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

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Abstract

This research assessed the extent of technology leadership of school heads and its relationship to the extent of technology integration of teachers in six selected science high schools in the National Capital Region. The study respondents were six school heads and 273 teachers. The study used validated, pilot tested and reliability-tested survey questionnaires adapted and modified from the Principals Technology Leadership Assessment and the Levels of Teaching Innovation (LoTI) Digital Age Survey. Percentage, weighted mean, Pearson correlation, chi-square, t-test, and ANOVA were used for statistical treatment. Results revealed that the school heads' extent of technology leadership across all areas ranges from partial to full implementation, and the teachers' extent of technology integration across all areas is being implemented "most of the time." The school heads' profile was not associated with their technology leadership, and only the highest educational attainment was found significantly related to the teachers' extent of technology integration. Furthermore, the technology leadership of school heads was not significantly related to the technology integration of teachers. The study also revealed no significant differences among school heads when grouped according to their profile. There was a significant difference between teachers' assessment of and school heads' self-assessment of their technology leadership.

KEYWORDS

Education 4.0
International Technology Standards
Online Training
Technology Integration
Technology Leadership

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 Jhingan (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 future and has the freedom to aspire and achieve personal goals by choice. In this regard, increased innovation in teaching methods and the availability of better learning opportunities supported by technology have been the major impetus for this shift toward personalization. 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.

With technology playing a major role in the current educational trend, international

technology standards will serve as a benchmark on how front-liners can effectively and efficiently integrate technology in schools. To realize this, the International Society for Technology in Education (ISTE, 2002) has set the foundation technology standards for education leaders which 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. Along with the new curriculum and opportunities that the K to 12 program provides, the country's education leaders are now faced with the demands of fast-paced technology developments and how to utilize these technological advancements for the betterment of the educational system.

As major key players in molding educational institutions, it is the duty of the school heads to be updated and knowledgeable about every trend and issue that might be affecting their institution. The school principals' attitude toward technological advancement and their strategy on how to integrate these advancements into their school's policy and curricula, and how to empower their teachers through these advancements are important factors in how the whole institution will produce their students. Aside from the principal, teachers also play a pivotal role in integrating technology into their pedagogy. Effective technology integration must happen across the curriculum in ways that deepen and enhance the learning process.

With particular emphasis, Science high schools in the country offer a specialized and relatively more challenging curriculum. Entry to these schools demands a grade requirement and passing an entrance exam. To accommodate the learners in Science high schools, teachers are also presumed to be highly qualified, excel in their academic and work performance, and be more advanced in their teaching approach, techniques, and strategies. They are expected to be incorporating technological trends in their pedagogy to bridge themselves with the generation of learners born with and into the technology and digital world. Consequently, the school head as a technology leader should primarily take into consideration the needs of both teachers and students in the area of integrating technology in academics, and find ways and means to actualize them to sustain the high educational quality expected from a Science high school.

Considering all the abovementioned discussion, this study aimed to assess the technology leadership of school heads in selected Science high schools in the National Capital Region and determine its relationship with the technology integration of teachers. The results of this study were used in developing a proposed online training module. Specifically, this study sought to find out (1) the profile of school heads and teachers; (2) the extent of technology leadership of school heads as assessed by themselves and as assessed by their teachers as to the areas of leadership and vision, learning and teaching, productivity and professional practice, support, management, and operations, assessment and evaluation, and social, legal, and ethical issues; (3) the extent of technology integration of teachers as to the areas of facilitating and inspiring student learning and creativity, designing and developing digital age learning experiences and assessments, promoting and modeling digital citizenship and responsibility, and engaging in professional growth and leadership; (4) the significant relationship between (a) the school heads' self- assessment of their technology leadership and their profile; (b) the teachers' self-assessment of their technology integration and their profile; (c) the technology leadership of school heads as assessed by their teachers and their technology integration; and (5) the significant difference between (a) the school heads' self-assessment when grouped according to their profile; and, (b) the teachers' and school heads' self-assessment on their technology leadership.

Methodology

The design of this study is a 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. The study is also both descriptive-correlational and descriptive-comparative since it sought to find out relationships between variables using statistical analyses and compares two or more groups by analyzing differences.

