Bulletin of Education and Research
August 2019, Vol. 41, No. 2 pp. 121-143

Technology Adoption and Integration in Teaching and Learning at Public and Private Universities in Punjab

Tahira Afridi[*] and Abid Hussain Chaudhry[**]

Abstract

The well-rounded education is the interpretation of a successful education system of 21st century. Well-rounded education has laid great stress on the use of modern technology in education. Policy makers are spotting at educational technologies to ensure this educational change. Rogers' Diffusion of Innovation Theory, which is considered more suitable for assessing the technological integration in education, was selected for this study. This study explores the perceptions of 3350 university students from Central Punjab, Pakistan, regarding the technology adoption and integration in teaching and learning at public and private universities in Punjab. Survey research was used to achieve the objectives of the study. A representative sample of administrators, teachers and students from faculties of Education and Business in eight Public and Private Universities of Central Punjab was taken. Descriptive and inferential statistics were applied to assess and compare responses taken on adapted five-point Likert rating scale. Respondents rated Laptop based Teaching activities as the highest and online teaching activities as the lowest factor in order of their preference. The overall level of technology adoption and integration in teaching at public and private universities in Punjab with respect to all three sub-scales was found to be at an average level, thus conventional teaching is continued. The major findings revealed that stakeholders were having an easy access and sufficient skills to use these technologies but even then these technologies' integration in teaching is not sufficient. This study recommended the continuation of current Prime Minister free Laptops Scheme, paying back student loans with easy installments, high speed internet facilities at department's computer labs, libraries, hostels and homes, improving searching skills of teachers, counseling centers with trained staff for teachers, teachers' subsidized trainings and rigorous application of online teaching activities.

Keywords: Computer based technologies (CBTs), technology adoption and integration, teaching, learning, diffusion of innovation (DOI)

[*]Assistant Professor, Institute of Education and Research, University of the Punjab, Lahore
Email: tahiraafridi2014@gmail.com
[**]Professor & Dean, Faculty of Education, Institute of Education and Research, University of the Punjab, Lahore

Introduction

Global efforts have been made to embrace every teacher and learner with computer based technologies (CBTs), e.g. computers, internet, World Wide Web and laptops to ensure digital age learning and eliminate digital divide. Researchers believe that one major factor which ensures students' effective learning is computer based technologies (Gulek & Demirtas, 2005). The free laptop initiative was introduced by many states of America, New Zealand, Canada, Turkey and India. Studies have been conducted to explore the use and effectiveness of these technologies in teaching learning environment (Ahmad & Rafiq, 2016; Iftakhar, 2016; Payal&Kanvaria, 2018; Silviyanti & Yusuf, 2015). The demand that society has placed on universities and its faculty is the integration of computer based technologies in education (Greenhow, Robella, &Hughes, 2009; Nicolle, 2005). New electronic technologies e.g. computers, Internet, www, laptops, facebook, blogs continue to spread in whole world (Muslem, Yusuf, &Juliana, 2018).

The administration of universities, government and other concerned authorities have always invested in computer based technologies with the hope that this access to the technologies will also ensure its effective use in education by the stakeholders (Pettersson, 2017; Ahmad & Rafiq, 2016). Yet the reality is different. Universities and specifically the university teachers, the main executors of these technologies, are expected to play a big part in modeling the integration of these technologies in universities' teaching, but the reality on the ground is different (Hariadi, Dewiyani, & Sudarmaningtyas, 2016). Faculties of universities have been observed as the ineffective users of these technologies (Olofsson, Lindberg, & Fransson, 2018).

Pakistan as one of the developing nations has been going through a difficult phase of integrating the computer-based technologies in teaching whereas the developed countries are decades ahead from their developing counterparts. According to Taimur and Abdur (2012) Pakistan is far behind in the technology accessibility and its integration in the teaching developments. Among other initiatives of technologies, the government of Pakistan initiated to equip every university student with such computer based technologies. The one-to-one laptop initiative was taken by Punjab Government back in 2011 with the purpose to equip 100 thousand brilliant students, studying in public sector universities/colleges. This initiative was expected to increase the adoption and integration of CBTs in education. Question arises whether such technology driven initiatives improves the situation or not? (Higher Education Commission, 2016).

According to Qureshi, Kholaand Michael (2012) there is a very limited research on assessing the adoption and integration of technology in teaching and learning at public and private universities in Pakistan. In Pakistan even after the accessibility of technology, there is still an issue of technology integration in teaching. Evidence also exists that investing in these technologies does not always result in their utilization and integration in teaching.

Measuring Technology Adoption and Integration

Different models of technological change have been coined in past. Almost in every era change models have been of interest to educational and managerial scientists. These models are somehow interdependent on each other and one model supports the other. Among these interrelated models are Rogers' Diffusion of Innovations (DOI) theory, the concerns-based adoption model (CBAM) of Hall and Hord (1987), Zaltman and Duncan's (1977) Strategies for Planned Change, Ely's (1990) conditions for change, and systemic change (Reigeluth & Garfinkle, 1994). The processes and models of change in business setups are similar to the models utilized in education (Bucherer & Uckelmann, 2011;Zott, Amit,& Massa, 2011). They believe that the academic theories regarding change and industry practices have many commonalities and interrelated in nature.

Theoretical frameworks of Rogers (1995) theory provide the information on facilitating factors within computer based technologies in education. He proposes that technological innovation and its diffusion is the outcome of stakeholders' efforts (leaders), but execution and acceptance of the technological innovation is dependent on teachers (workers) who eventually are the users or executors of the innovation. These users always need assistance in form of training and support. Roger's Diffusion of innovation framework explains a complete scenario of technology adoption and lays focus on the circumstances, environment, and attributes of innovation and conditions. It's been proposed that Rogers' DOI model as one of the most important model for technology adoption and integration because of its practicability (Zanaboni & Wootton, 2012; Ben & Hakkinen, 2014; Levin & Jacobson, 2017).

