Relevance of Principals' Technology Leadership and Management on 21st Century Teacher Preparation: A Reflection on Ghanaian Colleges of Education

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Abstract

This study aimed to identify the relevance of Principals' Technology Leadership on Tutors' Technology Integration in the Ghanaian Colleges of Education. This is a cross-sectional survey where simple random sampling was employed to select 13 principals and 229 tutors from the Colleges of Education in the Ashanti, Ahafo and Bono regions of Ghana. A two-part structured questionnaire guided by Principals' Technology Leadership Assessment (PTLA), which is based on the International Society for Technology in Education (ISTE)-Standards for Administrators [30] was used. Descriptive analysis was carried out using SPSS Version 25. Although the findings showed that the levels of Technology Leadership; the five constructs of ISTE [30], and Tutors' Technology Integration were essential but, much needs to be done to improve relationship between Principals' Technology Leadership and Tutors' Technology Integration in the selected colleges in Ashanti, Ahafo and Bono regions of Ghana. Principals' preparatory programmes should emphasize leadership based on technology to enhance the integration of technology in classrooms. Further research on professional development for principals is recommended

Keywords: Principals; Technology Leadership; Tutors; Technology Integration; ISTE; ICT; Colleges of Education.

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1. Introduction

The rapid advancement of technology, especially in Industrial Revolution 4.0 (IR 4.0), is evidently influencing every aspect of our lives including leaderships and education settings across the world [1]. Advanced technologies in IR 4.0 like Artificial Intelligence and Internet of Things are changing the role of school leaderships, approaches to teaching, and remodeling of classrooms [2]. Over the past decade, rampant changes have been obvious in the way leaders administer and manage technology use in schools [3]. The recent report from Training Industry Trends found that learners' needs are changing, technology is evolving, skills are different, automation is altering processes, and globalization is expanding our reach [4]. However, [5] reported that as many as 92% of leader preparation courses do not involve the use of technology. Many states and institutions in the United States do not make educational technology compulsory in school leadership preparatory programs. Out of their initiative and commitment toward 21st-century education demands, leaders acquire latest technological knowledge by themselves and promote collaboration and technology vision among teachers. Key findings from the [6] showed that one of the top three challenges faced by technology leaders, which remained the same from 2017 to 2019, was insufficient professional development. Technology leaders reported lack of relevant training and the unavailability of professional training. School leaders have the responsibility to encourage and support teachers to integrate technology in learning and to teach especially when the Internet of Things is rapidly making its way into classrooms in ways never before imagined. With Smart whiteboards and alternative interactive digital media being widely utilized during interactive learning in classrooms, school leaders have to keep abreast with the new technologies. Thus, school leadership preparatory training should include technology to produce future-ready school principals who can lead teachers and students, as learning experiences become virtual and ubiquitous [7, 8]. Moreover, it is the ultimate goal of school technology leaders to propel learning and teaching forward toward student achievement.

Technology leaders are required to take advantage of technology to transform, impact learning, and create a shared vision for how technology can meet the needs of all learners [9]. It is thus critical that school leaders envisage and facilitate the use of technology in this digital world ubiquitous to students who are now digital natives. However, according to a report by [10], poor leadership could be the biggest barrier to a successful Fourth Industrial Revolution strategy. According to the Teaching and Learning International Survey (TALIS) report, only 50% of teachers said that the use of information and communication technologies (ICT) for teaching was actually included in their initial training, and many agreed that they still require more professional development to master advanced ICT skills [11].

Nonetheless, ICT integration in classroom teaching and learning is expected to produce student-centered learning in line with 21st-century learning, which is an essential element in the new Ghanaian curriculum reforms where teachers need to equip themselves with the latest creative and innovative pedagogy including ICT. Consequently, [12] is of the view that a paradigm shift in the mind-set of school leaders to maximize the potential of ICT is required so that Ghana's education system grows in line with the rapid development of technology. In line with a 40-year study based on 25 meta-analyses, the use of computers in the classroom had a positive overall impact on student achievement [13]. However, it cannot be concluded that ICT would produce better results as there are other factors affecting student achievements, such as teacher training and ICT usage

linkages with pedagogy. On the other hand, a study by [14] confirmed that lack of teacher competence in ICT can impact the achievement of students in school. Similarly, [15] contend that integration of technology by leaders and teachers was affected by inadequate training, incompetence in ICT, and limited access to ICT.

Undeniably, there is evidential proof indicating an apparent gap in the context of Ghanaian Colleges of Education regarding technology integration among teachers and school leaders who are not skillful enough to manage technology integration at schools. For example, many teachers in Ghana's Pre-tertiary and tertiary institutions face untold challenges implementing *Learning Management Systems* like the Zoom and Google Meet Virtual Learning Environments in the wake of 21st century teaching and learning paradigm shift let alone employing hybrid approach [16]. Past studies have also shown that leadership is closely linked to the effectiveness of complex organizational functions [17]. As a result, [18] concluded that the lack of leadership and trained administrators are two of the main reasons for the failure to integrate technology into education. Additionally, this study is supported by [19, 20] who proved that technology could be successfully implemented in the classroom if there is a contribution from quality leadership. Approached in these terms, [21] identified that the role of the principal as a technology leader in the integration of technology at schools could have a significant influence on the level of technology utilization during the teaching and learning process. Research on principals' leadership technology is lacking in existing literacy bases [22, 23, 24, 25]. The technology leadership of principals and the readiness of teachers to embrace and integrate ICT will enable the education system of Ghana to be in line with government policies. The use of ICT in schools is still not satisfactory, in terms of both quality and quantity. The gap between high spending on educational technology and expected returns on school improvement is a widely debated global educational agenda [26, 27, 28]. While on-going efforts are being undertaken to enhance the skills of Ghanaian ICT and non-ICT teachers [29], the integration of ICT in schools has not reached the level of satisfaction [30]. Therefore, this study was conducted to demonstrate that principals' leadership in schools has a significant relevance on the integration of technology regarding teaching and learning.

Research Questions

In line with the above discussion, the following research questions guided the study:

1. What is the level of Principals' Technology Leadership in the Colleges of Education?
2. What is the level of Tutors' Technology Integration in the Colleges of Education?
3. Do the five constructs of Principals' Technology Leadership (Visionary Leadership, Digital Age Learning Culture, Excellence in Professional Practice, Systemic Improvement, and Digital Citizenship) affect Teachers' Technology Integration in the Colleges of Education?

2. Literature Review

In the past three decades, previous research has proven that knowledge and skills in technology have been pivotal in school leadership. According to [31], school principals need to be imaginative and courageous to become technology leaders. In addition, only the school principal has the power to make instructional decisions

on technology infrastructure and programmes in school [32]. Furthermore, technology leadership amongst school principal is crucial to increase technology literacy and technology integration in the classroom among teachers [33]. Principals as technology leaders and teachers' of educational establishments must be skilled and knowledgeable to be able to implement 21st century education in classrooms [34]. All teacher trainees are required to achieve competency standards as part of their prerogative training. Similarly, [35, 36] described that the lack of ICT usage might be due to lack of confidence in the use of ICT and lack of support for teachers. Further, studies show that professional development is among the most critical factors for improving students' learning through ICT integration [37].

Aside from this, a study conducted by UNESCO in 2012 found that the use of ICT by teachers in schools was limited to the use of word processing applications as a teaching tool [38]. Thus, the implication of the results of the above studies is that effective and concerted efforts for staff development programmes at educational establishments is a great necessity and this case scenario indeed reflects that school principals' or the school leadership need to be highly proactive, discretionary and assertive. Likewise, numerous scholars have conceptualized technology leadership as decisions made by organizations, policies or actions that facilitate the effective use of information technology in schools [39]. Technology leadership is perhaps the key to the success of technology integration in education [25]. However, researchers have reported research gaps in the topic of technology leadership [22, 23, 40, 24, 27, 28]. Studies on challenges faced by school technology leaders in Australia recommended that further research on professional development needs for leaders should be carried out [22]. In the United States and Ghana at large, limited studies have been carried out on technology leadership and its effect on technology integration among teachers [24]. In furtherance, [23, 42] recommended that further research on guidelines and development programs for technology leadership should be carried out. Previous research on technology leadership only used the National Education Technology Standards-Administrator (NETS-A), as a whole, to study technology integration [43]. Not many studies have analyzed the relationship between the five constructs of technology leadership [44] as well as the importance and performance of these constructs with technology integration in the Ghanaian Colleges of Education [33, 45] Hamzah[3,46]. Moreover, studies conducted by [47, 48, 49, 50, 51] suggested that professional development for technology leaders should be studied in depth. According to [32], leadership theories in the past century found that technology leadership was not a separate theory but a development of leadership theories. In addition, [52] found that technology leadership differed from traditional leadership theories because it does not focus on the leader's features or actions but emphasized that leaders should develop, guide, manage, and apply technology in different organizational operations with the aim of improving the organization's performance. Reference [48] suggested that schools should have leaders who are prepared to lead as technology leaders. Researchers found that principals are the key to effective learning outcomes from the use of technology in schools [74, 53]. Technology administrators have to be knowledgeable and responsive to rapidly changing technology and instructional needs [54, 55]. The review of the literature discusses educational technology standards and principals as digital leaders.

