TEACHERS' SELF-PERCEPTIONS FOR TECHNOLOGY INTEGRATION IN TEACHING THROUGH THE LENS OF TPACK FRAMEWORK

Firdous Bugti
Ph.D. Scholar,
Department of Education and Learning Sciences, Iqra University, Karachi,
Sindh, Pakistan
Email: firdous.bugti@salu.edu.pk

Fatima Dar
CEO & Managing Partner,
Oak Consulting,
Sindh, Pakistan
Email: fatimadar@oakconsultingedu.com

Pir Suhail Ahmed Sarhandi
Associate Professor,
Department of Linguistics and Social Sciences, The Begum Nusrat Bhutto Women University, Sukkur,
Sindh, Pakistan
Email: suhail.sarhandi@bnbwu.edu.pk

ABSTRACT

Technology can provide everlasting advantages in teaching and learning if utilized effectively however, it seems impossible without enhancing teachers' technological skills. The aim of this study is to analyze the current status of teachers' use of technology in their pedagogy and to examine teachers' self-perceptions regarding their technological and pedagogical knowledge using technological, pedagogical and content knowledge (TPACK) framework. The study was carried out in the context of Shah Abdul Latif University, Khairpur. The quantitative survey method was adopted for current case study to explore self-perceptions of the participants regarding level of understanding for their technological and pedagogical skills. Total 123 Teaching Assistant (TAs) taught in different departments of SALU, Khairpur, holding master degrees in their concerned field were selected purposively. Results revealed that all teaching assistants perceived themselves at high level of understanding in all pedagogical related skills while their self-perceptions displayed that they were at low level of understanding in all technological based domains. In the light of findings, current study recommended that the areas where TAs perceived themselves at low level need to be strengthened through technology trainings, secondly TAs can prepare

themselves for technology aligned pedagogical practices to contribute in teaching and learning and administration needs to plan and execute trainings on technological pedagogy specifically using TPACK framework to promote and encourage technological enriched teaching and learning environment.

KEYWORDS
Technology, perceptions, technological knowledge, pedagogical knowledge, TPACK, and teaching-learning

INTRODUCTION

Technology is recognized as an important and influencing factor in teaching and learning during last two decades and made traditional methods of teaching outdated (Negi, *et. al., 2011*). Different studies (Higgins, *et.al.* 2012 and Negi, *et. al., 2011)* stressed on effectiveness of technology for improving standard of teaching and learning. Gisbert and Bullen, (2015) assert that modern technology includes mobile phone, television, Google, YouTube, internet and its different applications and software is very popular and prominent tool to transform the process of teaching-learning, especially in higher education. Hence, a prominent role of technology is greatly recognized for learning of students that urges teachers to keep themselves technology literate and integrate technology in their teaching (Chang, *et.al.* 2017). It is therefore significant to examine the teachers' self-perceived understanding regarding technology integration in pedagogy. Three fundamental domains of teachers' knowledge; CK (content knowledge), PK (pedagogical knowledge), and TK (technological knowledge) of teachers not only incorporated in TPACK framework in isolation but it contains new kind of knowledge discovered with the node of these three fundamental domains of knowledge; TCK (technological content knowledge), TPK (technological pedagogical knowledge), PCK (pedagogical content knowledge), and TPACK (technological, pedagogical and content knowledge) are equally effective for quality teaching (Koehler and Mishra, 2008). TPACK framework mostly used in three distinct areas by different researchers; 1) To assess in-service teachers' beliefs and perceptions related to technology integration (Dawson et al. 2013; Kim et. al., 2013; Koh and Chai, 2014), 2) To educate preservice teachers particularly in-depth understanding of TCK and TPK during teacher training (Graham, Borup, and Smith, 2012; Liu et al., 2015), and 3) To measure technology integration in pedagogical practices of various in-service group of teachers (Archambault and Crippen, 2009; Graham et al. 2009; Grandgenett, Harris and Swan, 2011).

Moreover, many researchers (Willermark, 2018; Voogt, *et.al*. 2013; Wu, 2013; and Chai, *et.al*. 2013) used TPACK framework due to its usefulness for technology integration in the field of education. The researchers focused and used TPACK framework by looking its broaden scope and technological application for pedagogy,

and found it appropriate for current study to examine teachers' self-perceptions to integrate technology in pedagogy. Furthermore, current study would have significant contribution in the existing literature so for the context of Shah Abdul Latif University, Khairpur is concerned where similar study had never been carried out to analyze the teachers' perceptions for technology integration in teaching and learning using TPACK framework.

