Tracing the level of TPCK among Secondary EFL Teachers: A Study in Bangladesh Context

By

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DECLARATION

I do hereby declare that the thesis titled "Tracing the level of TPCK among Secondary EFL Teachers: A Study in Bangladesh Context" is my original research work, and contains no material which have been published by any other person. Materials are used in the study have been properly acknowledged and mentioned in the text as well as in the reference section. The content of the thesis is the result of my own research work which I have conducted during my submission of M Phil degree. To the best of my knowledge, any other higher degree has not been awarded of this particular topic in Bangladesh. The work has been done under the guidance of Dr Mahbub Ahsan Khan, Professor of Education and Dr Mohammad Ali Zinnah, Professor of Education of the Institute of Education and Research, University of Dhaka, Bangladesh.

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DEDICATION

I would like to dedicate this work to my beloved son Rafid Mahdee who is in heaven & Nafis Mahdee, for their love, patience and unconditional support.

Tracing the Level of TPCK among Secondary EFL Teachers: A Study in Bangladesh context

Abstract: Technological Pedagogical Content Knowledge (TPCK) is a young research field of education. To keep pace of the world research trend, the purpose of this study was to explore the level of TPCK among secondary EFL teachers in Bangladesh context. The study was quantitative in nature. The sample of the study comprised of 120 secondary EFL teachers in Dhaka city and outskirt of Dhaka. The instrument was a five point Likert scale questionnaire for the secondary EFL teachers. The level of Technological Pedagogical Content knowledge (TPCK) was 54.2%. Its primary sub factors' knowledge levelwas: Technological knowledge (TK) 60.8%, Pedagogical Knowledge (PK) 51.4% and Content Knowledge (CK) 73.3%. The first level transformative and mental knowledge was: Technological Pedagogical knowledge (TPK) 63.3%, Pedagogical Content Knowledge (PCK) 60.8% and Technological Content Knowledge (TCK) 58.3%. The CK was significantly decreased when correlate with other primary knowledge. There was a significant influence in terms of age, gender and experience on the teachers' respective knowledge. The knowledge was adequate, but not transformative to the students.The literature review and the findings of the study showed that the secondary EFL teachers' level of TPCK and its sub sets should be treated in an integrated manner, not as separate constructs in the secondary level EFL teacher training programme in Bangladesh.

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Chapter One: Introduction

1.0 Overview

Technological Pedagogical Content Knowledge (TPCK or TPACK) is a contemporary research field during the last decade. The concept of TPCK has received great attention from the research community and as a result, a significant number of articles have been published. Since the last two decades of previous millennium, instruction and learning have turned towards a new dimension to integrate information and communication technology (ICT) in the field of teacher education in the world. This turning is because of dissatisfaction about traditional teaching learning situation (Kilbane & Millman, 2005). The advancements in information and communication technologies, the integration of technology into education has established more attention in the research field. Teachers play a central role in the successful implementation of technology-enhanced instruction in the classroom (Wu, 2013). Consequently teachers have been increasingly expected to be capable to integrate technology into their instruction for innovative teaching learning process. Technological Pedagogical Content Knowledge (TPCK) has been recognised as the most crucial influential factor for teachers' successful integration of teaching into instruction (Koehler & Mishra, 2008).

Bangladesh is also searching alternatives to ensure quality education to keep pace to the modern world, e.g. incorporating ICT in education and ICT education as a compulsory subject in Education Policy (2010) to make the country information and knowledge based. So it is the time to search the right pathway to train teachers' for preparing the students into manpower in Bangladesh.

1.1 Background of the Study

Technological Pedagogical Content Knowledge (TPCK) is not a new idea. The framework built on Shulman's idea of Pedagogical Content Knowledge (PCK) in1986. Scholars argued that the knowledge about technology could not be treated as context-free and that quality teaching required an understanding of how technology related to the pedagogy and content (Vacirca, 2008). Conventionally, teachers had been trained separately in their content area knowledge (science, history, etc.) and in teaching strategies. According to Shulman's (1986) theory, P (Pedagogy) and C (Content) together make Pedagogical Content Knowledge (PCK), Schulman's idea of knowledge of pedagogy that is applicable to the teaching of specific content (Vacirca, 2008).

