

TECHNOLOGICAL LITERACY: TEACHERS' PROGRESSIVE APPROACH USED FOR 21ST CENTURY STUDENTS' ACADEMIC SUCCESS IN VIBRANT ENVIRONMENT

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Abstract

Technology plants concrete effects on the supremacy of humans' technological success that have been remaining awe-inspiring aspects for stakeholders; teachers and students since last eras. Teachers make students technologically literate, reshape their hidden potential, skill them through modern gadgets, help in understanding and evaluating their functions applying technological and engineering standards for goal achievements. Present research was conducted to explore the effect of teachers' technological literacy on students' academic success occurs in vibrant environment on conveniently selected sample of 200 teachers working in public and private universities of district Lahore. Researchers administered a self-developed survey to collect data from teachers. Content validity of questionnaire was ensured from experts and reliability was confirmed by calculating Cronbach's Alpha Scores .821. Normality of the data was assured by calculating Shapiro-Wilk's test, $n < 2000$, $p > .05$. Students' academic success was measured through acquiring achievement scores, obtained from concerned university offices ensuring ethical considerations, as in data collections. Results of independent samples t-test and regression analysis ascertained no significant difference between usage of technological literacy by teachers' gender and university type; male teachers working in public and private universities have same usage of technological literacy as compared to female teachers. Moreover, teachers' technological literacy affect 43% on students' academic success occurs in vibrant learning environment. On the basis of results, research recommends that universities may established digital lab ensuring vibrant environment and hire technologically literate staff providing fringe benefits to meet 21st century technological literacy demands for students' success.

Keywords: digital citizenship, students' achievement scores, technological literacy, technological concepts, vibrant environment

Introduction

Existence of human being is based on diverse eras since ago. These eras were named as Bronze era, Iron era, industrialization era and the era of technological innovations also vocalized as era of fourth industrialization that revolution characterized by exercise of modern technologies capturing physical, digital and biological aspects of social, political, economic and educational worlds (Cummins et al., 2007; Haas, 2013; Jewitt, 2006). As the era of technology has been changing, demands of human beings are growing to satisfy their needs (International Technology Education Association, 2006). These needs are fulfilled by making human beings technologically literate by supporting individual's abilities and potential that has long effects on present and future lives of any civilization (Pearson & Young, 2002; Yuen et al., 2004). Technological literacy is an innovation of human competencies. It is the ability to find, contact,

explore, assess and utilize information in diverse ways (American Library Association; ALA, 2003). It is a quick and authentic source of getting and receiving information (Solomonidou & Tassios, 2007). Technological literacy is a catalyst that incorporates human cognitive and psychomotor skills since last decades (Crowe, 2006). Technological literacy is branched as; application based, design based, high technology, science technology and society based, skill based, subject integrated, technological concepts and vocational based approach (Honey et al., 2014).

Technological education concerns about human designed-products, systems and procedures used to satisfy stakeholders' needs having multiple specifications; technological educations, information and communities technologies and technological and engineering literacy (Carr et al., 2012; National Assessment Governing Board, 2013; Sanders, 2009) that also provides influential launching aspect for technological learners in specialized areas. Technology, Engineering and Literacy; TEL is amalgamation of three words; a) *technology* that refers to adjustment of natural environment through individual's design products, methods and procedures applied to fulfill human requirements, b) *engineering* concerns with application of scientific laws and arithmetical interpretation to revamp technologies to congregate already prescribed demands / requirements and c), *literacy* is one's technical skills and ability to read and write essential aspect of technology in what ways people think, apply and spread information through digital means (National Assessment and Educational Progress, 2012; National Assessment Governing Board, 2013; International Society for Technology in Education, 2007; National Center for Education Statistics, 2013). Notion technological and engineering literacy refers to portrayal of individual's developing aspects; process and products (American Society for Engineering Education, 2009; Cummins et al., 2007; Heywood, 2009). Ultimate purpose is to involve students for hands-on, designed strategies and active involvement to develop practical problem-solving skills within real life situations (National Assessment Governing Board, 2013).

Relevance of technological and engineering literacy stipulates process to create and design key features of technological artifact for global inter-connection and far-reaching access of humans (Brinkerhoff, 2006; Cavanaugh et al., 2011). Key features help users in defining and describing every bit of knowledge for the sake of individual's growth and expansion of technological and engineering literacy. Internationally there is rudimentary consideration on beliefs underlying the aspects of technological and engineering literacy (Carr et al., 2012; Sanders, 2009). Myths existing among stakeholders belong to health, industries, commerce, politics and education as well, while learners finished their school life education acquiring minor concepts of fundamental thoughts and philosophies underling technological and engineering literacy (Donovan et al., 2007; Edwards, 2012).