LITERATURE REVIEW

The digital natives of 21st century (Prensky, 2008) replaced traditional teaching by technology enhanced learning (Ahmed, 2012). On the other hand globalization and increased demand of technology in the field of education draws our attention to adopt technology for effective teaching and learning (Heeks, 2010; Voogt & Plomp, 2010). Sparapani, *et.al.* (2014) therefore, stressed that teachers are required to adopt broaden perspective for technology use in teaching to meet the requirements of students' learning and international standard of education. Besides broadened perspective on mere use of technology as a tool is not effective without considering the appropriate pedagogical practices (Okojie, *et.al*. 2006) and teachers' technological skills alone never guarantee the effective technology integration in teaching and learning (Matherson, *et.al.* 2014; Carr, *et.al.* 1998). Although, technology integrated teaching and learning is encouraged in new educational policies (Karim, 2010; Ministry of Human Resource Development, 2010), yet resources to integrate technology are still limited (Wims & Lawler, 2007), also majority of the teachers lac in technological skills (Buabeng-Andoh, 2012). Therefore, teachers in majority feel this integration as a burden to learn technological skills and technology integration as obstacle in teaching and learning (Baba, 2014). This crucial matter was addressed and stressed by (Sarhandi *et.al.* 2017; Sparapani, *et.al.* 2014) that global perspective for technology integration must be accepted and adopted by the teachers globally. Without understanding the philosophy behind technology integration, it is of no use to learn how to integrate technology. Effective technology use requires not only competence and resources, but it also requires its acceptance.

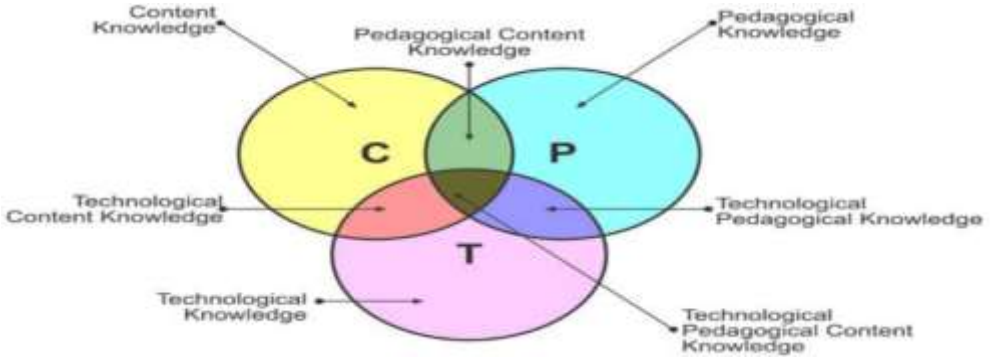
Teachers' Perceptions for Technology Integration

Teachers' positive perceptions regarding technology integration is considered as foundation for effective teaching and learning (Celik and Keskin, 2009). Cedillo and Kieran, (2003) stated that technology is integrated in a smaller amount in teaching and learning by the teachers who perceive technology as less important and they are not much interested to enhance their skills related to technology, pedagogy and content (TPACK). In contrast, those teachers who believe that technology contribute positively in students' learning they are much interested to integrate technology (Sulaimani *et. al*. 2017). The same results were portrayed by (Mumtaz, 2000) that teachers only supposed to integrate technology when perceived as helpful for students' learning.

Ertmer *et. al*. (2012) endorsed that technology would be effectively integrated in teaching-learning when aligned with teachers' beliefs. It was suggested by Cope and Ward (2002) that technology is integrated successfully when technology is perceived as central part of teachers' pedagogy and used to develop constructive approach for students' learning whereas, it is proposed by (Sarhandi *et. al.* 2016; Gu, *et.al.*2013) to examine teachers' as well as students' acceptance and use of technology in teaching and learning to fill the digital gap. The importance of teachers' beliefs for technology integration is highlighted in different studies (Ertmer, *et.al.* 2012; Kim, *et.al.* 2013), whereas, Kopcha, 2012; Georgina and Hosford, 2009 researched teachers' perception for integration of technology, while teachers' attitudes were investigated in the studies (i.e. Buabeng-Andoh, 2012; Alharbi, 2013) and lived experienced of teachers were examined by (Tuttle,2012) and revealed that teachers' beliefs, perceptions, attitudes and lived experiences are all important factors for technology integration in teaching and learning.

