Technological Pedagogical Content Knowledge (TPACK) and Preparedness of Tutors in Open and Distance Learning (ODL) for New Teacher Education Programs

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Abstract

This study aims at investigating preparedness of tutors to effectively use TPACK in the implementation of Associate Degree in Education (ADE) and Bachelors of Education (B.Ed., 4 years) programs in an open and distance learning organization. It used the conceptual framework of Technological Pedagogical Content Knowledge (TPACK) for collection of empirical data and its analysis. TPACK enables the researchers to conceptualize technology in its relationship with the content of school subjects and the pedagogical issues. Specifically, the study documented the characteristics of the population of tutors participating in the implementation of ADE and B.Ed. programs and assessed strength of relationship between the tutors' characteristics and their state of preparedness to use TPACK in delivering their courses. The study followed quantitative approach to address the research questions. A survey was conducted in regional centres of Allama Iqbal Open University (AIOU) Islamabad. Sample of the study was 94 tutors from 10 regional centres of AIOU. TPACK preparedness questionnaire was used as instrument to collect data from the participants. Data were analyzed using descriptive statistics. Results showed that in content knowledge, technology knowledge science tutors have sufficient knowledge and skills of use of technology integrated with content and various strategies of developing understanding of science. Although tutors' response was average on the factors of social studies, literacy and pedagogical knowledge. Mean scores of pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge and technology pedagogy content knowledge reveals that tutors have less knowledge about how to choose the technology that enhance the teaching and learning approaches for a lesson. Teacher educators are not as much prepares to select the technologies to use in their classroom that support teaching learning process.

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Keywords: Content knowledge, pedagogical knowledge, technological pedagogical content knowledge, teacher education in ODL

Introduction

According to the National Professional Standards for Teachers (2009) and National Education Policy (2009) teachers should have deep understanding of technological innovations and help prospective teachers cultivate the necessary ICT knowledge and skills. This is even more important in the context of distance education provision of the teacher education programs. Allama Iqbal Open University (AIOU) is the only university offering large scale pre-service teacher education programs in the distance education mode at the national level. AIOU is also launching the Associate Degree in Education (ADE) and Bachelors of Education (B.Ed. 4 Years) [Hereafter referred to as B.Ed]. The competencies of the regular faculty as well as the associated field based tutors and resource persons in the ICT will be of critical importance in the successful implementation of these two programs.

Therefore, it is important to get a clear and evidence-based understanding of the state of preparedness of the above-mentioned human resources. The findings of this study will directly inform the steps that must be taken by the policy makers at the AIOU to meet the preparedness needs in as much as they relate to the use of ICT in distance teacher education programs. The findings of the study will also be of help to other institutions aspiring to make use of distance education as a complement to their existing regular programs in the broader area of pre-service teacher education.

Research Questions

This study was conducted to address the following research questions:

1. What are the characteristics, including the knowledge and skills in the use of ICTs in education, of the university tutors participating in the implementation of ADE and B.Ed. programs?
2. What is the state of preparedness (operationalized in terms of TPACK explained in the next section) of the tutors/resource persons?

Literature Review

Preparedness for teaching requires both content knowledge as well as pedagogical skills. Lee Shulman (1986) introduced the concept of Pedagogical Content Knowledge (PCK), defining it as knowledge about how to teach particular content. Koehler and Mishra (2005) extended Shulman's idea of PCK to include the "relationships between content knowledge (subject matter that is to be taught), technological knowledge (computers, the Internet, digital video, etc.), and pedagogical knowledge (practices, processes, strategies, procedures, and methods of teaching and

learning)." Accordingly, they introduced the construct of TPCK (later called TPACK). As such, then, TPACK is an amalgam of Technological, Pedagogical and Content Knowledge to create Technical Pedagogical Content Knowledge (TPCK). As Matt Koehler states: "At the heart of the TPACK framework, is the complex interplay of three primary forms of knowledge: Content (CK), Pedagogy (PK), and Technology (TK)" (Schmidt, Baran, Thompson, Koehler, Shin & Mishra, 2009).