Construction of technological and engineering literacy aspects is based on technological and societal, proposed and structured and continuous application of ICT. Additionally, these features demand concerned wholehearted indication on logical and foremost overarching areas; understanding of technological laws, developing solutions and goal accomplishment and communication and collaboration with students to show off their capabilities (National Assessment Governing Board, 2013) that also lay foundations for the development of TEL assessment tool that multi-purposively participate in contributing fundamental aspects of technological and engineering literacy in educational institutions in measuring students' academic success. TEL scrupulously discusses factors affecting students' technological and engineering achievements, teachers' educational encounters and intense demographic characteristics of researchers, teachers and policymakers that vigorously put a considerable role in identifying students' academic successes that lead towards progressive change towards Science Technology Mathematics and Engineering STEM education (Brinkerhoff, 2006; Cavanaugh et al., 2011; Donovan et al., 2007; Edwards, 2012).

Application of TEL plays a significant role in developing scientific and analytical skills among learners (Carr & Strobel, 2011; Sanders, 2009) focusing international standards that measure students' technological proficiencies (International Society for Technology in Education, 2007; Metiri Group, 2009; National Governors Association for Best Practices & Council of Chief State School Officers, 2010). However, there are some discrepancies among these standards that were removed through focusing Next Generating Science Standards; NGSS, National Assessment and Engineering Progress; NAEP and Technological Engineering Literacy; TEL established integrating thirsd areas of Science Technology Engineering and Mathematics (Metiri Group, 2009; National Assessment Governing Board, 2013). Furthermore, standards were established to improve students' professional readiness towards 21st century technological performance and globally compare students' skills towards technology and engineering literacy (National Center for Education Statistics, 2013; National Assessment Governing Board, 2013) to gauge students' performance in Science, Technology, Engineering and Mathematics.

A technologically literate person has potential to grip on technological knowledge and successfully complete assigned tasks (Pearson & Young, 2002). It is obvious for common people to be technologically literate. A technologically literate person is a constant user of the acquired technological information, a regular information seeker, an analyzer & evaluator and an effective communicator. A technologically literate person has the ability to access, manage, use, analyze and evaluate information (Pearson & Young, 2002). He is an excellent problem solver, can publish and produce information, and an efficient user of inventive tools (Bennett et al., 2009). A technologically literate person has the ability to understand about technology, ways of creation of technology, how technology shapes civilization, and in turn shaped civilizations in diversity of ways (Belk, 2013; Williams & Coles, 2007). Teachers have been living in ever advanced era of technology. Technology affects the individual's entire life span gradually (Yuen et al., 2004). Millennium Development Goals; MDGs, Education for All and World Summit on the Information Society; WSIS, 2015 are also focusing technological literacy of teachers, prospective teachers and training institutions to meet international needs in educational institutions (UNESCO, 2006). Technological literacy for teachers has a significant effect on their assigned work and teaching learning process. It has also an effect on their logical reasoning abilities, techniques to solve queries, thought provoking and inspiring inventions (Collis & Monnen, 2001; Niederauser & Stoddart, 2001). Persistency in technological literacy among teachers is essential for the requirements of their professions (Gorder, 2008). In educational institution, less technologically literate teachers minimize daily working of an organization (Chuang & Rosenbusch, 2005; Crowe, 2006; Goddard, 2002; Mahapatra & Lai, 2005; Thompson, 2013). Teachers' training institutions are making efforts to reshuffle their programs to manage the impending and prospective capabilities for teachers. By using technological literacy with mind's eye, teachers design an instrument for conversation, communication and an announcement for pupils and teachers (Moursund & Bielefedt, 1999). Teachers made little use of information sources for their pedagogic practices, exchange of ideas with peers and colleagues. They opinioned that time constrains stop them to access information that requires technological literacy skills for effective use of information technology information (Williams & Cole, 2007).

Teachers enhance their technological skills by focusing performance indicators that are foundations for constant improvement towards teachers' professionalism. They play an essential role in effective teaching through expressing consents, attitudes and curiosity in teaching (Coiro, 2003; Ogris & Wetphal, 2006). Curriculum experts and educational stakeholders take initiative and construct outlines of performance indicators; technological concepts and operations, communication and collaboration and digital citizenship for teacher in the field of technological literacy (Cradler et al., 2002; Irum & Munshi, 2015; Wenglinsky, 2005; Williams et al., 2012).

Teachers have skills to understand and present the basic concepts and operations of technological literacy (Wenglinsky, 2005). These proficiencies are important for lifetime usage of technology (Grisham & Wolsey, 2011). Teachers' passions lead them towards acquisition of new skills towards technological literacy. Technological concepts and operations enable them to bring change and new directions in the teaching learning process (Greenhow et al., 2009). Abundance of latest technologies, educational infrastructure, skilled assistants, updated knowledge about applications' software and constructive changes in national curriculum for teachers produce technological literate students in the field of technology (DeMars et al., 2003). Teachers less efficient in technological concepts and operations have a negative effect on the educational progress. These gaps need appropriate training and technological support focusing on digital demands (Gibson et al., 2007).