TPACK Framework

Teacher's knowledge for effective teaching and learning has been emphasized in various frameworks (Pitts, *et.al.* 2013). The theory of pedagogical content knowledge (PCK) given by Shulman (1986) described that as knowledge about how to teach specific content. The concept of PCK was evolved by Mishra and Koehler (2006) and proposed TPACK (technological, pedagogical and content knowledge) describing relationship between content knowledge (subject matter that is to be taught), technological knowledge (computers, the internet, digital video, etc.) and pedagogical knowledge (process, practices, strategies, procedures and methods of teaching and learning). Schmidt, *et.al.* (2009) described that these three domains further intersect each other to form other complex relationships, i.e. (PCK) pedagogical content knowledge, (TPK) technological pedagogical knowledge, (TCK) technological content knowledge, and (TPACK) technological, pedagogical and content knowledge. As shown in the figure below;



Source: Koehler and Mishra (2006)

Mishra and Koehler (2006) believed that successful teaching based on effective technology integration in overall pedagogical practices of teachers. That was the reason that TPACK conceptual framework received significant attention by the researchers as studies (Mishra, *et.al.* 2011; Figg and Jaipal, (2012)) asserted that TPACK framework is useful for acquiring skills of teachers as per demand of the 21st century. Primarily, researchers used TPACK for; (1) for assessing perception and beliefs of teachers for technology integration (Dawson *et. al.* 2013; Kim, *et.al.* 2013; Koh & Chai, 2014); (2) for guiding education of perspective teachers specifically related to TCK and TPK during teacher training (Graham, *et.al.* 2012; Lieu *et.al.* 2015); and (3) for measuring integration of technology in teaching and learning of various groups of in-service teachers (Archmbault & Crippen, 2009; Hofer, *et.al.* 2016; Irum, *et.al.* 2018) while current study used TPACK framework to explore the perceptions of teaching assistants regarding level of understanding for their technological and pedagogical skills.

RESEARCH OBJECTIVES

1. To analyze the current status of teachers' use of technology in their pedagogy.
2. To examines teaching assistants' self-perceptions regarding their technological and pedagogical knowledge at Shah Abdul Latif University, Khairpur

RESEARCH QUESTIONS

1. What is the current status of teachers' use of technology in their pedagogy?
2. How teaching assistants of Shah Abdul Latif University, Khairpur do perceived themselves regarding their technological and pedagogical knowledge?

RESEARCH METHODOLOGY

Research method is the set of investigation and procedures carried out for specific research or constituting the process of sampling, selection of participants for study, methods for collecting data and data analyzing and interpretation techniques (Creswell, 2014). To meet the objectives of this study and to answer the questions, quantitative method was adopted. Quantitative is a way to learn about a particular group of people (Alen, 2017). In line with this definition, to explore the perceptions of TAs at SALU Khairpur, the quantitative methodology was preferred.

Research Design

A research design according to (Burns and Grove, 2003) is a complete plan or outline of the specific study to guide the researcher for conducting the research and analyzing the results. Moreover, researcher can get help through research design for investigating the problem of the research either employing quantitative methods, qualitative methods or both as mixed-methods, hence it provide guidelines to address the question of the study (Creswell, 2014).

Current study was a case study because all 123 TAs were selected from the context of Shah Abdul Latif University, Khairpur, taught in different departments of same university and they all had never availed any opportunity to acquire knowledge for technology integration in pedagogy, hence, their perceptions regarding their understanding for technology, pedagogy and content was focused in the study. The quantitative survey mode of inquiry was employed for data collection process and data was analyzed by using descriptive statistics. TPACK survey questionnaire, comprised of twenty-one statements adapted from Schmidt and Mishra (2009), was used to collect TAs' (teaching assistants) perceptions regarding their level of understanding for their technology, pedagogy and content knowledge.

Population and Sampling

The current study was a case study conducted in the context of Shah Abdul Latif University, Khairpur. Total 123 teaching assistants were selected purposively as sample based on the criteria that all TAs were holding master degree in their respective fields and had never or rarely availed the opportunity for enhancing their technology or pedagogy hence, considered as suitable sample for the study to examine the perceptions of TAs regarding their level of understanding for technological and pedagogical skills as mentioned by Bryman, (2012) when there is specific criteria for selecting participants, one can use purposive sampling technique.