2.1 Technology Standards

General leadership standards define the expectations; provide specificity of key behaviors, and competencies of

a successful school leader [56]. Additionally, leadership standards are viable when districts actually use them to shape how they select, hire, train, and evaluate school leaders [57]. In 2001, the International Society for Technology in Education (ISTE) convened a group of stakeholders, including the National Association of Secondary School Principals (NSSA), National Association of Elementary School Principals (NAESP), America Association of School Administrators (AASA), National School Board Association (NSBA), North Central Regional Educational Laboratory, state departments of education, and university faculty, among other interested parties [5]. Led by ISTE, this team decided there was a need to promote "the idea that knowledge, practice, and specific skills were needed for administrators to be ready to support the appropriate use of technology in a school" [5]. The technology standards were first published in 2002 as ISTE National Educational Technology Standards for Administrators (NETSA).

In 2009, ISTE updated the NETS-A to the ISTE Standards for Administrators to take into account the widespread function of technology within the work-place and the necessity for administrators to create learning environments. The ISTE Standards for Administrators consist of five technology leadership standards and 21 indicators that give more specific descriptions of the

overall standard, thus providing administrators with a guide to achieving the standard. The operational definitions for the five technology leadership standards are as follows:

Visionary leadership

[30] Standard 1-Visionary Leadership focused on ways educational administrators inspire and lead the development and implementation of a shared vision for comprehensive integration of technology to promote excellence and support transformation throughout the organization. This includes collaboration with stakeholders to inspire and facilitate a shared vision of purposeful change maximizing the use of digital-age resources to meet and exceed learning goals; support effective instructional practice; and maximize performance of district and school leaders. Besides, visionary leaders must engage in an ongoing process to develop, implement, and communicate technology-infused strategic plans aligned with a shared vision. This includes advocacy on local, state and national levels for policies, programs, and funding to support implementation of a technology-infused vision and strategic plan [30].

Digital age learning culture

[30] Standard 2-Digital Age Learning Culture emphasized the need for educational administrators to create, promote, and sustain a dynamic, digital-age learning culture providing a rigorous, relevant, and engaging education for all students. The impetus is to ensure implementation of instructional innovation using technology that is focused on continuous improvement of digital-age learning. The standard outlines expectations for administrators to model and promote frequent and effective use of technology for learning; provide learner-centered environments equipped with technology and learning resources to meet the individual, diverse needs of all learners; and ensure effective practice in the study of technology and its infusion across the curriculum [30]. To extend this concept, administrators are expected to promote and participate in local, national, and global

learning communities that stimulate innovation, creativity, and digital age collaboration.

Excellence in professional practice: [30] Standard 3-Excellence in Professional Practice established the responsibility of Educational Administrators to promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources to allocate time, resources, and access to ensure ongoing professional growth in technology fluency and integration. This is accomplished through facilitation and participation in learning communities that stimulate, nurture and support administrators, faculty, and staff in the study and use of technology. Administrators should promote and model effective communication and collaboration among stakeholders by using digital age tools; stay abreast of educational research and emerging trends regarding effective use of technology; and encourage evaluation of new technologies for their potential to improve student learning [30].

Systemic improvement

[30] Standard 4 – Systemic Improvement described the need for educational administrators to provide digital age leadership and management to continuously improve the organization. To do this, the effective use of information and technology resources to lead purposeful change and maximize the achievement of learning goals through the appropriate use of technology and media-rich resources is necessary. Specifically, administrators should collaborate to establish metrics, collect and analyze data, interpret results, and share findings to improve staff performance and student learning. With these core concepts in mind, administrators must recruit and retain highly competent personnel who use technology creatively and proficiently to advance academic and operational goals; establish and leverage strategic partnerships to support systemic improvement; and establish and maintain a robust infrastructure for technology including integrated, interoperable technology systems to support management, operations, teaching, and learning [44].

Digital citizenship

[44] Standard 5-Digital Citizenship charged educational administrators to model and facilitate understanding of social, ethical and legal issues, and responsibilities related to an evolving digital culture to ensure equitable access to appropriate digital tools and resources to meet the needs of all learners. Leaders are directed to promote, model, and establish policies for safe, legal, and ethical use of digital information and technology; promote and model responsible social interactions related to the use of technology and information; and model and facilitate the development of a shared cultural understanding and involvement in global issues through the use of contemporary communication and collaboration tools [44]. In 2018, ISTE released new standards for educational leaders highlighting key areas of impact. The current standards target the competencies and mindset required for leaders to leverage technology to transform learning, teaching and leading. The characteristics of effective technology leaders, which include a focus on equity, digital citizenship, and visionary planning, are defined in the [58] standards. The expected outcomes are meant to empower leaders to support teachers' use of technology in innovative ways to enrich teaching and learning. The educational leader is viewed as a system designer possessing the capacity to build teams and systems to implement, sustain and continually improve the use of technology to support learning.

Further, strong technology leaders are connected learners modeling and promoting continuous professional learning for themselves and others.

2.2 Principals as Digital Leaders

For the country's countless educational establishments, principals play a pivotal role in determining how well technology is used in schools. With society becoming more and more reliant on technology, it is incumbent upon leaders to stay up-to-date with the latest technologies, respond to technology problems, decide what technology to buy, decide how digital tools can be used for teaching and learning, navigate pressures from technology companies and vendors-while managing the other responsibilities of a campus principal in order to create school cultures that are transparent, relevant, meaningful, engaging, and inspiring [59].

[60] described the principal's role as a technology leader by providing a list of technology leadership tasks. These tasks include:

- Establish the vision and goals for technology.
- Carry the technology banner.
- Model the use of technology.
- Support technology use in the school.
- Engage in professional development opportunities that emphasize the use of technology and integration of technology in student learning.
- Provide professional development opportunities for teachers and staff that emphasize the use of technology and integration of technology in student learning.
- Secure resources to support technology use and integration in the school.
- Advocate for technology use that supports student learning.
- Be knowledgeable and supportive of national technology standards and promote attainment of the standards in the school.
- Communicate the uses and importance of technology in enhancing student learning experiences to the school's stakeholders.

Reference [60] further emphasized the importance that principals model effective technology use. In addition, Grady added that leaders of technology encourage the use of technology in classroom instruction. Reference [61] identified Seven Pillars of Digital Leadership–specific areas embedded in the culture of schools that can be improved or enhanced through the use of technology. The pillars present a framework from which any leader can begin to harness the power of technology to change professional practice and initiate sustainable change. The Seven Pillars of Digital Leadership include: (a) student engagement, learning, and outcomes; (b) learning environment and spaces; (c) professional growth and learning; (d) communications; (e) public relations; (f) brandings; and (g) opportunity. Context for leaders to lead in different ways, necessary because of societal shifts and the increased demand on technological fluency, is described in the Pillars of Digital Leadership. The Pillars are also aligned with the ISTE Standards for Education Leaders [58], and frameworks for school improvement in the twenty-first century. Today, the world is a student's classroom because of the connectedness and

ubiquitous nature of mobile devices. With this in mind, it behooves principal preparation programs to assess teachers and student perceptions of technology leadership preparation. Preparing principal candidates to lead digital technology implementation supports instructional shifts from traditional to new pedagogies which enables student-created content to be shared outside the traditional classroom and supports creation of engaging learning environments [62]. It is critical school leaders are prepared to lead the development of engaged learning environments using digital tools and resources to create deeper learning experiences for professionals and students [63].