Diffusion of Innovations (DOI) theory provides a conceptual framework to this study as this theory assess technology or innovation in three ways: (1) accessibility of technology or innovation, (2) skills of adopters in that technology, and (3) integration of that technology in teaching by the executors of technology. Therefore, current research study was conducted by using this model. DOI is based on stakeholder's expectations and perception which could be comprised of three dimensions as follows:

1. Accessibility of computer based technologies (CBTs)
2. Skills in computers based technologies
3. Integration of computer based technologies in teaching

Technology Adoption and Integration in Teaching: Past Researches

Globally speaking, the computer based technologies' adoption and integration in teaching at universities is appreciated, utilized and supported. In a previous study conducted by Cator (2010) the computer based technologies are praised and believed that the development of an infrastructure focusing on computer based technologies for teaching will free teaching from a rigid information transfer mode (from book to teacher to students). A study conducted by Phillip, Jameson-Charles and Cain (2015) in Trinidad and Tobago was about teachers' concerns and use of the Laptops in Secondary Schools. The study was about the opinions of teachers about the utilization of CBTs in teaching and the factors which they encounter while using these computer based technologies. The findings of the study concluded that there is unavailability of laptops for teachers, deficient and improper infrastructure, weak support systems, no professional development for teachers and intellectual challenges.

One of the previous researches conducted on CBTs (computer based technologies) was about one-to-one laptop initiative by Maschmann in 2015. This study explored perceptions of teachers and administrators about the implementation of CBTs in education, perceptions of student engagement, perceptions of student grades, benefits of one-to-one technology, and perceptions of continued success of the one-to-one initiatives. Some perceptions of the study were positive and some were negative. Another study by Catherine Gurley Raulston (2009) was about the initiatives taken by government for implementing computer based technologies in teaching and learning. An implication of this study was if teachers are given resources and proper training on how to implement technology in the classroom, attitudes and classroom practices can be changed.

Another past research by Nyirongo (2009) was about the barriers faced by stakeholders in the implementation of CBTs in teaching and learning in the universities of US. Results of the study revealed that while most faculty members actively engaged with electronic technologies but such engagements in electronic technologies often excluded instructional use. The study also revealed the major benefits of these technologies are the changing classroom configurations, using text messages for easier communication and investigating collaboration and social networking technologies for possible integration into the curriculum.

Research Objectives

This study was organized to attain the following objectives:

1. Determine the accessibility level and skills (adoption) of respondents to computer based technologies (CBTs).
2. Determine the integration of computer based technologies by the respondents (administrators and teachers) in teaching at Universities.
3. Determine the significant difference in the opinions of respondents (students, teachers and administrators) about the integration of computer based technologies in teaching at universities.
4. Identify differences of opinions among respondents regarding the integration of computer based technologies in university teaching with respect to demographic variables such as age, discipline, university type (sector) and gender.

Research Methodology

This study assessed technology adoption and integration in teaching at universities according to Diffusion of Innovation (DOI) model. The research design used for this study was quantitative based on a survey.

Sample of the Study

Multi stage sampling technique was used, at first stage, Punjab was divided into four zones i.e. Northern Punjab (04 districts), Central Punjab (18 districts), Western Punjab (07 districts) and Southern Punjab (07 districts). The Central Punjab was selected among the other zones of Punjab for its greater percentage of population and the larger numbers of universities as compared to other zones of Punjab Province. In second stage, the purposive sampling technique was used for the selection of universities. Sample of the study was taken as eight general type universities located in Central Punjab selected on the following criteria:

1. Public and private universities in the same geographic area
2. Having both faculties: the Education faculty and Business faculty
3. Working as main campuses of universities.

In third stage, the census and proportionate sampling techniques were used for selection of participants. The administrators and the teachers were selected on the basis of census and students on proportionate sampling technique. From the total students of these faculties, 30% of the students were selected for sample. Table 1 shows the distribution of the number of participants (estimated) in each sampled university.

Table 1
Distribution of the Number of Participants in the Sampled University

Sr. No	Name of University	Sector	Estimated Number of Participants (30% of total)			Total
			Students	Teachers	Admin	
1	University of the Punjab, Lahore	PUBLIC	1140	83	15	1238
2	Govt. College University, Faisalabad	PUBLIC	690	82	15	787
3	Lahore College for Women University	PUBLIC	187	23	5	215
4	University of Education, Lahore	PUBLIC	117	50	4	171
5	UMT, Lahore	PRIVATE	210	66	7	283
6	University of Faisalabad, Faisalabad	PRIVATE	210	66	7	283
7	Beacon House National University, Lahore	PRIVATE	180	11	2	193
8	University of Lahore, Lahore	PRIVATE	210	12	2	224
	Grand Total		2944	393	57	3394

Instrument

After the review of literature, the instrument of data collection comprising self-report questions on five- point Likert type scale was adapted. This adapted questionnaire was validated through expert opinions and the reported reliability of the instrument after the pilot testing was 0.814. The instrument was designed for the Education and Business students of public and private universities of Punjab. The questionnaire parted in different sections: Demographic information (gender, age, qualifications, sector of university and department/ discipline), Computer-based technologies: accessibility and skills/ extent of use scale(6 close ended items), Integration of technology in teaching scale (25 items). This questionnaire was later floated for data collection.

Collection and analysis of data

Quantitative data collection was conducted by taking data from students, teachers and administrators from Public and Private Universities in central Punjab. The survey was self-administered and the researchers personally visited the sampled universities and collected the data. Chi square, paired sample t-test, factor analysis, one sample t-tests, independent sample t-test, one-way ANOVA, Multi Analysis of Variance (MANOVA) and descriptive statistics were used to calculate the responses.

Findings of the study

The Cronbach's alpha coefficient of the instrument was 0.848. The findings of this study showed that the students (87.4%) were in majority followed by university administrators and teachers. Majority of administrators, teachers, and students were from University of the Punjab, Lahore (36.8%). The male respondents were 40.7% and female respondents were 59.3%. Respondents from public sector (64.7%) were in majority whereas respondents from private sector were (35.3%). Discipline split of respondents was as management sciences (60.1%) and social sciences (39.9%). Their age as 20-29 years (84.9%), 30-39 years (8.6%), 40-49 years (3.7%), 50-59 years (2.2%) and above 60 years (0.6%).