Instrumentation

According to Neuman (2013) survey are used to ask the opinion, beliefs, characteristics, and past and present behavior of respondents. Therefore, current study employed TPACK five-point Likert scale survey instrument ranging from strongly agree to strongly disagree. TPACK survey is mostly used for reporting self-perceptions and assessment of teachers' status regarding their technology, pedagogy and content knowledge (Abbitt, 2011; Jang & Tsai, 2012; Koh, Chai, Hong, & Tsai, 2015; Schmidt et. al., 2009). This study used TPACK survey adapted from Archambault and Crippen's (2009) validated and widely used and adapted in the field. The link was shared with the participant of current study through different WhatsApp groups and their personal contact numbers, and they were asked to fill the survey as per their level of understanding for technology, pedagogy and content knowledge.

Data Analysis

The quantitative data collected through TPACK survey revealing the findings about self-perceptions of teaching assistants about their technology, pedagogy and content skills was analyzed by using descriptive statistics; percentage, mean and standard deviations and represented in tables.

FINDINGS

Factor 1: *Pedagogical Knowledge (PK)*

Statement	Formul	Responses SDA	DA	N	A	SA	Total	Mean	Std. Dev
I know how to assess student performance in a classroom	*f*	1	8	15	92	7	123	3.78	.684
	%	.8	6.2	12.3	75	5.7	100%		
I can adapt my teaching based upon what students currently understand or do not understand	*f*	0	10	14	90	9	123	3.80	.689
	%	0	8.1	11.5	73.1	7.3	100%		
I can adapt my teaching style to different learners	*f*	1	7	16	91	8	123	3.80	.677
	%	.8	5.7	13.0	74.0	6.5	100%		
I can assess student learning in multiple ways	*f*	0	10	21	78	14	123	3.78	.752
	%	0	8.1	17.1	63.4	11.4	100%		
I can use a wide range of teaching approaches in a classroom setting	*f*	1	14	19	81	8	123	3.66	.789
	%	.8	11.4	15.4	65.9	6.5	100%		
I am familiar with common student	*f*	0	15	28	70	10	123	3.61	.806
	%								

understandings and misconceptions		0	12.2	22.8	56.9	8.1	100%		
know how to organize and maintain classroom management	*f*	0	16	21	75	11	123	3.66	.818
	%	0	13.0	17.1	61.0	8.9	100%		
Grand Total	*f*	3	80	134	577	67	861	**3.18**	**.745**
	%	0.34	9.26	15.6	67.0	7.8	100%		

Table No.1 represents the response of teaching assistants' about factor one, Pedagogical Knowledge. According to data 74.8% (67.0%+7.8) of respondents agree with the factor one, while 9.0% (0.34%+9.26%) of the respondents disagreed, whereas 15.6% of them remained neutral. Overall majority of the respondents agreed with factor one. Mean score 3.18 showed inclination towards agree that verified that teaching assistants had pedagogical knowledge. The value of standard deviation was .745.

Factor. 2 Pedagogical Content Knowledge (PCK)

Statement	Formula	Responses SDA	DA	N	A	SA	Total	**Mean**	**Std.**
I can select effective teaching approaches to guide student thinking and learning in the subject I teach.	*f*	0	14	12	86	11	123	3.76	.769
	%	0	11.4	9.8	69.9	8.9	100		
I can effectively teach different theories and	*f*	0	26	25	62	10	123	3.46	.917
	%	0	21.1	20.3	50.4	8.2	100%		

concepts related to my subject I teach									
Grand Total	*F*	0	40	37	148	21	246	3.61	.843
	%	0	16.26	15.04	60.16	8.54	100%		

Table No.2 represents the response of teaching assistants' about factor two, Pedagogical Content Knowledge. According to data 68.7% (60.16%+8.54%) of respondents agree with the factor one, while 16.26% (0%+16.26%) of the respondents disagreed, whereas 15.4% of them remained neutral. Overall majority of the respondents agreed with factor two. Mean score 3.61 showed inclination towards agree that verified that teaching assistants had pedagogical content knowledge. The value of standard deviation was .843.