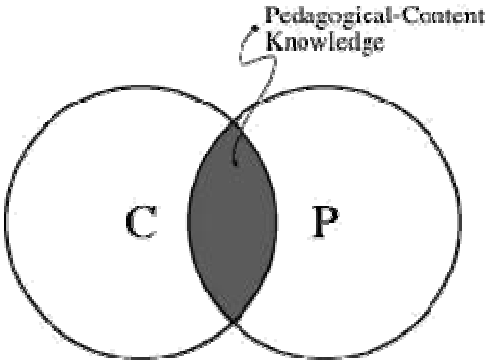


Figure 1.1The Two Circles of Pedagogical Knowledge and Content Knowledge are Joined by Pedagogical Content Knowledge

Mishra & Koehler (2006) correlate technology to PCK model to assist educators in understanding the interaction of Content, Pedagogy, and Technology. Mishra and Koehler (2006) introduced new theoretical framework that extends Shulman's notion of PCK known as Technological Pedagogical Content Knowledge (TPCK). Mishra & Koehler (2006) illustrated TPCK as a connection of these three knowledge categories.

The basic principle of TPCK is that a teacher's knowledge regarding technology is versatile and that the best possible mix for the classroom is a balanced combination of technology, pedagogy, and content. TPCK has been received with tremendous support in the instructional technology community. TPCK referred to the interrelationship of the three key components of learning: Content, Pedagogy, and Technology. More recently, scholars have begun to assert the importance of connecting Technology, Pedagogy, and Content in teacher preparation and professional development (Hofer & Swan, 2008-2009)

A teacher capable of negotiating these relationships represents a form of expertise different from and greater than, the knowledge of a disciplinary expert, a technology expert and a pedagogical expert. Effective technology integration for pedagogy around specific subject matter requires developing sensitivity to the dynamic relationship among all three components (Vacirca, 2008).

In Bangladesh, The education administrator, educators and the researcher also deeply thought about the problem of secondary level EFL teaching and searched the contemporary research field to find a better solution than the existing situation. So the researcher worked on the TPCK model which is emerging researched field in the teachers' training area.

1.2 Statement of Problem

After the liberation in 1971, different government has taken different initiatives for ensuring quality education in Bangladesh. To change the students into manpower ((National Curriculum 2012), English has been taught compulsorily as a foreign language at the secondary and higher secondary level in Bangladesh. Since 1996, communicative Language Teaching (CLT) has been introduced to replace traditional Grammar Translation Method (GTM) for preparing the students into more skilled for communication in English. But still the scenario is not satisfactory. Researchers stated that the proficiency in English was still a weak area of students in secondary level in Bangladesh. One of the reasons is that the teachers were reluctant to apply Communicative Language Teaching Method properly in English as a foreign language classes (Afroze, Kabir & Rahman, 2008, Shuchona, 2010 Parvin & Haider, 2012). The teachers did not use any teaching aids in the classroom also (Kabir and Rahman, 2008). In addition to, the teachers' content knowledge was not adequate; they use Bangla as instruction in the English language classes in secondary level in Bangladesh (Parvin & Haider, 2012).

Considering the above problems, National Education Policy (2010) aims to use Information and Communicative Technology as ICT in education to make the lesson more enjoyable and interactive. National curriculum (2012) has also retained communicative language approach as a pedagogical strategy again and English teachers have been strongly recommended to use ICT or technology in classrooms to enhance students learning to ensure quality education. So, different course/training has been offered to improve the quality of English teachers e.g. Continuous Professional Development (CPD), Digital Content Development (DCD) training etc. The CPD courses have been designed mostly focused on pedagogy and technology. The DCD training courses aim to develop teachers' skills to develop contents from internet to teach English effectively. Begum, Parvin & Khan (2015) found that the English teachers were not adequately qualified on content knowledge, pedagogy knowledge and technology knowledge.

So, the researcher felt that there should be an alternative EFL teachers' training programme where technology, pedagogy and content knowledge could be integrated and transformative to overcome the problems. In the contemporary educational research field, Koehlar and Mishra's (2006) TPCK model has drawn a great attention to meet the need of

existing teachers' problem of conducting their classes appropriately. To introduce TPCK model in secondary EFL classes, it was necessary to explore the existing TPCK level of the EFL teachers in Bangladesh, so that the training purpose would be asserted. So far it was known to the researcher, there was no prior research on tracing the level of TPCK among secondary level EFL teachers in Bangladesh context. Therefore the researcher was interested to work on this field.

