7
With Doctorate units	3	50.0
Total	6	100%

Table 3 presents the distribution of school heads according to highest educational attainment. Three (3) of them or 50% earned doctorate units, two (2) or 33.3% are with Master's units already, and only one (1) school head or 16.7% is a full-fledged Master's degree holder.

If Philippine colleges and universities offer various graduate programs on educational management, administration, and leadership, Young, et. al. (2018) found out otherwise in their United States study. The number of degrees conferred by principal preparation programs nationally declined by roughly 19% from 2010 to 2015. Moreover, the relative proportion of degrees awarded by research universities has also decreased since 2010. Significant to note from the same study, a larger proportion of females are earning degrees from principal preparation programs. In 2016 for instance, approximately 66.4% of graduates were females and 33.6% were males.

Table 4. Frequency and Percentage Distribution According to Years of Service as School Head

Years of Service as School Head	f	%
1-5 years	4	66.7
26-30 years	1	16.7
36 years and above	1	16.7
TOTAL	6	100%

Table 4 shows the distribution of school heads according to number of years in their current position. Four (4) school heads or 66.7% are in their current position for 1-5 years as of this date. There is only one (1) or 16.7% who is in the service as school head for 26-30 years, and another one (1) or 16.7% who has been serving as school head for more than 35 years already.

These data from the present study agree with the data from the study of Thannimalai and Raman (2018) wherein 65 of the principals had 2 to 10 years of experience (72.2%), followed by 14 (15.6%) who had less than a year's experience, 7 had 11-20 years of experience (7.8%), and only 4 of the principals had more than 21 years of experience (4.4%).

The implication of being relatively young in the service was discussed by Walker, et. al. (2003). First time principals were often surprised by the high expectations related to their new roles and the sense that they were expected to have answers to the many problems in the school. The transition from being a classroom teacher to becoming a principal resulted in considerable role confusion. These factors contributed to a sense of unpreparedness in the face of unexpected demands on these neophyte principals. Though many first-time principals reacted strategically to address their newfound difficulties, the general findings from the study centered on training and experience related to administration of schools. Many of the first time principals had limited specific preparation for the principalship and only a few had related administrative experience.

Table 5. Frequency and Percentage Distribution of Teachers According to Age

Age	f	%
20-29 years old	76	27.8
30-39 years old	103	37.7
40-49 years old	56	20.5
50-59 years old	34	12.5
60-65 years old	4	1.5
Total	273	100%

Table 5 presents the distribution of teachers according to age. Majority of them, one hundred three (103), or 37.7% are 30-39 years old, followed by seventy six (76) or 27.8% who are 20-29 years old. Fifty six (56) or 20.5% of the teachers belong to the 40-49 years old age bracket; thirty four (34) or 12.5% belong to the 50-59 years old age bracket; and only four (4) teachers or 1.5% are 60-65 years old.

This high number of young teaching professionals in the Philippines is mainly due to the massive hiring of teachers which commenced during the onset of the K to 12 curriculum. Dela Cruz (2019) in her Business Mirror article says that the Department of Education (DepEd) targeted to hire 10,000 new teachers as of 2019. With this influx of young educators, it is important to note from the study of Rogayan Jr. (2018) that young teachers have the following reasons for teaching: to bring transformational change, prepare students for life, being an inspiration, values promotion, transforming lives, teaching for as a life mission, setting a higher bar of excellence in the field, curing societal dilemmas, sharing basic skills, and enabling others' dreams.

Table 6. Frequency and Percentage Distribution of Teachers According to Sex

Sex	F	%
Male	92	33.7
Female	181	66.3
Total	273	100%

As to the distribution of teachers according to sex, table 6 shows that one hundred eighty one (181) or 66.3% are females while ninety two (92) or 33.7% are males.

The Philstar global article, "Teacher education regains popularity" (2017), says that teaching is still a female-dominated profession in the Philippines. Of the educators nationwide, twice as many male educators have graduated over eleven (11) years. In figures, a total of 9,564 male education students graduated in 2004. In 2014, the figure rose to 15,187. Yet they are still far outnumbered by women; in which only one in four teachers is a male.

Table 7. Frequency and Percentage Distribution of Teachers According to Highest Educational Attainment

Highest Educational Attainment	f	%
Bachelor's degree	78	28.6
With Master's units	149	54.6
Master's degree	37	13.6
With Doctorate units	7	2.6
Doctorate degree	2	0.7
Total	273	100%

Table 7 shows the distribution of teachers based on their highest educational attainment. Most of them, one hundred forty nine (149), or 54.6% obtained Master's units. This is followed by seventy eight (78) teachers or 28.6% who are Bachelor's degree holders. Thirty seven (37) or 13.6% are full-fledged Master's degree holders; seven (7) or 2.6% obtained some doctorate units; and, two (2) teachers or 0.7% are full-fledged Doctorate degree holders.

The high number of teachers pursuing Master's degree is a fact that goes beyond the Philippine setting. Horn and Jang (2017) laid down that 48% of teachers held a master's degree in U.S. public schools, and 9% of teachers held a doctoral degree. States and school districts frequently promote graduate education as a means of improving teacher effectiveness, however, this approach is not uniformly efficacious. Overall, past research depicts a complex, poorly understood relationship between teacher educational attainment and student outcomes that may vary by such factors as level of schooling and academic subject.

Table 8. Frequency and Percentage Distribution of Teachers According to Years of Service in Teaching

Years of Service in Teaching	f	%
1-5 years	85	31.1
6-10 years	59	21.6
11-15 years	60	22.0
16-20 years	31	11.4
21-25 years	20	7.3
26-30 years	3	1.1
31-35 years	11	4.0
36-40 years	2	0.7
41 years and above	2	0.7
Total	273	100%

The distribution of teachers based on their number of years in teaching is shown in table 8. Eighty five (85) of them or 31.1% has been teaching for 1-5 years, followed by sixty (60) or 22% who has been teaching for 11-15 years as of this date. Fifty nine (59) teachers or 21.6% are in the 6-10 years in teaching bracket; thirty one (31) or 11.4% who belong to the
16-20 years in teaching bracket; twenty (20) or 7.3% who are in the 21-25 years in teaching bracket; and, eleven (11) teachers or 4.0% who belong to the 31-35 years in teaching

bracket. There are only three (3) teachers or 1.1% who have been teaching for 26-30 years; two (2) or 0.7% who have been teaching for 36-40 years; and another two (2) or 0.7% who have been teaching for 41 years and above.

Most teachers in the present study are in active service for only 1-5 years due to the abrupt high demand for teachers due to the implementation of the K to 12 curriculum. Mateo (2018) said that the Department of Education (DepEd) should have hired an additional 75,000 teachers to further reduce the class size and decongest classrooms in public elementary and high schools nationwide.

Table 9. Extent of Technology Leadership of School Heads as assessed by themselves in the area of Leadership and Vision

LEADERSHIP AND VISION	WM	VI
1. To what extent did you participate in your division's or school's most recent technology planning process?	3.33	F
2. To what extent did you communicate information about your division's or school's technology planning and implementation efforts to your school's stakeholders (parents, barangay officials, government and private organizations and students)?	3.17	P
3. To what extent did you promote participation of your school's stakeholders (parents, barangay officials, government and private organizations and students) in the technology planning process of your school or division?	3.17	P
4. To what extent did you compare and align your division or school technology plan with other plans such as your school improvement plan (SIP) and annual improvement plan (AIP)?	3.33	F
5. To what extent did you compare and align your division or school technology plan with other plans such as instructional plans or lesson plans/daily lesson logs of teachers?	3.50	F
6. To what extent did you advocate for inclusion of research-based technology practices in your school improvement plan (SIP)?	2.83	P
7. To what extent did you engage in activities to identify best practices in the use of technology (e.g. reviews of literature, attendance at relevant conferences, or meetings of professional organizations)?	2.83	P
AVERAGE	3.17	P

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 9 presents the self-assessment results of school heads on their technology leadership in the area of leadership and vision. It can be noticed that three (3) items are being fully implemented and the other four (4) items are only partially implemented. These four partially implemented items include communicating technology planning and implementation efforts to stakeholders, promoting participation of stakeholders, inclusion of research-based technology practices in the school improvement plan, and engaging in activities to identify best practices in the use of technology. Overall, leadership and vision is partially implemented by the school heads.

This overall partial implementation of school heads in the area of leadership and vision affirms the results of the study of Thannimalai and Raman (2018) which reveals that out of the five (5) constructs of technology leadership, one of the lowest means goes to Visionary Leadership. In addition to this, Hamzah, et. al. (2010) also found out that while technology leadership elements exist in schools, the area of vision and leadership is only at the average level.

As stipulated in "Reimagining the Role of Technology in Education" (2017), education leaders should communicate with all stakeholders by using appropriate media and technology tools and establish effective feedback loops. While implementing the vision through a collaboratively developed strategic plan, leaders have to use technology as a learning tool for both students and teachers. Leaders are bound to be creative and forward-thinking in securing sustainable streams of human and capital resources to support their efforts, including appropriate partnerships both within their institutions and beyond.

Table 10. Extent of Technology Leadership of School Heads as assessed by themselves in the area of Learning and Teaching

LEARNING AND TEACHING	WM	VI
1. To what extent did you provide or make available assistance to teachers to use technology for analyzing and interpreting student assessment data such as National Achievement Test (NAT) and summative tests results?	3.17	P
2. To what extent did you provide or make available assistance to teachers (or coursed through the master teachers/head teachers) for using student assessment data to modify instruction?	2.83	P
3. To what extent did you disseminate or model best practices in learning and teaching with technology to teachers?	2.83	P
4. To what extent did you provide support (e.g., budget allowance) to teachers who were attempting to share information about technology practices, issues, and concerns?	3.50	F
5. To what extent did you organize or conduct assessments of teachers' needs (Needs Based Assessment) related to professional development on the use of technology?	2.83	P
6. To what extent did you facilitate or ensure the delivery of professional development (e.g., Learning Action Cell, In-Service Training for Teachers) on the use of technology to teachers?	3.00	P
AVERAGE	3.03	P

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

The self-assessment results of school heads on their technology leadership in the area of learning and teaching is shown in table 10. Only one (1) item is being implemented fully with a weighted mean of 3.50; while the rest of the items are being implemented partially. Overall, the area of learning and teaching is only partially implemented as per average weighted mean of 3.03.

This partial implementation of learning and teaching area may pose concerns since the study of Billheimer (2007) revealed that learning and teaching was considered important to the role of the principal. It implies that the principal as an instructional leader is essential which corresponds to the obtained high mean score from the said study.

With this, it is necessary for school heads to focus on the learning and teaching aspect of their technology leadership so as to consequently develop the Information and Communications Technology (ICT) competencies of their teachers in the long run. Based on the United Nations Educational, Scientific, and Cultural Organization or UNESCO's ICT Competency Framework for Teachers (2011), the aim of the knowledge creation approach to technology integration is to increase productivity by creating

students, citizens, and a workforce that is continually engaged in, and benefits from knowledge creation, innovation and life-long learning. This means that teachers in this approach should not only be able to design classroom activities that advance these goals but also participate in the development of programs within their school that advance these goals.

As regards providing professional training to teachers, Dunham (2012) revealed in her study that principals included professional training for teachers, ensuring that teachers were trained not only on how to use the technology devices, but also on how to incorporate technology resources and materials to enhance instruction in the classroom. Moreover, these principals modeled the use of technological devices, and supported and expected teachers to integrate technology throughout the curriculum.