Factor 3. Technological Content Knowledge (TCK)

Statement	**Formul**	**Responses**					**Total**	**Mean**	**Std.Dev**
		SDA	**DA**	**N**	**A**	**SA**			
I know about technologies that I can use for understanding and applying in my subject I teach	*F*	1	42	31	40	9	123	3.11	.993
	%	0.8	34.2	25.2	32.5	7.3	100%		
I can select appropriate technologies to identify different theories and concepts related to my subject I teach	*F*	2	65	19	31	6	123	2.79	1.002
	%	1.6	52.8	15.4	25.3	4.9	100%		
Grand Total	*F*	3	107	50	71	15	246	2.9	.99

	%	1.21	43.5	20.33	28.86	6.1	100%

Table No.3 represents the response of teaching assistants' about factor three, Technological Content Knowledge. According to data 44.71% (1.21%+43.5%) of respondents disagreed with the factor one, while 34.96% (28.86%+6.1%) of the respondents agreed, whereas 20.33% of them remained neutral. Overall majority of the respondents disagreed with factor three. Mean score 2.95 showed inclination towards disagree that verified that teaching assistants did not have technological content knowledge. The value of standard deviation was .997.

Factor. 4 Technological Pedagogical Knowledge (TPK)

Statement	**Formula**	**Responses**							
		SDA	**DA**	**N**	**A**	**SA**	**Total**	**Mean**	**Std.Dev**
I can choose technologies that enhance the teaching approaches for a lesson	*F*	0	70	15	32	6	123	2.79	.994
	%	0	56.9	12.2	26.0	4.9	100%		
I can choose technologies that enhance students' learning for a lesson	*F*	3	61	15	37	7	123	2.87	1.056
	%	2.4	49.6	12.2	30.1	5.7	100%		
My current qualification has caused me to think more deeply about how technology could influence the teaching	*F*	1	67	22	23	10	123	2.79	1.026
	%	0.8	54.5	17.9	18.7	8.1	100%		

approaches I use in my classroom									
I am thinking critically about how to use technology in my classroom	*F*	5	57	15	39	7	123	2.89	1.080
	%	4.1	46.3	12.2	31.7	5.7	100%		
I can adapt the use of the technologies that I am learning about to different teaching activities	*F*	4	57	19	34	9	123	2.89	1.077
	%	3.3	46.4	15.4	27.6	7.3	100%		
I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn	*F*	4	57	22	31	9	123	2.87	1.063
	%	3.3	46.3	17.9	25.2	7.3	100%		
I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom	*F*	1	65	19	34	4	123	2.80	.966
	%	.8	52.9	15.4	27.6	3.3	100%		
I can provide leadership in helping others to	*F*	3	54	23	31	12	123	2.96	1.089

coordinate the use of content, technologies and teaching approaches at my department and/or university	%	2.4	43.9	18.7	25.2	9.8	100%		
I can choose technologies that enhance the content for a lesson	*F*	2	53	24	37	7	123	2.95	1.015
	%	1.6	43.1	19.5	30.1	5.7	100%		
Grand Total	*F*	23	541	174	298	71	1107	2.86	1.040
	%	2.07	48.9	15.71	26.91	6.41	100%		

Table No.4 represents the response of teaching assistants' about factor four, "Technological Pedagogical Knowledge". According to data 50.97% (2.07%+48.9%) of respondents disagreed with the factor one, while 33.32% (26.91%+6.41%) of the respondents agreed, whereas 15.71% of them remained neutral. Overall majority of the respondents disagreed with factor four. Mean score 2.86 showed inclination towards disagree that verified that teaching assistants did not have technological content knowledge. The value of standard deviation was 1.040.

Factor. 5 Technology Pedagogy and Content Knowledge (TPACK)

Statement	Formula	Responses SDA	DA	N	A	SA	Total	**Mean**	**Std.**
I can teach lessons that appropriately combine my subject, technologies and teaching approaches	*f*	3	55	25	32	8	123	2.89	1.031
	%	2.4	44.8	20.3	26.0	6.5	100		

Grand Total	*f*	3	55	25	32	8	123	2.89	1.031
	%	2.4	44.8	20.3	26.0	6.5	100%		

Table No.5 represents the response of teaching assistants' about factor five, "Technological Pedagogical and Content Knowledge". According to data 50.97% (2.4%+44.8%) of respondents disagreed with the factor one, while 32.5% (26.0%+6.5%) of the respondents agreed, whereas 20.3% of them remained neutral. Overall majority of the respondents disagreed with factor five. Mean score 2.89 showed inclination towards disagree that verified that teaching assistants did not have technological, pedagogical and content knowledge. The value of standard deviation was 1.03.

The purpose of this study was to examine the perceptions of teaching assistants related with their technology, pedagogy and content knowledge. The overall findings of the study collected through TPACK survey reflects that teaching assistants in majority perceived that they had pedagogical knowledge (refer to *Table No. 1*), pedagogical content knowledge (refer to *Table No. 2*), while they perceived themselves at lower-level of knowledge associated with their technological content knowledge (refer to *Table No. 3*), technological, pedagogical knowledge (refer to *Table No. 4*) and technological, pedagogical and content knowledge refer to *Table No. 5).* This informed researcher that all teaching assistants need to improve their technology related skills and its use in their pedagogy.