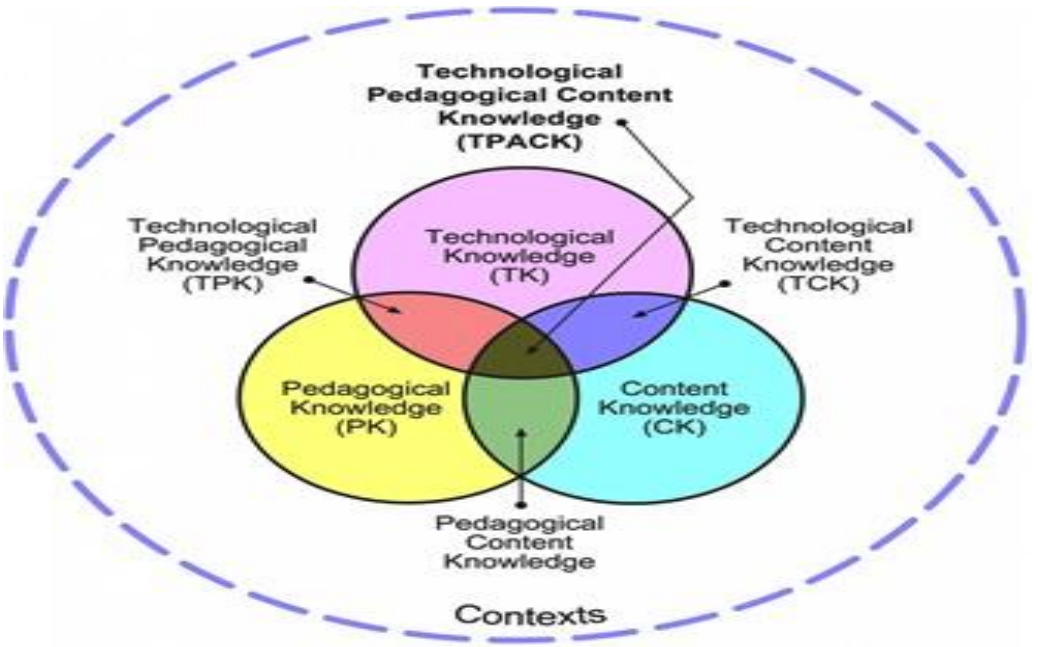

Figure 1. Schematic Diagram of TPACK

In examining how teachers should be prepared to use ICTs in teaching, TPACK addresses each of the three major components needed to ensure high quality instruction. This can be a framework for researchers to examine how these elements are currently covered and how they would need to be altered to specifically meet the ICT knowledge and skills requirement for the teachers in the A.D.E and B.Ed. programs.

After having been introduced by Mishra and Matt Koehler in 2005, the TPACK framework has been used extensively by scholars around the world to assess teacher education programs (Schmidt; et al; 2009). While numerous studies/surveys have been conducted in Pakistan to assess the ICT competencies of teachers and teacher educators, so far no study has measured ICT preparedness in terms of TPACK.

With the rise of advanced technology, innovation has turned into a vital piece of instructors' and students' lives, changing the way educators and students associate and learn in an innovative (technological) rich. Technology-based education does not just mean providing technology (both hardware and software), but the whole process, involving teaching methods and techniques that use technology in education. The International Institute for Educational Technology (ISTE) has developed and described some of the teacher's standards. All teachers should meet these criteria and performance indicators when designing, implementing and evaluating any learning experience (ISTE, 2014).

In teacher education program, need of positive associates between technology, pedagogy and content is unavoidable. Preparation of new teachers with reference to use of technology in their teaching practice is the composite of teacher education programs (Hofer & Grandgenett, 2012).

It is considered that today's teachers must be prepared not only academically but also educational control integrated with technology. They must integrate 21st century technology in their instructions (Clark, 2013). In teacher education programs, students had different backgrounds with multidimensional potentials. Therefore, take advantage of one's strengths for the best professional development. It is suggested that building of learning communities according to specific content area, collaborative work of same teaching subject teachers and discussion sessions on technology integration into teaching would improve the teachers' pedagogical knowledge and content knowledge as well as with the effective use of technology (Chang, Hsu & Ciou, 2017).

The teacher's preparation course needs to shift from a skill-focused technical course to a technology-based pedagogy course. Today's teacher education program should provide a wealth of innovative teaching techniques for pre-service teachers (Martin, 2015). When teachers adapt technology during their instruction, students become showing more interest in learning of subject. Information and communication technology helps students to learn effectively so, it is imperative, future teacher must know the use of technology with their knowledge (Chang, Hsu, Ciou, 2017). Niess (2011) cited that Angeli and Valanides (2009) come up with two vital perceptions. First important view, they argue that the use of the term "technology" is misleading and reworded it into information and communication technology. Secondly, they expressed TPACK as a tool appealed by its users, the subject from the teacher's knowledge to reconstruct the teaching content.