Respondents for this research came from Science high schools. The researcher utilized purposive sampling to select the six Science high schools. Purposive sampling involves the deliberate selection of individuals based on predefined criteria (DePoy & Gitlin, 2016). In this study, it covered the schools designated by the Department of Education (DepEd) as Science high schools. These schools were given the 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 Science high schools from the northern part of the National Capital Region for geographical representation; (4) inclusion of two 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 years to date; and (6) the Science high school should have already won international awards. Meanwhile, the total population of six school heads and 377 teachers from all selected Science high schools were targeted as respondents. However, only 273 teacher-respondents participated in the study because the others were either on official leave of absence or declined to participate in the study.

In relation to the selection of respondents, all reasonable efforts were made to ensure their ethical treatment. Through an informed consent form, the following were assured - respondent involvement was voluntary, and the option to withdraw anytime from the research was communicated. The researcher was confident that a reasonable degree of anonymity was assured for all respondents and that no unusual risks existed.

This study used two instruments adapted and modified from their original sources. To measure the extent of technology leadership of school heads, the first instrument was modified from the Principals Technology Leadership Assessment (PTLA) survey questionnaire (Anandan et al., 2005) developed by the Center for the Advanced Study of Technology Leadership in Education (CASTLE). The second instrument was modified from the 20th anniversary edition of the Levels of Teaching Innovation ("LoTi") Digital Age Survey (Moersch, 2016) and used to know the extent of technology integration of teachers. The survey instruments were initially validated by experts, revised, and then pilot-tested to establish 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, which are both acceptable values.

For the mode of analysis, descriptive statistical tools were applied to reveal the profile of the school heads and teachers. Results were reported using tables, frequency percentages, and means. Profile characteristics included age, sex, highest educational attainment, and years of service as school head or years of service in teaching. Meanwhile, inferential statistics were utilized to find possible relationships and significant differences between the selected variables. To describe both the extent of the technology leadership of school heads based on the six areas and the extent of technology integration of teachers based on the four areas, the weighted mean was utilized. 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. To know if there is a significant relationship between the technology integration of teachers and the technology leadership of school heads assessed by their teachers, the Pearson-r was utilized. 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 of their technology leadership. Meanwhile, the ANOVA was used to know if there are significant differences between technology leadership and the selected profiles of the school heads.

Results and Discussion

Profile of Science High School Heads and Teachers

The majority of the school heads are in their middle age, females, neophytes in their current position, and predominantly earned their doctorate units. Based on a foreign perspective, the data affirm the results of the study of Hill et al. (2016) that the change in the 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 to 48.0 years in 2012. The present data likewise affirm the study of Guiab and Ganal (2014) which revealed that 57.14% are female principals and only 42.86% are male principals in the elementary schools in Alicia, Isabela, Philippines. The good number of principals attaining graduate school units is a response to the Civil Service Commission's qualification standards for principal candidates, that is, a candidate for the school head position should preferably be a Master's degree holder with at least 18 units in leadership and management. Moreover, these results agree with the study of Thannimalai and Raman (2018) wherein 72.2% of the principals had 2 to 10 years of experience, followed by 15.6% who had less than a year's experience, 7.8% had 11-20 years of experience, and only 4.4% had more than 21 years of experience.

Meanwhile, 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. This high number of young teaching professionals in the country is mainly due to the massive hiring of teachers which commenced during the onset of the K to 12 curricula. 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. In addition, Espeso et al., (2017) in his PhilStar article, says that teaching is still a female-dominated profession in the Philippines. Of the educators nationwide, twice as many male educators have graduated over 11 years. The high number of teachers pursuing a 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. 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 curricula. Mateo (2018) said that the Department of Education (DepEd) should have hired, at that time, an additional 75,000 teachers to further reduce the class size and decongest classrooms in public elementary and high schools nationwide.

Extent of School Heads' Technology Leadership

The school heads rated themselves best in implementing the technology leadership areas of productivity and professional practice; and, social, legal, and ethical issues (Table 1a). 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.

The 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 constructs of technology leadership, one of the lowest means goes to Visionary Leadership. In

Table 1a

Summary Ranking of School Heads' Self-Assessment of Their Technology Leadership

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

Scale: 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

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. Meanwhile, the partial implementation of the learning and teaching area may pose concerns since the study of Billheimer (2007) revealed that learning and teaching were 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.