DISCUSSION

The globalization of the world demands for pedagogical shift from traditional teaching to technology integrated teaching and learning, whereas teachers are not as much prepared to integrate technology in their pedagogy (Sarhandi *et. al*. 2017). The current study conducted to examine the perceptions of teaching assistants for their level of understanding related to their skills of technology, pedagogy and content using TPACK framework. The findings of the study showed that teaching assistants found that they have sufficient knowledge and skills in all pedagogy related domains of TPACK. On the other hand, the results of the study revealed that teaching assistants perceived that they have average knowledge in all technology related domains of TPACK. This showed that teaching assistants were not found good enough to integrate technology in their teaching and learning. The same results were revealed in the studies (Guzey, & Roehrig, 2009; Zhou, *et. al.* 2011 and Apau, 2017) that teachers lack in technological content knowledge, technological pedagogical knowledge, and technological, pedagogical and content knowledge and highlighted the reason behind

it was lack of proper technology trainings and resources to integrate technology in teaching. In contrast the studies (Owusu, 2014; Oz's, 2015) found that pre -service teachers can chose and integrate technology effectively in their teaching.

Current study concluded that teaching assistants' overall level of understanding towards TPACK was not up to mark as displayed initially in the questionnaire regarding their perceptions that they could not integrate technology with content and pedagogy. Also, the findings of the study show that the lack of trainings at the workplace has been a major barrier in integrating technology. The current study also revealed that teachers take technology integration as an essential practice in teaching our technology generation, but also are of the opinion that up to date technology practices be introduced to them by organizing and arranging more context specific trainings and workshops.

RECOMMENDATIONS

The areas where TAs perceived them at low level need to be strengthening through technology trainings.

Teachers can prepare themselves for technology aligned pedagogical practices to contribute teaching and learning.

Administration needs to plan and execute trainings on technological pedagogy specifically using TPACK model to promote and encourage technological enriched teaching and learning environment.

REFERENCES

Abbitt, J. T. (2011). An investigation of the relationship between self-efficacy beliefs about technology integration and technological pedagogical content knowledge (TPACK) among pre-service teachers. Journal of Digital Learning in Teacher Education, 27(4).

Ahmed, S. (2012). *On being included*. Duke University Press.

Alharbi, A. M. (2013). *Teacher's attitudes towards integrating technology: Case studies in Saudi Arabia and the United States*. [Master's Thesis, College of Education, Grand Valley State University, USA].

Allen, M. (2017). *The SAGE encyclopedia of communication research methods* (Vols. 1-4). Thousand Oaks, CA: SAGE Publications Inc.

Apau, S. K. (2017). Technological Pedagogical Content Knowledge Preparedness of Student-Teachers of the Department of Arts and Social Sciences Education of University of Cape Coast. Journal of Education and Practice, 8(10), 167-181.

Archambault, L., and Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary issues in technology and teacher education*, *9*(1), 71-88.

Baba, P. A. (2014). Technology in the classroom: A tool or a drag. *Journal of Education and Practice*, *5*(27), 75-78.

Bryman, A., 2012. *Social Research Methods*. 4th ed. Oxford: Oxford University Press.

Koehler, M. J., Mishra, P., Bouck, E. C., DeSchryver, M., Kereluik, K., Shin, T. S., & Wolf, L. G. (2011). Deep-play: Developing TPACK for 21st century teachers. *International Journal of Learning Technology*, *6*(2), 146-163.

Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. International Journal of Education and Development using Information and Communication Technology, 8(1), 136-155.

Burns, N. and Grove, S.K. 2003. *Understanding nursing research*. 3rd ed. Philadelphia: Saunders Company.

Carr, A. A., Jonassen, D. H., Litzinger, M. E., and Marra, R. M. (1998). Good ideas to foment educational revolution: The role of systemic change in advancing situated learning, constructivism, and feminist pedagogy. *Educational Technology*, 5-15.

Cedillo, T., and Kieran, C. (2003). Initiating students into algebra with symbol-manipulating calculators. *Computer algebra systems in secondary school mathematics education*, 219-239.