Table 2

Chi-Square against Respondents as the Level of Accessibility to the Computer Based Technologies like Computers/Laptops

Scales	Administrators		Teachers		Students		Total		χ^2	*p*
	n	*%*	*n*	*%*	*n*	*%*	*N*	*%*		
No-Access	---	---	-	-	72	2.5	72	2.5		
Slight Access	---	---	10	3.1	76	3.5	87	3.0		
Average Access	1	2.2	14	4.3	200	7.9	215	7.5	4.45	.05
Full Access	43	97.7	296	92.6	2163	86.1	2501	87		
Total	44	100.0	320	100.0	2511	100.0	2875	100.0		

Table 2 shows that majority of respondents (87%) identified that they have full access to computers. A Chi-square test for independence indicated there is a significant difference among the respondents groups and their present access to Computers, χ^2 (3, n =36) =4.45, p =.05, phi=.11.

Table 3

Chi-Square against Respondents as the Level of Accessibility to the Computer Based Technologies like internet and World Wide Web (www)

Scales	Administrators		Teachers		Students		Total		χ^2	*P*
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*		
No-Access	---	---	4	1.3	32	1.3	36	1.3		
Slight Access	---	---	25	7.8	217	8.6	242	8.4		
Average Access	34	77.3	218	68.1	1928	76.8	2180	75.8	4.46	.05
Full Access	10	22.7	73	22.8	334	13.3	417	14.5		
Total	44	100.0	320	100.0	2511	100.0	2875	100.0		

Table 3 shows that majority of respondents (75.8%) identified that they have an average access to the computer based technologies. A Chi-square test for independence indicated that there is a significant difference among the respondents groups and their present access to the CBTs, χ^2 (3, n =36) =4.46, p =.05, phi=.11.

Table 4

Paired-Sample t-test against Respondents as the Degree to Which Students Were Engaged with Computer Based Technologies Before and After Government Laptop Initiative

Statement	Before		After		*T*	*P*	Effect size (d)
	M	*SD*	*M*	*SD*			
Students engaged with computer due to laptop initiative.	2.7134	1.300	3.051	1.340	12.720	.00	0.25

In table 4, a paired-samples t-test was conducted to compare the degree to which students are engaged with computer based technologies before and after the laptop initiative. There was a significant difference in the scores before laptop initiative (*M* =2.71, *SD* =1.30) and after laptop initiative (*M*=3.05, *SD*=1.34) conditions; *t* (287) =12.73, *p* = .00. Kohn's D formula was used to calculate the effect size 0.25. The real difference between the mean scores is medium. These results suggest that the laptop initiative has increased students' engagement to computer based technologies.

Table 5

Chi-Square against Respondents as Hours per Week Administrators, Teachers and Students Use the Computer Based Technologies for Educational Purposes

Scales	Administrators		Teachers		Students		Total		$\chi 2$	*P*
	n	%	*n*	%	*n*	%	*N*	%		
0-2 hrs. per week	14	31.8	146	45.6	1245	49.6	1405	48.9		
2-4 hrs. per week	23	52.3	83	25.9	523	20.8	629	21.9		
4-6 hrs. per week	7	15.9	43	13.4	355	14.1	405	14.1	17.66	.00
6+ hrs. per week	---	---	48	15.0	388	15.5	436	15.2		
Total	44	100.0	320	100.0	2511	100.0	2875	100.0		

Table 5 shows that less than half of respondents (48.9%) have identified that they use 0-2 hours per week the computer based technologies for educational purposes. A Chi-square test for independence indicated there is a significant difference among the respondents groups and the hours per week they use CBTs for educational purposes, $\chi 2$ (3, n=36) = 17.66 p=.00, phi=.22.

Table 6
Chi-Square against Respondents as their Skills with Computer Based Technologies(CBTs)

Scales	Administrators		Teachers		Students		Total		$\chi 2$	p
	n	*%*	*n*	*%*	*n*	*%*	*N*	*%*		
I have never used a computer much except for email but I intend to learn.	---	---	19	5.9	216	8.6	235	8.2		
I have created a PowerPoint.	---	---	---	---	48	1.9	48	1.7		
I have created an iMovie.	---	---	1	0.3	4	0.2	5	0.2		
I have created a Podcast.	---	---	1	0.3	27	1.1	28	1.0		
I use applications like word processing, spreadsheets, etc.	---	---	---	---	127	5.1	130	4.5	3.53	.69
I use computers for instruction in the classroom.	---	---	1	0.3	81	3.2	82	2.9		
All Above (statements 2-6)	44	100.0	295	92.2	2008	80.0	2347	81.6		
Total	44	100.0	320	100.0	2511	100.0	2875	100.0		

Table 4.13 shows that majority of respondents (81.6%) have identified that they have much experience with computer as they have created an iMovie; a Podcast; used word processing, PowerPoint, spreadsheets, etc.; and also used computers for teaching/study in the classroom. A Chi-square test for independence indicated no significant difference between respondents' groups and their present expertise in the use of computer based technologies, $\chi 2$ (5, n =36) =3.53 p= .61, phi=.09

Table 7
Mean Scores and One-Sample t-values Against Integration of Computer Based Technologies in Teaching at Universities

(Factors)	Statements	Mean
Online Teaching Activities	Created and used an on-line syllabus	3.10*
	Enabled and supported students' online group work	2.99*
	Enabled and supported online students' collaboration	2.97*
	Used internet-based audio systems for instruction	2.74*
	Conducted online academic advising	2.73*
	Used on-line chat rooms	2.45*
	Provided grades online	2.99*
	Exchanged students' written work via internet (e.g. Email attachments, digital drop boxes, discussion)	3.56*
	Used Email as the primary source of student contact outside the classroom	3.55*
	Used for instant messaging	3.47*
	Experienced for blogging/ mobile blogging (twitter)	2.84*
Web-based Teaching Activities	Designed web-based lectures, notes, and tutorials	3.14*
	Designed web-based tests or quizzes	2.83*
	Experienced internet for research in teaching	4.07*
Laptop-based Teaching Activities	Used a computer and projector in the classroom	3.87*
	Used a laptop in the classroom	4.07*
	Used softwares in the classroom (e.g., PowerPoint, Excel and others)	3.14*

Table 7 shows that the respondents have shown disagreement about the use of online teaching activities as in most cases the mean score in below the cut point 3.0. In web-based teaching activities the respondents agree with two of the web-based teaching activities as the mean scores are above the cut point 3.0 whereas the respondents disagree with one of the web-based teaching activity. The respondents have shown agreement in the use of laptop based teaching activities as in all such activities respondents marked mean score above 3 which is greater than the cut point.