Communication skills pose diversities of challenges for individuals. Illustration of textbooks of physics for earth scientists mostly discuss huge ice glaciers and the vast bulk of waves on the beach while many teachers actually considered highlands / mountains are on the beach (Buckingham, 2007) which shows misconception. They neither communicate properly nor collaborate effectively (Cradler et al., 2002). Communication and collaboration refer to strong conceptual demonstration regarding technological perceptions, structures and processes. Teachers have potential to comprehend, select, operate and transfer contemporary technological applications for better production of future generation. Teachers' learning about communication and collaboration significantly affects societies, workplace and students' academic achievements (Bybee & Starkweather, 2006). Communication and collaborative skills are important competencies of teachers. They communicate clearly by speaking, writing and nonverbal cues with efficient collaboration to students (Buckingham, 2007). Teachers make proper usage of digital media for their effective communication and collaboration towards effective teaching.

Digital citizenship has been given consideration due to the usage of digital tools among individuals (Larson et al., 2010; Lau & Yuen, 2013). Digital citizenship is the change in attitudes and values of citizens towards digital components (Bennett et al., 2009). Teachers promote technological literacy among students focusing on harmless, permissible and answerable aspects for their better achievements. Digital citizenship provides technological standard that enables teachers to prepare students technologically literate (Anumudu et al., 2018; Hollandsworth et al., 2011; Irum & Munshi, 2015; Larson et al., 2010; Lau & Yuen, 2013; Ribble, 2015; Williams et al., 2012). Key elements of digital citizenship facilitate teachers to understand the mechanism of technological literacy for students' achievements (Cavanaugh et al., 2011; Donovan et al., 2007; Mike & Gerald, 2007; Ribble, 2015).

Learning environment is one of the factors that strengthen learners' logical potential (Lombardozi, 2015). Vibrant learning environment promotes students' learning, makes them critical thinkers and problem solvers. It also enhances students' self-directed learning towards goal achievement. Students enjoy flavor of constructive learning as compared to teachers' declarative instructions. Application of vibrant learning environment bestows incredible opportunities in creating comprehensive, logical and thought-provoking abilities among learners (Grisham & Wolsey, 2011; Moyle, 2010). Vibrant learning environment with modern technological gadgets grasps students' cognitive abilities, grants extra knowledge acquisition and strengthens technological skills (Lombardozi, 2015). Literature reported that vibrant learning environment provides jam packed atmosphere for students in diversity of ways; supports and fosters healthy relationship between learners and instructors (Pianta et al., 2002), assists prospect for students' frequent performance and self-motivated learning (Niemi, 2002), sustains students' activity based and problem based learning (David, 2008), supports students' autonomous learning (Zimmerman, 1990), promotes students' knowledge spot (Tinto, 1997), provokes learners' appealing access towards goal attainment (Caroline et al., 2010) and strengthens students' active involvement and engagement (Edwards, 2012; Wannarka & Ruhl, 2008).

Problem Statement

Teachers use their technological literacy skills in educational institutions to operate digital tools that effect students' learning in productive ways (Reid & Boyer, 2013; Ribble, 2015). Research evidence confirms that different developmental projects have been carried out to promote technological literacy for teachers in educational institutions (Williams et al., 2012). It is evident that Pakistani students enrolled in public and private universities are facing problems of regularly shifting of cultural diversity, language dilemma, teachers' technological skills, weak media-structured classrooms, poor technological literacy knowledge and facing poor vibrant learning environment (Gopang et al., 2016; Govt. of Pakistan, 2013; Hassan, 2019; Hassan & Akbar, 2016; Rahman, 2004; Saleem et al., 2019; Yousaf & Dahmani, 2008). Furthermore, there is lack of policymakers' cooperation, poor application of curriculum based technological literacy skilled staff, less structuring of technological and physical facilities and educational infrastructure (Ameen, 2007; Batool & Qureshi, 2007; Govt. of Pakistan, 2009). Resultantly, students remain incapable to cope with current age scientific management and factory model-education system that demands the revisiting of school curriculum and application of technological and engineering literacy and content-based activities to establish successful education system. Application of technological education enables individuals to eradicate poverty and gear up continuous societal, economic and educational development through improving easy and busy lifestyle. It also shapes lives of individuals, flatters and makes hub of technological knowledge. Govt. of Pakistan allocated billion rupees to Higher Education Commission; HEC to flourish IT sector, announced IT policy in 2000, developed IT Action Plan and implemented National Information and Communication Technology; NICT strategy 2003 to overcome these dilemmas but all in vain (Ameen, 2007; Batool & Qureshi, 2007), implemented curriculum in educational institutions focusing this aspect but teachers are indulged in dozens of problems, issues and challenges including lack of skilled staff, infrastructure and resources. Human beings had been remaining in search of innovation to satisfy their needs. These needs and wants only might be fulfilled by making human beings technologically literate. States develop curriculum, invest billions of rupees, institutions arrange seminars and organize conferences to flourish IT sector. Teaching problems is an alarming situation in favor of spreading continuous usage of TEL in Pakistan. Dilemma is uncontrolled in Pakistan because teachers working in universities less focus on the worth of IT sector. Teachers' technological literacy has an effect on their teaching, but still it needs to be explored and discussed especially in public and private sector universities. Researchers conducted studies to explore the effect of teachers' technological literacy on students' academic success but none of research was planned in Pakistani universities to explore the phenomenon in vibrant learning environment concentrating on technological and engineering literacy concepts. Focusing the worth of TEL, researchers are eager to explore the effect of public and private university teachers' TEL on their students' academic success. Ultimate purpose of this research was to compare male and female teachers' technological literacy of public and private sector universities working under jurisdiction of HEC. Researchers try their best to explore the actual situations happening in public and private sector universities of Lahore-Division, Punjab-province of Pakistan.