Reference [43] studied school leaders' behavior in 135 secondary schools in Saudi Arabia and discovered that the school leaders demonstrated high technology leadership. [64] Reference found that technology leadership practices correlated with teacher ICT competence and were supported by many leadership theories [65, 66, 67, 68, 69, 70]. This finding is in line with [32] who postulated that only school technology leaders have the power to make instructional decisions related to technology and the implementation of technology programs. Based on previous research, this study analyzed the importance and performance of the five constructs of technology leadership on technology integration of teachers. Beside these, relevance of principals' technology leadership and teachers' technology integration in the Ghanaian Colleges of Education is the focal point of this study. The NETS-A is a guideline for school principals to understand their role as a technology leader so that they can accomplish technology integration in the educational process [71]. Over the last three decades, NETS-A, as a whole was used in research to study the effect of principals' technology leadership on teachers' technology integration but did not investigate the effect of its constructs [43]. ISTE has since renamed the NETS-A to ISTE Standards for Administrators [30, 58]. Although there was a study linking ISTE- Standards for Administrators [44] (2014) with other variables such as receiving and using SMS by teachers (UTAUT2) [72], no other study in the Ghanaian context researched the relationship of the five constructs of ISTE-Standards for Administrators [44] with technology integration in the Colleges of Education. Reference [73] proved that studies using NETS-A standards, were very poorly conducted in western countries and suggested further studies on Digital Citizenship, which is one of the [74] NETS-A constructs. This research was based on current issues related to technology leadership models as suggested [75, 23, 76] Haynes, Arafeh, and McDaniels (2014) and the technology integration model suggested by [77].

2.3 Framework

The International Society for Technology in Education (ISTE) Standards for Administrators [78] is the framework for this study. The ISTE standards are considered the *gold standard* framework for technology competencies for administrators [79].

The purpose of the standards was to define what school leaders should know and be able to do to use technology effectively in teaching and learning. The standards also establish the benchmark for evaluating skills and knowledge school administrators and leaders need to support digital age learning, implement technology, and transform the instructional landscape [58].

3. Methodology

The study employed quantitative approach underpinned by positivist paradigm with its design being cross-sectional survey hence it was hoped to present the researchers with numerous advantages such as looking at the relationships between variables and establishing the cause and effect in highly controlled circumstances.

In addition, this method often reduces and restructures a complex problem to a limited number of variables.

A. Method

Since the study was quantitative in nature, questionnaire was used to answer all the research questions. This study empirically measured the level of technology leadership as well as its effect on the integration of technology in the classroom by the teacher.

Population and Sampling

Data was collected from the population of the study. Study population comprised 13 principals and 610 tutors from the Colleges of Education in the Ashanti, Ahafo and Bono regions of Ghana which consist of metro/municipal/districts namely, Kumasi, Adansi West, Asante Akyem North, Offinso South, Mampong, Sekyere East, Tano South, Berekum, Wenchi and Atebubu Amanten (according to the available statistics in the selected colleges). The numerical strengths of the population based on the existing data of the said institutions total 623. The choice of the population became necessary since the said colleges possess similar characteristics (in terms of curricular use, pedagogical approaches, technology integration style, school climate and the likes) of other Colleges of Education in Ghana in line with the relevance of Technology Leadership and Management on 21st century teacher preparation. Accordingly, taking inspiration from [80] table for determining sample size of a given population, the acceptable sample size became 242 which fairly represented the finite population. Simple random sampling was used to select the finite population. The use of this sampling technique according to [81] offers the opportunity where everyone in the target population has equal chance of being selected for the study. Table 1 shows the distribution of colleges in each metro/municipal/district. Each college is headed by a principal. Principals are considered homogeneous as they are appointed according to specifications from Ghana Tertiary Education Commission.

Table 1: Distribution of Respondents.

Metro/Municipal/District	Principals	Tutors
Kumasi	2	101
Adansi West	1	50
Asante Akyem North	1	49
Offinso South	1	50
Mampong	2	90
Sekyere East	1	44
Tano South	1	49
Berekum	2	109
Wenchi	1	32
Atebubu Amanten	1	36
Total	13	610

Table 2: Respondents' Demographic Information.

	Principals n (%)	Tutors n (%)
Gender		
Male	8 (62)	441 (72)
Female	5 (38)	169 (28)
Age		
Thirties	0 (0.0)	155 (25)
Forties	4 (31)	299 (49)
Fifty+	9 (69)	156 (26)
Current roll in institution		
Tutor	0 (0.0)	282 (47)
Academic Affairs Officer	0 (0.0)	13 (2)
Counselor	0 (0.0)	225 (36)
Professional Development-Coordinator	0 (0.0)	35 (6.0)
School Administrator	6 (46)	15 (2.0)
Systems Administrator	0 (0.0)	28 (5.0)
Others	2 (15)	12 (2.0)
Level you would rate technology in your college		
Very low	1 (8.0)	15 (2.0)
Low	2 (15)	30 (5.0)
Medium	3 (23)	150 (25)
High	6 (46)	230 (38)
Very High	1 (8.0)	185 (30)

From the descriptive study, it was found that 8 (62%) of the principals were males compared to 5 (38%) who were females. A total of 4 (31%) principals were in their 40 years' age range compared to 9 of them (69%) who were in their 50 years' age range In addition, in terms of current roles played the principals in the colleges, only 6 (46%) of them work as a school administrator compared to 2 of the principals (15%) performing others. Regarding how technology is rated in the principals' colleges, 1 of them (8.0%) reported very low compared to 2 of them (15%) confirming low. In line with this same item, 3 of them (23%) reported medium rate whilst 6 (46%) in affirmation said high rate. Similarly, 1 (8.0%) undoubtedly responded very high rate in terms of technology usage in their colleges. Judging from this finding, it can be said without any slightest doubt that principals' technology leadership and management skills in the colleges are appreciable. In another breath, it was discovered that 441 (72%) of the tutors were males as against 169 (28%) who were females. A total of 155 (25%) tutors were in their 30 years' age range compared to 299 (49%) who were in their forties. Moreover, 156 (26%) of the tutors had clocked their 50 years' age range. In respect of the current roles played by tutors in their respective institutions, 282 (47%) were categorized as tutors as against 13 (2%) who were academic affairs' officers. In agreement with this same finding, 225 (36%) served as academic counselors whilst 35 (6%) worked as professional development coordinators. On this same finding, 15 (25%) of the tutors played the role as school administrators whereas 28 (5.0%) held systems' administrators office as well 12 (2.0%) assuming others. On the issue of rating technology use in the colleges, 15 (2.0%) affirmed very low compared to 30 (5.0%) who reported low threshold. Concerning the said finding, a total of 150 (25%) tutors affirmed medium rate as against 230 (38%) who reported high rate. Interestingly to this same finding, 185 (30%) of the tutors by popular acclamation rated technology use to be very high and comparing the response rate of the tutors to measure the discussed finding, it is evident that technology acceptance in the Ghanaian Colleges of Education is uncontestable.

Instrumentation

This study was approved by the Institutional Review Board of a recognized university in Ghana. All participants consented to be part of this study by agreeing to participate.

A two-part structured questionnaire was used to collect the following: a) demographic information and a question regarding technology integration at the colleges where the respondents work; b) the Principal Technology Leadership Assessment (PTLA); and c) open-response questions regarding specific strengths and recommendations in meeting the ISTE standards.

The Principal Technology Leadership Assessment (PTLA) is a freely available survey developed and psychometrically validated by the American Institutes for Research as part of a grant CASTLE received from the U.S. Department of Education Fund for the Improvement of Postsecondary Education (FIPSE). The current PTLA survey is aligned with the ISTE Standards for Administrators. The original 2002 PTLA was modified to conform to the ISTE Standards for

Administrators. The PTLA consists of 21 questions with a five-point Likert scale from "Not at all "to "Fully." The survey consists of five constructs – Visionary Leadership (Questions 1-3), Digital Age Learning Culture (Questions 4-8), Excellence in Professional Practice (Questions 9 -12), Systemic Learning (13-17), Digital Citizenship (18-21).

Reliability analyses for the instrument suggested that both the subscales and overall instrument functioned reliably with high scores of internal consistency. The subscales had Cronbach's *Alpha* levels ranging from .87 (Visionary Leadership scale) to .93 (Digital Age Learning Culture scale) and overall the instrument had a Cronbach's *Alpha* of .97.

4. Data Analysis

The quantitative data collected were analyzed using Statistical Product and Service Solution (SPSS version 25.0).

The item responses from the PTLA were analyzed using frequency distribution tables for individual items in each of the five areas assessed. Open-response questions used to investigate the specific strengths and recommendations in meeting the ISTE standards, experiences that were not of assistance, and new experiences that should be added to the preparation program were reviewed and analyzed for themes.

Tables 3-7 show the number and percentage of respondents and how they answered each item for each domain.

Table 3: Item Responses for Visionary Leadership.