Table 8

Mean Scores and One-Sample t-values Against Respondents groups for Sub-Scales

Factors (CBTs in teaching activities)	Alpha	Mean	*SD*	*df*	*t*-values
Online Teaching Activities	0.81	3.14	0.72	2874	231.20*
Web-based Teaching Activities	0.71	3.35	0.83	2874	215.36*
Laptop-based Teaching Activities	0.82	3.75	1.16	2874	172.27*
Overall Teaching Activities	0.85	3.22	0.69	2874	248.11*

The factor analysis explored 3 factors of teaching activities namely: online teaching activities, web based teaching activities and laptop based teaching activities. The ranking using the mean scores and standard deviation are given in table. In teaching activities, the use of laptop based teaching activities is the most prominent activity with highest scores (*M*= 3.75, *SD*=1.17) stating that the three groups of respondents as administrators, teachers and students agree most with the use of laptop based teaching activities. The use of laptop during teaching activities is highest and most prominent. It is followed by web based teaching activities (*M* = 3.35, *SD* = 0.83), than online teaching activities (*M* = 3.22, *SD* = 0.69).

Table 9

One-Way MANOVA and Post Hoc Tests Tukey HSD for Multiple Comparisons of Technologies' Integration in Teaching and Learning for Sub-Scales with respect to Respondents groups

CBTs in Teaching Activities	Administrators 01 (N=44)		Teachers 02 (N=320)		Students 03 (N=2511)		Mean Diff. 01 v/s 02	Mean Diff. 01 v/s 03	Mean Diff. 02 v/s 03	F-values	Effect size (d)
	Mean	*SD*	Mean	*SD*	Mean	*SD*					
Online Teaching	3.05	0.79	3.03	0.82	3.15	0.71	0.01	-0.10	-0.12*	4.07*	.01
Web-based Teaching	3.19	0.83	3.34	0.93	3.35	0.82	-0.15	-0.15	-0.01	0.75	.00
Laptop-based Teaching	4.02	0.97	3.86	1.19	3.72	1.16	0.15	0.29	0.14*	3.43*	.01
Overall Teaching Activities	3.14	0.74	3.15	0.79	3.23	0.68	-0.00	-0.08	-0.08	2.05	.00

**p<0.05*

Multivariate analysis of variance (MANOVA) was applied along with post-hoc tests in order to compare the technology adoption and integration in teaching across the respondent's groups. The three age groups of respondents of the study as shown in Table 9 were administrators as 01, teachers as 02 and students as 03.

Within the teaching activities, the students as respondents significantly show higher degree of agreement than teachers regarding use of online teaching activities. Between the groups, the real difference in the mean scores was small. Eta square was used for calculating the effect size which was .01.Similarly, the administrators as respondents significantly show higher degree of agreement than the students regarding the use of Laptop in teaching activities. Between the groups, the real difference in the mean scores was small. Eta square was used for calculating the effect size which was .01.There were no significant differences of opinion among the respondents' groups regarding CBTs' adoption and integration in overall teaching activities at .05 levels in mean and standard deviation values, with F value of 2.05. Table 4.13 also shows the pair wise significant differences among different groups. There were no significant differences between; 01 vs 02, 01 vs 03 and 02 vs 03.

Table 10

Independent Samples t-test against Technologies' Adoption and Integration in Teaching and Learning for Sub-Scales with respect to Sector

CBTs in Teaching Activities	Sector	*N*	Mean	*SD*	*MD*	*t*-values	*P*	Effect size (d)
Online Teaching	Public	1859	3.13	0.72	-0.02	-0.79	0.43	.03
	Private	1016	3.15	0.73				
Web-based Teaching	Public	1859	3.36	0.83	0.02	0.52	0.59	.02
	Private	1016	3.34	0.84				
Laptop-based Teaching Activities	Public	1859	3.71	1.18	-0.10	-2.23	0.03*	.10
	Private	1016	3.81	1.13				
Overall Teaching Activities	Public	1859	3.22	0.69	-0.02	-0.73	0.46	.02
	Private	1016	3.24	0.70				

**p<0.05*

T-test was done to find the difference of opinion among the respondents on basis of public and private sector (Table 9). Significant difference was found in the mean values of one teaching activities between public and private sector. Private sector (Mean=3.811, SD=1.180) was more in agreement with using laptop based teaching activities than public sector (Mean=3.811, SD=1.137) with (p =0.026). The real difference in the mean scores was small with effect size .10. Kohn's d formula was used to calculate the effect size.

Table 11

Independent Samples t-test against Technologies' Adoption and Integration in Teaching and Learning in Sub-Scales by Gender

CBTs in Teaching Activities	Gender	*N*	Mean	*SD*	*MD*	*t*-values	*P*	Effect size(d)
Online Teaching	Male	1171	3.15	0.73	0.03	1.11	0.27	.04
Activities	Female	1704	3.12	0.72				
Web-based Teaching	Male	1171	3.34	0.83	-0.01	-0.46	0.64	.01
Activities	Female	1704	3.35	0.83				
Laptop-based Teaching	Male	1171	3.75	1.18	0.02	0.46	0.65	.01
Activities	Female	1704	3.73	1.15				
Overall Teaching	Male	1171	3.23	0.70	0.02	0.79	0.43	.03
Activities	Female	1704	3.21	0.69				

**p<0.05*

There was no statistically significant difference in respondents' opinion on the basis of gender about the computer based technologies' adoption and integration in teaching activities; learning activities and the barriers.