Table 11. Extent of Technology Leadership of School Heads as assessed by themselves in the area of Productivity and Professional Practice

PRODUCTIVITY AND PROFESSIONAL PRACTICE	WM	VI
1. To what extent did you participate in professional development activities meant to improve or expand your use of technology?	3.33	F
2. To what extent did you use technology to help complete your day-to-day tasks (e.g., developing budgets, communicating with others, gathering information)?	3.67	F
3. To what extent did you use technology-based management systems to access teacher records?	3.50	F
4. To what extent did you use technology-based management systems to access student records?	3.50	F
5. To what extent did you use technology (e.g. e-mail, blogs, video conferences) as a means of communicating with internal school stakeholders - teachers, students, and their parents/guardians?	3.50	F
6. To what extent did you use technology (e.g. e-mail, blogs, video conferences) as a means of communicating with external school stakeholders - other educational institutions, non-education government and private organizations, and the barangay officials?	3.50	F
AVERAGE	3.50	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 11 presents the self-assessment results of school heads on their technology leadership in the area of productivity and professional practice. It can be noted that all items in this area are being fully implemented by the school heads. The average weighted mean of 3.50 is interpreted as fully implemented.

The full implementation of school heads in this area responds to Morrison's (2006) article where it was implied that the traditional role of the principal has been to manage the school's day-to-day operations. However in today's world, principals are also expected to be architects of change by modelling and encouraging effective practices. In addition to that, Anderson, an instructional technology specialist points out, "Principals still need all the other qualities that have always been associated with leadership, but if they don't stay current with technology, principals may lose the respect of those around them." Unfortunately, some principals may be unsure about their own technology knowledge and skills. Although technology training for teachers is an integral part of most schools' professional development plans, similar programs for principals are rare. Furthermore as stated in the article, principals are expected to model effective technology use on a daily basis, hence, demonstrating to the faculty that they value the efficacy of technology in performing everyday tasks and makes it evident that the principals are personally embracing the initiative.

Table 12. Extent of Technology Leadership of School Heads as assessed by themselves in the area of Support, Management, and Operations

SUPPORT, MANAGEMENT, AND OPERATIONS	WM	VI
1. To what extent did you support teachers in connecting to and using division- and building-level technology systems for management and operations (e.g., management information system, electronic class record, curriculum management system)?	3.33	F
2. To what extent did you allocate school discretionary funds (MOOE) to help meet the school's technology needs?	3.33	F
3. To what extent did you pursue supplemental funding to help meet the technology needs of your school?	3.00	P
4. To what extent did you ensure that hardware and software replacement/upgrades were incorporated into school technology plans?	3.00	P
5. To what extent did you advocate at the division level for adequate, timely, and high-quality technology support services?	3.00	P
6. To what extent did you investigate how satisfied teachers were with the technology support services provided by your division/school?	3.17	P
AVERAGE	3.14	P

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 12 shows the results of self-assessment of school heads on their technology leadership in the area of support, management, and operations. Majority of the items are only partially implemented and only two (2) items are being fully implemented by the school heads which include supporting teachers in connecting to and using division- and building-level technology systems for management and operations, and allocating discretionary funds to meet school's technology needs. On the average, the area of support, management, and operations is only partially implemented.

Focusing on allocating discretionary funds to meet technology needs, this element was emphasized in the study of Ochada and Gempes (2018) where "Principal's Proper Implementation/Utilization of Fund" emerged as the first major theme of the lived experiences of teachers regarding Maintenance and Other Operating Expenses (MOOE) allocation. The participants of the study revealed that MOOE utilization of fund was properly managed and utilized. It has been noted that the principal has created committees to assist on the proper implementation of MOOE fund.

Table 13. Extent of Technology Leadership of School Heads as assessed by themselves in the area of Assessment and Evaluation

ASSESSMENT AND EVALUATION	WM	VI
1. To what extent did you promote or model technology-based systems to collect student assessment data?	3.00	P
2. To what extent did you promote the evaluation of instructional practices, including technology-based practices, to assess their effectiveness?	3.00	P
3. To what extent did you assess and evaluate existing technology-based administrative and operations systems for modification or upgrade?	3.00	P
4. To what extent did you evaluate the effectiveness of professional development offerings in your school to meet the needs of teachers and their use of technology?	3.33	F
5. To what extent did you include the effective use of technology as a criterion for assessing the performance of teachers?	3.17	P
AVERAGE	3.10	P

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

The results of self-assessment of school heads on their technology leadership in the area of assessment and evaluation is presented in table 13. It can be noted that only one (1) item is being implemented fully by the school heads while the rest of the items are implemented partially. The average weighted mean of 3.10 means that the area of assessment and evaluation is only partially implemented.

This overall partial implementation in the area of assessment and evaluation conforms to the article from Education World 2012, which revealed that most principals do not know what to look for when assessing classroom technology use. The following are suggested questions that should be answered during classroom observations: (1) What specifically is the teacher doing with technology within the classroom?; (2) Is the teacher using technology *with* the current curriculum?; (3) What standards are being used in relation to the technology?; and, (4) What evidence of the *results* of technology use are displayed in the classroom? All of these should lead to technology extending the lessons in visible ways.

On the affirmative side, the current study revealed that the element of evaluating the effectiveness of professional development offerings in the school to meet the needs of teachers and their use of technology is being fully implemented. With this, Zimmerman (2018) pointed out five (5) key points to guide teachers and coaches through a professional-development curriculum: (1) Content Focus; (2) Active Learning; (3) Sustained Duration; (4) Collective Participation; and (5) Coherence.

Table 14. Extent of Technology Leadership of School Heads as assessed by themselves in the area of Social, Legal, and Ethical Issues

SOCIAL, LEGAL, AND ETHICAL ISSUES	WM	VI
1. To what extent did you work to ensure equity of technology access and use in your school?	3.50	F
2. To what extent did you implement policies or programs meant to raise awareness of technology-related social, ethical, and legal issues for teachers and students?	3.67	F
3. To what extent were you involved in enforcing policies related to copyright and intellectual property (Republic Act 8293)?	3.67	F
4. To what extent did you support the use of technology to help meet the needs of teachers?	3.67	F
5. To what extent did you support the use of technology to help meet the needs of students?	3.50	F
6. To what extent were you involved in addressing issues related to privacy and online safety (e.g., Republic Act 10173 or Data Privacy Act and Republic Act 10175 or Cybercrime Prevention Act)?	3.33	F
7. To what extent did you support the use of technology to assist in the delivery of special education programs such as Alternative Learning System, Madrasah, and Special Education?	3.17	P
8. To what extent did you disseminate information about health concerns related to technology and computer usage in classrooms and offices?	3.00	P
AVERAGE	3.44	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 14 shows the self-assessment results of the school heads on their technology leadership in the area of social, legal, and ethical issues. Majority of the items are implemented fully while there are only two (2) items which are being implemented partially by the school heads. These two include supporting the use of technology to assist in the delivery of special education programs, and disseminating information about health concerns related to technology and computer usage in classrooms and offices. Overall, the area of social, legal, and ethical issues are implemented fully by the school heads with an average weighted mean of 3.44.

The partial implementation on the element of health concerns related to technology use affirms the study of Lai (2006) which revealed that not a single secondary school from the research locale had a policy on health and safety issues associated with computer use. 85% of the primary and 86% of the secondary school principals felt the need for some kind of policy and guidelines. A number of school heads preferred that policies be developed by the ministry of education. Some principals also felt that since "computer use is being imposed upon schools" and the "new curriculum initiatives require that schools be equipped with computers", the ministry of education therefore should be responsible for developing and disseminating guidelines for computer use in schools.

As regards the partial implementation of the element of technology support to special programs, it can be deduced from the fact that only selected schools provide special education programs, and that Science high schools are not directly focused on and involved in it. Based on a Sunstar article (2017), DepEd has recognized only 648 Special Education (SPED) Centers and 177 regular high schools that offer the SPED program. The Alternative Learning System (ALS) is another special program provided by the DepEd. Malipot (2019) considered it as one of DepEd's flagship programs serving as an "alternate or substitute when one does

not have or cannot access formal education in schools" and includes both the non-formal and informal sources of knowledge and skills. In 2018, DepEd data showed that there are 823,301 students enrolled in the ALS program. Both the SPED and ALS, however, is not a priority program of Science high schools.

Table 15. Summary Ranking of School Heads' Technology Leadership Areas as assessed by themselves based on Average

Technology Leadership Area	Weighted Mean Average	Rank
Leadership and Vision	3.17	3
Learning and Teaching	3.03	6
Productivity and Professional Practice	3.50	1
Support, Management, and Operations	3.14	4
Assessment and Evaluation	3.10	5
Social, Legal, and Ethical Issue	3.44	2

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 15 presents the ranking of technology leadership areas as assessed by the school heads themselves based on the weighted mean average. It can be noticed that based on the rank, the two (2) areas on top of the list are (1) productivity and professional practice, and (2) social, legal, and ethical issues, hence, fully implemented as perceived by the school heads themselves. On the other hand, the lowest ranking four (4) areas are on (1) leadership and vision, (2) support, management, and operations, (3) assessment and evaluation, and (4) learning and teaching, hence, only partially implemented as perceived by the school heads themselves.

Table 16. Extent of Technology Leadership of School Heads as assessed by their teachers in the area of Leadership and Vision

LEADERSHIP AND VISION	WM	VI
1. To what extent did your school head participate in your division's or school's most recent technology planning process?	3.47	F
2. To what extent did your school head communicate information about your division's or school's technology planning and implementation efforts to your school's stakeholders (parents, barangay officials, government and private organizations and students)?	3.44	F
3. To what extent did your school head promote participation of your school's stakeholders (parents, barangay officials, government and private organizations and students) in the technology planning process of your school or division?	3.41	F
4. To what extent did your school head compare and align your division or school technology plan with other plans such as your school improvement plan (SIP) and annual improvement plan (AIP)?	3.45	F
5. To what extent did your school head compare and align your division or school technology plan with other plans such as instructional plans or lesson plans/daily lesson logs of teachers?	3.40	F
6. To what extent did your school head advocate for inclusion of research-based technology practices in your school improvement plan (SIP)?	3.46	F
7. To what extent did your school head engage in activities to identify best practices in the use of technology (e.g. reviews of literature, attendance at relevant conferences, or meetings of professional organizations)?	3.41	F
AVERAGE	3.44	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 16 presents the results of teachers' assessment on their school heads' technology leadership in the area of leadership and vision. It can be noticed that all items are perceived by the teachers as being fully implemented by their school heads, with participating in technology planning process obtaining the highest weighted mean of 3.47. The average weighted mean is 3.44 which corresponds to full implementation.

While it is good that teachers in the present study perceive a full implementation of leadership and vision from their school heads, the wide scale problem of poverty in developing countries such as the Philippines may still impede advancements in education and educational technology. According to Jhurree (2005), the reality of educational challenges in many developing countries is not obscure. For instance, Africa is considered to be the poorest continent and it is overrun by a plethora of problems ranging from political instability and social unrest, to disease and poverty. It is also difficult to obtain figures to gauge the technological and digital divide between Africa and the rest of the world. Access to technology and ICT correlates with the economic health of a country. Many developing countries do not have the resources that other countries have. The major disparities lie in the following areas: (1) Vision of an education for the 21st century – many countries have little or no vision on the need to reform their education systems and their commitment to accommodate the challenges they will face in the global market economy of the 21st century; (2) An economic reality – many countries do not have the financial means to support technology integration in schools; and, (3) Infrastructure – many countries do not even have a proper physical school infrastructure, such as libraries, classroom furniture, electricity, and telephone lines.

Table 17. Extent of Technology Leadership of School Heads as assessed by their teachers in the area of Learning and Teaching

LEARNING AND TEACHING	WM	VI
1. To what extent did your school head provide or make available assistance to teachers to use technology for analyzing and interpreting student assessment data such as National Achievement Test (NAT) and summative tests results?	3.33	F
2. To what extent did your school head provide or make available assistance to teachers (or coursed through the master teachers/head teachers) for using student assessment data to modify instruction?	3.35	F
3. To what extent did your school head disseminate or model best practices in learning and teaching with technology to teachers?	3.37	F
4. To what extent did your school head provide support (e.g., budget allowance) to teachers who were attempting to share information about technology practices, issues, and concerns?	3.28	F
5. To what extent did your school head organize or conduct assessments of teachers' needs (Needs Based Assessment) related to professional development on the use of technology?	3.24	P
6. To what extent did your school head facilitate or ensure the delivery of professional development (e.g., Learning Action Cell, In-Service Training for Teachers) on the use of technology to teachers?	3.49	F
AVERAGE	3.35	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

The results of teachers' assessment on their school heads' technology leadership in the area of learning and teaching is shown in table 17. Only one (1) item is perceived to be partially implemented by their school heads which is organizing or conducting assessment of teachers' needs related to professional development on the use of technology. The rest of the items are perceived to be fully implemented. Overall, the area of learning and teaching is being fully implemented with an average weighted mean of 3.35.