Research Questions

Present research was conducted to explore the answers of the following questions:

1. To what extent male and female university teachers working in public and private universities make use of technological literacy for students' academic success?
2. What is the effect of university teachers' technological literacy on their students' academic success?

Research Methodology

General Background

Research methodology deals with methods and procedures used in research to conquer results. They are a systematic way followed by researchers used to the obtained results. Present research was quantitative in nature and researchers applied causal comparative; *ex-post-facto* research design to explore current practices happening in public and private sector universities of district Lahore. Researchers used this design to determine cause and effect between already existing independent and dependent variables (Fraenkel & Wallen, 2009; Gay et al., 2014; Lodico et al., 2006; Johnson & Christensen, 2012).

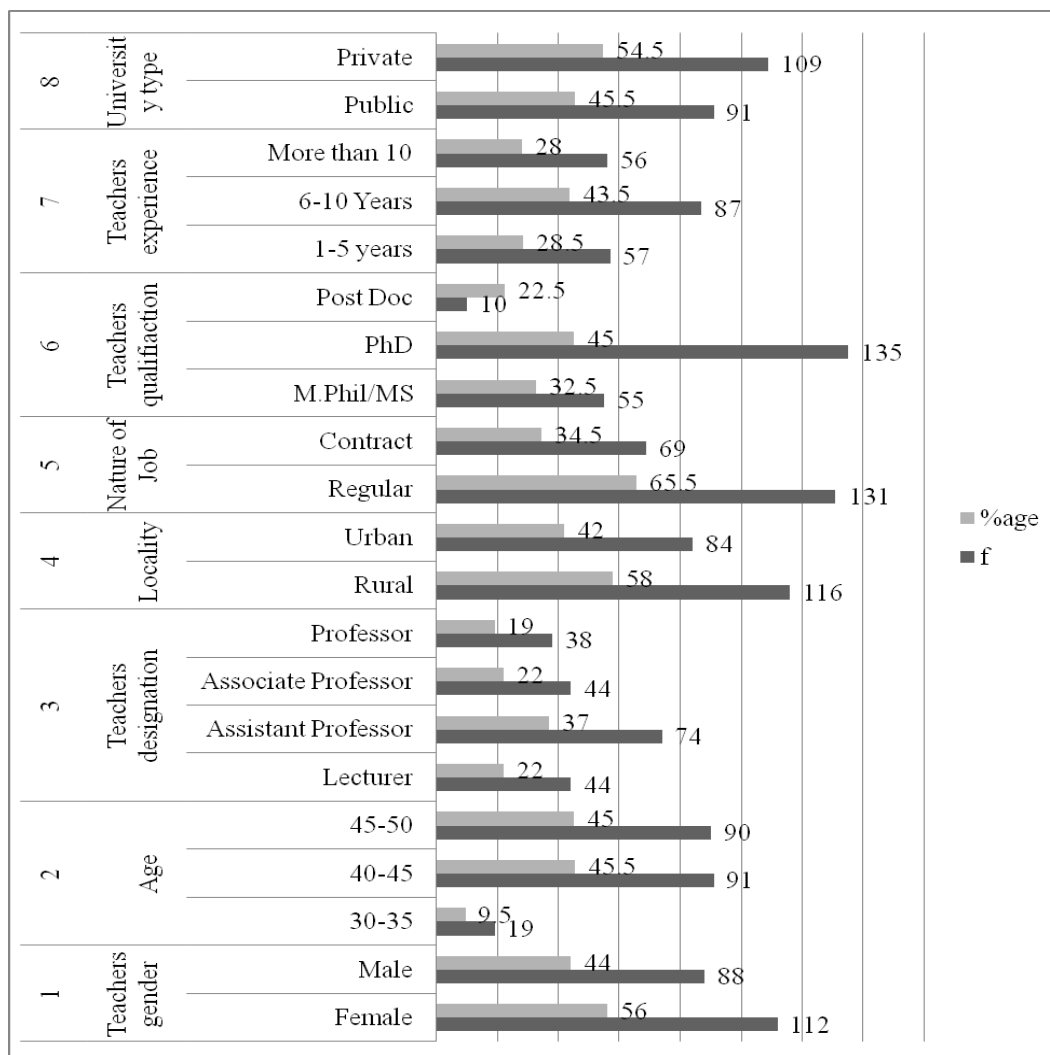
Population

Population of the research consisted of male and female teachers working in public and private sector universities of Lahore Division, administratively divided in District Lahore, Kasur and Sheikhpura (Pakistan District Education Rankings, 2016; Punjab Development Statistics, 2015). Currently 1,789 faculty members; lecturers, assistant professors, associate professors and professors are working in 14 public and 35 private universities of Lahore Division. University teachers are providing their services with true spirit, essence and vigor (Ameen, 2007; Hanif, 1999; Pakistan Education Statistics, 2018). Public sector universities are funded by HEC whereas private sector universities are self-funded / self-supporting. Teachers and students honored after obtaining admission / job in public sector universities as they provide benefits to its stakeholders. Whereas, the situation in private universities is totally different as they low pay, less job security and principal of autocracy is to some extent applicable.