Table 12

Independent Samples t-test for Technologies' Adoption and Integration in Teaching and Learning for Sub-Scales with respect to Discipline

CBTs in Teaching Activities	Discipline	*N*	Mean	*SD*	*MD*	*t*-values	*P*	Effect size(d)
Online Teaching	Mge. Sci.	1727	3.13	0.73	-0.01	-0.18	0.86	.00
Activities	Education	1148	3.14	0.71				
Web-based	Mge. Sci.	1727	3.34	0.84	-0.01	-0.30	0.76	.01
Teaching Activities	Education	1148	3.35	0.82				
Laptop-based	Mge. Sci.	1727	3.71	1.18	-0.07	-1.57	0.12	.06
Teaching Activities	Education	1148	3.78	1.13				
Overall Teaching	Mge. Sci.	1727	3.21	0.70	-0.01	-0.38	0.70	.01
Activities	Education	1148	3.22	0.68				

**p<0.05*

There was no statistically significant difference in respondents' opinion on the basis of disciplines.

Table 13

One-Way MANOVA for Technologies' Adoption and Integration in Teaching and Learning for Sub-Scales with respect to Respondents' Age

CBTs in Teaching Activities	20-29 Year 01 (N=2442)		30-39 Year 02 (N=246)		40-49 Year 03 (N=105)		50-59 Year 04 (N=63)		60 Y/Above 05 (N=19)		F-values	Effect size (d)
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*		
Online Teaching	3.156	0.71	3.12	0.77	3.01	0.85	2.87	0.80	2.73	0.89	5.04*	.01
Web-based Teaching	3.36	0.82	3.39	0.85	3.19	0.92	3.15	0.81	2.98	0.91	3.09*	.01
Laptop-based Teaching	3.75	1.16	3.77	1.15	3.82	1.19	3.52	1.10	3.68	1.37	0.73	.00
Overall Teaching Activities	3.24	0.68	3.22	0.73	3.09	0.82	2.97	0.73	2.84	0.81	4.66*	.01

**p<0.05*

Table 14

One-Way MANOVA Tukey HSD for Multiple Comparisons of Technologies' Adoption and Integration in Teaching and Learning in Sub-Scales by Respondents' Age

Factors	CBTs in Teaching Activities	(I) Age	Mean Difference (I-J) (J) Age			
			30-39 Year (02)	40-49 Year (03)	50-59 Year (04)	60 Y/Above (05)
Teaching Activities	Online Teaching Activities	20-29 Year (01)	0.04	0.15	0.29*	0.43
		30-39 Year (02)		0.11	0.25	0.39
		40-49 Year (03)			0.14	0.28
		50-59 Year (04)				0.14
	Web-based Teaching Activities	20-29 Year (01)	-0.04	0.17	0.21*	0.38
		30-39 Year (02)		0.21	0.25	0.42
		40-49 Year (03)			0.03	0.21
		50-59 Year (04)				0.17
	Laptop-based Teaching Activities	20-29 Year (01)	-0.03	-0.07	0.22	0.06
		30-39 Year (02)		-0.04	0.25	0.09
		40-49 Year (03)			0.29	0.14
		50-59 Year (04)				-0.16
	Overall Teaching Activities	20-29 Year (01)	0.02	0.14	0.27*	0.39
		30-39 Year (02)		0.12	0.25	0.38
		40-49 Year (03)			0.13	0.26
		50-59 Year (04)				0.13

**p<0.05*

Multivariate analysis of variance (MANOVA) was applied along with post-hoc tests in order to compare the technology adoption and integration in teaching across the respondent's age groups. The five age groups of respondents shown in table are 20-29 years as 01, 30-39 years as 02, 40-49 years as 03, 50-59 years as 04 and 60-above years as 05.

There was a statistically significant difference in respondents' opinion on the basis of age regarding technology adoption and integration in teaching at .05 levels in mean and standard deviation values, with F value of 4.660. Table shows pair wise significant differences among groups. There were significant differences between; 01 vs. 04 in overall teaching activities.

Within the teaching activities, the table shows that the respondents with age group 20-29 years significantly show higher degree of agreement than the age group of 50-59 years regarding use of online teaching activities. The real difference in the mean scores between the respondents according to their ages was small. Eta square was used to calculate the effect size which was0.01.Similarly the respondents with age group of 20-29 years significantly show higher degree of agreement than the age group of 50-59 years regarding use of CBT in web based teaching activities. The real difference in the mean scores between the respondents according to their ages was small. Eta square was used to calculate the effect size which was0.01.

Discussion

This study was designed to answer three basic objectives. The first research objective was to, "determine the accessibility level and skills (adoption) of respondents to computer based technologies (CBTs)" according to results, the majority of respondents have either a laptop or a computer but they have an average access to internet and World Wide Web. The reasons for having full access to laptops or personal PCs by a greater number of university students, administrators and teachers might be the affordable prices of PCs in the country or the Prime Minister initiative of providing free Laptops scheme in the Public Sector Universities in Pakistan but, a large population did not have proper access to internet and World Wide Web, should be a matter of concern for the authorities (Ahmad &Rafiq 2016). The reason for average access to internet and WWW may be the limited access of resources like internet, electricity crises and computer labs (Khalid, Ahmad,& Norman, 2016).

The majority of respondents have identified that they use the computer based technologies 0-2 hours per week for educational purposes. Minority of respondents have identified that they use computer based technologies 6 plus hours per week for educational purposes. Such low use of CBTs for educational purposes may be due to average access to these technologies. A previous research study indicated that there is poor maintenance of these technologies and the limited access of internet but even then the effects of these technologies are always positive on students' performance (Binbin, Mark, Chin, & Chi, 2016). Certain initiatives have been taken by the government to improve the access of computer based technologies in teaching at universities which include the laptop initiative as well. According to findings of this study the majority of respondents have identified that they were slightly engaged with CBTs before laptop initiative and the majority of respondents have identified that they are very much engaged with computer based technologies after the laptop initiative. This means that the use of computer based technologies has increased after the laptop initiative by the government (Ahmad & Rafiq 2016; Ballew, 2017). In the opinions of administrators and teachers, government should take more initiatives to improve the access to computer based technologies like internet for everyone, computer labs and maintenance of these technologies (Iftakhar, 2016).