N=242

Item	Respondents	
	Principals N=(13) n (%)	Tutors N=(229) n (%)
1. Facilitate a change that maximizes learning goals using digital resources.		
Not at all	-------	21 (9.0)
Minimally	1(7.0)	35 (15)
Somewhat	3 (21)	40 (17)
Significantly	6 (43)	63 (28)
Fully	4 (29)	70 (31)
2. Engage in an ongoing process to develop, implement, and communicate technology infused-strategic plans.		
Not at all	--------	30 (13)
Minimally	2(14)	39 (17)
Somewhat	2 (14)	47 (21)
Significantly	7 (50)	55 (24)
Fully	3 (21)	58 (25)
3. Promote programs and funding to support implementation of technology infused-plans		
Not at all	1 (7.0)	25 (11)
Minimally	1 (7.0)	31 (14)
Somewhat	2 (14)	42 (18)
Significantly	5 (36)	68 (30)
Fully	4 (29)	63 (27)

Table 4: Item Responses for Digital Age Learning Culture.

N= (242)

Item	Respondents	
	Principals N=(13) n (%)	Tutors N=(229) n (%)
4. Ensure instructional innovation focused on continuous improvement of digital learning.		
Not at all	--------	15 (6.0)
Minimally	1 (8.0)	29 (13)
Somewhat	3 (23)	38 (17)
Significantly	5 (38)	78 (34)
Fully	4 (31)	69 (30)
5. Model and promote the frequent and effective use of technology for learning.		
Not at all	1 (8.0)	9 (4.0)
Minimally	3 (23)	18 (8.0)
Somewhat	2 (15)	32 (14)
Significantly	3 (23)	80 (35)
Fully	4 (31)	90 (39)
6. Provide learning environment with technology and learning resources to meet the diverse needs of all learners		
Not at all	1 (8.0)	19 (9.0)
Minimally	1 (8.0)	30 (13)
Somewhat	3 (23)	51 (22)

Significantly	5 (38)	69 (30)
Fully	3 (23)	60 (26)

7. Ensure effective practice in the study of technology
   and its infusion across the curriculum

Not at all	--------	11 (5.0)
Minimally	1 (8.0)	27 (12)
Somewhat	3 (23)	48 (21)
Significantly	4 (31)	83 (36)
Fully	5 (38)	60 (26)

8. Promote and practice in learning communities that stimulate
innovation, creativity and digital collaboration.

Not at all	2 (15)	20 (9.0)
Minimally	1 (8.0)	42 (18)
Somewhat	4 (31)	56 (25)
Significantly	5 (38)	51 (22)
Fully	1 (8.0)	60 (26)

Table 5: Item Responses for Excellence in Professional Practice.

Item	Respondents	
	Principals **N=(13)** **n (%)**	**Tutors** **N=(229)** **n (%)**
9. Allocate time, resources and access to ensure ongoing professional growth in technology fluency and integration.		
Not at all	---------	17 (7.0)
Minimally	1 (8.0)	34 (15)
Somewhat	3 (23)	48 (21)
Significantly	4 (31)	61 (27)
Fully	5 (38)	69 (30)
10. Facilitate and participate in learning communities that stimulate and support colleges in the study and use of technology.		
Not at all	1 (8.0)	14 (6.0)
Minimally	2 (15)	35 (15)
Somewhat	1 (8.0)	49 (21)
Significantly	5 (38)	60 (27)
Fully	4 (31)	71 (31)
11. Promote and model effective communication and collaboration among stakeholders using digital age tools		
Not at all	1 (8.0)	22 (10)
Minimally	1 (8.0)	38 (17)
Somewhat	2 (15)	46 (20)
Significantly	4 (31)	65 (28)
Fully	5 (38)	58 (25)
12. Prepared to stay up-to-date on educational research and emerging trends of effective use of technology and encourage new technologies for potential to improve student learning		
Not at all	1 (8.0)	17 (7.0)
Minimally	2 (15)	41 (18)
Somewhat	3 (23)	50 (22)
Significantly	4 (31)	57 (25)
Fully	3 (23)	64 (28)

Table 6: Item Responses for Systematic Improvement.

N=(242)

Item	Respondents	
	Principals **N=(13)** **n (%)**	**Tutors** **N=(229)** **n (%)**
13. Lead purposeful change to reach learning goals through the use of technology and media-rich resources.		
Not at all	1 (8.0)	9 (4.0)
Minimally	2 (15)	37 (16)
Somewhat	1 (8.0)	45 (20)
Significantly	4 (31)	67 (29)
Fully	5 (38)	71 (31)
14. Collaborate to establish metrics, collect and analyze data, and share findings and results to improve staff performance and student learning.		
Not at all	-------	13 (6.0)
Minimally	1 (8.0)	29 (13)
Somewhat	3 (23)	38 (16)
Significantly	5 (38)	80 (35)
Fully	4 (31)	69 (30)
15. Recruit highly competent personnel who use technology to advance academic and operation goals		
Not at all	1 (8.0)	23 (10)
Minimally	2 (15)	30 (13)
Somewhat	1 (8.0)	47 (20)
Significantly	4 (31)	61 (27)
Fully	5 (38)	68 (30)
16. Establish and leverage strategic partnerships to support systematic improvement.		
Not at all	1 (8.0)	19 (8.0)
Minimally	3 (23)	30 (13)
Somewhat	2 (15)	41 (19)
Significantly	3 (23)	74 (32)
Fully	4 (31)	65 (28)
17. Establish and maintain a robust infrastructure for technology to support management, operations, teaching and learning		
Not at all	2 (15)	21 (9.0)
Minimally	1 (8.0)	33 (14)
Somewhat	3 (23)	49 (21)
Significantly	4 (31)	58 (26)
Fully	3 (23)	68 (30)

Table 7: Item Responses for Digital Citizenship.

Item	Respondents	
	Principals N=(13) n (%)	**Tutors** N=(229) n (%)
18. Ensure access to appropriate digital tools and resources to meet the needs of all learners.		
Not at all	1 (8.0)	24 (10)
Minimally	2 (15)	35 (15)
Somewhat	3 (23)	40 (18)
Significantly	3 (23)	58 (26)
Fully	4 (31)	72 (31)
19. Promote, model and establish policies for safe, legal and ethical use of digital information and technology.		
Not at all	1 (8.0)	13 (6.0)
Minimally	2 (15)	32 (14)
Somewhat	1 (8.0)	49 (21)
Significantly	4 (31)	60 (26)
Fully	5 (38)	75 (33)
20. Promote and model responsible social interactions related to the use of technology and information		
Not at all	1 (8.0)	18 (8.0)
Minimally	2 (15)	28 (12)
Somewhat	3 (23)	50 (22)
Significantly	3 (23)	77 (34)
Fully	4 (31)	56 (24)
21. Model and facilitate the development of a shared cultural understanding and involvement of global issues through communication and collaboration tools		
Not at all	1 (8.0)	21 (9.0)
Minimally	1 (8.0)	39 (18)
Somewhat	4 (31)	51 (22)
Significantly	2 (15)	53 (23)
Fully	5 (38)	65 (28)

4. 1 Results

In line with the levels of Principals' technology leadership and tutors' technology integration in the Colleges of Education, table 3 indicates how visionary leadership affects these constructs. Respondents were presented with the options below to choose from; *Not at all, Minimally, Somewhat, Significantly and Finally*. Respondents (principals and tutors) were asked to react to the first item reading principals facilitate a change that maximizes learning goals using digital resources. From the views of the principals, none of them selected *not at all*; 1 of them representing 7.0% confirmed minimally whilst 3 representing 21% settled on somewhat. With this same item, 6 of them representing 43% indicated significantly but 4 representing 29% confirmed fully. On the part of tutors in respect of the said item, 21 representing 9.0% were in disagreement; 35 representing 15% indicated minimally whereas 40 representing 17% were comfortable with somewhat as against 63 representing 28% confirmed significantly. Regarding this same item, 70 representing 31% settled on fully. Considering the view points of the principals and tutors against the first item, it can be said unequivocally that principals are contributing to ensure that digital resources are in place to add value to learning goals in the selected Colleges of Education.