Çelik, L., and Keskin, M. (2009). The effects of the primary class teachers 'information technology literacy skill level on students' achievement: The case of afyonkarahisar. *Procedia-Social and Behavioral Sciences*, 1(1), 1167-1171.

Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2013). A review of technological pedagogical content knowledge. Journal of Educational Technology & Society, 16(2), 31–51.

Chang, Y., Hsu, C., & Ciou, P. (2017). Examining the use of learning communities to improve pre-service teachers' technological pedagogical content knowledge. International. Journal of Learning and Teaching.3(2), 136-143.

Cope, C., & Ward, P. (2002). Integrating learning technology into classrooms: The importance of teachers' perceptions. Journal of Educational Technology & Society, 5(1), 67-74.Creswell, J.W. 2014. *A Concise Introduction to Mixed Methods Research*. California, London, New Delhi and Singapore: Sage Publications.

Chung, T., Creswell, K. G., Bachrach, R., Clark, D. B., & Martin, C. S. (2018). Adolescent binge drinking: Developmental context and opportunities for prevention. *Alcohol research: current reviews*.

Dawson, K., Ritzhaupt, A., Liu, F., Rodriguez, P., and Frey, C. (2013). Using TPCK as a lens to study the practices of math and science teachers involved in a year-long technology integration initiative. *Journal of Computers in Mathematics and Science Teaching*, *32*(4), 395-422.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., and Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers and education*, *59*(2), 423-435.

Feroz-Nainar, C., Selvaraj, P., & Roy, M. (2006). Risperidone induced oedema in a child with learning disability and autism. *Autism*, *10*(3), 308-310.

Figg, C., and Jaipal, K. (2012). TPACK-in-Practice: Developing 21st century teacher knowledge. In *Society for Information Technology and Teacher Education International Conference* (pp. 4683-4689). Association for the Advancement of Computing in Education (AACE).

Georgina, D. A., and Hosford, C. C. (2009). Higher education faculty perceptions on

technology integration and training. *Teaching and Teacher Education*, *25*(5), 690-696.
Gisbert, M., & Bullen, M. (Eds.). (2015). *Teaching and Learning in Digital World: Strategies and Issues in Higher Education* (Vol. 70). Publicacions Universitat Rovira i Virgili.
Graham, C. R., Borup, J., and Smith, N. B. (2012). Using TPACK as a framework to understand teacher candidates' technology integration decisions. *Journal of Computer Assisted Learning*, *28*(6), 530-546.
Gu, X., Zhu, Y., and Guo, X. (2013). Meeting the "digital natives": Understanding the acceptance of technology in classrooms. *Journal of Educational Technology and Society*, *16*(1), 392-402.
Guzey, S. S., and Roehrig, G. H. (2009). Teaching science with technology: case studies of science teachers' development of technological pedagogical content knowledge (TPCK). *Contemporary Issues in Technology and Teacher Education*, *9*(1), 25-45.
Heeks, R. (2010). Do information and communication technologies (ICTs) contribute to development? Journal of International Development, 22(5), 625–640.
Higgins, S., Xiao, Z., & Katsipataki, M. (2012).The impact of digital technology on learning: A summary for the education endowment foundation. Durham: Education Endowment Foundation.
Hofer, M., Lee, J. K., Slykhuis, D. A., & Ptaszynski, J. (2016). Opportunities and challenges of TPACK-based professional development on a global scale. In M. Herring, M. Koehler, & P. Mishra (Eds.), Handbook of technological pedagogical content knowledge (TPACK) for educators (pp. 225–234). New York, NY: Routledge
Irum, S., Munshi, P., Bhatti, T., and Awan, J. H. (2018). University Teachers knowledge about technological devices and their use: An Analytical study. *International Journal of Computer Science and Network Security*, *18*(8), 74-80.
Jang, S., & Tsai, M. (2012). Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect to use of interactive whiteboards. Computers & Education, 59(2), 327–338.
Karim, M. A. (2010). Digital Bangladesh for good governance. Bangladesh Development Forum.
Kim, C., Kim, M. K., Lee, C., Spector, J. M., and DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and teacher education*, *29*, 76-85.
Koh, J. H. L., and Chai, C. S. (2014). Teacher clusters and their perceptions of technological pedagogical content knowledge (TPACK) development through ICT lesson design. *Computers and Education*, *70*, 222-232.
Koh, J. H. L., Chai, C. S., Hong, H. Y., & Tsai, C. C. (2015). A survey to examine teachers' perceptions of design dispositions, lesson design practices, and their relationships with technological pedagogical content knowledge (TPACK). Asia-Pacific Journal of Teacher Education, 43(5), 378–391.
Kopcha, T. J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers and Education*, *59*(4), 1109-1121.
Li, L., and Walsh, S. (2011). Technology uptake in Chinese EFL classes. *Language teaching research*, *15*(1), 99-125.
Liu, Q., Zhang, S., and Wang, Q. (2015). Surveying Chinese in-service K12 teachers' technology, pedagogy, and content knowledge. *Journal of Educational Computing*