As one of the objective of this study was to analyze the skills of respondents in using these technologies so the results of this study showed that the majority of administrator, faculty members and students are highly skillful and have much expertise in computer based technologies. They have created an iMovie, a Podcast, used applications like word processing, PowerPoint, spreadsheets, etc. and also used computers for teaching and learning in the classroom. The findings explored that all three groups of respondents are competent enough in computer based technological skills especially the teachers and administrators possess high competence in these technologies. The reason could be the educational background of these teachers, students and administrators. Moreover the teachers are motivated to struggle for learning these skills in order to improve their teaching and satisfy their students. There are studies symmetrical with the findings of our study revealing that the university students and teachers are competent enough in the use of CBTs (Iftakhar, 2016; Muslem & Abbas, 2017). The interviews data provided by the administrators and teachers of our study also support the quantitative findings of this study. Ghavifekr and Rosdy (2015) also addressed the teachers' needs to learn good ICT skills for improving teaching and ensuring effective learning as well as to meet the demands of the 21st century teaching skills. The respondents of our study revealed that students also possess the skills needed to operate CBTs at their own and university administration is not providing them the opportunities of trainings, professional development, technical support and capacity building to get market demanded skills in

these technologies for effective university teaching. Another research study aligned to our research's findings has also emphasized that technological skills are changing every day which is resulting in job's transitions that's why the university administration must train the stakeholders in changing market demanded skills (Jahnke, Bergstrom, Marell-Olsson, Hall, & Swapna, 2017).

The second research objective of the study was to, "determine the integration of computer based technologies by the respondents (administrators and teachers) in teaching at Universities" The university administrators and teachers are utilizing computer based technologies in teaching in three ways i.e. online teaching activities, laptop based teaching activities and web based teaching activities. In teaching activities the use of laptop based teaching activities is the most prominent activity, followed by web based teaching activities and then online teaching activities. According to a past research, the teachers and administrators use the laptop based teaching activities the most (Jahnke et al., 2017). The reason may be the convenience and availability of the laptops as previously results show that the access to laptop has increased due to government laptop initiative and affordable prices (Ahmad & Rafiq, 2016). Similarly, the use of online teaching activities and web based teaching activities is comparatively low. The reasons may be the limited access to internet. Yousaf (2012) analyzed the negative and positive effects of internet on Pakistani youth. He explored that most of the parents being illiterate, did not know the causes of the misuse of internet and complained about their children unsatisfactory performance in education. Similarly he reported that internet is majorly used for nonacademic purposes. In the same year, Devi and Roy (2012) studied the internet use of students at Assam University, India. They found that students primarily use internet 80% for educational purposes, 5% each for entertainment and searching jobs, while 3% for online shopping. In the light of these results researchers suggested to start awareness programs for students to maximize the use of internet for educational purposes. The limited internet access restricts them from much use of online and web based teaching activities. Similarly, the online activities are used for non-academic purposes as compared to academic purposes (Salomon & Ben, & Kolikant, 2016) like Facebook, whatsapp, chat room and others. The positive thing noticed was that all three computers based teaching activities is used by teachers and administrators to ensure the improved and 21st century teaching.

Among the online teaching activities the findings of this study revealed that the most practiced online teaching activity is exchange of students' written work via the Internet (e.g., email attachments, digital drop boxes etc.). The reason may be the convenience, very basic skill required, entertaining and interesting for students to use emails to exchange written work through it (Neilson, 2014). The situation in rest of online teaching activities is not good and most of them are not usually practiced by teachers and

administrators. Among the web based teaching activities the findings revealed that the most practiced web based teaching activity is use of websites/ internet for research. The reason could be the research articles and thesis supervision by the teachers for which they need to read the articles through the search engines. Moreover, in teaching the websites/internet is used for searching material or research which helps them to prepare lectures and give assignments to students (Bulfin, Johnson, Nemorin & Selwyn, 2016).

Among the laptop based teaching activities the findings of this study revealed that the most practiced laptop based teaching activity is the use of laptop for teaching in the classroom (Jahnke et al., 2017). The reason could be that the teachers present their lectures through slide show and they don't need to use the conventional way of using writing boards. Moreover the teachers make their lectures colorful and interesting by showing colorful slides to the students (Bagdasarov, Yupeng, & Wuet, 2017).

The last research objective of this study was, "Identify differences of opinions among respondents regarding integration of computer based technologies in university teaching with respect to demographic variables such as age, discipline, university type (sector) and gender". The results of this study showed that there were no significant differences of opinions among the respondents on basis of public and private sector for overall teaching activities. The reason of the same opinion by both sector universities may be due to the leveled playing field in computer bases technologies. In private universities due to the ongoing digitalization of universities, students can use their own digital devices (BYOD) (Song, 2014) whereas in public universities the governments' technology boosted initiatives like laptop initiative, internet (wingle) by Punjab Government, technological resources by Higher Education Commission (HEC) have increased the CBTs' use during their time in universities (Ahmad & Rafiq, 2016). The results of this study indicated no statistically significant difference in respondents' opinion on the basis of gender about the computer based technologies' integration in teaching at universities. Some research studies are also aligned with the findings of our study that the respondents on basis of gender have no difference in use of technologies and the reason giving equal opportunities to students in universities avoiding any gender discrimination (Muslem, Yusuf, & Juliana, 2018). The findings of our study are in contrast with some of the studies as Hafkin and Huyer (2007) and Goyal (2011) argue that most women will not benefit from the information technology to the extent that men do, but that this is hard to quantify due to lack of data. They suggested that new technologies should be integrated with no gender bias and inequality must be removed. The findings of our study indicated no statistically significant difference in respondents' opinion on the basis of disciplines. The reason could be the emphasized importance of technology in academics and curriculum across the board. Muslem, Yusuf and Juliana, (2018) also presented symmetrical findings to our study claiming that universities' every discipline has realized that technology is for all and it should be embedded in curriculum of every discipline, as no profession can survive in future without technology.