Sample

Sample of the research consisted of 200 respondents; 88 male and 112 female teachers conveniently selected from public and private universities working under Higher Education Commission in District Lahore. Researchers gauge students' academic success through obtaining students' achievement scores; SAS from concerned university departments ensuring ethical consideration that their information will be used for research purpose only.

Figure 1
Sample of teachers' demographic information



Pakistani teachers working in public and private universities impart educational and technological instructions among students to make them technological literate. Universities hire teachers having minimum MS / M. Phil degree for the post of lecturers and PhDs for assistant professors, associate and professors with set criteria of age limit and job status. These criteria are applicable for public and private university teachers approved by Higher Education Commission.

Instrumentation and Procedure

After the review of literature and experts' views, the researchers used a self-developed questionnaire to obtain data from the respondents. Questionnaire was categorized into three sub-scales; technological concepts and operations, 12-items, communication and collaboration, 14-items and digital citizenship consisted of 14-items based on 5-point Likert type options mode of very skillful, skillful, moderate, weak, and very weak used in other studies (Judi et al., 2011).

Self-constructed questionnaire is designed to be filled by respondents without researchers' interventions, focuses on respondents' cultural variations, captures accurate information, easily filters, screens and measures responders' rate of responses, incorporates significant preventions during typing and formatting errors and there is less chance of measuring inaccuracies. It also focuses on format and flexibility of self-constructed questionnaires, low cost, covers anonymity and bias of researchers and traceable assenters specially when the topic has sensitive nature and cheapest methods of collecting unsusceptible' information when researcher (s) comprehensively understands respondents' cognitive levels (Bifulco et al., 2005; Bird, 2009; Edwards, 2010; Goodman, 1997; Kazi & Khalid, 2012; Lavrakas, 2008; Seebregts et al, 2010; Zouwen, 2000). Researchers measured content validity and reliability of the questionnaire to enhance the accuracy of the research work (Tavakol & Denick, 2011; Twycross & Shields, 2004). Validity of the instrument was confirmed from experts' opinions and used for correctness of items and reliability measure of the consistency of scores (Field, 2005; Fraenkel et al., 2012).

Table 1
Reliability statistics

No.	Name of factors	Cronbach's Alpha	N of Items
1	Technological concepts and operations	.817	12
2	Communication and collaboration	.834	14
3	Digital citizenship	.849	14

Collected data were entered in SPSS to confirm normality. Researchers applied Shapiro-Wilk's test to confirm normality of data, $p > .05$, $n < 2000$. Bell shaped data are assumed to be normally distributed when values of skewness and kurtosis ranged between +2 to +7 (Anumudu et al., 2018; Ho & Yu, 2015).

Table 2
Tests of normality

No.	Variables	Kolmogorov-Smirnov ^a			Shapiro-Wilk			Skewness	Kurtosis
		K-S	df	p	S-W	df	p		
1	Gender	.372	200	.01	.631	200	.90	1.48	-3.66
2	Age	.290	200	.01	.761	200	.08	-2.20	4.52
3	Designation	.234	200	.01	.866	200	.62	2.11	-5.04
4	Locality	.382	200	.01	.627	200	.09	1.25	.450
5	Nature of job	.420	200	.01	.601	200	.08	-2.30	-5.09
6	Qualification	.229	200	.01	.806	200	.68	1.50	4.20
7	Experience	.218	200	.01	.809	200	.69	-1.29	3.39
8	University type	.364	200	.01	.633	200	.81	1.36	4.21

a. Lilliefors Significance correction

Normally distributed data provide concrete directions by applying parametric and non-parametric techniques on collected data (Corder & Foreman, 2009; Elliott & Woodward, 2007; Öztuna et al., 2006; Singh & Masuku, 2014). Analyzed data were auto correlated. Auto correlated data is valuable as it informed possible harms and significant features regarding manipulated variables within model formation (Cronk, 2012; Montgomery et al., 2012).

Research Results

Following section consist of data analysis and interpretation of results. There were 40-items modes of 5-point Likert type options. Data was analyzed in SPSS by applying independent sample t-test and regressions analysis techniques.

Table 3
t-test on technological literacy by teachers' gender and university type

No.	Variables		N	M	SD	F	t	p
1	Gender	Female	112	147.938	17.014	2.68	2.61	.10
		Male	88	154.807	20.143			
2	University type	Public	91	147.989	17.363	1.74	2.07	.19
		Private	109	153.440	19.519			

As delineated in table 3, independent sample t-test was applied to usage teachers' technological literacy by their gender, $t(198) = 2.61, p > .01$; male teachers have about same usage of technological literacy ($M = 154.807, SD = 20.143$) as compared to female university teachers ($M = 147.938, SD = 17.014$) and teachers' university type, $t(198) = 2.07, p > .01$; public sector university teachers have about same usage of technological literacy ($M = 147.989, SD = 17.363$) as compared to private sector teachers ($M = 153.440, SD = 19.519$).