The area of learning and teaching is crucial since it is the core function of every educational institution. Therefore, the integration of technology in learning and teaching should also be a primary concern given the current generation of learners in schools. Unfortunately based on the article of Ra and Ping (2018), a recent Asian Development Bank report concludes that ICT has not had a significant impact in South Asia, partly because it has not been adopted at scale. Students' use of ICT is often not an integral part of the teaching and learning process. In Bangladesh and Nepal for instance, ICT in education approaches are not always coherent at national level. Utilization is low because most schools have limited ICT tools and infrastructure, and teacher competency levels are basic. Teachers need technical, content and pedagogical support to optimize the potential of ICT for education.

Table 18. Extent of Technology Leadership of School Heads as assessed by their teachers in the area of Productivity and Professional Practice

PRODUCTIVITY AND PROFESSIONAL PRACTICE	WM	VI
1. To what extent did your school head participate in professional development activities meant to improve or expand his/her use of technology?	3.41	F
2. To what extent did your school head use technology to help complete his/her day-to-day tasks (e.g., developing budgets, communicating with others, gathering information)?	3.48	F
3. To what extent did your school head use technology-based management systems to access teacher records?	3.35	F
4.To what extent did your school head use technology-based management systems to access student records?	3.40	F
5. To what extent did your school head use technology (e.g. e-mail, blogs, video conferences) as a means of communicating with internal school stakeholders - teachers, students, and their parents/guardians?	3.41	F
6. To what extent did your school head use technology (e.g. e-mail, blogs, video conferences) as a means of communicating with external school stakeholders - other educational institutions, non-education government and private organizations, and the barangay officials?	3.33	F
AVERAGE	3.40	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 18 presents the results of the assessment of teachers on the technology leadership of their school heads in the area of productivity and professional practice. It can be noted that all items are perceived to be fully implemented by their school heads, particularly using technology to help complete day-to-day tasks obtaining the highest weighted mean of 3.48. Generally, the area of productivity and professional practice is implemented fully.

Focusing on the element of communicating with internal and external stakeholders, Cator and Kinney (2017) pointed out the importance and challenges of keeping stakeholders not only informed, but also engaged. It seems the breadth of school stakeholders has grown over the past decades. Today, the list of stakeholders who school leaders must keep apprised of their school activities and direction has expanded. Local elected officials, business owners, religious and cultural leaders, and a myriad of community organizations, as well as students themselves, are all critical audiences with whom effective and progressive school leaders are seeking to engage in an effort to support the success of all learners. Engaging the influencers will come from an ever-deepening understanding of the community and where they get their information, as well as developing strategies for identifying, owning, and sharing the stories that showcase powerful teaching and learning.

Table 19. Extent of Technology Leadership of School Heads as assessed by their teachers in the area of Support, Management, and Operations

SUPPORT, MANAGEMENT, AND OPERATIONS	WM	VI
1. To what extent did your school head support teachers in connecting to and using division- and building-level technology systems for management and operations (e.g., management information system, electronic class record, curriculum management system)?	3.41	F
2. To what extent did your school head allocate school discretionary funds (MOOE) to help meet the school's technology needs?	3.26	F
3. To what extent did your school head pursue supplemental funding to help meet the technology needs of your school?	3.34	F
4. To what extent did your school head ensure that hardware and software replacement/upgrades were incorporated into school technology plans?	3.26	F
5. To what extent did your school head advocate at the division level for adequate, timely, and high-quality technology support services?	3.30	F
6. To what extent did your school head investigate how satisfied teachers were with the technology support services provided by your division/school?	3.23	P
AVERAGE	3.30	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

The results of teachers' assessment on the technology leadership of their school heads in the area of support, management, and operations is presented in table 19. Only one (1) item is perceived to be partially implemented by the school heads which is investigating how satisfied teachers were with the technology support services provided by the division or school. The average weighted mean of 3.30 tells us that the area of support, management, and operations is being fully implemented.

Habler, et. al. (2016) highlighted the importance of successful introduction of technology in schools: technology management, appropriate infrastructure and overcoming barriers. Effective technology management, underpinned by sound change management principles, is critical to the successful introduction of educational technologies in schools. An existing technical team may successfully play the role of a change agent, while the cultivation of a supportive school culture that fosters collegiality and teacher empowerment at different levels can be pivotal for the effective introduction of technology. Development of rigorous contingency plans from the outset is essential for school-based education technology projects. When assessing investment in technology, educators should also acknowledge that this is most effective when there is a holistic strategy to integrate digital and non-digital resources. The school's infrastructure needs to facilitate the use of the technology being introduced.

Table 20. Extent of Technology Leadership of School Heads as assessed by their teachers in the area of Assessment and Evaluation

ASSESSMENT AND EVALUATION	WM	VI
1. To what extent did your school head promote or model technology-based systems to collect student assessment data?	3.32	F
2. To what extent did your school head promote the evaluation of instructional practices, including technology-based practices, to assess their effectiveness?	3.36	F
3. To what extent did your school head assess and evaluate existing technology-based administrative and operations systems for modification or upgrade?	3.32	F
4. To what extent did your school head evaluate the effectiveness of professional development offerings in your school to meet the needs of teachers and their use of technology?	3.35	F
5. To what extent did your school head include the effective use of technology as a criterion for assessing the performance of teachers?	3.36	F
AVERAGE	3.34	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 20 shows the assessment results of teachers on the technology leadership of their school heads in the area of assessment and evaluation. It can be noted that all items in this area are perceived by the teachers to be fully implemented by the school heads. Overall, assessment and evaluation area is being fully implemented with an average weighted mean of 3.34.

The findings in the study of Foley (2016) show that principals used the educator evaluation process to have open and honest discussions about classroom practices. These types of conversations can cause people to reflect on their own beliefs and create an opportunity to develop new understandings. Principals celebrated successes with technology and established goals on an individual basis. They were unanimous in not using the evaluation system to penalize technology mishaps or the non-use of technology. These opportunities and conversations support critical reflection, feedback, and personal goals among teachers to help develop teachers' technology knowledge and skills. The conditions of critical reflection, feedback, and personal goals is required for growth and development. Principals promote the condition of critical reflection through discussions that prompts teachers to think about their own experiences, attitudes, opinions, and beliefs and the ways they integrate technology. Principals promote the condition of feedback with private and honest conversations with teachers regarding classroom observations and technology use.

As cited in the study, Galster (2013) investigated principal behaviors that support innovative practices and found that principals perceived observations, evaluations, and feedback helpful to inspire new classroom practices; however, that study also found out that teachers did not find those practices helpful. Moreover, O'Dwyer, et. al. (2005) found out that principals who included technology integration as part of the educator evaluation process influenced the rate of technology use in classrooms.

Table 21. Extent of Technology Leadership of School Heads as assessed by their teachers in the area of Social, Legal, and Ethical Issues

SOCIAL, LEGAL, AND ETHICAL ISSUES	WM	VI
1. To what extent did your school head work to ensure equity of technology access and use in your school?	3.35	F
2. To what extent did your school head implement policies or programs meant to raise awareness of technology-related social, ethical, and legal issues for teachers and students?	3.40	F
3. To what extent was your school head involved in enforcing policies related to copyright and intellectual property (Republic Act 8293)?	3.34	F
4. To what extent did your school head involve in addressing issues related to privacy and online safety (e.g., Republic Act 10173 or Data Privacy Act and Republic Act 10175 or Cybercrime Prevention Act)?	3.35	F
5. To what extent did your school head support the use of technology to help meet the needs of teachers?	3.42	F
6. To what extent did your school head support the use of technology to help meet the needs of students?	3.40	F
7. To what extent did your school head support the use of technology to assist in the delivery of special education programs such as Alternative Learning System, Madrasah, and Special Education?	3.10	P
8. To what extent did your school head disseminate information about health concerns related to technology and computer usage in classrooms and offices?	3.27	F
AVERAGE	3.33	F

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 21 presents the results of teachers' assessment on their school heads' technology leadership in the area of social, legal, and ethical issues. All of the items are perceived to be fully implemented except for one (1) item perceived to be partially implemented, that is, supporting the use of technology to assist in the delivery of special education programs. Overall, this area is being implemented fully as per average weighted mean of 3.33.

Akcay (2008) noted that teachers are important elements in the education system. Since they are responsible for the development of students, teachers need to be aware of ethical responsibilities. Teachers should be good role models for students because students learn by examples. Being a good model requires caring, compassion, sensitivity, commitment, the pursuit of truth and respect of self and others, honesty, trustworthiness, integrity, equality, impartiality, fairness, and justice. Teachers should teach students the possible harm of not following the ethical rules while using the internet, and guide them through their use of the internet at a level appropriate to their age. Teachers are in a unique position to show students how to use technology properly.

According to the International Society for Technology in Education, teachers should follow performance indicators for social, ethical, legal, and human issues. After proper training in technology integration, teachers can engage students effectively in technology classrooms. At this point, schools should make in-service workshops for teachers to develop these skills. Therefore, the role of schooling is also changing. Schools also can provide a different learning environment to people, such as distance learning through the use of the internet; it would help people to pursue their studies in their own time and location. The responsibility of schools is increasing too. Schools should have rules and obligations to help students learn how to use the internet in a safe and responsible manner. Schooling should help students learn how to think critically about technology issues, not what to think about them. Teachers can help students acquire informed attitudes about the various technologies and their social, cultural, economic, and ecological consequences.

Table 22. Summary Ranking of School Heads' Technology Leadership Areas as assessed by their teachers based on Average

Technology Leadership Area	Weighted Mean Average	Rank
Leadership and Vision	3.44	1
Learning and Teaching	3.35	3
Productivity and Professional Practice	3.40	2
Support, Management, and Operations	3.30	6
Assessment and Evaluation	3.34	4
Social, Legal, and Ethical Issues	3.33	5

- Fully (F) 3.26-4.00; Partially (P) 2.51-3.25; Minimally (M) 1.76-2.50; Not at All (N) 1.00-1.75

Table 22 shows the ranking of technology leadership areas as assessed by teachers based on the weighted mean average. It can be noticed that based on the rank, the three (3) areas on top of the list are (1) leadership and vision, (2) productivity and professional practice, and (3) learning and teaching. On the other hand, the lowest ranking three (3) areas are on (1) assessment and evaluation, (2) social, legal, and ethical issues, and (3) support, management, and operations. Despite the ranks, all the areas were perceived by teachers to be fully implemented by their school heads.

Table 23. Comparative Ranking of Technology Leadership Areas as assessed by School Heads themselves and their Teachers based on Average

As assessed by school heads themselves	Rank	As assessed by teachers
Productivity and Professional Practice	1	Leadership and Vision
Social, Legal, and Ethical Issues	2	Productivity and Professional Practice
Leadership and Vision	3	Learning and Teaching
Support, Management, and Operations	4	Assessment and Evaluation
Assessment and Evaluation	5	Social, Legal, and Ethical Issues
Learning and Teaching	6	Support, Management, and Operations

Table 23 presents the comparative ranking of technology leadership areas as assessed by the school heads themselves and their teachers. Notably, the areas of (1) leadership and vision, and (2) productivity and professional practice were both in the top of the list based on the two sets of assessment. A good implication of this is, despite some constraints, school heads still try to establish a clear technology vision and sustainable plan for the schools, and have been utilizing technology in the performance of their daily tasks. On the other hand, both (1) assessment and evaluation, and (2) support, management, and operations fall in the lower ranks based on the two sets of assessment. This implies that there should be more professional trainings anchored on technology in order to improve current technological practices and technologically-specific future programs and projects.