The results show that the respondents with different age groups have different opinion regarding computer based technologies adoption and integration in teaching and learning at their universities. The reason of this disparity is that the people with different ages respond differently to certain phenomenon. The results of our study showed that within the teaching activities the respondents with age group 20-29 years significantly showing higher degree of agreement than the age group 50-59 years regarding use of online teaching activities. Similarly, the respondents with age group of 20-29 years significantly showing higher degree of agreement than the age group of 50-59 years regarding use of CBT in web based teaching activities. This means that young respondents or youth participates more in the computer based technologies in online and web based teaching activities as compared to old age people or senior citizens. Bhatti and Amjad, (2013) also explored same findings in their study that people with different ages utilize the technologies differently. They claimed that this disparity could be the youth's motivation to do challenging tasks and adopting change whereas the old or aged people do not adopt changes easily.

Conclusion

The findings of this study concluded that the technology adoption and integration in teaching at public and private universities in Punjab has not achieved a satisfactory status yet. The findings revealed that the general accessibility and adoption of computer based technologies is much higher than the integration of these technologies in teaching. Administrators, teachers and students of universities in Punjab are having an easy access to these computer based technologies. Along with the easy access the respondents specifically the teachers possess enough skills and expertise for operating these computer based technologies. Despite of easy access and sufficient skills, the integration of these technologies in teaching at universities has yet not achieved the status which it should have been achieved. All three groups of respondents are skillful and have expertise in using these technologies specifically teachers are most competent in using CBTs. Even then the use of these technologies is low in university teaching; hence the conventional teaching is continued. Significant difference was found among respondents according to ages and respondent's groups. No significant difference was found among the respondents with respect to sector, gender and discipline.

Recommendations

HEC, the universities' authorities and government may take measures to overcome the slow speed of the internet, the frequent power breakages and providing students with easy access to internet facilities at department's computer labs, libraries, hostels, and even homes. Similarly the continuations of the Prime Minister free Laptops Scheme for deserving university students may improve the situation. Use of CBTs in university teaching should

be encouraged and nonacademic use of these technologies on campus may be discouraged. Respondents of the study have much expertise and skills in general computer based technologies like iMovie; a Podcast; applications of word processing, PowerPoint, spreadsheets, etc.; thus it is recommended that the universities' authorities, HEC and ministry of education may arrange professional market demanded ICT trainings and skills in teachers and students specifically in teachers as the teachers are the real executors of these technologies in education. The teachers may also be offered subsidized teacher training programs and low cost or free online teaching resources. The authorities might release funds to these universities for organizing international projects like Microsoft, Google etc. to assist the integration process.

The integration of computer based technologies in teaching at universities might be a must and not an option. The use of online teaching activities and web based teaching activities may be enhanced by pedagogical integration in teaching. The e-teaching may be integrated and made part of curriculum and teaching pedagogies. Instead of considering these activities as a barrier in teaching, the teachers and university administration might conduct discussions between teachers, students and parents to promote e-teaching. The use of online teaching activities might be encouraged so that social interaction and collaborative learning can be boosted. Young teachers utilize computer based technologies more than the senior/old teachers. Thus it is recommended that senior faculty of universities may be motivated to utilize computer based technologies in teaching. Training courses, IT staff support and team work between young and senior faculty will motivate the senior teachers to use CBTs in teaching and learning.

References

Adams B. S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., & Ananthanarayan an, V. (2017). *NMC horizon report: 2017 higher education edition*. Austin, Texas: The New Media Consortium.

Ahmad, M., & Rafiq, S. (2016). Accessibility and usability of internet among university students in Khyber Pakhtunkhwa, Pakistan. *Pakistan Journal of Information Management & Libraries (PJIM&L), 18*(1), 37-51.

Bagdasarov, Z., Yupeng, L., & Wuet, W. (2017). The influence of tablet-based technology on the development of communication and critical thinking skills: an interdisciplinary study. *Journal of Research on Technology in Education, 49*(1), 55-72. doi:10.1080/15391523.2017.1293576.

Ben, A., & Hakkinen, P. (2014). Tieto-javiestintäteknologiakouluissa – uskomuksiajaniidenkyseenalaistamista. *The Finnish Journal of Education, 5*(2), 415-417.

Bhatti, R., & Amjad, A. (2013). Approach towards social media of LIS students, Islamia University, Bahawalpur Pakistan. *Library and Information Science Journal, 44*(2), 10-16.

Binbin, Z., Mark, W., Chin, H. L., & Chi, C. (2016). Learning in one-to-one laptop environments: A meta-analysis and research synthesis. *Review of Educational Research, 86*(4), 1052 – 1084.

Bucherer, E., & Uckelmann, D. (2011). Business models for the internet of things. *Architecting the Internet of Things, 40*(2), 253-277.

Bulfin, S., Johnson, N., Nemorin, S., & Selwyn, N. (2016). Nagging, noobs and new tricks students' perceptions of school as a context for digital technology use. *Educational Studies*, *42*(3), 239-251. doi: 10.1080/03055698.2016.1160824.

Cator, K. (2010). Transforming American education: Learning powered by technology. *National Education Technology Plan.US Department of Education*.

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative*. New Jersey: Upper Saddle River.

Creswell, J. W., Plano, C. V. L., Guttman, M., & Hanson, W. (2003). Advance mixed methods research designs. In A. Tashakkori., & C. Teddlie. (Eds.), *Handbook on Mixed Methods in the Behavioral and Social Sciences* (p. 209). Thousand Oaks, CA: Sage.

Devi, C. B., & Roy, N. R. (2012). Internet use among university students: A case study of Assam University Silchar. *A Journal of Humanities and Social Science, 1*(2), 183-202.

Dexter, S. (2007). Show me the leadership: *The impact of distributed technology leadership teams' membership and practices at four laptop schools*. In 88th Annual Meeting of the American Educational Research Association, Chicago, IL.

Dunleavy, M., Dexter, S., & Heinecke, W. F. (2007). What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning? *Journal of Computer Assisted Learning*, *23*(5), 440-452.

Ely, D. P. (1999). Conditions that facilitate the implementation of educational technology innovations. *Educational Technology*, *39*(6), 23-27.

Ghavifekr, S., & Rosdy, W. A.W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science (IJRES), 1*(2), 175-191.