This depiction was not extraordinary among all teacher educators' endeavors to depict PCK as another state of mind about information development in educating. Put forward the TPACK framework to emphasize the need to put technical knowledge in content and teaching knowledge. TPACK regards teacher knowledge as a complex and

multidimensional, technology-centric approach to focus on achieving technical skills that are separated from pedagogy and content (Baran, Chuang & Thompson, 2011). TPACK includes all three forms of knowledge in the sense of interaction: technological knowledge, pedagogical knowledge and content knowledge (Dilworth et al.2012; Mishra & Koehler, 2006). TPACK framework includes seven components: technological knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge. They are explained as:

1. Technological knowledge: This knowledge includes all the teaching materials from the blackboard to the advanced technology. Knowledge of information processing, communication and problem solving techniques, focusing on the production and application of technology in daily life (Chang, Hsu & Ciou, 2017). In general, it refers to the various techniques used in the learning environment (Margerum-Leys & Marx, 2002). Technical knowledge is always in a state of flow - more than content and teaching knowledge. This makes it very difficult to define and get it. Mastering the latest trends in technology development is apt to become a ravenous teacher (Harris, Mishra & Koehler, 2009).
2. Content knowledge: Content knowledge is about learning or teaching the subject of knowledge, including, for example, secondary school science, high school history, undergraduate art history or graduate class astrophysics. The nature of knowledge and investigation is very different in the field of content, and it is important for teachers to understand the disciplines "thought habits" that are adapted to the subject they teach. This type of knowledge is about the subject area of teacher guidance. It contains terms, concepts, philosophies, theories and applications specific to the content area, such as mathematics, biology, and history. Individuals without such knowledge may have misunderstandings or misleading facts about the unit (Sahin, 2011; Koehler & Mishra, 2009).
3. Pedagogical knowledge: The pedagogical knowledge as the main area of teacher knowledge, and the PCK field explains the pedagogical knowledge that is particularly suitable for specific content areas. This knowledge includes teaching strategies for explaining individual learning needs and presenting themes (Sahin, 2011; Kanuka, 2006). Learn about teaching methods and processes such as classroom management, assessment, curriculum development and student learning (Baran, Chuang & Thompson, 2011).
4. Pedagogical content knowledge: It refers to the practitioner knowledge required to develop and provide specific instructions for effective content (Shinas et al., 2013). It is different for a variety of content areas because it integrates content and pedagogy to develop better teaching practices in the content area (Baran, Chuang & Thompson, 2011). It deals with the teaching process, and combines content and pedagogy to develop teaching practice in the field of subject content (Liu, 2013).

5. Technical Content Knowledge: Knowledge of appropriate technical content and how technology and content affect and constrain each other (Jaipal-Jamani, Figg, Gallagher, Scott & Ciampa, 2015; Koehler & Mishra, 2008). Clark (2013) argues that technical content knowledge must be flexible, inventive and adaptively so that teachers can manage, guide and apply technology in a concrete way.
6. Technological Pedagogical Knowledge : According to Apau (2017), It is about there are a number of tools for specific teaching tasks, the ability to choose teaching tools based on their applicability, the use of teaching tools, and the prerequisites for knowledge of technical teaching. For Owusu (2014), implementation of different teaching methods by using technological knowledge is refers to as TPK. With the use of technology teaching and learning, including the existence of a variety of technology knowledge, components and capabilities, in turn, learn how teaching can change with the use of specific techniques. Technological pedagogical content knowledge (TPACK): Knowledge and understanding of the interaction between CK, PK and TK when using technology for teaching and learning (Baturay, Gokcearslan & Sahin, 2017; Schmidt; et al; 2009). Combining technology with education requires a strong technical, pedagogical and content knowledge. Thus, teachers should combine technology and pedagogy with the courses they use in the learning environment . It includes understanding the complexity of the relationship between students, teachers, content, practice and technology (Archambault and Crippen, 2009). In any content area, teachers integrate technology into the knowledge needed in teaching. Teachers with TPACK make an intuitive understanding of the complex interactions between the three basic components of knowledge CK, PK and TK (Baran, Chuang & Thompson, 2011).

Contribution of this paper to the literature

- It identified teachers' assessment beliefs which need to be aligned with assessment practices through intervention in form of in-service trainings.
- It identified the weak areas of teachers in assessment practices which could be strengthen through in-service trainings
- Teachers can prepare themselves which indirectly will contribute to students' academic achievement and the planners would be in the position to plan in respect of the context.

Research Design

The research questions lend themselves to a quantitative approach consisting of the use of the structured survey instrument. This study was a primary data based study. Survey methodology is justified as it has been used extensively by other scholars to

measure the state of preparedness of teachers in terms of TPACK (Schmidt; et al; 2009).