The present study tried to find out the level of TPCK among the secondary English as foreign language teachers in Bangladesh context. The statement of the problem therefore, to be read as: **Tracing the level of TPCK among Secondary EFL Teachers: A Study in Bangladesh Context**

1.3 Rationale of the study

Technology is a vital part of today's children. However, it is a known fact that teachers' technology-related knowledge, skills and competencies is comparatively shorter when compared with those of their technology-native students (Belland, 2009; Yalin, Karadeniz, & Şahin, 2007; Lim & Khine, 2006). The finding means the teachers' were not enough competent to integrate technology into pedagogical applications. In Bangladesh, technological equipment was available in many secondary schools. In-service training on technology and pedagogy was adequate for the teachers. But the training did not guarantee better use of technology. The teachers were lack of technology, pedagogy and content knowledge also. This specific knowledge to optimize technology to support students' learning of the subject is termed technological pedagogical content knowledge (TPCK) (Mishra & Koehler, 2006). Technology can be used to improve students' learning, support students and parents, make the school more engaging and relevant for the learners, provide equal opportunities for the disadvantaged students, allow for and support teacher professional development (Zuker, 2008). To ensure the learners' maximum output, teachers' training programme should be integrated and designed according to the model of TPCK (Mishra & Koehler, 2006) to meet the demand of the students'. TPCK is unique in different situation. So it was essential to trace the level of TPCK and its sub sets among the secondary English as a foreign language teachers' in Bangladesh context. The findings might help to design the EFL teachers' training purpose and programme schedule in Bangladesh to achieve maximum output from the teachers as well as from the students.

1.4 Objective of the study

The overall objective of this study is to create a dynamic, collaborative, and interactive learning community using TPCK in secondary English language teaching learning situation. Therefore, the outline of the objective was:

--to measure the level of TPCK among the secondary EFL teachers in Bangladesh context.

1.5 Research questions

--what is the level of understanding of Pedagogical Content Knowledge (PCK) among - the secondary EFL teachers in Bangladesh context?

--what is the level of understanding of Technological Content Knowledge (TCK) among the secondary EFL teachers in Bangladesh context?

--what is the level of understanding of Technological Pedagogical Knowledge (TPK) among the secondary EFL teachers in Bangladesh context?

--what is the level of understanding of Technological Pedagogical Contents Knowledge (TPCK) among the secondary EFL teachers in Bangladesh context?

1.6 Significance of the study

TPACK is a new research field in Bangladesh. The scholars thought that there was a scope to introduce TPCK in the field of secondary EFL teacher training in Bangladesh. In this study, the level of the TPCK's sub sets will be traced in terms of gender, age, experience, type of institution, educational background, training etc. The study would aid in trying to improve English language teachers' training courses in the long run by providing the findings of the research. In addition to, the study hoped to open the door to the field of TPCK research in Bangladesh.

1.7 Conclusion

In recent years, researchers reported that effective ICT integration in teaching learning process, teachers had to adequate knowledge of technology, content, pedagogy and the intersection of the knowledge known of TPCK (Mishra & Koehler, 2006; Archambault, & Crippen, 2009). The study specifically sought to find out what the secondary EFL teachers' perception of TPCK mastery level was. The study continued to support for exploring the teachers' perception level of TPCK. The research was underway with a quantitative survey in M Phil programme that would well equip the EFL teachers of secondary schools in Bangladesh.

Chapter Two: Literature Review

2.0 Introduction

The purpose of the review was to provide an insight into the existing context and theoretical framework of the study. The review of literature focused on (1) theoretical framework on TPCK (2), and current studies on TPCK and English as foreign language teaching.