Goyal, A. (2011). Developing women: Why technology can help. *Information Technology for Development, 17*(2), 112-132. doi:10.1080/02681102.2010.537252

Green, D. W., & O'Brien, T. (2002). The internet's impact on teacher practice and classroom culture. *THE Journal (Technological Horizons in Education), 29*(11), 44-54.

Greenhow, C., Robella, B., & Hughes, J. A. (2009). Learning teaching and scholarship in a digital age. *Educational Researcher*, *38*(4), 246-259

Gulek, J. C., & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *The Journal of Technology, Learning and Assessment, 3*(2), 440-460.

Hafkin, N., & Huyer, S. (2007). Women and gender in ICT statistics and indicators for development. *information technologies and international development, 4*(2), 25-41. Retrieved from http://itidjournal.org/itid/article/view/254

Hall, G., & Hord, S. (1987). *Change in schools: Facilitating the process*. Albany, NY: State University of New York Press. (ED 332 261).

Hariadi, B., Dewiyani, M., & Sudarmaningtyas, P. (2016). Development of web-based learning application for generation Z. *International Journal of Evaluation and Research in Education, 5*(1), 60-68.

Higher Education Commission. (2016). *Pakistan Educational Research Network (PERN-II) Project.* Retrieved from http://www.pern.edu.pk/index.php/pern-II.html

Iftakhar, S. (2016). Google classroom: What works and how? *Journal of Education and Social Sciences, 3*(1), 12-18.

Jahnke, I., Bergstrom, P., Mårell-Olsson, E., Hall, L., & Swapna, K. (2017). Digital didactical designs as research framework – iPad integration in Nordic schools. *Computers & Education, 113*(2), 1-15.

Kayalar, F. (2016). Cross-cultural comparison of teachers' views upon integration and use of technology in classroom. *The Turkish Online Journal of Educational Technology, 15*(2), 11-19.

Khalid, K., Ahmad F. S., & Norman R. (2016). Information and communication technology in learning physics at secondary school level in Pakistan. *Bulletin of Education and Research, 38*(2), 135-151.

Levin, J. A., & Jacobson, M. J. (2017). *Education as a complex system: Implications for educational research and policy*. Paper to be presented at the American Educational Research Association Meeting. San Antonio, 27 April-1 May. Retrieved from https://www.academia.edu/31085744/Education_as_a_Complex_System_Implications_for_Educational_Research_and_Policy

Maschmann, B. (2014). *One-to-one laptop initiative: Perceptions of teachers and administrators* (Unpublished doctoral dissertation). University of Nebraska, Lincoln: Nebraska.

Muslem, A., Yusuf , Y. Q., & Juliana, R. (2018). Perceptions and perceptions to ICT use among English Teachers in Indonesia. *Teaching English with Technology*, *18*(1), 3-23.

Muslem, A., & Abbas, M. (2017). The effectiveness of immersive multimedia learning with peer support on English speaking and reading aloud. *International Journal of Instruction 10*(1), 203-218.

Neilson, J. (2014). *Music education designer at Yousician*. Interview 23.03.2014. Interviewer Kozina, A. Transcribed.

Nicolle, P. M. (2005). *Technology adoption into teaching and learning by mainstream university faculty: A mixed methodology study revealing the "how, when, why and why not"* (Unpublished doctoral dissertation). Louisiana State University and Agricultural and Mechanical College. Baton Rouge, LA.

Nyirongo, N. K. (2009). *Technology adoption and integration: A descriptive study of a higher education institution in a developing nation* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg: Virginia.

Olofsson, A. D., Lindberg, O. J., & Fransson, G. (2018). Students' voices about information and communication technology in upper secondary schools. *The international journal of information and learning technology*, *35*(2), 82-92.

Payal, H., & Vinod, K. K. (2018). Learning with ICT: Use & barriers from teachers' perceptions. *International Journal of Recent Science Researches, 9*(1), 23545-23548.

Pettersson, F. (2017). On the issues of digital competence in educational contexts – a review of literature. *Education and Information Technologies*, *44*(3), 330-350.

Phillip, S., Jameson-Charles, M & Cain, M. (2015). *Teachers Concerns and Level of Use of the Laptops in Secondary Schools in Trinidad and Tobago*. Published in proceedings, Trinidad.

Qureshi, I. A., Ilyas, K., Yasmin, R., &Whitty, M. (2012).Challenges of implementing e-learning in a Pakistani university. knowledge management & e-learning. *An International Journal (KM&EL)*, *4*(3), 310-324.

Raulston, C. G. (2009). *Analysis of teachers' perceptions and attitudes of a teacher laptop initiatives* (Unpublished doctoral dissertation). The University of Albama, Tuscaloosa: Albama.

Reigeluth, C., & Garfinkle, R. (1994).*Systemic change in education*. Englewood Cliffs, NJ: Educational technology Publications. (ERIC Document Reproduction Service No. ED 376055).

Salomon, A., &Ben, D., Kolikant, Y. (2016). High-school students' perceptions of the effects of non-academic usage of ICT on their academic achievements. *Computers in Human Behavior*, *64*(2), 143-151.

Silviyanti, T. M., & Yusuf, Y. Q. (2015). EFL teachers' perceptions on using ICT in their teaching: To use or to reject? *Teaching English with Technology*, *15*(4), 29-43.

Song, Y. (2014). Bring your own device (BYOD) for seamless science inquiry in a primary school. *Computers & Education,74*(2), 50-60

Taimur, H., & Abdur, R. S. (2012).ICTs in learning in Pakistan. *International Journal of Evaluation and Research in Education* (IJERE), *1(*2), 51-60.

Yousaf, Z. (2012). The use of internet by youngsters of Gujarat city (Pakistan).*New Media Mass Communication*, *4*(1), 26-36.

Zaltman, G. & Duncan, R. (1977). *Strategies for planned change*. New York: John Wiley.

Zanaboni, H., & Wootton, G. (2012). Adoption of telemedicine: From pilot stage to routine delivery. *BMC Medical Informatics and Decision Making*, *12*(1), 1-9.

Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research. *Journal of Management*, *37*(4), 1019-1042.