Population

The study was conducted in AIOU's system; therefore the population of the study was the tutors associated with the implementation of ADE and B.Ed programs. The population included university based teaching faculty (N1=35) and all other registered tutors (N2=5881). The total population of the study was N= 5916. The population was scattered across the country (36 Regions) of AIOU operating in Pakistan.

Sampling

Stratified random sampling technique was used to select sample of the study. Each region was taken as stratum. Stratified sampling entails first dividing the population into non-overlapping subpopulations called strata that together comprise the entire population and then drawing an independent sample from each stratum. If the sample in each stratum is a simple random sample, the whole procedure is described as stratified random sampling. Numerous reasons may be given as justification for stratified sampling. First, stratification is used to increase the precision of population estimates. To understand the potential for gain in precision that may be achieved with stratification.

Sample Size

20% (Male and Female as per their proportion in the population n=1212) of the sample from each stratum was drawn. Sample was recruited through the data bank and regional offices of AIOU. Sample size (n=1212) shows level of confidence on results is more than 95%. All members of university based teaching faculty (N1) were included in sample. The total number of the tutors from ten (10) regions was ninety four (94).

Instrument

This was a primary data based study. An existing survey questionnaire for measurement of TPACK was used in the study (Annexed). The instrument was prepared by the TPACK pioneer team at the Michigan State University and has already been standardized and tested for its reliability and validity (Schmidt et al., 2009). Technological Pedagogical Content Knowledge attempts to identify the nature of knowledge required by teachers for technology integration in their teaching, while addressing the complex, multifaceted and situated nature of teacher knowledge.

The study was used standardized survey instrument to collect:

- Demographic data – such as age, gender, qualification, experience, as well as prior familiarity with the use of ICTs.
- TPACK data from sample of the study.

- TPACK questionnaire consisted of seven factors which were Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge and three subjects, that is, social studies, science and literacy were selected which the used to relate with TPACK. Total items in the questionnaire were forty seven and six items were related to demographics of the participants.

Results

Data collected through surveys was analyzed using SPSS for descriptive Statistics. Appropriate coefficients were computed to determine the strength of relationship between various characteristics and the levels of preparedness measured in terms of TPACK.

Table1

Demographic information of the participants

Variables	Male		Female	
	Frequency	%	Frequency	%
Age				
25-30 years	5	9.4	8	19.5
31-35 years	3	5.7	7	17.1
36-40 years	4	7.5	9	22
41-45	16	30.2	8	19.5
46 & above	25	47.2	9	22
Academic Qualification				
B.A/B.Sc	0	0	0	0
M.A/ M.Sc	44	83	38	92.7
M.Phil	7	13.2	2	4.9
Ph.D	2	3.8	1	2.4
Professional Qualification				
B.Ed	8	15.5	4	9.8
M.Ed	41	77.4	36	87.8
M.Phil	3	5.7	1	2.4
P.hD	1	1.9	0	0
Experience as AIOU Tutor				
Less than 5 years	8	15.1	15	36.6
5-10 years	16	30.2	14	34.1
11-15 years	15	28.3	8	19.5
More than 15 years	14	26.4	4	9.8

Total	53	56.4	41	43.6

There were 94 tutors from ten regions participating in this study. As indicated in the table 1, 56.4% (53) of the participants were males and 43.6% (41) were females. There were 36.3% tutors of age 46 and above. Although, 82(87.2%) participants academic qualification were M.A/M.Sc, 9.6% were M.Phil and only three participants were Ph.D. degree holders. However, 31.9% tutors have a 5-10 years' experience as AIOU tutor, 24.5% participants have less than five years' experience and only 18 tutors have experience of more than 15 years.

Table 2

Distribution of the subject on the basis of gender among districts

District	No. of selected teachers		Total
	Male	Female	
Chakwal	5	5	10
Faisalabad	6	2	8
Bahawalpur	4	6	10
Abbottabad	5	5	10
Karachi	5	5	10
Rawalpindi	5	5	10
Dera Murad Jmali	8	0	8
Swat	4	6	10
Islamabad	6	2	8
D.G Khan	5	5	10
Total	53	41	94

Table 2 present the distribution of participants based on gender among districts. There were 94 respondents, ten participants from each of the districts, Chakwal, Bahawalpur, Abbottabad, Karachi, Rawalpindi, Swat and DG Khan. However, there were eight respondents from each of these areas, Faisalabad, Dera Murad Jamali and Islamabad.