Research, 53(1), 55-74.
Matherson, L. H., Wilson, E. K., and Wright, V. H. (2014). Need TPACK? Embrace sustained professional development. *Delta Kappa Gamma Bulletin*, *81*(1), 45.
Ministry of Human Resource Development, 2010.
Mishra, P., and Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers college record*, *108*(6), 1017-1054.
Mishra, P., Koehler, M. J., and Henriksen, D. (2011). The seven trans-disciplinary habits of mind: Extending the TPACK framework towards 21st century learning. *Educational Technology*, 22-28.
Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of information technology for teacher education*, *9*(3), 319-342.
Negi, P. S., Negi, V., and Pandey, A. C. (2011). Impact of information technology on learning, teaching and human resource management in educational sector. *International Journal of Computer Science and Telecommunications*, *2*(4), 66-72.
Neuman, W.L, (2013), *Social Research Methods: Qualitative and Quantitative Approaches* (7th Edition).
Okojie, M. C., Olinzock, A. A., & Okojie-Boulder, T. C. (2006). The pedagogy of technology integration. *Journal of technology studies*, *32*(2), 66-71.
Owusu, K. A., Conner, L., and Astall, C. (2015). Assessing New Zealand high school science teachers' technological pedagogical content knowledge. *Journal of Computers in Mathematics and Science Teaching*, *34*(3), 345-373.
Pitts, Vanessa, and Mariano, G. J. (2013). Snapshots of student thinking: An exploration of video cases for extending prospective teachers' knowledge. *Action in Teacher \ Education*, *35*(5-6), 430-444.
Prensky, M. (2008). The role of technology. *Educational Technology*, *48*(6), 1-3.
Sarhandi, P. S., Khan, I. F., Buledi, M. H., and Asghar, J. (2016). Integration of technology with pedagogical perspectives: An evaluative study of in-house CALL professional development. *Arab World English Journal (AWEJ) Special Issue on CALL*, (3).
Sarhandi, P.S.A, Bajunaid, A., and Elyas, T. 2017, Impact of Smartphone Based Activities on EFL Students' Engagement. *English Language Teaching,* 10 (6).
Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., and Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of research on Technology in Education*, *42*(2), 123-149.
Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for pre-service teachers. Journal of Research on Technology in Education, 42(2), 123–149.
Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, *15*(2), 4-14.
Sparapani, E. F., Callejo Perez, D., Gould, J., Hillman, S., & Clark, L. (2014). A global curriculum? Understanding teaching and learning in the United States, Taiwan, India, and Mexico. *SAGE Open*, *4*(2), 2158244014536406.
Sulaimani, A. O., Sarhandi, P. S. A., and Buledi, M. H. (2017). Impact of CALL in-house

professional development training on teachers' pedagogy: An evaluative study. *Cogent Education*, *4*(1).

Tuttle, H. V. (2012). *The lived experiences of faculty who use instructional technology: A phenomenological study*. [Unpublished doctoral dissertation, University of Nebraska Lincoln, Lincoln, NE].

Voogt, J., and Plomp, T. (2010). Innovative ICT-supported pedagogical practices: results from the international study of information technology in education. *Journal of Computer Assisted Learning*, 26(6), 449 – 452.

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & Van Braak, J. (2013). Technological pedagogical content knowledge–A review of the literature. Journal of Computer Assisted Learning, 29(2), 109–121.

Willermark, S. (2018). Technological pedagogical and content knowledge: A review of empirical studies published from 2011 to 2016. Journal of Educational Computing Research, 56(3), 315–343. doi:10.1177/0735633117713114

Wims, P., and Lawler, M. (2007). Investing in ICTs in educational institutions in developing countries: An evaluation of their impact in Kenya. *International Journal of Education and Development using ICT*, *3*(1), 5-22

Wu, H. K., Lee, S. W. Y., Chang, H. Y., and Liang, J. C. (2013). Current status, opportunities, and challenges of augmented reality in education. *Computers and education*, *62*, 41-49.