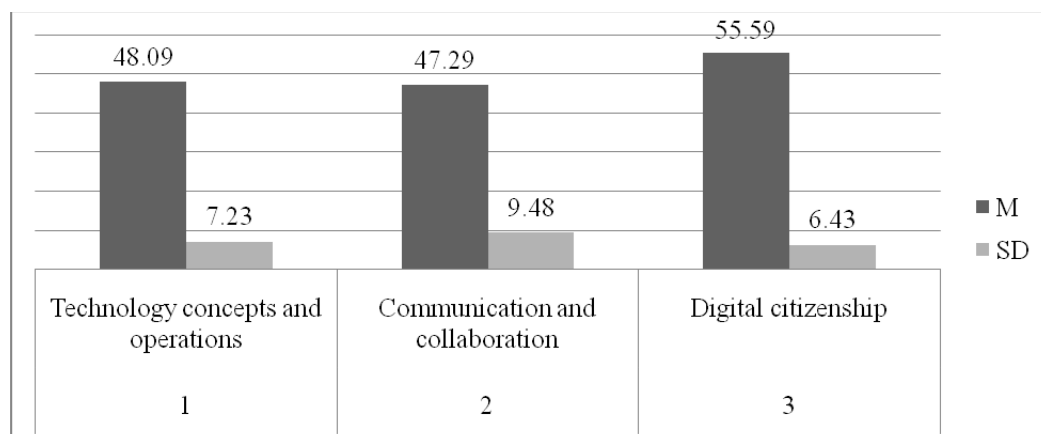
Table 4
T-test on factors of technological literacy by teachers' gender and university type

No.	Factors name	Variables	N	M	SD	F	t	p
1	Technology concepts and operations	Male	88	49.557	7.762	1.385	2.588	.241
		Female	112	46.929	6.593			
2	Communication and collaboration	Male	88	50.171	10.004	7.087	3.947	.008
		Female	112	45.027	8.419			
3	Digital citizenship	Male	88	55.080	6.904	.513	0.985	.475
		Female	112	55.982	6.037			
4	Technology concepts and operations	Public	91	47.297	7.040	.027	1.412	.869
		Private	109	48.743	7.355			
5	Communication and collaboration	Public	91	44.967	8.064	8.992	3.242	.003
		Private	109	49.229	10.15			
6	Digital citizenship	Public	91	55.725	6.838	2.414	0.281	.122
		Private	109	55.468	6.102			

As presented in Table 4, independent sample t-test was conducted to explore significant difference between male and female university teachers' usage of technological literacy against factor regarding: technology concepts and operations, $t(198) = 2.588, p > .01$; male university teachers possess same technology concepts and operations ($M = 49.557, SD = 7.762$) as compared to female teachers ($M = 46.929, SD = 6.593$); significant difference exists between communication and collaboration, $t(198) = 3.947, p < .05$; male teachers were more communicators and collaborators ($M = 50.171, SD = 10.004$) as compared to female ($M = 45.027, SD = 8.419$) and found no significant difference against factors regarding digital citizenship, $t(198) = .985, p > .05$; male university teachers were making more usage of digital citizenship ($M = 55.080, SD = 6.904$) as compared to female university teachers ($M = 55.982, SD = 6.037$). Interpretation further ascertained no significant difference between public and private university teachers' usage of technology concepts and operations, $t(198) = 1.412, p > .01$; public university teachers possess same technology concepts and operations ($M = 47.297, SD = 7.040$) as compared to private university teachers ($M = 48.743, SD = 7.355$); significant difference exists against factors on communication and collaboration, $t(198) = 3.242, p < .05$; private university teachers were more communicators and collaborators ($M = 49.229, SD = 10.15$) as compared to public university teachers ($M = 44.229, SD = 8.064$) and found no significant difference against factors on digital citizenship, $t(198) = .281, p > .05$; public university teachers were making more usage of digital citizenship ($M = 55.725, SD = 6.838$) as compared to private university teachers ($M = 55.468, SD = 6.102$).

Figure 2

University teachers' usage of TEL for students' academic success



As delineated in Figure 2, descriptive statistics was applied to investigate university teachers' maximum usage of technological literacy for students' academic success. Results declared that university teachers were making more use of digital citizenship ($M = 55.59, SD = 6.43$), then applying technological concepts and operations in classrooms ($M = 48.09, SD = 7.23$) and were making less use of communication and collaboration ($M = 47.29, SD = 9.48$) for university students academic purpose for students' effective learning.