Table 3
Factors contributing towards tutors' knowledge of teaching and technology

Factors	*Mean*	*SD*
Technology Knowledge	4.08	.744
Content Knowledge	4.11	.793
Social Studies	3.87	1.24
Science	4.08	.993
Literacy	3.76	1.30
Pedagogical Knowledge	3.59	1.18
Pedagogical Content Knowledge	2.52	1.09
Technological Content Knowledge	2.20	.666
Technological Pedagogical Knowledge	2.28	1.09
Technology Pedagogy and Content Knowledge	2.29	.969

Table 3 presented the mean values of factors contributing towards tutors' knowledge of teaching and technology. High mean values of factors: content knowledge (M=4.11, SD=.793), technology knowledge (M=4.08, SD=.744) and science (M=4.08, SD=.993) shows tutors have sufficient knowledge and skills of use of technology integrated with content and various strategies of developing understanding of science. Although, tutors respond average on the factors of social studies, literacy and pedagogical knowledge. Mean scores of pedagogical content knowledge (M=2.52,SD=1.09), technological content knowledge (M=2.20,SD=.666), technological pedagogical knowledge (M=2.28, SD=1.09) and technology pedagogy content knowledge (M=2.29, SD= .969) reveals that tutors have less knowledge about how to choose the technology that enhance the teaching and learning approaches for a lesson. Teacher educators are not as much prepare to select the technologies to use in their classroom that enhance what they teach and how they teach and what their students learn.

Table 4
Comparison of Male and Female Tutors' Opinion about Factors Contributing Towards Knowledge of Teaching and Technology

Factors	Male		Female		*t*.value	Sig.
	Mean	*SD*	*Mean*	*SD*		
Technological Knowledge	4.13	.776	4.01	.705	.773	.441
Content Knowledge	4.12	.803	4.10	.790	.121	.904
Social Studies	3.93	1.16	3.78	1.34	.573	.568
Science	4.16	.741	3.99	1.25	.829	.409
Literacy	3.98	.979	3.47	1.59	1.77	.082
Pedagogical Knowledge	3.77	1.05	3.37	1.31	1.58	.117
Pedagogical Content Knowledge	2.27	.954	2.84	1.18	-2.47	.015*
Technological Content Knowledge	2.05	.572	3.84	1.18	-2.48	.015*
Technological Pedagogical Knowledge	2.04	.921	2.60	1.21	-2.46	.016*
Technology Pedagogy and Content Knowledge	2.16	.841	2.46	1.10	-1.451	.151

* $p<0.05$

Table 4 reveals that there is no significance difference in mean score of male and female tutors' responses on the factors of technological knowledge, content knowledge, social studies, science, literacy, pedagogical knowledge, pedagogical content knowledge and technological pedagogy and content knowledge. Whereas, there is significance difference in mean score of male and female respondent on the factors of pedagogical content knowledge, technological content knowledge and technological pedagogical knowledge.

Conclusion and Discussion

In today's more connected and more collaborative world the impact of new technologies on teaching and learning demands a pedagogical shift. Teacher educators are not as much prepared to select the technologies to use in their classrooms. This study was conducted to check the preparedness of tutors' to use TPACK model in their teaching. The study results revealed that in Content Knowledge, Technology Knowledge, science tutors have sufficient knowledge and skills to integrate technology with content and design different strategies to teach science subject. Tutors of science mostly integrate technology in their teaching. They create the link between content, technology and pedagogy to enhance the understanding of students.

On the other hand study found the contrary results about the preparedness of tutors' of social sciences to use TPACK model in their teaching. They display average response towards the factors of social studies and pedagogical knowledge. Results

about Pedagogical Content Knowledge , Technological Content Knowledge, technological Pedagogical Knowledge and Technological Pedagogical Content Knowledge indicate that tutors' did not had proper training and resources to use technologies in their teaching (Guzey, & Roehrig, 2009; Zhou, Zhang & Li, 2011 & Apau, 2017). Contrary results were found in the studies conducted by Owusu, 2014 and Oz's, 2015 as cited in (Apua, 2017) and concluded that pre service teachers could choose and apply different type of technologies that were helpful for different teaching activities.

The findings of the study concluded the lack of tutors' preparedness towards the use of TPACK framework in their teaching. Tutors display poor skills and techniques in integrating technology with content and pedagogy.

Recommendations

Keeping the conclusions in view, following recommendations are given to improve the situation:

- Pedagogical shift is needed to execute new teacher education programs effectively.
- Training on technological pedagogy should be given in multiple phases.
- Workshops on TPACK model may be conducted especially for teachers in social sciences subjects.
- Tutors in open and distance learning may be equipped with skills to use content with suitable technology to practice TPACK in the classroom.

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