In addition, in an attempt to inquire whether principals are prepared to develop, implement and communicate technology strategic-infused plans, not even a single principal disputed that fact. In line with the said item, 2 principals representing 14 % admitted minimally whilst additional 2 representing 14% confirmed somewhat as against 7 representing 50% agreed on significantly. Another interest of concern has it that 3 representing 21% concluded fully. When tutors were tasked to share their views on the foregoing item, 30 representing 13% disagreed as against 39 representing 17% hinged on minimally whereas 47 representing 21% indicated somewhat. Similarly on the same item, 55 representing 24% without slighted doubt banked their hope on significantly. What is more, 58 representing 25% by popular acclamation confirmed fully. To this end, the simple fact cannot be denied that principals have shirked their responsibility towards developing, implementing and communicating technology strategic-infused plans in their colleges

To continue to probe further visionary leadership of the principals, respondents were asked whether principals have the wherewithal to promote programs and funding to support implementation of technology strategic-infused plans. As regards their views, 1 denoting 7% sat on the fence whereas another 1 denoting 7.0% welcomed minimally. In another breath of the same item, 2 denoting 14% settled on somewhat as against 5 denoting 36% with unassuming conviction selected significantly. Interestingly enough, on this same item, 4 more principals denoting 29 % alluded to fully. Tutors were equally given the opportunity to share their views on the item under consideration. 25 denoting 11% had a contrary view as against 31 denoting 14% indicated minimally but 42 denoting 18% confirmed somewhat. In line with the said item, 68 denoting 30% being the overwhelming majority settled on significantly whilst 63 denoting 27% banked their hope on fully. In this direction, it can be testified that principals are discharging their duties thereby promoting programs and funding to support implementation of technology strategic-infused plans.

Similarly, to ascertain whether principals possess digital age learning culture being the second element regarding the five constructs of their Technology Leadership, views were sampled from them to indicate their readiness according to table 4. The item on the said table inquired as to the principals' ability to ensure instructional innovation focused on continuous improvement of digital learning. Clearly, none of them said anything in disagreement as against 1 representing 8.0% indicated minimally; 3 representing 23% settled on somewhat whereas 5 representing 38% confirmed significantly. On this same item, an encouraging number (4) representing 31% ascribed to the view point of the majority. In another breath, 15 of the tutors representing 6.0% disagreed vehemently as against 29 representing 13% who admitted minimally. In furtherance, 38 representing 17% welcomed somewhat whereas 78 representing 34% were comfortable with significantly coupled with 69 representing 30% unanimously accepted fully. Apparently, to marry the views of both the principals and the tutors on this item, it can be concluded that the former's interest in ensuring instructional innovation focused on continuous improvement of digital learning in their colleges is incontestable.

To further verify whether principals are able to model and promote frequent and effective use of technology for learning measuring possession of their digital age learning culture, respondents' views were expressed as follows. In one breath, 1 of the principals denoting 8.0% disputed that fact as against 3 denoting 23% echoed minimally. On this same item, 2 denoting 15% admitted somewhat but another 3 denoting 23% confirmed significantly together with overwhelming number (4) denoting 31% embraced fully. In another breath on the

part of the tutors, 9 denoting 4.0% refused to agree whilst 18 denoting 8.0% opted for minimally coupled with 32 denoting 14% indicated somewhat. In a similar vein, 80 denoting 35% with uttermost conviction welcomed significantly as against 90 denoting 39% by popular acclamation banked their hope on fully. By comparing and contrasting the viewpoints of the respondents, it is succinctly clear that principals as technology leaders have the capability to model and promote frequent and effective use of technology for useful teaching and learning in their colleges.

Besides, respondents were tasked to make their views presented whether principals provide learning environment with technology and learning resources to meet the diverse needs of all learners in lieu with the possession of digital learning culture. Against this backdrop, 1 of the principals denoting 8.0% sat on the fence coupled with another 1 denoting 8.0% confirmed minimally. To address this same item, 3 denoting 23% admitted somewhat as against 5 denoting 38% as the majority became convinced with significantly. Interestingly enough, additional 3 denoting 23% were in agreement with the majority. On the other hand, 19 of the tutors representing 9.0% refused to attest to that fact whilst 30 representing 13% settled on minimally with an encouraging number (49) representing 21% bagged somewhat. Addressing the said item, an appreciable number (60) representing 27% were convinced with significantly whilst the highest numerical strength (71) representing 31% by popular acclamation welcomed fully. Judging from the finding of this item, it is clear that principals indeed provide learning environment with technology and learning resources to meet the diverse needs of all learners.

Similarly, respondents were asked to share their candid views regarding principals' ability to ensure effective practice in the study of technology and its infusion across the curriculum in their colleges. Principals as chief executive officers of the selected colleges responded accordingly as follows. None of them undoubtedly denied the sated item whereas 1 representing 8.0% indicated minimally coupled with 3 representing 23% echoed somewhat. Against this same item, 4 representing 31% bagged significantly whilst the greatest number (5) representing 38% got settled with fully. Conversely, 11 tutors representing 5% vehemently disagreed as against 27 representing 12% opted for minimally. Aside from this, 48 representing 21% confirmed somewhat whilst 83 (36%) being the greatest number chalked significantly whereas 60 representing 26% became comfortable with fully. In respect of the views of the two respondents on the discussed item, the simple fact remains that the former is doing everything possible to ensure effective practice in the study of technology and its infusion across the curriculum in their colleges. Moreover, to substantiate whether principals are promoting and practicing in learning communities that stimulate innovation, creativity and digital collaboration, respondents reacted to this item as follows. In accordance with the standpoints of the principals, 2 representing 15% indicated not at all as against 1 representing 8.0 who admitted minimally. However, 4 representing 31% confirmed somewhat as 5 representing 38% were comfortable with significantly. Interestingly, one more principal (8.0%) bagged fully to unveil the truth. In another direction on this same item, 20 tutors representing 9.0% refused to agree as opposed to 42 representing 18% indicated minimally. To buttress on this same item, 56 representing 25% confirmed somewhat whilst 51 representing 22% chalked significantly together with the countless majority of 60 (26%) settling on fully. Reflecting soberly on the reactions of the respondents towards this item, it is obvious that principals are promoting and practicing in learning communities that stimulate innovation, creativity and digital collaboration.

Added to this, table 5 brings to bear program type for excellence in professional practice put in place by the principals to measure their responsibility as technology leaders. To address this construct, respondents were quizzed whether principals allocate time, resources and access to ensure ongoing professional growth in technology fluency and integration. In one breath, none of the principals denied that fact whereas 1 representing 8.0% admitted minimally. In a related development, 3 representing 23% bagged somewhat as against 4 representing 31% opted for significantly coupled with 5 (38%) being the outstanding number settling on fully. In another breath of this same item, 17 of the tutors representing 7.0% declined that fact as against 34 representing 15% who confirmed minimally. In furtherance, 48 representing 21% indicated somewhat but 61 representing 27% admitted significantly coupled with 69 (30%) being the overwhelming majority banking their hope on fully. In respect of this finding, it is undoubtedly evident that principals are allocating time, resources and access to ensure ongoing professional growth in technology fluency and integration.

In furtherance, respondents were required to share their views as to whether principals facilitate and participate in learning communities that stimulate and support colleges in the study use of technology. The views of principals regarding this finding are as follows; 1 denoting 8.0% indicated not at all as against 2 denoting 15% confirmed minimally coupled with additional 1 (8.0%) admitting somewhat. On this same item, 5 (38%) being the overwhelming majority bagged significantly whilst 4 denoting 31% chalked fully. Regarding the standpoint of tutors on the said finding, 14 denoting 6.0% disagreed wholly as opposed to 35 denoting 15% welcoming minimally together with 49 denoting 21% who were comfortable with somewhat. An encouraging number of 60 respondents denoting 27% settled on significantly whereas the greatest number (71) denoting 31% banked their hope on fully. In consonance with the views of both respondents, it is evident that principals are stepping up measures to facilitate and participate in learning communities that stimulate and support their colleges in the use of technology.

In much the same way, respondents' views were sought regarding principals' ability to promote and model effective communication and collaboration among stakeholders using digital age tools. This was done to address program type for excellence in professional practice championed by the principals in their colleges. In this light, 1 of the principals representing 8.0% disproved that view coupled with another 1 representing 8.0% admitted minimally whilst 2 representing 15% confirmed somewhat as against 4 representing 31% welcomed significantly. On this same item, 5 representing 38% being the greatest number bagged fully. On the other hand, 22 of the tutors representing 10% sat on the fence whilst 38 representing 17% embraced minimally as against 46 representing 20% admitted somewhat. In line with the said finding, 65 representing 28% assuming the biggest number indicated significantly in addition to 58 representing 25% accepted fully. Marrying the view points of both respondents against the addressed finding, it is glaringly explicit that promotion and modeling effective communication as well as collaboration among stakeholders using digital tools under the instrumentality of the principals cannot be underestimated.