Table 24. Extent of Technology Integration of Teachers in the area of Facilitating and Inspiring Student Learning and Creativity

Facilitating and Inspiring Student Learning and Creativity	WM	VI
1. My students work together using digital tools that require them to analyze information and ask questions based on a teacher-provided prompt.	2.97	M
2. My students work either alone or in groups to create traditional reports with web-based or multimedia presentations (e.g., Prezi, PowerPoint, Google Slides) that showcase information on topics that I assign in class.	3.04	M
3. My students are provided with tasks that emphasize teacher-directed investigations with a known outcome (e.g., science experiments, mathematical problem solving, literary analysis) using available digital tools.	3.04	M
4. My students use digital tools to participate in teacher-directed activities that require them to transfer their learning to a new situation.	2.89	M
5. My students find innovative ways to use our school's advanced digital tools (e.g. mobile devices and digital media authoring tools) for inquiry-based learning opportunities that use social media.	2.97	M
6. My students use a variety of digital tools that support the evolving nature of my grade level content and promote student academic success.	3.05	M
7. My students readily self-select the most appropriate digital tool to aid them in completing any given task.	2.98	M
8. My students use digital tools to define real life problems and then find solutions that are grade level appropriate.	2.93	M
9. My students engage in standards-based applied learning projects that emphasize student investigations using digital tools.	2.95	M
10. My students use classroom digital tools to engage in relevant, challenging, self-directed learning experiences that address the content standards.	3.01	M
11. My students complete online tasks that emphasize high level cognitive skills.	2.67	M
12. My students use digital tools to confirm their content understanding or to improve their basic knowledge and skills in my subject.	2.93	M
13. My students use digital tools to explore deeper content connections (e.g., analyzing data from surveys and experiments, making inferences from text passages) that require them to draw conclusions.	2.93	M
14. My students self-select digital tools for higher-order thinking and personal inquiry related to project-based learning (PBL) experiences.	2.92	M
AVERAGE	2.95	M

- Always (A) 3.26-4.00; Most of the time (M) 2.51-3.25; Occasionally (O) 1.76-2.50; Never (N) 1.00-1.75

Table 24 shows the results of teachers' self-assessment on their technology integration in terms of facilitating and inspiring student learning and creativity. It can be noted that all items are being done most of the time; though item number 11 - letting students complete online tasks that emphasize high level cognitive skills - got the lowest weighted mean of 2.67. Overall, the average weighted mean is 2.95 which corresponds to being implemented "most of the time."

Focusing on the item with the lowest weighted mean, Edwards (2016) pointed out that critical thinking and higher order thinking skills are closely linked and often, the idea of teacher as facilitator or collaborator is promoted with the endorsement of critical thinking skills. It was found out that students operating in a technology-rich environment were

able to demonstrate higher order thinking skills. It was further pointed out that if technologies can enhance and nurture and encourage critical thinking in students, then their implementation into teaching practices should be embraced. It is rational for educators to implement technological advances into educational settings and attempt to remain abreast of these advances in technology.

Another salient item in this area of technology integration, which is related to developing higher-order thinking skills, is the important role of project-based learning experiences. Scott (2015) emphasizes that project and problem-based learning are ideal instructional models for meeting the objectives of twenty-first century education because they employ the 4Cs Principle – (1) critical thinking, (2) communication, (3) collaboration and (4) creativity - alongside "teaching for transfer" and learning structured in real world contexts. Carrying out projects in teams which require learners to research across subject boundaries, take responsibility for different parts of their project, critique each other's work and create a professional quality product, will help develop real-world problem solving skills.

Table 25. Extent of Technology Integration of Teachers in the area of Designing and Developing Digital Age Learning Experiences and Assessments

Designing and Developing Digital Age Learning Experiences and Assessments	WM	VI
1. I provide different formative and summative assessments that encourage students to demonstrate their content understanding in non-traditional ways such as e-portfolio, mobile applications, and interactive games.	2.92	M
2. I use digital tools to support my instruction (e.g., multimedia, online simulations, videos) so that students can better understand the content that I teach.	3.30	A
3. I design learning activities that address the content standards based on my students' questions, interests, and readiness levels.	3.22	M
4. I allow my students to collaborate with me in setting both group and individual academic goals that provide opportunities for them to direct their own learning aligned to the content standards.	3.26	A
5. I reinforce specific content standards and confirm student learning using digital tools (e.g., discussion forums, wikis, blogs).	2.89	M
6. I use digital tools and resources to differentiate the content, process, and/or product of learning experiences.	3.00	M
7. I use student-centered performance assessments that involve students transferring what they have learned to a real world context using the available digital tools and/or environmental resources such as blogs and vlogs.	2.97	M
AVERAGE	3.08	M

Always (A) 3.26-4.00; Most of the time (M) 2.51-3.25; Occasionally (O) 1.76-2.50; Never (N) 1.00-1.75

The extent of technology integration by teachers in terms of designing and developing digital age learning experiences and assessments as assessed by themselves is presented in table 25. The table shows that there are two (2) items which are being implemented always by the teachers – "I use digital tools to support my instruction (e.g., multimedia, online simulations, videos) so that students can better understand the content that I teach", and "I allow my students to collaborate with me in setting both group and individual academic goals that provide opportunities for them to direct their own learning aligned to the content standards." All other items are being done most of the time; with the average weighted mean of 3.08 that still corresponds to "most of the time" extent of implementation.

The two (2) items with the highest weighted mean are supported by the Technology Integration Matrix developed from 2005 to 2019 by the Florida Center for Instructional Technology. Based on its table of teacher descriptors, a teacher under Entry-Active cell may be the only one actively using technology. This may include using presentation software to support delivery of a lecture. The teacher may also have the students' complete "drill and practice" activities on computers to practice basic skills. Moreover, a teacher who falls in the Entry-Constructive cell uses technology to deliver information to students. Both Entry-Active and Entry-Constructive cells support item number two (2) in table 4.2.

Table 26. Extent of Technology Integration of Teachers in the area of Promoting and Modelling Digital Citizenship and Responsibility

Promoting and Modelling Digital Citizenship and Responsibility	WM	VI
1. My students use collaborative digital tools (e.g., social media forum) to create solutions for real world problems (e.g., bullying, health awareness, global warming).	2.94	M
2. My students use digital tools such as blogs and vlogs to participate in problem-solving activities with others beyond the classroom.	2.72	M
3. My students use digital tools such as Google Scholar and e-journals for collaboration, publishing, and research to tackle real world questions, themes, and/or challenges within our community.	2.82	M
4. My students demonstrate global awareness in my classroom as I provide digital opportunities for them to collaborate with others beyond the classroom.	2.87	M
5. My students apply their classroom content learning to real world situations within the local or global community using the digital tools at our disposal.	2.93	M
6. My students use all forms of the most advanced digital tools to pursue collaborative problem-solving opportunities of personal and/or social importance.	2.82	M
7. My students apply what they have learned in class to the world they live in when planning group projects.	3.11	M
8. My students see that I promote, monitor, and model the ethical use of digital tools in my classroom (e.g., appropriate citing of resources, respecting copyright permissions).	3.13	M
9. My students see that I model and facilitate the effective use of current and emerging digital tools to support teaching and learning in my classroom.	3.02	M
10. My students are provided with learner-centered strategies (e.g., learning contracts) to address their diversity using developmentally-appropriate digital tools.	3.00	M
11. My students see that I model the safe and legal use of digital tools while I am delivering content and/or confirming their understanding of pertinent concepts.	3.12	M
12. My students model the "correct and careful" use of digital tools (e.g., ethical usage and proper digital etiquette) and are aware of the consequences regarding their misuse.	3.06	M
AVERAGE	2.96	M

Always (A) 3.26-4.00; Most of the time (M) 2.51-3.25; Occasionally (O) 1.76-2.50; Never (N) 1.00-1.75

Table 26 presents the results of teachers' self-assessment on their technology integration in the area of promoting and modelling digital citizenship and responsibility. As seen in the table, all items are being done "most of the time" by the teachers with item number 2 – "My students use digital tools such as blogs and vlogs to participate in problem-solving activities with others beyond the

classroom" getting the lowest weighted mean of 2.72. Overall, the average weighted mean is 2.96 which means that this area is being implemented "most of the time" by teachers.

Focusing on utilizing blogs and vlogs, La Caze (2017) noted that the nature of literacy has already changed. An understanding of multi-literacies and the underpinning pedagogy can empower educators to transform the literacy curriculum in their classrooms. The new dimensions of technology provide clarity in understanding how to ensure the curriculum is not simply using technology at a surface level, but rather develops students' understanding and skills to be critical thinkers and creators who can share their perspectives of the world and be agents for positive change. Using blogs and vlogs in the classroom enhanced students' engagement and their desire to produce writing of a high quality.

Table 27. Extent of Technology Integration of Teachers in the area of Engaging in Professional Growth and Leadership

Engaging in Professional Growth and Leadership	WM	VI
1. I use digital tools to expand my communication opportunities with my students.	3.19	M
2. I use digital tools to expand my communication opportunities with the parents/guardians of my students.	3.08	M
3. I use digital tools to expand my communication opportunities with my peers/colleagues.	3.21	M
4. I collaborate with students to explore creative applications of digital tools that improve their learning.	3.06	M
5. I collaborate with other faculty members to explore creative applications of digital tools that improve student learning.	3.04	M
6. I promote the effective use of digital tools in my school.	3.09	M
7. I promote the effective use of digital tools within my professional community.	3.05	M
AVERAGE	3.10	M

Always (A) 3.26-4.00; Most of the time (M) 2.51-3.25; Occasionally (O) 1.76-2.50; Never (N) 1.00-1.75

The results of self-assessment of teachers on their technology integration in terms of engaging in professional growth and leadership is shown in table 27. It can be noted that all items in this area are being done "most of the time" by the teachers, with item number 3 – "I use digital tools to expand my communication opportunities with my peers/colleagues" - obtaining the highest weighted mean of 3.21. Generally, this area obtained an average weighted mean of 3.10 which means "most of the time" extent of implementation by teachers.

In relation to expanding communication opportunities with colleagues, the observed most common digital means of communicating with peers and colleagues in the workplace is the e-mail. Mano (2012) suggests that e-mail provides important benefits for the organization and work performance, which is mainly due to rapid dissemination of information relevant to the tasks that must be accomplished. Work performance is a function of the number of work-related e-mails. As a technological means, it has been proven beneficial in many areas such as providing better use of time, and fluidity in correspondence.

Since collaboration is tantamount to professional development, educators through technology, can collaborate far beyond the walls of their schools. Based on "Reimagining the Role of Technology in Education" (2017), educators through technology are no longer restricted to collaborating only with other educators in their schools. They now can connect with other educators and experts across their communities or around the world to expand their perspectives and create opportunities for student learning. They can connect with community organizations specializing in real-world concerns to design learning experiences that allow students to explore local needs and priorities.

Table 28. Ranking of Technology Integration Areas as assessed by the Teachers Themselves

Technology Integration Area	Weighted Mean Average	Rank
Engaging in Professional Growth and Leadership	3.10	1
Designing and Developing Digital Age Learning Experiences and Assessments	3.08	2
Promoting and Modelling Digital Citizenship and Responsibility	2.96	3
Facilitating and Inspiring Student Learning and Creativity	2.95	4

Always (A) 3.26-4.00; Most of the time (M) 2.51-3.25; Occasionally (O) 1.76-2.50; Never (N) 1.00-1.75

Table 28 presents the ranking of technology integration areas as assessed by the teachers themselves. It is important to note the extremes - on top of the list is "engaging in professional growth and leadership", while at the bottom of the list is "facilitating and inspiring student learning and creativity." The affirmative implication of this is that teachers exert efforts to grow professionally and eventually become teacher-leaders reflect an innate desire to alleviate the quality of teaching and learning infused with technology in coordination with colleagues, parents, stakeholders, and the professional community in general. However, the challenge lies in addressing teachers' concerns on how they can strategize ways, techniques, and means to inspire student learning and creativity. The apparent notion is that inspired learners, with the aid of technology, will become more active to partake in the teaching and learning process.