Table 5
Effect of teachers' technological literacy on students' academic success

No.	Model	B	SE	β	t	p
1	Constant; SAS	268.786	29.527		9.103	.01
	Teachers' technological literacy	.613	.194	.218	3.158	.02

Note: $R = .218^a$, $R^2 = .480$; ($F(1, 199) = 9.970$, $p < .02^a$)

As revealed in table 5, simple linear regression was applied to measure the effect of teachers' technological literacy on university students' academic success that shows construction of significant regression equation ($F(1, 199) = 9.970$, $p < .01$) having .480 value of R^2 with 48% explained variations were observed with standardized regression coefficient ($\beta = .218$). Concerning outputs of regression coefficient, interpretation of independent sample t-test exposes that teachers' technological literacy was a significant predictor on university students' academic success, $t(198) = 3.158$, $p < .05$. University students' predicted academic successes were equal to $268.786 + .613$ where teachers' technological literacy was measured in terms of their expertise. It is concluded that students' academic success increased by .613 scores by putting teachers' technological literacy in classroom.

Table 6
Effect of factors regarding teachers' technological literacy on students' academic success

No	Names of Variables	B	SE	β	t	p
	Constant; SAS	346.17	34.119		10.14	.01
1	Technological concepts and operations	1.123	.654	.017	.188	.85
2	Communication and collaboration	2.154	.515	.389	4.181	.01
3	Digital citizenship	1.455	.592	.178	2.459	.02

Note: $R = .351^a$, $R^2 = .123$, ($F(3, 197) = 9.231$, $p < .05^a$)

As ascertained in Table 6, multiple linear regression technique was performed to explore the effect of teachers' technology concepts and operations, communication and collaboration and digital citizenship on students' achievement success. Interpretation confirms construction of significant regression equation ($F(3, 197) = 9.231$, $p < .01$) having .123 value of R^2 with 12.30% explained variations were observed with standardized regression coefficient in favor of technological concepts and operations ($\beta = .017$), communication and collaboration ($\beta = .389$) and digital citizenship ($\beta = .178$). Focusing the value of regression coefficient, explanation of independent sample t-test established that teachers' technology concepts and operations, $t(198) = .188$, $p > .05$ was non-significant predictor, whereas communication and collaboration, $t(198) = 4.181$, $p < .01$ and digital citizenship, $t(198) = 2.459$, $p < .05$ was significant predictor on SAS. Students' academic achievements were equal to $346.17 + 1.123 + 2.154 + 1.455$ scores where university teachers' technology concepts and operations, communication and collaboration and digital citizenship were calculated in account of their technological abilities applied in classroom. It is concluded that students' academic achievements were improved 4.732 scores by putting teachers' technological potential on students in classroom.

Discussion

Humans are making continuous innovations using contemporary technologies in every walk of life. Industrialization and information revolts have brought effective and immense amendments in the universal civilization. Revolution of technological literacy innovation put universe in jam packed environment which gives birth to creative destruction of skills. This revolt opened new ways in creation of technological division which drives social, political, educational and technological difference among non-users and users; teachers. It has collectively influenced different aspects of human beings in all fields of life (Kozma, 2005). It has brought individual sources of enlargement, administration and supervision all over the universe. Its effects on every part of life especially in education are valuable and successful (Cradler et al., 2002; Derbyshire, 2003). It is also important for the upcoming generations, national money-making prosperity and even on the prolonged existence of earth. Traditional teaching is less contribution in modern constructive educational environment to gain individual's productive outcomes. Educational institutions do not incorporate usage of innovative devices and show poor effects on future students learning outcomes (Nicola, 2001). Resultantly educational institutions less incorporate their technologies for effective products. To overcome these deficiencies, states demand technology literate persons. This technology transfers nation builders of the states called teachers who penetrate technology in future generations and bring positive change in innovative system of education. Teachers' technological literacy enhances skills, thoughts, interest towards subject matter and handles real life situations (Kent & Facer, 2004). Teachers' technological literacy leads students towards effective success (Moore & Kearsley 1996; Tondeur et al., 2007). Technological literacy in classroom learning activities facilitates the understanding of socio-cultural issues (Tomei, 2008; Venezky, 2004).

Technological literacy has remained as an effective indicator in educational institutions. Results of present research have ascertained that male and female teachers were making same use of technological literacies $t(198) = 2.61, p > .01$ working in public and private universities $t(198) = 2.07, p > .01$ that are congruent with the results of the research conducted by Norris et al. (2003) which ascertained that usage of technological literacy has no effect on gender. Results of present research contradict with the findings of the research planned by Volman and Van Eck, (2001) which revealed that female teachers are less technologically literate, have limited access on technologies, less skilled and show dispossessed attitudes as compared to male teachers. However, findings of the research conducted by (Kay, 2006; Wozney et al., 2006) revealed that male were more technologically literate as compared to female respondents which entirely contradicts with the findings of present research. Moreover, Jamieson-Proctor et al. (2006) framed quantitative research on sample of 929 teachers in Queensland State and declared that female teachers are less technologically literate as compared to male ones that contradict with the findings of present research. It is dire need to enhance the quality of technologically literate persons to reduce gender differences in educational institutions (Ali et al., 2013). Results of present research have established that male and female teachers' technological literacy affects 48% on students' academic success with construction of significant regression equation ($F(1, 199) = 9.970, p < .01$) which supports with the findings of the research framed by Mitchell (2017) which revealed that teachers' gender, socio-economic status and ethnicity have a significant effect on students' academic success in vibrant learning environment.