In the researchers' bid to inquire whether principals are prepared to stay up-to-date on educational research and emerging trends of effective use of technology, and encourage new technologies for potential to improve student learning, respondents presented their views accordingly. As regards the views of the principals, 1 denoting 8% disproved it as against 2 denoting 15% settling on minimally. As well, 3 denoting 23% confirmed

somewhat whereas the countless numerical strength, 4 denoting 31% bagged significantly with another encouraging proportion, 3 denoting 23% welcomed fully. In another context, 17 of the tutors denoting 7.0% refused to buy that idea whilst 41 denoting 18% minimally accepted coupled with 50 denoting 22% opted for somewhat. What is more, 57 denoting 25% embraced significantly as against 64 denoting 28% symbolizing the greatest numerical strength fully admitted that fact. By tying together the standpoints of both respondents on this finding, it can be concluded that principals are able to stay up-to-date regarding educational research as well as emerging trends of effective use of technology thereby encouraging new technologies for potential to improve student learning in their colleges.

To ascertain program type for systematic improvement being the 4th construct of principals' technology leadership capability, table 6 unearths various views expressed by the respondents and this was done to address principals' ability to lead purposeful change to reach learning goals through the use of technology and media-rich resources. In one direction, 1 principal representing 8.0% failed to agree as against 2 representing 15% minimally admitted coupled with similar 1 representing 8.0% somewhat shared same view. Interestingly enough, 4 representing 31% significantly accepted whilst 5 representing 38% fully sided with that view. In another direction, 9 of the tutors representing 4.0% doubted it whereas 37 representing 16% minimally bought into it coupled with 45 representing 20% somewhat shared similar view. In addition, 67 representing 29% significantly concurred with the motion but an uncountable part of the respondents, 71 representing 31% fully adopted it. Judging from the views expressed by the respondents, the fact remains that principals are leading purposeful change to reach learning goals through the use of technology and media-rich resources. In an attempt to ensure principals' tendency to collaborate to establish metrics, collect, analyze data, and share findings and results to improve staff performance and student learning, the respondents shared their thoughts as follows; None of the principals disputed that finding whilst 1 representing 8.0% minimally accepted together with 3 representing 23% somewhat bought into it. In the same vein, additional 5 representing 38% significantly admitted whilst 4 representing 31% fully confirmed it. On the part of the tutors, 15 representing 6.0% resisted as against 29 representing 13% minimally accepted where 38 representing 16% somewhat supported. As well, 80 representing 35% significantly accepted whilst 69 representing 30% fully welcomed that viewpoint. Regarding the views of both respondents, a foregone conclusion can be made that principals try to collaborate in order to establish metrics, collect, analyze data, and share findings and results to improve staff performance and student learning. Pursuant to another item measuring the 4th construct of principals' technology leadership, respondents were charged to share their concerns as to whether principals recruit highly competent personnel who use technology to advance academic and operation goals. To this end, 1 principal representing 8.0% overly disagreed whilst 2 representing 15% minimally supported. Additional 1 representing 8.0% somewhat concurred as against 4 representing 31% significantly admitted that fact coupled with similar 4 representing 31% fully welcomed it. Inversely, 23 tutors representing 10% failed to accept as against 30 representing 13% minimally confirmed the viewpoint. As regards this same item, 47 representing 20% somewhat welcomed it coupled with 61 representing 27% significantly appreciated the viewpoint whereas 68 (30%) symbolizing the overwhelming majority bagged fully. By comparing and contrasting the views expressed by the respondents, it is succinctly clear that principals are able to recruit highly competent personnel who use technology to advance academic and operation goals.

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Addressing establishment and leverage of strategic partnerships to support systematic improvement by the principals, as part of their technology leadership mandate, views of the respondents are shared as follows; 1 principal representing 8.0% refused to admit as against 3 representing 23% were on the minimal side together with 2 representing 15% somewhat consented whereas additional 3 representing 23% bagged significantly. Discussing this same finding, 4 representing 31% fully agreed. As regards tutors' views, 19 representing 8.0% sat on the fence whilst 30 representing 13% minimally supported that as against 41 representing 19% joined the somewhat view In a similar vein, 74 (36%) denoting the greatest majority settled on significantly whereas an encouraging number (65) representing 28% fully supported the viewpoint. Reacting to the views of all the respondents, it can be concluded that principals are doing their possible best regarding establishment and leverage of strategic partnerships to support systematic improvement in their colleges.

In another development, respondents were tasked to come clear with the principals' capability to establish and maintain a robust infrastructure for technology to support management, operations, teaching and learning. To address to finding, 2 principals denoting 15% disproved that fact whilst 1 denoting 8.0% minimally bought into it together with 3 denoting 23% somewhat consented. In this same vein, 4 denoting 31% significantly admitted that view whereas another 3 denoting 23% fully embraced it. Reacting to the views of the tutors on the said finding, 21 denoting 9.0% disagreed fervently as against 33 denoting 14% minimally supported coupled with 49 denoting 21% somewhat consented whilst 58 denoting 26% significantly concurred. Interestingly, 68 (30%) symbolizing uncontested numerical strength fully bagged landslide view. In line with the views shared by the respondents on this finding, it is undisputable that principals are able to establish and maintain a robust infrastructure for technology to support management, operations, teaching and learning. In addressing the 5th construct (digital citizenship) of principals' technology leadership, table 7 clearly depicts various views shared by the respondents. The first item being ensuring access to appropriate digital tools and resources to meet the needs of all learners, only a single principal (8.0%) disputed that view as against 2 denoting 15% minimally consented together with 3 denoting 23% somewhat believed. Funneling down to the same item, another 3 denoting 23% with significant appreciation welcomed it whilst 4 denoting 31% fully immersed themselves in that view. As regards tutors' views, 24 denoting 10% reacted in the opposite direction whereas 35 denoting 15% accepted minimally coupled with 40 denoting 18% somewhat agreed to that viewpoint as against 58 denoting 26% consented significantly. An issue of interesting concern to this item has it that uncontestable number (72) denoting 31% fully accepted it. Per the views shared by both respondents on this item, it is amply evident that principals are indeed ensuring access to appropriate digital tools and resources to meet the needs of all learners to an appreciable level. To additionally ascertain principals' enablement by promoting, modeling and establishing policies for safe, legal and ethical use of digital information and technology, 1 of the principals (8.0%) as a stakeholder respondent disputed that view as against 2 denoting 15% minimally appreciated coupled with another 1 denoting 8.0% expressing somewhat position. In line with this same item, 4 denoting 31% significantly bought into it whilst 5 (38%) being the landslide majority fully advocated that viewpoint. On the part of the tutors, 13 denoting 6.0% opposed that view completely whereas 32 denoting 14% minimally admitted together with 49 denoting 21% shared somewhat view as against 60 denoting 26% significantly welcomed the said. In consonance with same view, 75 (33%) representing the greatest numerical portion fully and openly admitted that view. Judging from the views of the respondents, it is clear that principals are making

every effort possible to promote, model and establish policies for safe, legal and ethical use of digital information and technology tools.

Once again, to validate principals' wherewithal to promote and model responsible social interactions related to the use of technology and information, divergent views shared by the respondents can be mirrored as follows. 1 of the principals (8.0%) disagreed whilst 2 representing 15% supported minimally together with 3 representing 23% somewhat admitted. On this same item, additional 3 representing 23% significantly welcomed the idea whereas 4 representing 31% fully lauded it. Funneling it down to the tutors, 18 representing 8.0% fiercely disproved as against 28 representing 12% minimally consented with additional 50 representing 22% somewhat concurred. To make this item interesting, uncountable number (77) representing 34% significantly welcomed the idea whilst an encouraging proportion (56) representing 24% undoubtedly consented to it. In accordance with the views expressed by both parties, principals promote and model responsible social interactions related to the use of technology and information to an appreciable extent.

By and large, to digest how principals model and facilitate development of a shared cultural understanding and involvement of global issues through communication and collaboration tools, respondents reacted in relation to their perception. In one breath, 1 principal representing 8.0% opposed the idea as against another 1 (8.0%) minimally welcomed it together with 4 representing 31% somewhat bought the idea whereas 2 representing 15% significantly shared similar view. As regards the said item, 5 representing 38% by popular acclamation fully immersed themselves into the tabled view. On the other hand, 21 tutors representing 9.0% refused to admit the view under consideration whilst 39 representing 18% minimally accepted together with 51 representing 22% somewhat confirmed it. Regarding this same item, 53 representing 23% significantly approved of it whereas 65 representing 28% fully consented. Judging from the views expressed by both respondents, it is clear that principals model and facilitate development of a shared cultural understanding and involvement of global issues through communication and collaboration tools in their colleges

5. Discussion

Visionary Leadership

In addressing visionary leadership as the first construct of Principals' Technology Leadership affecting College of Education tutors' level of technology integration, percentage margins of the respondents (principals and tutors) for not at all stood at 9.0 together with minimally amounting to 22. As regards somewhat position, 38 percent of the respondents cumulatively bought that view as against 71 percent that saw a significant improvement. In terms of full integration, 99 percentage thresholds acknowledged that view. The item that respondents reacted to had to with principals facilitate a change that maximizes learning goals using digital resources, Since the percentage margins of the respondents who admitted that viewpoint outweigh that of the contrary, it is evident that principals are facilitating a change that has the tendency to maximize learning goals using digital resources and this finding is consistent with [7, 8] who postulate that school leadership preparatory training should include technology to produce future-ready school principals who can lead teachers and students, as learning experiences become virtual and ubiquitous.