Table 29. Relationship between the School Heads' Profile Variables and their Self-assessment on Technology Leadership

Profile and Technology Leadership	Computed Chi-square value	df	Tabular Chi-square value	Decision	Interpretation
Age	4.667	4	9.488	Ho Accepted	Not Significant
Sex	3.000	2	5.991	Ho Accepted	Not Significant
Highest Educational Attainment	4.667	4	9.488	Ho Accepted	Not Significant
Years of Service as School Head	3.250	4	9.488	Ho Accepted	Not Significant

Table 29 presents the relationship between the school heads' profile and their self-assessment on technology leadership. Using chi-square at 0.05 level of significance, all the four (4) variables yield no significant relationship to the extent of their technology leadership.

The results affirm the study of Baker, et. al. (2007) on the effects of gender and age on new technology implementation in a developing country. The most salient finding of this study is the non-significance of age and gender as moderating variables on attitude, subjective norm, and perceived behavioral control as they affect behavioral intention to utilize technology.

Additionally, the results of the present study are also in consonance with the findings of Yorulmaz and Cal (2016). It was found out that the school directors' technology leadership competency scores and scores taken from its sub-dimensions do not vary significantly depending on gender and length of service. In addition, the school directors' technology leadership competency and visionary leadership scores, digital age learning culture, digital citizenship and systematic development scores do not vary significantly depending on age.

Table 30. Relationship between the Teachers' Profile Variables and their Self-assessment on Technology Integration

Profile and Technology Integration	Computed Chi-square value	df	Tabular Chi-square value	Decision	Interpretation
Age	10.729	8	15.507	Ho Accepted	Not Significant
Sex	2.218	2	5.991	Ho Accepted	Not Significant
Highest Educational Attainment	24.515	8	15.507	Ho Rejected H_A Accepted	Significant
Years of Service in Teaching	21.244	16	26.296	Ho Accepted	Not Significant

Table 30 shows the relationship between the teachers' profile and the extent of their technology integration. Using chi-square at 0.05 level of significance, only one (1) profile variable – highest educational attainment, among the four (4) has a significant relationship on their technology integration.

The results of the present study affirm the study of Mahdi and Al-Dera (2013) that teachers' age and teaching experience (years of service in teaching) have no effect in their ICT use in teaching. In agreement, Tweed (2013) found out that there was no significant correlation between teacher technology use and teacher age, and between the classroom technology use of teachers and years of teaching experience.

Kiboro (2012) found out that teachers' level of education greatly affects ICT integration as few who are highly qualified preferred using ICT while more teachers with certificates and diplomas did not see the need of adopting ICT in their teaching. Furthermore, the study of Adedokun (2018) revealed significant moderate positive relationship for holders of bachelor's and master's degree, and a weak negative linear relationship for doctoral degree holders.

Table 31 Relationship between Technology Leadership of School Heads as assessed by their Teachers and Technology Integration of Teachers

	Mean	SD	df	r-value	Tabular value	Decision	Interpretation
Technology Leadership	3.36	0.55	271	0.106	0.1218	Ho Accepted	Not Significant
Technology Integration	3.00	0.54					

Table 31 shows the relationship between the technology leadership of school heads as assessed by their teachers and technology integration of teachers as assessed by themselves. Using Pearson-r at 0.05 level of significance, the r-value of 0.106 implies that there is no significant relationship between the technology leadership of school heads as assessed by their teachers and their extent of technology integration.

The result of the present study does not agree with the findings of the study of Omwenga, et. al. (2015) wherein the teachers' integration of ICT in teaching science, in particular, is significantly influenced by the principals' competency in ICT. It was established that the principals' competency in ICT had linear significant relationship when correlated with teachers' integration of ICT.

Furthermore, this present result is not in consonance with the study of Fisher (2013) who found out that strong technology leadership by campus administrators is positively correlated to teachers' abilities to integrate technology in the classroom effectively. Still in disagreement with the current results is the findings of Thannimalai and Raman (2018) in their study that there is a significant relationship between principals' technology leadership and teachers' technology integration in the classroom.

To support the present result, the ability of teachers in integrating technology in their pedagogy, regardless of the extent of technology leadership of their school heads, can be affirmed by three significant considerations – (1) the generation they belong to, (2) self-efficacy theory, and (3) self-determination theory (SDT).

Most of the teacher-respondents in this study belong to Generation Z, also known as "digital natives", and Generation Y, also known as the "millennial generation". As described by Grail Research (2010), Generation Z are technologically-savvy and globally connected. Furthermore, Dolot (2018) described these "digital natives" as those who were born in the 1990's and raised in the 2000's, during the most profound changes in the century who exists in a world with web, internet, smart phones, laptops, freely available networks and digital media. Generation Z uses different mobile devices, they comment on reality, the environment, they manifest their opinions and attitudes using Twitter, blogs, and internet forums, and they share photos (Instagram, Pinterest) and films (YouTube, Instagram). Facebook can be used for all of abovementioned activities. Generation Z not only uses the content of the Internet, but they also create and control it. Furthermore, Grail Research (2010) described the millennial generation as those who witnessed emerging digital technologies such as the e-mail and text messaging, making them also not strangers to digital technologies.

Moreover, the theory of self-efficacy serves as strong ground why teachers integrate technology in their instructions. Bandura (1977) describes self-efficacy as individual's belief on his or her ability to organize and execute the action to attain goods. This belief influences many aspects of behavior that is the choice of action, amount and duration of effort and emotional response to success. To prove this, Bakar, et. al. (2018) explored various studies that examined the relationship between teacher's self-efficacy and technology integration, with most of the studies utilized the quantitative method. It was found out that that the relationship between teacher's self-efficacy and technology integration yielded positive results.

Aside from the self-efficacy theory, the self-determination theory (SDT) serves also as a major reason why teachers integrate technology in their teaching-and-learning situations, regardless of technology leadership. Deci and Ryan (2000) defined SDT as a macro theory of human motivation and personality that concerns people's inherent growth tendencies and innate psychological needs. It is concerned with the motivation behind choices people make without external influence and interference. SDT focuses on the degree to which an individual's behavior is self-motivated and self-determined. This theory incorporates three basic fundamentals of autonomy, competence, and relatedness. Based on the study of Schrum, et. al. (2008), teachers who are using technology are doing it because it is possibly fulfilling these three inherent needs. These teachers realize that using technology has risks that may cost some class time, but the rewards outweigh them. Additionally, teachers in the study attributed student success to technology because they believe that every student gets involved and more particularly, because technology can appeal to diverse learning styles.

Table 32. Difference between School Heads' Self-assessment on their Technology Leadership when grouped according to Profile

Profile	Computed F-test value	Degrees of Freedom	Tabular F-test value	Decision	Interpretation
Age	0.375	5	19.16	Ho Accepted	Not Significant
Sex	0.444	5	7.71	Ho Accepted	Not Significant
Highest Educational Attainment	1.00	5	9.55	Ho Accepted	Not Significant
Years of Service as School Head	0.318	5	9.55	Ho Accepted	Not Significant

Table 32 presents the difference in the school heads' self-assessment on their technology integration when grouped according to their profile. Using F-test at 0.05 level of significance, results show that school heads have no significant differences in their self-assessment of technology leadership when grouped according to their profile variables.

Contrary to the present results, Hang (2011) analyzed differences among principals' demographic factors of gender, age, educational level, and years of services as they relate to technology leadership and significances were found in principals' demographic factors of gender and educational level. Moreover, the current results do not affirm with the findings of Hang that female principals were perceived significantly higher than male principals. In addition, principals who hold higher educational degree tended to be perceived significantly higher than those who hold lower educational degree.

The results imply that school heads, regardless if they are digital natives or digital immigrants, are capable of technology leadership in their schools. They all perceive the importance of their role as technology leaders in improving the school system, thereby transforming the school as responsive agent to the current generation of learners and demands of stakeholders.

Table 33. Difference between Teachers' Assessment on Technology Leadership of their School Heads and School Heads' Self-assessment on their Technology Leadership

	Mean	SD	df	t-value	Tabular value	Decision	Interpretation
School Heads	3.24	0.072	43	2.62	2.021	Ho Rejected H_A Accepted	Significant
Teachers	3.36	0.006					

The difference between teachers' assessment on the technology leadership of their school heads and the school heads' self-assessment on their technology leadership is shown in table 33. Using t-test at 0.05 level of significance, the result shows that there is a significant difference between the teachers' assessment on the technology leadership of their school heads and the school heads' self-assessment on their technology leadership.

The results agree with the findings of Hang (2011) where it was revealed that the teachers perceived their principal's capacities more positively than negative. According to the calculation, principals were perceived highest positive in developing a school vision, promote positive school culture, and understanding of the policies and laws that affect schools. This result further implies that principals were perceived to be good in school vision, integrity, politics and law. However, principals were perceived least positive on some dimensions of leaderships such as using and promoting technology in school, deployment of financial and human resources, implementing professional development, allocate and using fiscal, human and material resources, and using community resource positively.

The Online Training Module

The analysis phase is the process of defining what is to be learned which includes knowing the learner profile, description of constraints and needs, and task analysis. For the online training module, all of these were noted and considered with school heads as learners, availability of time and geographical location as constraints, and online modality for instructional delivery.

The design phase is the process of specifying measurable objectives and instructional strategy. For the online training module, the goals, intended learning outcomes, and objectives were stipulated and based on the ISTE standards as reflected in the national educational technology standards for administrators (NETS-A).

The development phase is the process of producing the materials which includes the storyboard and exercises. For the online training module, the 4A's was adapted which include Activity, Analysis, Abstraction, and Application. Aside from required tasks and activities, reading and video links are also provided in every lesson.

The implementation phase is the process of installing the project in the real world context where student comments are taken into consideration.

Then, the evaluation phase is the process of determining the adequacy of the instruction through recommendations and project report in order to come up with a revised prototype. The last two phases of implementation and evaluation are points for recommendation in this study.

5. Summary, Conclusions, and Recommendations

5.1 Summary

The findings of the study are as follows:

1. The profile of the school heads are the following: in terms of age, the greatest number belongs to the 40-49 years old age bracket (50%); majority are females (66.7%); half of them earned doctorate units (50%); and, most of them are in their current position for 1-5 years to this date (66.7%).
2. The profile of the teachers are the following: in terms of age, the greatest number belongs to the 30-39 years old age bracket (37.7%); majority are females (66.3%); more than half of them already earned Master's units (54.6%); and, most of them have been teaching for 1-5 years to this date (31.1%).
3. (a) The school heads' self-assessment on their technology leadership was divided into six (6) areas: leadership and vision obtained an average weighted mean of 3.17 with a verbal interpretation of being partially implemented; learning and teaching obtained an average weighted mean of 3.03 which corresponds to partial implementation; productivity and professional practice got an average weighted mean of 3.50 which is interpreted as being fully implemented; support, management, and operations has an average weighted mean of 3.14 with a verbal interpretation of partial implementation; assessment and evaluation obtained an average weighted mean of 3.10 which corresponds to partial implementation; and social, legal, and ethical issues with an average weighted mean of 3.44 with a verbal interpretation of being fully implemented. As per ranking, the school heads rated themselves best in implementing the technology leadership areas of productivity and professional practice; and, social, legal and ethical issues. On the other hand, the lowest ranking technology leadership areas are leadership and vision; support, management and operations; assessment and evaluation; and, learning and teaching.