2.1 Theoretical Framework of TPCK

Technological Pedagogical Content Knowledge (TPCK) has been introduced to the educational research field as a theoretical framework for understanding teacher knowledge required for effective technology integration (Mishra & Koehler, 2006). The TPCK framework acronym has been renamed TPCK (Pronounced ―tee-pack) for the purpose of making it easier to remember and to form a more integrated whole for the three kinds of knowledge addressed: Technology, Pedagogy, and Content (Thompson & Mishra, 2007–2008). The TPCK framework builds on Shulman's construct of Pedagogical Content Knowledge (PCK) to include Technology Knowledge as situated within content and Pedagogical Knowledge. Although the term is new, the idea of TPCK has been around for a while. A precursor to the TPCK idea was a brief mention of the triad of content, theory (as opposed to pedagogy), and technology in Mishra (1998), though within the context of educational software design. Pierson (1999, 2001 as cited in Baran), Thompson. A, Mishra, Koehler & Shin, n. d), Keating and Evans (2001), and Zhao (2003 as cited in Koehler& Mishra, n. d.) similarly describe the relationships among Technology, Content, and Pedagogy. Other researchers have addressed similar ideas, though often under different labeling schemes, including integration literacy (Gunter & Bumbach, 2004); information and communication (ICT)-related PCK (e.g., Angeli & Valanides, 2005); Technological Content Knowledge (Slough & Connell, 2006); and electronic PCK or e-PCK (e.g., Franklin, 2004; Irving, 2006). Others who have demonstrated a sensitivity to the relationships among Content, Pedagogy, and Technology included Hughes (2004); McCrory (2004); Margerum-Leys and Marx (2002); Niess (2005); and Slough & Connell (2006). TPCK is a framework that introduces the relationships and the complexities between all three basic components of knowledge (Technology, Pedagogy, and Content).

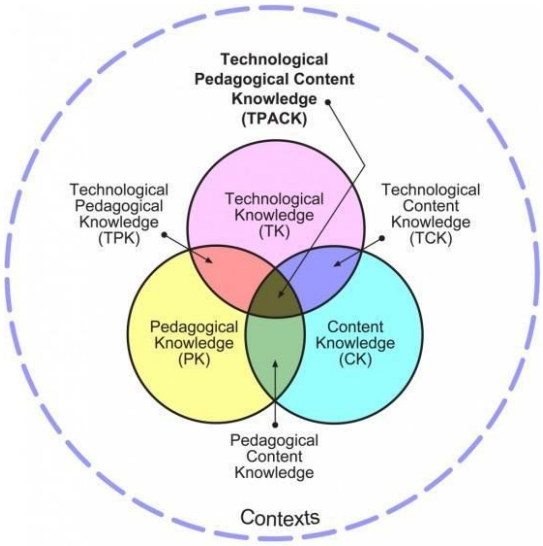


Figure 2.1: TPACK framework and its knowledge components (Mishra & Koehler, 2006a)
http//TPACK.org/

At the intersection of the three knowledge types is an intuitive understanding of teaching content with appropriate pedagogical methods and technologies. Seven components (see Figure2.1) are included in the TPCK framework.

The complex interplay of three primary forms of knowledge: Content Knowledge (CK), Pedagogy knowledge (PK), and Technology knowledge (TK) interplay a complex role is at the center of the TPCK framework. The TPCK approach goes beyond seeing these three knowledge bases in isolation. The TPCK goes further by emphasizing the new kinds of knowledge that lie at the intersections between them, representing four more knowledge bases teachers applicable to teaching with Technology: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and the intersection of all three circles, Technological Pedagogical Content Knowledge (TPCK) ((UNESCO,2013). They are defined as:

2.1.1. Technological Knowledge (TK)

Koehler & Mishra (2009) defined Technological knowledge as the knowledge of certain ways of thinking, working with technology, tools and resources such as ranging from low-tech technologies. Technological knowledge includes understanding information technology broadly enough to apply it productively at work and in everyday life, being able to recognize when information technology can assist or impede the achievement of a goal, and being able continually adapt to changes in information technology. The knowledge includes all instructional materials from pencil and paper to digital

technologies, such as the internet, digital video, interactive whiteboards, and software programs *(*Baran, Chuang, Thompson, 2011). In general, it refers to a variety of technologies used in learning environments (Margerum-Leys & Marx, 2002).