There is a debate that teachers' technological literacy significantly effects on students' academic achievements. Teachers' technological literacy enhances students' learning and shapes the process of research (Giordano, 2007). Researchers conducted studies to explore the effect of teachers' TEL by gender, age, teaching experience, educational level, academic and professional qualification on students' academic success. Findings of present research revealed that teachers' technical literacy put 12.30% effect on students' academic success with formation

of significant regression equation ($F(3, 197) = 9.231, p < .01$) which supports with the results of other studies (Hernández-Ramos, 2005; Mitchell, 2017; Wong & Li, 2008; Giordano, 2007). Furthermore, results of present research contradict with the findings of research conducted by Baek et al. (2008) that revealed weak relationship between teachers' technological literacy and students' academic success (Zidon & Miller, 2002). Teachers having more teaching experience are high technologically literate. Findings of the research conducted by Rose and Maguire, (1990) on meta-analysis and review on 81 research studies revealed significant effect of teachers' technological literacy on students' academic success. Less technologically literate teachers feel worries, anxiety and tension. Less technologically literate teachers possess low intentions towards technology, job security and lessen intention towards students' academic achievements. New selected teachers have more expertise and grip on technological knowledge that may lead to better students' academic success (Ali et al., 2013). Teachers' qualification effects on students' academic achievements. Teachers with low qualification are less technologically literate, have poor technological competencies and destructive approaches towards technology (Veenhof & Cindy, 2006). Standardized constructed scales remain helpful to measure public and private sector university teachers' attitudes, usages and technological literacies. These scales empirically provide current pictures of working teachers more / less technologically literate competencies (Borghans & ter Weel, 2004). Findings of present research have revealed that public and private university teachers are same in technological competencies that significantly effects on students' academic achievements, $t(198) = 2.07, p > .01$. It is fact that higher education commission provides equal opportunities to public and private sector universities. Universities are checked and balanced by higher education. Report offered by National Centre on Adult Literacy, (2005) remarked that teachers holding higher education degree were skilled in technologies. They were eager to use technologies for effective communication, to save money and time and to achieve good results for future correspondence (Ali et al., 2013). HEC is funded and well-established self-governing body by Government of Pakistan having continuous check and balance on public and private universities. It sets criteria, implements rules and regulations, scheme of studies and resolves university conflicts (Ameen, 2007; Batool & Qureshi, 2007). Quality is a key slogan of HEC that has already been discussed in the meeting of developing and developed Asian countries on faculty improvement, conduction research, curriculum improvement and application of standards of technological and engineering literacy (Ameen, 2007; Batool & Qureshi, 2007; Haider & Mehmood, 2007; Mikiko, 2006; Satija, 2006).

Conclusions

Endeavor of countrywide development and success depends on implementations of technology education to young generations. States focused to arrange digital devices in educational institutions. To achieve this target, revolt steps have been adopted for the progressiveness and encouragement of the standard of education with the help of technology. This technology put comprehensive collisions in the field of education sector. It furnishes occasion for the teachers to take advantages from the current technology in their educational path. It facilitates teachers to decide the place of work where they argue their educational matters and discuss different topics. Historically speaking, Pakistan is lacking in the field of technology since last decades. Government of Pakistan is taking revolutionary steps to fill the deficiency of technologically literate persons. Policies are going to be changed, curriculum is up-to-dated and new teachers are hired to make students' technologically and engineering literate. Keeping in view this research was conducted to explore the effect of teachers' literacy on students' academic success. Findings of present research revealed that male and female university teachers of public and private universities were same in their technological literacy.

Teachers who were more experienced were same technology experienced as new appointed were. They make continuous users of technological literacy whereas more experienced teachers remain passive in technology literacy. Overall research concludes that university teachers were deficit 52% in technological and engineering literacy skills, whereas in technological concepts and operations, communication and collaboration and digital citizenship 87.70% less skilled. It is one of the factors that universities were lacking operating computer labs with digital devices, latest hardware and software attracting students towards their use with vibrant learning environment that significantly affects students' academic success. The reason behind this is HEC of Pakistan which provides funds to enhance the quality of education in universities. Both universities have same selection criteria and provide equal physical facilities to make teachers and students technologically literate. On the basis of results, research recommends proper training, inclusion of training based on pedagogical aspects of teachers used in educational institutions focusing new educational reforms on technological literacy, teaching and learning workplace environment and transformation of teachers' positive attitudes towards students' better academic success.

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List of Abbreviations

AAS	Academic Achievement Scores
ALA	American Library Association
ANOVA	Analysis of Variance
EFA	Education for All
HEC	Higher Education Commission
ICT	Information and Communication Technologies
IT	Information Technology
ITEA	International Technology Education Association
MDGs	Millennium Development Goals
NGSS	Next Generating Science Standards
NICT	National Information and Communication Technology
SAA	Students' Academic Achievement
SAAS	Students' Academic Achievement Scores
TEL	Technological and Engineering Literacy
WSIS	World Summit on the Information Society

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