   (b) The teachers' assessment of their school heads on their technology leadership also focused on the same six (6) areas: leadership and vision obtained an

average weighted mean of 3.44 with a verbal interpretation of being fully implemented; learning and teaching obtained an average weighted mean of 3.35 which corresponds to full implementation; productivity and professional practice got an average weighted mean of 3.40 which is interpreted as being fully implemented; support, management, and operations has an average weighted mean of 3.30 with a verbal interpretation of full implementation; assessment and evaluation obtained an average weighted mean of 3.34 which corresponds to full implementation; and social, legal, and ethical issues with an average weighted mean of 3.33 with a verbal interpretation of being fully implemented. While all areas were perceived by teachers as being fully implemented by school heads, the teachers rated their school heads best in implementing the technology leadership areas of leadership and vision; productivity and professional practice; and, learning and teaching as per ranking. On the other hand, the lower ranking technology leadership areas as assessed by teachers are assessment and evaluation; social, legal, and ethical issues; and, support, management, and operations.

4. The teachers' self-assessment on the extent of their technology integration is divided into four (4) areas: facilitating and inspiring student learning and creativity obtained an average weighted mean of 2.95 with a verbal interpretation of being implemented most of the time; designing and developing digital age learning experiences and assessments has an average weighted mean of 3.08 with a verbal interpretation of being implemented most of the time; promoting and modelling digital citizenship and responsibility obtained an average weighted mean of 2.96 with a verbal interpretation of being implemented most of the time; and, engaging in professional growth and leadership with an average weighted mean of 3.10 with a verbal interpretation of being implemented most of the time. While all areas are implemented "most of the time" by the teachers, the technology integration areas are ranked as follows based on the weighted mean average: (1) engaging in professional growth and leadership; (2) designing and developing digital age learning experiences and assessments; (3) promoting and modelling digital citizenship and responsibility; and (4) facilitating and inspiring student learning and creativity.
5. For the relationship between school heads' self-assessment on their technology leadership and four (4) profile variables, none of the variables were found significant. The computed Chi-square values were 4.667, 3.000, 4.667, and 3.250 for age, sex, highest educational attainment, and years of service as school head, respectively. All these computed values were less than the tabular Chi-square values, thus, not significant.
6. For the relationship between teachers' self-assessment on their technology integration and four (4) profile variables, only the profile on highest educational attainment was found to be significant. The computed Chi-square values were 10.729, 2.218, 24.515, and 21.244 for age, sex, highest educational attainment, and years of service in teaching, respectively. Only the computed value for highest educational attainment was greater than the tabular Chi-square value, thus, significant.
7. For the relationship between technology leadership of school heads as assessed by their teachers and technology integration of teachers as assessed by themselves, the finding is not significant. Statistically, the computed r-value of 0.106 is lesser than the tabular value of 0.1218 at df = 271, hence, not significant.
8. For the difference between school heads' self-assessment on their technology leadership when grouped according to their profile, none was found to be significant. The computed F-test values were 0.375, 0.444, 1.000, and 0.318 for age, sex, highest educational attainment, and years of service as school head, respectively. All these computed values were less than the tabular F-test values, thus, not significant.
9. For the difference between teachers' assessment on technology leadership of their school heads and school heads' self-assessment on their technology leadership, it was found to be significant. Statistically, the computed t-value of 2.62 is greater than the tabular value of 2.021 at df = 43, hence, significant.
10. Based on the results of the study, an online training module was designed for school heads for the development and enhancement of their technology leadership. The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model was utilized and the module adapted the 4A's (Activity, Analysis, Abstraction, and Application) format.

5.2 Conclusions

Based on the findings, the following conclusions were drawn:

1. Majority of the school heads are in their middle age, females, but are still neophytes in their current position. However, the school heads predominantly earned their doctorate units. These generally imply that most of the school heads are millenials (Generation Y) and digital natives (Generation Z) who have a strong grasp of technological knowledge and skills. This could be translated into the

actualization of the technology leadership standards provided by the ISTE and the gradual adaption of the Education 4.0 paradigm. Moreover, the school heads meet the qualification standards of the Civil Service Commission for the principal position such as minimum requirements for years of experience and academic preparation.

2. Most of the teachers are females and already earned their Master's units. While most of them are within and towards the middle age bracket, they are still relatively young in teaching practice. These generally imply that most of the teachers in the selected Science high schools are millenials (Generation Y) and digital natives (Generation Z) which make them technologically-savvy and inclined into integrating technology in their daily task. Significantly, the teachers are capable of putting into practice the dynamic technology layer of Education 4.0, particularly on instructional delivery and content. Moreover, the teachers can adapt to and address the preference and needs of the learners, who also belong to the same generation as the teachers are, such as but not limited to aspects of multitasking and remote learning.

3.a. All of the areas of technology leadership were self-assessed by school heads as being partially implemented; except for the two (2) areas on productivity and professional practice, and social, legal, and ethical issues assessed as being fully implemented. Since partial implementation can still be apparently considered as good, this implies that school heads are generally capable of translating into institutional practice the international standards on technology leadership provided by the ISTE. Given this, the school heads can become primary movers of their schools in technology planning and sustainability implementation.

3.b. All of the areas of technology leadership of school heads were assessed by their teachers as being fully implemented. The perception of teachers on their school heads as capable of being technology leaders posits a positive implication on their effectiveness as classroom teachers, particularly on acquiring the support they need in technology integration. Consequently, the teachers will actively take part towards the realization of a viable technology vision for the school.

4. All of the areas of technology integration were self-assessed by teachers as being implemented "most of the time." While there are still some constraints that hinder teachers into integrating technology "always" in instruction, this generally implies that teachers are technologically-inclined which make them capable of applying the dynamic technology layer stipulated in Education 4.0, developing higher-order thinking skills among students by providing authentic tasks, implementing techniques and strategies that will hone the future work skills required by year 2020, and ultimately, embodying technological, pedagogical and content knowledge.

5. Age, sex, highest educational attainment, and years of service in the current position are not associated with technology leadership as self-assessed by the school heads. This implies that all school heads, regardless of profile, are capable of actualizing international technology standards in their institutions. Significantly, this breaks the barrier between digital natives and digital immigrants since both have the capacity and skill to serve as technology leaders.

6. Age, sex, and years of service in teaching are not associated with technology integration as self-assessed by the teachers. However, highest educational attainment has a correlation with technology integration. This implies that while majority of the teachers were already born with and into technology as imperative of their generation, the technology trainings and practice acquired from their graduate school work help teachers further enhance their technological knowledge and skills making them relatively advanced in technology integration.

7. Technology leadership of school heads as assessed by their teachers and technology integration of teachers as assessed by themselves are not associated with each other. This implies teachers' independence in relation to technology integration brought about by the generation they belong to, their self-efficacy, and their self-determination.

8. There are no significant differences between school heads' self-assessment on their technology leadership when grouped according to age, sex, highest educational attainment, and years of service in the current position. This implies that all school heads view technology leadership as important, thereby seeing its relevance in actualizing Education 4.0 and consequently transforming their schools as responsive institutions into developing students' future work skills.

9. There is a significant difference between teachers' assessment on technology leadership of their school heads and school heads' self-assessment on their technology leadership. This implies a positive perception among teachers on their school heads' technology leadership, which in effect compels teachers to provide support and encouragement to their school heads in actualizing a sustainable and viable technology vision and plan for the school.

5.3 Recommendations

In the light of the findings of the study, the following recommendations are suggested:

1. School heads may draft an institutional technology plan with particular emphasis on the four (4) areas which are only partially implemented. Particularly, school heads are advised to:
   a. Plan activities and school improvement project titles (areas) to be included in the school improvement plan (SIP) and in the annual improvement plan (AIP), respectively, for the prioritization of the development of best practices in the utilization of technology with feasible outputs and budget sources. Pursuant to Republic Act 9155 or the "Governance of Basic Education Act of 2001", this is in line with the mandate of the Department of Education (DepEd) that SIP serves as roadmap that lays down specific interventions that a school will undertake within a period of three (3) consecutive school years with the help of community and stakeholders. In relation to this, DepEd provides guidelines for identifying priority improvement areas.
   b. Participate in local and international professional development trainings for technology leadership and integration. This should be reflected in the Individual Performance and Commitment Review Form (IPCR) of school heads.
   c. Involve stakeholders for supplemental funding for hardware and software upgrade and other technology-support services, if school funds are found to be insufficient. This is in line with the school report card (SRC) of DepEd which serves as a tool for advocating and communicating the school situation, context, and performance to internal and external stakeholders – with the objective of increasing the participation and involvement of the community and other stakeholders in making the school a better place for learning. In this regard, DepEd provides guidelines in listening to the voice of the learners and stakeholders. Furthermore, involving stakeholders is under the key result area (KRS) of school leadership, management and operations as stipulated in the Office Performance and Commitment Review Form (OPCRF) of school heads.
   d. Emphasize technology integration in evaluating instructional practices, together with technology coaches if possible. This should be done because technology integration is included in the standards provided for in the Philippine Professional Standards for Teachers (PPST) under Domain 1, "Content Knowledge and Pedagogy" wherein Strand 3 is "Positive Use of ICT" across beginning to distinguished teachers. Furthermore, school heads should find ways on how to reconcile division technology plan with the daily instructional plan of teachers. This activity may be stipulated in the OPCR under the key result areas of (1) instructional leadership, and (2) human resource management and development. Mentoring of this may be done via school learning action cells (SLAC) and in-service training program for teachers (INSET) during semester and summer break.
2. A needs-based assessment should be conducted by school heads in order to address the technology concerns and needs of teachers. This will serve as springboard to training and development programs as mandated by DepEd Order No. 32 series of 2011. In school context, Training and Development (T&D) is the process by which an educational institution provides professional development activities to enhance individuals (teachers and other personnel) with knowledge, skills and attitudes to enable them to perform their functions effectively. Conduct of training and development activities shall involve a systematic process of competence or needs assessment, planning, designing, resource development and the actual delivery of the programs.
3. There is a need to create health policy and ethical use guidelines for technology use in classrooms and school offices. This may be crafted collaboratively through learning action cell (LAC) sessions. This responds to the key result area (KRA) of learning environment in the OPCR of school heads.
4. Teachers may conceptualize an implementable and collaborative technology-integrated quarterly and/or annual plan with emphasis on the integration of the following:
   a. Technology-based research tools for students to tackle real world issues and concerns, and utilization of blogs and vlogs for students' collaborative learning and problem-based learning.
   b. Online tasks that emphasize high level cognitive skills in order to address and develop 21st century skills responsive to future work skills 2020.

   These technology-integration activities may be reflected in the Individual Performance and Commitment Review Form (IPCRF) of teachers with attainable objectives and observable performance indicators.
5. A supplemental study may be conducted to include students' and stakeholders' perceptions on the extent of technology integration of their teachers and school heads, respectively.

6. Future researchers have to include more Science high schools in the National Capital Region for a wider and more comprehensive perspective.
7. A parallel study may be conducted with regular public secondary schools as locale.
8. The online training module may be utilized in order to test its efficiency and effectiveness and acquire feedback from participants on what aspects are needed to be improved. These will serve as inputs into the implementation and evaluation phases of the ADDIE model.

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7. REFERENCES

[1] Bordens, K. S. & Abbott, B. B. (2008). Research design and methods: A process approach. New York, NY: McGraw-Hill Education.

[2] Creswell, J. W. (1994). Research Design: Qualitative and Quantitative Approaches. Thousand Oaks. CA: Sage.

[3] Creswell, J. W. (2012). Qualitative inquiry & research design: Choosing among five approaches (4th ed.). Thousand Oaks, CA: Sage.

[4] DePoy, E., & Gitlin, L. N. (1998). Introduction to research: Understanding and applying multiple strategies. St. Louis: Mosby.

[5] Glatthorn, A. A. (2000). The principal as curriculum leader: Shaping what is taught and tested. Thousand Oaks, CA: Corwin.