To find out whether principals are developing, implementing and communicating technology strategic-infused plans as part of their visionary leadership responsibility, a total percentage of 13 respondents disagreed as against a cumulative percentage of 31 who acknowledged minimal development, implementation and communication of technology strategic-infused plans. Regarding somewhat development and implementation, a combined percentage of 35 opened a defense together with 94 percent margin who affirmed they had witnessed a significant roll-out. In terms of full-fledged development, implementation and communication of technology strategic-infused plans, 46 percent of the respondents supported it. Clearly, as the percentage margin of those in disagreement doesn't have any material effect on the majority, it can be said that principals are doing their possible best regarding developing, implementing and communicating technology strategic-infused plans. In compatibility with this finding, [9] buttresses that technology leaders are required to take advantage of technology to transform, impact learning, and create a shared vision for how technology can meet the needs of all learners.

In addition, as to the principals' ability to promote programs and funding to support implementation of technology strategic-infused plans in their colleges, 18 percentage threshold refused to admit whereas a combined percentage of 21 confirmed minimal action coupled with 32 percent appreciating somewhat level. As regards this finding, an added percentage of 66 testified significant margin whilst 56 cumulative percentage confirmed full promotion of programs and funding to aid implementation of technology strategic-infused plans. Per this finding, it is glaring that principals are bent on promoting programs and funding to support implementation of technology strategic-infused plans to an appreciable level. This finding is then supported by [21] who opine that with the many roles of a principal, it is crucial that they are prepared with the skills and knowledge necessary to be technology leaders

Digital Learning Culture

Considering digital learning culture as the second construct of Principals' Technology Leadership impacting tutors' level of technology integration in the Colleges of Education, percentage thresholds of both respondents regarding instructional innovation focused on continuous improvement of digital learning for not all option was 6.0 as against minimally totaling 21. In respect of somewhat view, an aggregation of 40 percent welcomed it whilst a combined percentage of 72 by popular acclamation acknowledged significantly together with a concerted percentage of 61 bagging fully position. Judging from the views of all the respondents on this finding, it is succinctly clear that college principals are doing their possible best to warrant tutors' technology integration ability as part of 21st century teacher preparation requirement. This finding is consistent with the views of [63] who postulate that it is critical school leaders are prepared to lead the development of engaged learning environments using digital tools and resources to create deeper learning experiences for professionals and students. To verify as to whether principals model and promote frequent and effective use of technology for learning, measuring tutors' technology integration level, percentage margins of the respondents who disputed that viewpoint stood at 12. On this same finding, a combined percentage of 31 minimally accepted whilst another aggregated percentage of 29 chalked somewhat position as against appreciable percentage of 58 jointly confirmed significantly. Next of importance is the overwhelming majority who admitted without any slightest doubt that frequent and effective use of technology for learning is instituted in the colleges fully. Hence the

views of the respondents on this finding substantiate principals' effort in promoting and modeling the said finding, it is uncontestable that the leaders in question are staying afloat to ensuring that frequent and effect use of technology for learning is at its best of implementation. In consistency with this finding, [32] affirms that only the school principal has the power to make instructional decisions on technology infrastructure and programmes in school.

Highlighting on the principals' capability to provide learning environment with technology and learning resources to meet the diverse needs of all learners, a total of 17 percent of the respondents vehemently objected as against cumulative percentage of 21 who minimally supported that finding. On the views of 45 percent, somewhat position was selected together with the landslide percentage of 68 bagging significantly whereas an encouraging percentage of 49 unanimously confirmed fully. In respect of the views of the respondents on this finding, it is evident that almost all of them attested to the fact that principals are providing learning environment with technology and learning resources to meet the diverse needs of all learners. This finding is then congruent with [19, 20] who proved that technology could be successfully implemented in the classroom if there is a contribution from quality leadership. Besides, to ascertain whether principals ensure effective practice in the study of technology and its infusion across the curriculum, 5 percent of both respondents sat on the fence whilst an amalgamated percentage of 20 confirmed minimally together with 44 percent who were comfortable with somewhat viewpoi8nt. As regards this same finding, the greatest percentage of 67 by popular acclamation banked their hope on significantly as against 64 confirming fully. By marrying the viewpoints of all the respondents on the said finding, it is amply clear that principals as technology leaders are doing their possible best in ensuring effective practice in the study of technology and its infusion across the curriculum. This finding is supported by viewpoints of [21] who opined that the role of the principal as a technology leader in the integration of technology at schools could have a significant influence on the level of technology utilization during the teaching and learning process. Similarly, pursuant to principals' effort to promote and practice in learning communities that stimulate innovation, creativity and digital collaboration, a cumulative percentage of 24 kicked against that view whilst 26 percentage margin indicated minimally together with 56 percent chalking somewhat position. In respect of the said finding, a highest combined percentage of 60 admitted significantly as against 27 percent welcoming fully standpoint. Since the viewpoints of the respondents who disagreed do not outnumber the majority, it goes to confirm that principals are making every conscious effort to promote and practice in learning communities that stimulate innovation, creativity and digital collaboration. In agreement with this finding, [75, 21] confirm that principals are the key to effective learning outcomes from the use of technology in schools

Excellence in Professional Practice

By unearthing excellence in professional practice as the third construct of Principals' Technology Leadership adding value to time allocation, resources and access to ensure ongoing professional growth in technology fluency and integration, a joint percentage of 17 respondents disputed it as against 23 settling on minimal viewpoint. In line with this same finding, a combined percentage of 44 respondents confirmed somewhat whilst an appreciable percentage of 58 was comfortable with significantly coupled with unassuming percentage of 68 throwing their weight behind fully. In view of the fact that the percentage margins of the respondents who

supported this finding far outweigh that of the disagreed, it can be said with an uttermost conviction that principals allocate time, resources and access to ensure ongoing professional growth in technology fluency and integration. This finding is in line with [33] claiming that technology leadership amongst school principal is crucial to increase technology literacy and technology integration in the classroom among teachers. To further verify whether principals facilitate and participate in learning communities that stimulate and support colleges in the study and use of technology, an aggregated percentage of 14 failed to admit as against 30 who indicated minimally. In addressing this same finding, a cumulative percentage of 29 respondents confirmed somewhat whilst unimaginable percentage of 65 appreciated significantly coupled with impressive percentage of 62 concurring to fully standpoint. In the light of this finding, it is evident that principals as technology leaders are facilitating and participating in learning communities that stimulate and support colleges in the study and use of technology and this is in agreement with [63] view indicating that it is critical school leaders are prepared to lead the development of engaged learning environments using digital tools and resources to create deeper learning experiences for professionals and students.

In uncovering the views of the respondents in respect of the principals' ability to promote and model effective communication and collaboration among stakeholders using digital age tools, a combined percentage of 18 respondents sat on the fence whereas 25 percent welcomed minimal position. 35 percent of the respondents in reacting to this finding admitted somewhat position as against amalgamated appreciable percentage of 59 supporting significantly. It is interesting to note that an untold percentage of 63 backed fully option. Judging from this finding, it is uncontestable fact that principals are doing all what it takes to facilitate promotion and modeling effective communication and collaboration among stakeholders using digital age tools. In buttressing this finding, [60] added that leaders of technology encourage the use of technology in classroom instruction. Pursuant to excellence in professional practice as a construct adding value to 21st century teacher preparation, respondents were quizzed whether principals are prepared to stay up-to-date on educational research and emerging trends of effective use of technology thereby encouraging new technologies for potential to improve student learning. Against this backdrop, a total percentage of 15 respondents vehemently disagreed whereas 33 percent settled on minimally. In addition, a cumulative percentage of 45 admitted somewhat as against landslide percentage of 56 being comfortable with significant position. An encouraging percentage of 51 welcomed full position to indicate that principals are up-to-task in respect of staying up-to-date on educational research and emerging trends of effective use of technology as well as encouraging new technologies for potential to improve student learning, To strengthen this finding, [24] suggested that schools should have leaders who are prepared to lead as technology leaders.