On a positive note, the full implementation of school heads in the area of productivity and professional practice 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.

In the area of support, management, and operations with emphasis on allocating discretionary funds to meet technology needs, this element was emphasized in the study of Ochada and Gempes (2018) where the "Principal's Proper Implementation/Utilization of Funds" 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 funds was properly managed and utilized.

In the area of assessment and evaluation, the report titled "Reimagining the Role of Technology in Education" (2017) provided by the Office of Educational Technology of the U.S. Department of Education significantly posited the role of using assessment data to support learning. Generally, and within the school context, data help individuals personalize and adapt experiences to individual needs. With improved educational data systems, leaders can leverage aggregate data to improve the quality and effectiveness of technology-enabled learning tools and resources. For instance, it is now possible to gather data during formative and summative assessments that can be used to create personalized digital learning experiences. In addition, teachers can use these data to inform interventions and decisions about how to engage individual students; personalize learning; and create more engaging, relevant, and accessible learning experiences for all learners.

In the area of social, legal, and ethical issues, it is important to note the study of Lai (2000) which revealed that not a single secondary school from the research locale had a policy on health and safety issues associated with computer use. 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.

Extent of Technology Integration of Teachers

All areas of technology integration are being implemented "most of the time" by the teachers (Table 2). One salient item in the area of "Facilitating and Inspiring Student Learning and Creativity" is related to developing higher-order thinking skills through project-based learning experiences. Scott (2015) emphasizes that project and problem-based learning are ideal instructional models for meeting the objectives of 21st-century education because they employ the 4Cs Principle–critical thinking, communication, collaboration, and creativity - alongside "teaching for transfer" and learning structure in real-world contexts.

Table 1b

Summary Ranking of School Heads Technology Leadership Areas as Assessed by Their Teachers

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 Issue	3.33	5

Scale: 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

Moreover, the results aligned with the Technology Integration Matrix (TIM) developed from 2005 to 2019 by the Florida Center for Instructional Technology. Based on its table of teacher descriptors, a teacher under the Entry-Active cell may be the only one actively using technology. This category may include using presentation software to support the delivery of a lecture. The teacher may also have the students complete "drill and practice" activities on computers to practice basic skills. On the other hand, a teacher who falls into the Entry-Constructive cell uses technology to deliver information to students. The results of the study further affirm the implications of technology integration to teaching as analyzed by Raman et al. (2014) in their study wherein the fundamental implication is for teachers to be encouraged on the wider use of technology beyond basic applications such as word processing, spreadsheets, and databases. Using software tools such as web development and learning management systems helps teachers to integrate technology effectively and efficiently. In addition, since collaboration is tantamount to professional development, educators through technology can collaborate far beyond the walls of their schools. Based on a 2017 US Department of Education Report, 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.

Relationship Between the School Heads' Profile Variable s and their Self-Assessment of Technology Leadership

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 (Table 3a). This result affirms the study of Baker et al. (2007) on the effects of gender and age on new technology implementation in a developing country. Their most salient finding was 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 Yorulmaz and Cal (2016) who found that the school directors' technology leadership competency 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. Esplin (2017) also revealed that gender, age, number of years as principal, and highest degree earned were not significantly related to the participants' technology leadership level.

Relationship Between the Teachers' Profile Variables and Their Self-assessment of Technology Integration

Age, sex, and years of service in teaching are not associated with technology integration as self-assessed by the teachers (Table 3b). This result affirms the study of Mahdi and Al-Dera (2013) that teachers' age and teaching experience do not affect their ICT use in teaching. In agreement, Tweed (2013) found 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. On the other hand, Kiboro (2018)

Table 2

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

Scale: 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 3a

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 3b

Relationship Between the Teachers' Profile Variables and Their Self-Assessment on Technology Integration

Profile and Technology Leadership	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 HA Accepted	Significant
Years of Service as School Head	21.244	16	26.296	Ho Accepted	Not Significant

found that teachers' level of education greatly affects ICT integration as few who are highly qualified preferred using ICT. This result supports the significant relationship between the highest educational attainment profile variable and the teacher's technology integration level. Furthermore, the study of Adedokun (2018) revealed a significant moderate positive relationship to classroom technology integration for holders of both bachelor's and master's degrees.