[6] Murphy, J. & Louis, K (1994). Reshaping the principalship: Insights from transformational reform efforts. Thousand Oaks, CA: Corwin Press Philadelphia, PA: Laboratory for Student Success, Temple University.

[7] Sharp, W. L., & Walter, J. K. (1994). The principal as school manager. Lancaster, PA: Technomic.

[8] Adedokun, A. (2018). Teachers Perceptions and Demographics on Technology Integration in Ibadan Metropolis Secondary Schools. Journal of Education and Practice. Vol.9, No.9.

[9] Akbaba-Altun. (2004). Information technology classrooms and elementary school principals' roles: Turkish experience. Education and Information Technologies Vol. 9 No. 3.

[10] Akcay, B. (2008). The relationship between technology and ethics; from society to schools. Turkish Online Journal of Distance Education, Vol. 9 No. 4.

[11] Akman, T. (2016 April 27). Younger school principals mean less experience, but more idealism and social and digital skills. The Philadelphia Inquirer.

[12] Aksoy, H. H. (2003). Analysis of technology use in educational institutions and of its effects. Education Science and Society. 1(4), 4-23.

[13] Alkrdem, M. (2014). Technological leadership behavior of high school headteachers in Asir Region, Saudi Arabia. Journal of International Education Research – Second Quarter 2014, Volume 10, No. 2. The Clute Institute.

[14] Anderson, R. E. & Dexter, S. (2005). School technology leadership: An empirical investigation of prevalence and effect. Educational Administration Quarterly, Vol.41, No. 1.

[15] Awalt, C., & Jolly, D. (1999). Educational Technology & Society 2(3). Retrieved from http://ifets.ieee.org/periodical/vol_3_99/awalt.html.

[16] Bakar, N. S. A., Maat, S. M., & Rosli, R. (2018). A Systematic Review of Teacher's Self-efficacy and Technology Integration. International Journal of Academic Research in Business and Social Sciences, 8(8), 540–557.

[17] Baker, E. W., Hubona, G. & Al-Gahtani, S. S. (2007). The effects of gender and age on new technology implementation in a developing country: Testing the theory of planned behavior (TPB). Information Technology and People, Vol. 20 No. 4.

[18] Ball, L. & Forzani, F. (2009). The work of teaching and the challenge for teacher education. Journal of Teacher Education Vol. 60.

[19] Banoglu, K. (2011). School principals' technology leadership competency and technology coordinatorship. Educational Sciences: Theory & Practice, Volume 11 No. 1.

[20] Brockmeier, L., Sermon, J., & Hope, W. (2005). Principals' relationship with computer technology. NASSP Bulletin, 89(643), 45–63.

[21] Cakir, R. (2012). Technology integration and technology leadership in schools as learning organizations. TOJET: The Turkish Online Journal of Educational Technology, Volume 11, Issue 4. Amasya University.

[22] Cator, K. & Kinney, S. (2017). Seven ways to communicate with your community. Digital Promise.

[23] Çelikten, M. (2002). Competency of school administrators in computer usage. Journal of National Education, pp. 155-156, 2002.

[24] Chang, I. H. (2012). The effect of principals' technological leadership on teachers' technological literacy and teaching effectiveness in Taiwanese elementary schools. Educational Technology & Society, Volume 15 No. 2.

[25] Chang, H., Chin, J. M., & Hsu, C. M. (2008). Teachers' perceptions of the dimensions and implementation of technology leadership of head teachers in Taiwanese schools. Educational Technology & Society, 11(4), 229-245.

[26] Checkley, K. (2000). The contemporary principal: New skills for a new age. Education Update, 42(3), 1-8.

[27] Colwill, C. & Townsend, J. (1999). Women, leadership and information technology: The impact of women leaders in organizations and the role in integrating

information technology with corporate strategy. Journal of Management Development Vol. 18 No. 3.

[28] Cox, M. (1997). Identification of the changes in attitude and pedagogical practices needed to enable teachers to use information technology in the school curriculum. Paper presented at the Joint Working Conference on Information Technology: Supporting Change Through Teacher Education, Kiryat Anavim, Israel.

[29] Creighton, T. (2003). The Principal as Technology Leader. Thousand Oaks, California: Corwin Press, Inc. Greaves Group, The Hayes Connections, One-to-One Institute. (2012). Project RED: The Research. Retrieved from: http://www.projectred.org.

[30] Daggett, B. (2014). Addressing Current and Future Challenges in Education. International Center for Leadership in Education.

[31] Davies, A., et. al. (2011). Future Work Skills 2020. Institute for the Future for Apollo Research Institute. California, USA.

[32] Dawson, C., & Rakes, G. (2003). The influence of principals' technology training on the integration of technology into schools. Journal of Research on Technology in Education, 36(1), 29-49. http://dx.doi.org/10.1080/15391523.2003.10782401.

[33] De la Cruz, J. M. (2019 May 10). DepEd hiring 10,000 new teachers for 2019, government allots P2.11-billion budget. Retrieved from https://businessmirror.com.ph/2019/05/10/deped-hiring-10000-new-teachers-for-2019-government-allots-p2-11-billion-budget/.

[34] Deci, E. and Ryan, R. (2000). The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. Psychological Inquiry, Vol. 11, No. 4. Lawrence Erlbaum Associates, Inc.

[35] Dexter, S. (2011). School technology leadership: artifacts in systems of practice. Journal of School Leadership, Vol. 21 No. 2.

[36] Dolot, A. (2018). The characteristic of Generation Z. http://dx.doi.org/10.15219/em74.1351

[37] Duncan, J. (2011). An Assessment of Principals' Technology Leadership: A Statewide Survey. Virginia Commonwealth University.

[38] Education by 2020 - A Sector Operations Plan. (2010). Asian Development Bank.

[39] Edwards, L. (2017). Education, technology, and higher order thinking skills. La Trobe University, Bendigo.

[40] Espeso, F. J., Nakpil, D. & Tapao, A.C. (2017 June 5). Teacher Education Regains Popularity. Retrieved from https://verafiles.org/articles/teacher-education-regains-popularity.

[41] Fernandez-Cruz, F. and Diaz, M. (2016). Teachers Generation Z and their Digital Skills. Complutense University of Madrid.

[42] Fisher, D.M., et. al. (2013). The 21st Century Principal: A Study of Technology Fisk, P. (2017). https://www.thegeniusworks.com/2017/01/future_education-young-everyone-taught-together/

[43] Foley, D. A. (2016). Technology underutilized: Principal's role in creating a culture of high-level uses. Educational Studies Dissertations, Vol. 12.

[44] Fullan, (2011). Choosing the wrong drivers for whole system reform. Melbourne, AU.: Seminar Series 204, Centre for Strategic Education.

[45] Fullan, M. & Stiegelbauer, S. (1991). The new meaning of educational change. School effectiveness and school improvement. Vol. 2 No. 4.

[46] Ghavifekr, S. and Rosdy W. A. W. (2015). Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools. Faculty of Education, University of Malaya, Malaysia.

[47] Glickman, E. (2003). Technology leadership: What school administrators should know and be able to do. Retrieved from http://www.temple.edu/MARTEC/publications/edtechreviews/technology_leadership.rf.

[48] Gorra, V. and Bhati, S. (2016). Students' perception on use of technology in the classroom at higher education institutions in Philippines. International Journal of Research in Education and Science.

[49] Grady, M. (2011). The Principal's Role as Technology Leader. Southeast Education Network.

[50] Guiab, M.R. & Ganal, N. N. (2014). Demographic profile of public school heads and school-related problems. International Journal of Multi Disciplinary Research, Vol 1 No. 4.

[51] Hallinger, P. & Heck, R. H. (1996). Reassessing the principal's role in school effectiveness: A review of empirical research, 1980-1995. Educational Administration Quarterly, 32, 5-44.

[52] Hashim, A. R. (2017). Preparing graduates for the 4th industrial revolution. Plenary forum presented at the 7th World Engineering Education Forum 2017, Kuala Lumpur, Malaysia.

[53] Habler, B., Major, L., Warwick, P., Watson, S., Hennessy, S., & Nicholl, B. (2016). Perspectives on technology, resources and learning: Productive classroom practices, effective teacher professional development. Available from http://tiny.cc/perspectives.

[54] Hill, J., Ottem, R., DeRoche J., Owens, C. (2016). Trends in public and private school principal demographics and qualifications: 1987-88 to 2011-12. Stats in Brief.

[55] Horn, A. S. & Jang, S. T. (2017). The impact of graduate education on teacher effectiveness: Does a master's degree matter? Midwestern Higher Education Compact.

[56] Hughes, M., & Zachariah, S. (2001). An investigation into the relationship between effective administrative leadership styles and the use of technology. International Electronic Journal for Leadership in Learning, 5(5), 1-10.

[57] ICT education should bridge tech gaps between teacher, student (2017). Department of Education. rappler.com.

[58] Incikabi, L., Ozgelen, S., Pektas, M., Kurnaz, M. A. (2013). Motivations and expectations for pursuing graduate education in mathematics and science education. Anthropologist, Vol. 16 No. 3.

[59] International Society for Technology in Education. (2002). National educational technology standards for administrators. Retrieved 1 August 2019 from http://www.iste.org/Content/NavigationMenu/NETS/ForAdministrators/2002Standards/NETS_for_Administrators_2002_Standards.htm.

[60] Jhingan, A. (2017). Foreword. Leapfrogging to Education 4.0: Student at the Core. India.

[61] Jhurree, V. (2005). Technology integration in education in developing countries: Guidelines to policy makers. International Education Journal, Vol. 6 No. 4.

[62] Johnson, L., Adams, S. & Cummins, M. (2012). The NMC horizon report: 2012 higher education edition. Austin, TX: The New Media Consortium.

[63] Kocoglu, Z. (2008). Exploring the technological pedagogical content knowledge of pre-service teachers in language education. Turkey.

[64] Koehler, M. and Mishra, P., et. al. The Technological Pedagogical Content Knowledge Framework.Leapfrogging to Education 4.0: Student at the Core (2017). Federation of Indian Chambers of Commerce and Industry. India.

[65] La Caze, S. (2017). Changing classroom practice through blogs and vlogs. Literacy Learning: Middle Years, Vol. 5 No. 1.

[66] Lacson, M. (2017 February 25). DepEd ensures inclusive education for learners with special needs. Sunstar Philippines. Retrieved from https://www.sunstar.com.ph/article/128141.

[67] Lai, K.W. (2006). Health risks with teachers' computer use: some New Zealand observations. Journal of Information Technology for Teacher Education, Vol. 9 No. 3.

[68] Leithwood, K. A., & Riehl, C. (2003). What we know about successful school leadership.

[69] Leng, N. W. (2008). Transformational leadership and the integration of information and communications into teaching. The Asia-Pacific Education Researcher, 17(1), 1-14.

[70] Mahdi, H. & Sa'ad Al-Dera, A. (2013). The impact of teachers' age, gender and experience on the use of information and communication technology in EFL teaching. English Language Teaching, Vol.6 No. 6.

[71] Malipot, M. H. (2019 March 1). DepEd rolls out improved alternative learning system. Manila Bulletin.

[72] Mateo, J. (2018 May 27). DepEd hiring 75,000 new teachers. The Philippine Star. Retrieved from https://www.philstar.com/headlines/2018/05/27/1819032/deped-hiring-75000-new-teachers.

[73] Matulac, M. (2016). Experiences in Technology Integration. University of Santo Tomas.

[74] McGriff, S. (2000). Instructional System Design (ISD): Using the ADDIE Model. Instructional Systems, College of Education, Penn State University.

[75] McLeod, S. & Richardson, J. W. (2011). The dearth of technology leadership coverage. Journal of School Leadership, Vol. 21 No. 2.

[76] Montealagre, M. A. C. (2019 July 28). Education 4.0: Rebooting Philippine teacher education. The Philippine Star.