2.1.2 Content Knowledge (CK)

Content knowledge *is* about the subject area a teacher instructs (Koehler et al.2007). In other words, it answers the question of ―what will be taught? (Margerum-Leys & Marx, 2002). UNESCO (2013*)* argued that the teachers' knowledge about the subject matter to be learned or taught. It includes terms, theories, ideas, constructs, and applications specific to a content area (Shulman, 1986). Teachers must know about the content they are going to teach and how the nature of knowledge is different for various content areas**.**

2.1.3 Pedagogical Knowledge (PK)

Pedagogical knowledge refers teachers' deep knowledge about the processes and practices or methods of teaching and learning (Koehler & Mishra, 2009). It applies to understand the methods and processes of teaching and includes classroom management skills, assessment, lesson plan development, and student learning (UNESCO, 2013).

2.1.4. Pedagogical Content Knowledge (PCK)

Shulman's conceptualization of PCK is the notion of the transformation of the subject matter for teaching. According to Shulman (1986), this transformation occurs as the teacher interprets the subject matter, finds multiple ways to represent it, and adapts and tailors the instructional materials to alternative conceptions and students' prior knowledge. PCK covers the core business of (Koehler & Mishra, 2009) the content knowledge that deals with the teaching process (Shulman, 1986). Pedagogical Content Knowledge is different for various content areas such as teaching, learning, curriculum, assessment and reporting, such as the conditions that promote learning and the links among curriculum, assessment and pedagogy, as it blends both content and pedagogy with the goal being to develop better teaching practices in the content area. PCK refers to teaching knowledge applicable to a certain subject area (Harris et al., 2007). It is necessary to turn content into instruction, like presenting a subject in different ways or adapting instructional materials, based on student needs and alternative ideas. This supports the links between curriculum, assessment, and pedagogy (Shahin, 2011).

2.1.5. Technological Content Knowledge (TCK)

The Technological Content Knowledge refers how technology can create new representations for specific content (Baran, Chuang, Thompson, 2011). It suggested that teachers understand by using a specific technology, they can change the way of learners practice and understand concepts in a specific content area. Teachers need to know more than the subject matter they teach. They must also have a deep understanding of the manner in which the subject matter (or the kinds of representations that can be constructed) can be changed by the application of particular technologies. Teachers need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology—or vice versa (Koehler & Mishra, 2009).

2.1.6. Technological Pedagogical Knowledge (TPK)

The Technological Pedagogical Knowledge refers how various technologies can be used in teaching. It requires an understanding of how teaching and learning will change with use of certain technologies. It consists of the integration of technological tools and equipment with appropriate instructional designs and strategies by realizing their strengths and limitations. The majority of popular computer software is not designed for educational purposes (Koehler & Mishra, 2009). Instead, they are produced for business, entertainment, communications, and social-interaction purposes. Therefore, teachers need to go beyond the general uses of these technologies and integrate them into instruction. An understanding of how teaching and learning can change when particular technologies are used in particular ways. Technological Pedagogical Knowledge mentions to the knowledge of how various technologies can be used in teaching, and to understanding that using technology may change the way teachers teach. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies (Koehler & Mishra, 2009).

2.1.7. Technological Pedagogical Content Knowledge (TPCK)

The Technological Pedagogical Content Knowledge required integrating technology into teaching in any content area. Teachers, who have TPCK, act with a spontaneous understanding of the complex interplay between the three basic components of knowledge (CK, PK, and TK). TPCK is different from all three concepts individually rather than underlying truly meaningful and deeply skilled teaching with technology. TPCK is the

basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach Content Knowledge of what makes concepts difficult or easy to learn and how technology can help some of the problems that students face, adding knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (Koehler & Mishra, 2009). As Mishra, Koehler (2006: 1017-1057) point out, the practice of integrating ICT into curriculum should be based on the interaction between these three basic elements and the foundation of this framework is to understand that teaching is a blend of highly complex activities that are concerned about diversified knowledge and the interaction between them (Mishra, Koehler, 2006; cited in Ruan & Li, 2012). In order to apply ICT into teaching effectively, teachers should not only be clear that where, how and why they should integrate ICT into instruction, but also need to have a deep understanding of ICT, subject content and teaching methodology and mutual influences between them (Zhan, 2011).