The results imply that while the majority of the teachers were already born with and into technology as imperative of their generation, the technology trainings, and practices acquired from their graduate school work helped them further enhance their technological knowledge and skills making them relatively advanced in technology integration.

Relationship Between Technology Leadership of School Heads as Assessed by Their Teachers and Technology Integration of Teachers

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 (Table 3c). 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 members are technologically-savvy and globally connected. Furthermore, Dolot (2018) described these "digital natives" as those who were born in

Table 3c

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					

the 1990s and raised in the 2000s who exist in a world with the web, internet, smartphones, laptops, freely available networks, and digital media. Generation Z uses different mobile devices, they comment on reality, and 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 the above-mentioned 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 e-mail and text messaging, making them also not strangers to digital technologies.

Difference Between School Heads' Self-Assessment on Their Technology Leadership when Grouped According to Profile

There are no significant differences between school heads' self-assessments on their technology leadership when grouped according to age, sex, highest educational attainment, and years of service in the current position (Table 4a). Contrary to the results of the study, Hang (2011) analyzed differences among principals' demographic factors of gender, age, educational level, and years of service as they relate to technology leadership, and found gender and educational level significantly associated with technology leadership. Moreover, the results of the conducted study do not affirm the findings of Hang (2011) that female principals were perceived as significantly higher in technology leadership than male principals. Furthermore, principals who hold higher educational degrees tended to be perceived to have significantly higher technology leadership than those who hold a lower educational degree.

The conflicting results of the study with the literature 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 a responsive agent to the current generation of learners and the demands of stakeholders. This result is viable proof of the school heads' adherence to the technology standards expected from them as educational leaders as provided by the International Society for Technology in Education (ISTE).

Difference Between Teachers' Assessment of Their School Heads' Technology Leadership and School Heads' Self-Assessment

The difference between teachers' assessment of technology leadership of their school heads and school heads' self-assessment of their technology leadership was found to be significant (Table 4b). The results agree with the findings of Hang (2011), which revealed that the teachers perceived their principal's capacities more positively than negatively. Principals were perceived highest positive in developing a school vision, promoting positive school culture, and understanding 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 as least positive on some dimensions of leadership such as using and promoting technology in school, deployment of financial and human resources, implementing professional development, allocating and using fiscal, human, and material resources, and using community resources positively.

Table 4a

Difference Between School Heads' Self-Assessment on Their Technology Leadership when Grouped According to Profile

Profile	Computed Chi-square value	df	Tabular F- 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 4b

Relationship Between Technology Leadership of School Heads as Assessed by Their Teachers and Technology Integration of Teachers

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

This result 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.

The Online Training Module

Based on the results of the study, an online training module was designed specifically for school heads to develop and enhance their technology leadership. The researcher utilized the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model in designing the online training module. According to McGriff (2000) of Penn State University, the ADDIE model is a systematic approach to instructional design. 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 strategies. 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 include the storyboard and exercises. For the online training module, the 4As were 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 a 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 reports to come up with a revised prototype. The last two phases of implementation and evaluation are points for recommendation in this study.

Conclusions

The school heads and teachers of Science high schools are mostly millennials (Generation Y) and digital natives (Generation Z). The school heads have strong grasp of technological knowledge and skills, and the teachers are technologically savvy inclined into integrating technology into their daily task. Based on self-assessment, the school heads are capable of translating the international standards on technology leadership into institutional practice in the Science high schools. The teachers also perceive them as capable of being technology leaders, regardless of their demographic profile. On the other hand, the teachers self-assess themselves as technology inclined and 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 future work skills, and ultimately, embodying technological, pedagogical, and content knowledge. These results convey that Science high schools, as generally perceived by the public, are actually capable of conceptualizing, implementing, and sustaining the technological layer of Education 4.0 as imperative and significant drivers for curriculum delivery, instructional strategies, assessment modalities, and institutional planning.

The study also revealed a non-significance between the technology leadership of school heads as assessed by their teachers and the technology integration of teachers as assessed by themselves. This implies teachers' independence in relation to technology integration brought about by the generation they belong to, their self-efficacy, and their self-determination. The non-significant differences between school heads' self-assessments on their technology leadership, when grouped according to their profile variables, imply 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. The significant difference between teachers' assessment of the technology leadership of their school heads and school heads' self-assessment of their technology leadership implies a positive perception among teachers of 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.