[77] Morrison, B. (2006 October 31). Six strategies to help principals become technology leaders. EdTech. Retrieved from https://edtechmagazine.com/k12/article/2006/10/6-strategies-help-principals-become-technology-leaders.

[78] Murakami, E. T. & Tornsen M. (2017). Female secondary school principals: Equity in the development of professional identities. Educational Management Administration and Leadership, Vol. 45 No. 5.

[79] National Educational Technology Standards for Administrators (2002). International Society for Technology in Education.

[80] Ochada, N.R.C., Gempes, G.P. (2018). The realities of maintenance and other operating expenses (MOOE) allocation in basic education system: Unheard voices of public school teachers. International Journal of Scientific and Technology Research, Vol. & No. 4.

[81] Odabasi, H. F. (2007). Information and communication technology in teacher education. Ankara: Nobel.

[82] Okonta, O. (2010). Effects of online interaction via computer-mediated communication (CMC) tools on an e-mathematics learning outcome.

[83] Papa, R. (ed). (2011). Technology leadership for school improvement. Thousand Oaks, California: SAGE Publications.

[84] Patrick, S. (2004b). Toward a new golden age in American education: How the internet, the law and today's students are revolutionizing expectations. Washington, D.C.: U.S. Department of Education, Office of Educational Technology.

[85] Placido, L. & Lachica, F. (2015). Classroom communication and ICT integration: Public high school teachers' notions. International Journal on

Integrating Technology in Education (IJITE), Vol. 4 No. 2.

[86] Principals Technology Leadership Assessment (2009). Center for Advanced Study in Technology Leadership in Education. University of Kentucky.

[87] Ra, S., & Ping, L.C. (2018). Six ways to deploy ICT for quality education. Retrieved from https://blogs.adb.org/blog/6-ways-deploy-ict-quality-education.

[88] Rogayan, D. (2018). Why young Filipino teachers teach? Asia Pacific Higher Education Research Journal, Vol. 5 No. 2.

[89] Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. Journal of Educational Computing Research, 22(4), 455-472.

[90] Saban, A., Kocbeker, B, N. & Saban, A. (2006). An investigation of the concept of teacher among prospective teachers through metaphor analysis. Learning and Instruction Vol. 17.

[91] Sahin, I. (2006). Detailed review of Roger's diffusion of innovations theory and educational technology-related studies based on Roger's Theory. The Turkish Online Journal of Educational Technology. Vol. 5, No. 2.

[92] Saiti, A., and Prokopiadou, G. (2009). Impact of information and communication technologies on school. In M. A. Wimmer (Ed.), Administration: Research on the Greek schools of secondary education (pp. 305-316). Berlin: Springer

[93] Samancioglu, M., Baglibel, M., Kalman, M., & Sincar, M. (2015). The Relationship between Technology Leadership Roles and Profiles of School Principals and Technology Integration in Primary School Classrooms. Journal of Educational Sciences Research, Vol. 5 No. 2.

[94] Schmoker, M. (2000). Standards versus sentimentality: Reckoning–successfully–with the most promising movement in modern education. NASSP Bulletin, 84(620), 49-60.

[95] Schrum, L., Galizio, L. M., & Ledesma, P. (2011). Educational leadership and technology integration: An investigation into preparation, experiences, and roles. Journal of School Leadership Vol. 21 No. 2.

[96] Schrum, L., Shelley, G., & Miller, R. (2008). Understanding tech-savvy teachers: Identifying their characteristics, motivation, and challenges. International Journal of Technology in Teaching and Learning, 4(1), 1–20.

[97] Schulman L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher Vol. 15 No. 2.

[98] Scott, C.L. (2015). The futures of learning 3: What pedagogies for the 21st century? http://repositorio.minedu.gob.pe/bitstream/handle/123456789/3747/The%20Futures%20of%20Learning%203%20what%20kind%20of%20pedagogies%20for%20the%2021st%20century.pdf?sequence=1.

[99] Shahroom, A. A., & Hussin, N. (2018). Industrial Revolution 4.0 and Education. International Journal of Academic Research in Business and Social Sciences, 8(9), 314–319.

[100] Sobejana, N. (2015). Educational technology and academic performance of students in basic English in selected higher education institutions in Davao del Sur. www.uminjournals.org.

[101] Stegall, P. (1998). The principal: Key to technology implementation. Retrieved from ERIC database. (ED424614).

[102] Strizek, G. A., Pittsonberger, J. L., Riordan, K. E., Lyter, D. M. & Orlofsk, G. F. (2006). Characteristics of schools, districts, teachers, principals, and school libraries in the United States, 2003-04, schools and staffing survey. Washington, DC: U.S. Department of Education, National Center for Education Statistics.

[103] Thannimalai, R. & Raman, A. (2017). Principals' technology leadership and teachers' technology integration in the 21st century classroom. International Journal of Civil Engineering and Technology, Vol. 9 No. 2. U.S. Department of Education. Office of Educational Technology. (2017). Reimagining the Role of Technology in Education.

[104] Van Vugt, M. (2014 August 22). Age and Leadership: The wisdom of elders and elephants. Psychology Today. Retrieved from https://www.psychologytoday.com/intl/blog/naturally-selected/201408/age-and-leadership-the-wisdom-elders-and-elephants.

[105] Walker, K. D., Sackney, L., Anderson, K., & Woolf, J. (2003). Unexpected learning by neophyte principals: factors related to success of first year principals in schools. ResearchGate.

[106] Wilsmore, D., & Betz, M. (2000). Information technology and schools: The Principal's role [Electronic Version]. Educational Technology & Society.

[107] Yorulmaz, A., Can, S., Sitki, M. (2016). The technology leadership competencies of elementary and secondary school directors. Educational Policy Analysis and Strategic Research, Vol. 11No. 1.

[108] Young, M. D., Spicer, E., Perrone, F., Clement, D., Player, D., Thornton, M., Doiron, T. (2018). Examining the principal preparation terrain: Issues of supply, demand, and capacity. Charlottesville, VA: University Council for Educational Adminsitration.

[109] Yu, C., and Durrington, V. (2006). Technology standards for school administrators: An analysis of practicing and aspiring administrators' perceived ability to perform the standards. NASSP Bulletin, 90(4), 301-317.

[110] Zhao, Y., Pugh, K., Sheldon, S., and Byers, J. (2002). Conditions for classroom technology innovations: Executive summary. Teachers College Record, 104(3), 482-515.

[111] Zhou, G. & xu, J. (2007). Adoption of educational technology: How does gender matter? International Journal of Teaching and Learning in Higher Education. Vol. 19 No. 2.

[112] Zimmerman, E. (2018). Five key areas of technology professional development for teachers. EdTech. Retrieved from https://edtechmagazine.com/k12/article/2018/09/5-key-areas-technology-professional-development-teachers.

Theses and Dissertations

[113] Aguirre, E. and Faller Jr., S. (2018). Lived Stories of Mid-Career Teachers: Their Struggles with Millennial Learners in the Philippines. Journal of Educational and Social Research. Vol. 8 No. 1.

[114] Alazzam, A., et. al. (2012). Effects of Demographic Characteristics, Educational Background, and Supporting Factors on ICT Readiness of Technical and Vocational Teachers in Malaysia. International Education Studies; Vol. 5, No. 6. Canadian Center of Science and Education.

[115] Billheimer, D. M. (2007). A study of West Virginia principals: Technology standards, professional development, and effective instructional technology leaders Ph.D. thesis, Marshall University.

[116] Cheng, Y. (2004). A study of the relationship between principals' instructional leadership and school effectiveness in elementary schools in Miaoli County (Unpublished master's thesis). National Taichung Teachers College, Taiwan.

[117] Dunham, C. (2012). Principals Roles and Responsibilities in Technology Integration in Rural Georgia. Georgia Southern University. https://digitalcommons.georgiasouthern.edu/etd/786.

[118] Ford, J. I. (2000). Identifying technology leadership competencies for Nebraska's K-12 technology leaders (Unpublished doctoral dissertation). University of Nebraska- Lincoln, Nebraska.

[119] Esplin, N. L. (2017). Utah elementary school principals' preparation as technology leaders (Ed.D. thesis), Utah State University.

[120] Hamzah, Mohd Izham Mohd, et. al. (2010). A Quantitative Analysis of Malaysian Secondary School Technology Leadership. Management Science and Engineering Vol. 4, No. 2.

[121] Huang, H. (2004). A study of elementary school principals' instructional leadership strategies in elementary schools in Taipei County (Unpublished master's thesis). National Taiwan Normal University, Taiwan.

[122] Inkster, C. D. (1998). Technology leadership in elementary school principals: A comparative case study (Unpublished doctoral dissertation). University of Minnesota, Minnesota.

[123] Kadela, T. (2002). Technology leadership of elementary principals: Standards, competencies, and integration (Unpublished doctoral dissertation). Seton Hall University, New Jersey.

[124] Kumus, A. (1998). School as a learning organization. Unpublished master's thesis. Marmara University. Istanbul.Leadership principles in technology. (2008). Retrieved from https://www.brown.edu/academics/educationalliance/sites/brown.edu.academics.education-alliance/files/uploads/KLOOM_tech_entire.pdf.

[125] Mano, R. S. & Mesch, G. A. (2012). A blessing or a curse? Email effects on employees' work performance. University of Haifa.

[126] Matthews, A. W. (2002). Technology leadership at a junior high school: A qualitative case study (Unpublished doctoral dissertation). University of Nevada-Las Vegas, Nevada.

[127] May, S. J. (2003). The impact of technology on job effectiveness: Perceptions of high school principals. Dissertation Abstracts International, 64(05A), 1480.

[128] Omwenga, Ezekiel, et. al. (2015). Assessing the influence of the PTTC Principal's competency in ICT on the teachers' integration of ICT in teaching Science in PTTCs in Nyanza Region, Kenya. Journal of Education and Practice Vol.6, No.35. www.iiste.org.

[129] Peterson, R. B. (2000). Principals' perceptions of the technological knowledge and skills necessary for effective school leadership. Dissertation Abstracts International, 61(04A), 1245.

[130] Pisseth, H. (2011). Teachers' perceptions of their principals' leadership capacities (Master's thesis). Royal University of Phnom Penh, Cambodia.

[131] Raman, A., et. al. (2014). The Relationship between Principals' Technology Leadership and Teachers' Technology Use in Malaysian Secondary Schools. Asian Social Science; Vol. 10, No. 18. Canadian Center of Science and Education.

[132] Scott, G. (2005). Educator perceptions of principal technology leadership competencies (Unpublished doctoral dissertation). The University of Oklahoma, Oklahoma.

[133] Seay, D. A. (2004). A study of the technology leadership of Texas high school principals. Dissertation Abstracts International, 65(03A), 788.

[134] Seneca, T.S. (2008). The principal as technology leader: the skills elearners consider essential to the creation of a technology-rich school community. Louisiana State University. *https://digitalcommons.lsu.edu/gradschool_dissertations.*

[135] Thannimalai, R. and Raman, A. (2018). THE INFLUENCE OF PRINCIPALS' TECHNOLOGY LEADERSHIP AND PROFESSIONAL DEVELOPMENT ON TEACHERS' TECHNOLOGY INTEGRATION IN SECONDARY SCHOOLS. *School of Education and Modern Languages. Universiti Utara Malaysia, Malaysia.*

[136] Tweed, S. (2013). Technology Implementation: Teacher Age, Experience, Self-Efficacy, and Professional Development as Related to Classroom Technology Integration. East Tennessee State University.

[137] Ury, G. G. (2003). Missouri public school principals' computer usage and conformity to technology standards. Dissertation Abstracts International, 64(05A), 1489.

[138] Wu, H. (2004). A study of the elementary school principals' curriculum leadership in elementary schools Taipei City (Unpublished master's thesis). National Chungcheng University, Taiwan.

[139] Yen, L. (2010). A study of the relationship between principals' technological leadership and teachers' teaching effectiveness of elementary schools in Tainan County (Unpublished master's thesis). Southern Taiwan University, Taiwan.