TPCK has the following features: 1. Comprehensiveness: Although TPCK is the product of Technology Knowledge, Pedagogical Knowledge and Content Knowledge, it is a knowledge structure higher than these three items of knowledge. Therefore, it's comprehensive, complex, multi-faceted knowledge (Mishra & Koehler, 2006). 2. Dynamic: TPCK is not static knowledge; instead, it's dynamic and changing (Cox & Graham, 2009). 3. Situationally: TPCK contains the complex relationship among specific content, instructions and technology in specific teaching situation. Besides, TPCK cannot be acquired through isolated technology curriculum which is separated from a specific context (Chen, 2009). 4. Uniqueness: to have a good command of TPCK one should first understand the dynamic, transactional relationship between these three components — pedagogical knowledge, subject content (English) and ICT. As the mastery level of each English teacher towards these three items of knowledge is different, especially towards technology knowledge, hence, the TPCK knowledge of each teacher is very different. 5. Practicality: it has two main meanings, within the first one; TPCK originates from teaching practice or the reflection of others' practice. The second one is that teachers' TPCK is embodied in the process of teaching practice and plays a role in the process of practice, which has a strong influence on the teaching process. Hence, TPCK is an important part of modern teachers' knowledge since it provides a theoretical

framework for the ways of integration of ICT into teaching.

TPCK not only serves as the direction for teachers on how to apply technology into their teaching effectively, but also acts as a set of evaluation standards to measure teachers' competence of doing that **(**Xiaobin; Lijun; Huiwen; Wei, 2014).The Framework of TPCK-in-Practice shows identified practice based characteristics and actions representing TPCK-in-Practice. TPCK-in-Practice Knowledge is about how to design technology-enhanced instructional experiences for different models of teaching (e.g., Direct Instruction, Problem-based Learning, Inquiry-based Learning) to meet content learning goals. TCK-in- Practice Knowledge about content-appropriate technologies (knowledge of tools of a discipline and ability to appropriately repurpose tools across disciplines) and teachers' ability to use the tool (personal attitudes, skills, and comfort level with these technologies) TPK-in- Practice Knowledge of practical teaching competencies (use e.g., classroom management, differentiated support, and assessment) to plan and implement technology enhanced lessons.