Recommendations

In light of the conclusions, it is recommended that first, school heads may draft an institutional technology plan with particular emphasis on the four areas which are only partially implemented. Particularly, school heads are advised to plan activities and school improvement project titles (areas) to be included in the school improvement plan (SIP) and 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. School heads are recommended further to: a) participate in local and international professional development trainings for technology leadership and integration and reflect such in their Individual Performance and Commitment Review Form (IPCR); b) in line with the DepEd school report card, which serves as a tool for communicating the school situation, context, and performance to internal and external stakeholoders to increase the participation and involvement of the community and other stakeholders in making the school a better place for learning, involve stakeholders for supplemental funding of hardware and software upgrades and other technology-support services, if school funds are found to be insufficient; and c) Emphasize technology integration in evaluating instructional practices, together with technology coaches if possible since 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; and d) to serve as a springboard to training and development programs as mandated by DepEd Order No. 32 series of 2011, Deped may conduct a needs-based assessment to address the technology concerns and needs of teachers.

Secondly, health policies and ethical use guidelines for technology use in classrooms and school offices need to be created. These policies may be crafted collaboratively through learning action cell (LAC) sessions and as part of the key

result area (KRA) of the learning environment in the OPCR of school heads.

Thirdly, 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 to address and develop 21st-century skills. 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.

Fourthly, 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. Also, the online training module (Appendix 1) developed based on this study may be utilized to test its efficiency and effectiveness and acquire feedback from participants on what aspects need improvement. The feedback will serve as inputs into the implementation and evaluation phases of the ADDIE model.

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Appendix 1

THE ONLINE TRAINING MODULE ON TECHNOLOGY LEADERSHIP

What is this online training module on technology leadership about?

Introduction

The different roles of school heads entail essential and crucial accountabilities. With the advent of Education 4.0, globalization, and the influx of 21st century learners, there has been a consistent demand for relevance on how school leadership should influence all stakeholders in order to sustain the school as the primary agent of change in a society. In addition to the functions of school heads which are embedded in instructional, managerial, cultural, and strategic leadership among others, the current international and local arena calls for a responsive technology leadership. School heads are expected to plan, implement, and utilize technology in various forms within the educational institution.

This e-module is intended to refresh, develop, and deepen among school heads the different facets of technology leadership based on the standards set by the International Society for Technology in Education (ISTE). While there have been revisions already to the standards for school administrators since its conception, it is important to reconsider again the compliance and adherence to the foundation areas of technology leadership as spelled out in the National Educational Technology Standards for Administrators (NETS-A) which are:

1. Leadership and Vision
2. Learning and Teaching
3. Productivity and Professional Practice
4. Support, Management, and Operations
5. Assessment and Evaluation
6. Social, Legal, and Ethical Issues

The aim of this e-module is primarily to help every school head draft and craft their technology plan for the school, and consequently to carry out these plans to prepare not only technologically-savvy graduates but technologically-responsible citizens as well. This will also pave the way to either commence or sustain the collaboration between school heads and teachers as classroom front liners in the efficient and effective integration of technology in their teaching-learning situations - for the ultimate benefit of education's clients: the students.

Table of Contents

This e-module is comprised of four (4) required lessons and two (2) optional enrichment lessons:

REQUIRED LESSONS
Lesson 1. Leadership and Vision
Lesson 2. Learning and Teaching
Lesson 3. Support, Management, and Operations
Lesson 4. Assessment and Evaluation

OPTIONAL ENRICHMENT LESSONS
Enrichment Lesson 1. Productivity and Professional Practice
Enrichment Lesson 2. Social, Legal, and Ethical Issues

Overview of the e-Module Teaching-Learning Aspects

Teaching-Learning Aspects	Description/s	Detail/s
Mode of Delivery	Full Online	The e-module lessons will be delivered fully online via a website link which also serves as the official virtual classroom.
Instructional Materials	Online Module	A total of four (4) required lessons and two (2) optional enrichment lessons are all uploaded in the website.
Submission of Outputs	Online; Flexible	Participants are expected to submit their outputs to every lesson every weekend. However for flexibility and consideration purposes, extension periods may be given by the facilitator.
Feedback and Evaluation	Online; Flexible	Comments and feedback of the facilitators are to be posted mainly in the "forum section" of the website. However, facilitators may also utilize other modes of feedback channels such as through e-mail, SMS, or chat groups.