Systematic Improvement

Addressing systematic improvement as the forth construct of Principals' Technology Leadership in order to lead purposeful change to reach learning goals through the use of technology and media-rich resources, a summative percentage of 12 respondents failed to support that viewpoint whilst 31 percent indicated minimally. 28 percentage margin on this same finding somewhat accepted as against a combined appreciable percentage of 60 welcoming significant viewpoint and on the more serious note, an unbeatable percentage of 69 threw their weight behind full viewpoint. In accordance with this finding, [54, 53], postulate that technology administrators

have to be knowledgeable and responsive to rapidly changing technology and instructional needs. To probe further on the said construct, respondents were asked as to principals' capacity to collaborate in order to establish metrics, collect, analyze data, and share findings and results to improve staff performance and student learning.

A minute percentage (6) of the respondents refused to accept that standpoint as against 21 percent who greeted minimal standpoint. A percentage margin of 39 admitted somewhat whilst unassuming percentage of 73 indicated significantly coupled with another appreciable percentage of 61 inviting full standpoint. Mirroring critically the viewpoints of the respondents, majority has carried the vote and this finding in line with [18] who opine that technology leadership is perhaps the key to the success of technology integration in education Similarly, to interrogate as to principals' tendency to recruit highly competent personnel who use technology to advance academic and operation goals, a total percentage of 18 respondents completely disbelieved whereas 28 percent welcomed minimal option. An additional percentage of 28 was comfortable with somewhat position as against an appreciable percentage of 58 chalking significant position. Interestingly, an untold percentage 68 by popular affirmation supported full viewpoint. Talking about this finding, it is almost certain that principals are doing well in terms of recruiting competent personnel who use technology to advance academic and operation goals.

To buttress finding, [21] identified that the role of the principal as a technology leader in the integration of technology at schools could have a significant influence on the level of technology utilization during the teaching and learning process. What is more, to ascertain principals' prowess to establish and leverage strategic partnerships to support systematic improvement, a cumulative percentage of 16 respondents denied that fact whilst 36 percent selected minimal viewpoint together with 34 percent who somewhat believed. In line with the same finding, an eye appealing percentage of 55 admitted significant level as against the overwhelming percentage (59) confirming full viewpoint. By marrying the viewpoints of the respondents, principals are staying afloat regarding establishment and leverage strategic partnerships to support systematic improvement. To ground this finding, [7, 8] contend that school leadership preparatory training should include technology to produce future-ready school principals who can lead teachers and students, as learning experiences become virtual and ubiquitous.

To inquire deeper regarding principals' enablement to establish and maintain a robust infrastructure for technology to support management, operations, teaching and learning, a combined percentage of 24 respondents disputed that viewpoint whereas 22 percent indicated minimal threshold. Regarding somewhat viewpoint, 44 percent of the respondents were bought into it as against overwhelming 57 percent being comfortable with significant viewpoint. With this same finding, another cumulative encouraging percentage of 53 settled on full viewpoint. Judging from the sampled views of the respondents on this finding, principals are doing their possible best to establish and maintain a robust infrastructure for technology to support management, operations, teaching and learning and this is supported by [39] Anderson and Dexter (2000) that numerous scholars have conceptualized technology leadership as decisions made by organizations, policies or actions that facilitate the effective use of information technology in schools.

Digital Citizenship

Assessing digital citizenship as the fifth and last construct of Principals' Technology Leadership in ensuring access to appropriate digital tools and resources to meet the needs of all learners, a total percentage of 18 respondents overly disagreed whereas 30 percent minimally approved coupled with aggregated percentage of 41 who somewhat accepted, On this same finding, an appreciable percentage of 49 respondents significantly admitted that viewpoint as against an amalgamated landslide percentage of 62 by popular acclamation bagged full access. Talking about the said finding, the viewpoints of the majority attest to the fact principals as technology leaders are on track to ensure access to appropriate digital tools and resources to meet the needs of all learners. In consistency with this finding, [9] contend that technology leaders are required to take advantage of technology to transform, impact learning, and create a shared vision for how technology can meet the needs of all learners. In measuring the said construct, respondents' views were sampled regarding principals' capability to promote, model and establish policies for safe, legal and ethical use of digital information and technology. As a result, 14 percent of the respondents declined that fact as against 29 percent who clung to the minimal viewpoint. In addition, 29 percent of the respondents confirmed somewhat whereas an encouraging percentage of 57 chalked significantly together with overwhelming percentage of 71 without lightest doubt backed fully. In evaluating this finding, it is explicit that principals are doing what they can to promote, model and establish policies for safe, legal and ethical use of digital information and technology and to make the outcome of this data relevant, [63] postulate that it is critical school leaders are prepared to lead the development of engaged learning environments using digital tools and resources to create deeper learning experiences for professionals and students.

To further ascertain as to principals' ability to promote and model responsible social interactions related to the use of technology and information, a summation of 16 respondents sat on the fence whilst minimal position was supported by 27 percent together with 25 percent applauding somewhat position. Interestingly enough, countless percentage of 57 by popular confirmation indicated significant viewpoint as against 55 percent who welcomed fully. Considering the viewpoints of all the respondents on this finding, principals are able to promote and model responsible social interactions related to the use of technology and information. Accordingly, [24] suggested that schools should have leaders who are prepared to lead as technology leaders.

Finally, in an attempt to uncover principals' wherewithal to model and facilitate the development of a shared cultural understanding and involvement of global issues through communication and collaboration tools, a combined percentage of 17 respondents vehemently disagreed whereas minimal viewpoint was welcomed by 26 percent, As regards the said finding, a 53 percentage margin of the respondents lauded somewhat stance as against 38 percent who banked their hope on significantly coupled with landslide percentage of 66 acknowledging full stance. Judging from the viewpoints of the respondents on this finding, it is explicitly evident that principals are doing what they can to model and facilitate the development of a shared cultural understanding and involvement of global issues through communication and collaboration tools at an appreciable level. In congruence with this finding, [54, 53] postulate that technology administrators have to be knowledgeable and responsive to rapidly changing technology and instructional needs.

6. Conclusion and Recommendations

Even though the findings of this research showed that the levels of Technology Leadership; the five constructs of ISTE and Tutors' Technology Integration were important, much needs to be done to improve relationship between Principals' Technology Leadership and Tutors' Technology Integration in the selected colleges in Ashanti, Ahafo and Bono regions of Ghana. Future studies should emphasize leadership based on technology to enhance school leaders' confidence in using technology and integrate ICT in classrooms. Continuous professional development programs that have been designed for principals and tutors under the Ghana government policies funded by [38], to support Colleges of Education should be further improved to suit 21st century education. These findings suggest that further research needs to be done on effective Technology Leadership and ICT training programmes for college principals, tutors and student teachers to prepare for the inevitable I.R. 4.0. Professional development for principals should be designed so that they can not only be exemplary models but have the ability to supervise Tutors' Technology Integration. Tutors must be innovative to integrate IoT in the classrooms in order to make 21st century education a reality and they must continue to accommodate the needs of Z generation students. Despite few disagreements of the respondents regarding the use of the five constructs of Principals' Technology Leadership (Visionary Leadership, Digital Age Learning Culture, Excellence in Professional Practice, Systemic Improvement, and Digital Citizenship) to impact Tutors' Technology Integration level, this study will still be useful as a worthy point of reference for policy makers in effectively planning, designing and providing professional development for the present pool of principals in the selected Colleges of Education. In addition, principal preparatory training and programmes should emphasize the use of 21st century knowledge pedagogical skills and leadership style such as the Technology Leadership to enhance and accelerate the implementation of ICT for more effective teaching and learning in the classroom. Since this study was only carried out in the Ashanti, Ahafo and Bono regions of Ghana, further research must be carried out in other regions to enable more conclusive data to be obtained. This study was carried out as a cross-sectional study and data was collected in three-month period. It is thus recommended that a longitudinal study be carried out so that more comprehensive findings can be drawn

Limitation

The study findings, however, have some limitations. Since the PTLA is a self-reporting questionnaire, it is possible that principals and tutors as key respondents overrated or underrated their technology leadership standards. Secondly, the study data was collected from only thirteen Colleges of Education which constituted 242 respondents in the Ashanti, Ahafo and Bono regions of Ghana. Consequently, the sample and its findings may not represent all Colleges of Education in Ghana and other countries where differences in Principals' Technology Leadership implementation levels and usage exist.

Authorship Contribution

Benjamin Baiden: Manuscript writing, editing and data analysis

John Nimako-Koduah: References' organisation

Vickor King Anyanful: Manuscript proof reading

Daniel Oppong: Coding of data for analysis

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