General Outcomes and Flow of Instruction

At the end of the e-module, participants should have realized the following:

a. maintain a comprehensive process to develop, implement, and monitor a dynamic, long-range, and systemic technology plan,
b. facilitate and support collaborative technology-enriched learning environments conducive to innovation for improved learning,
c. allocate financial and human resources to ensure complete and sustained implementation of the technology plan,
d. use multiple methods to assess and evaluate appropriate uses of technology resources for learning, communication, and productivity,
e. employ technology for communication and collaboration among colleagues, parents, students, and the larger community,
f. promote and enforce environmentally safe and healthy practices in the use of technology.

Lesson	Goal	Targets	Topic/s and Output/s	Time Frame
Pre-assessment			Reflective Journal	TBA
Leadership and Vision	School heads as educational leaders should inspire a shared vision for comprehensive integration of technology and foster an environment and culture conducive to the realization of that vision.	-identify policy gaps in technology integration in Philippine schools; -formulate a vision statement for technology integration in school systems; and, -develop a research-based technology integration plan	Strategic Planning and Crafting an Action Plan	48 hours (flexible)

Learning and Teaching	School heads as education leaders should ensure that curricular design, instructional strategies, and learning environments integrate appropriate technologies to maximize learning and teaching.	-determine the five levels of technology integration; -use the Technology Integration Matrix in designing lessons; and, -integrate technology in a standards-based lesson.	Technology Integration Matrix and Enhanced Instructional Plan	48 hours (flexible)
Support, Management, and Operations	School heads as educational leaders should ensure the integration of technology to support productive systems for learning and administration.	-identify threats to integrating technology to improve the learning experiences of students; -determine financial needs to realize technology integration targets; -allocate funds from school and other resources to advance implementation of the technology integration plan; and, -develop a sustainability action plan consistent to the school's technology integration plan.	Sustainability Action Plan	48 hours (flexible)
Assessment and Evaluation	School heads as educational leaders should use technology to plan and implement comprehensive systems for effective assessment and evaluation.	-trace the progression of technology integration in the classroom using the SAMR model; -determine the effects of technology use in one's practice; and, -use SAMR in planning, and evaluating technology use in the classroom.	The SAMR Model and Modified Instructional Plan	48 hours (flexible)

Productivity and Professional Practice	School heads as educational leaders should apply technology to enhance their professional practice and to increase their own productivity and that of others.	-identify the key features of the TPACK framework as it relates to professional practice; -assess current level of pedagogical, content, and technological knowledge in relation to professional practice; and, -determine the interrelationships between pedagogical, content, and technological knowledge for continuing professional development.	The TPCK Framework and Training Plan	48 hours (flexible)
Social, Legal, and Ethical Issues	School heads as educational leaders should understand the social, legal, and ethical issues related to technology and model responsible decision-making related to these issues.	-identify key ethical, social, and legal issues in the use of technology in schools; -determine ways to properly and safely use technology in school; and, -produce an acceptable use policy for the use of technology in school.	Key Issues and Acceptable Use Policy	48 hours (flexible)
Post-assessment			e-portfolio	TBA
				Required Lessons: 192 hours (flexible) **Optional Enrichment Lessons: 96 hours (flexible)** **Total: 288 hours**

Note: Outcomes, goals, and targets are stipulated in the NETS-A crafted by the ISTE.

Parts of the Module

This e-module is composed of four (4) main parts:

1. Activity - this part will bring understanding to what you already know and clarity to what you should learn further. Here, you should already have a retrospect of what you will be learning through the activities presented.
2. Analysis – this part presents a more in-depth understanding of the lesson where you will process and classify what is valid and not. You will gain a wider view of the lesson but at the same time draw closer to the main topic.
3. Abstraction – this part focuses entirely on the lesson to lead you in reinforcing what you know and should know more. You start to feel more the importance of the lesson and see its necessity and relevance.
4. Application - this is the part where you have a more practical way of how you are going to use what you have learned and think of new ways on how it can be improved further.