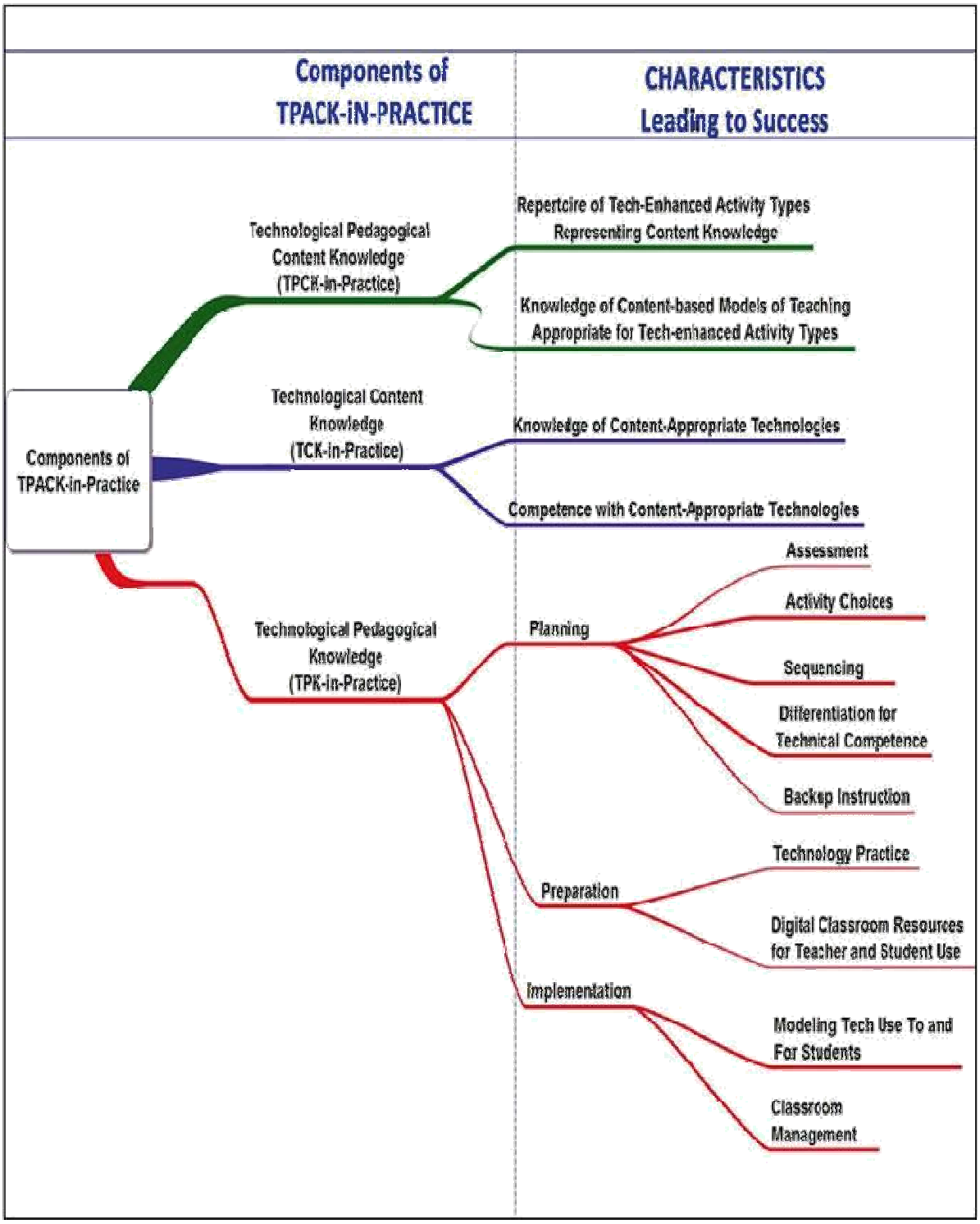


Figure 2.2 Components of TPACK-in-Practice
Source: KaminiJaipal-Jamani and Candace Figg 2015, p 142)

TPCK research has largely focused on the practice of teacher training and professional development, as well as on measures to evaluate respective training programs. Less effort has been put into developing TPCK as a theory (cf. Graham, 2011) and specifying the assumed cognitive processes underlying the development of TPCK. In the research literature, this problem has been discussed as the competing integrative view of TPCK, as spontaneously emerging knowledge when the teacher possesses knowledge in the sub-domains TK, PK, and CK versus the transformative view, defining TPCK as a unique body of knowledge that is qualitatively different from all other proposed sub-domains (Angeli & Valanides, 2009; Graham, 2011).

2.1.7.1 First Level of Transformation: Teacher Knowledge as Mental Model Representations

The cognitive transformation of knowledge in the basic sub domains (TK, PK and CK) is defined as the construction of mental models.

Table 2.1 The constructs proposed by the TPCK framework and hierarchical structure:

Hierarchical structure	TPCK constructs		
Basic sub-domains	Technological knowledge (TK)		
	Pedagogical knowledge (PK)		
	Content knowledge (CK)		
Intersecting sub-domains, *first level*	Technological pedagogical		
of transformation	knowledge (TPK)		
	Pedagogical	content	Knowledge
	(PCK)		
	Technological	content	Knowledge
	(TCK)		
Meta-conceptual awareness, second	Technological pedagogical content		
level of transformation	knowledge (TPCK or TPACK)		

Source: Angeli.C. &Valanides. N. (2015, p 43)

On the first level, the transformation of knowledge of the basic sub-domains (TK, PK, and CK) into knowledge of the intersecting sub-domains (PCK, TPK, TCK) is defined as the construction of mental models (Brewer, 1987; Johnson-Laird, 1980, 1983). On the second level, considerations from the conceptual change literature are followed (Clark, D'Angelo, & Schleigh, 2011; diSessa, Gillespie, & Esterly, 2004; Ioannides &

Vosniadou, 2002; Vosniadou, 1994), and TPCK is conceptualized as meta-conceptual awareness of the demands of the teaching task. The cognitive transformation of knowledge in the basic sub- domains (TK, PK, and CK) into knowledge in the intersecting sub-domains (PCK, TPK, TCK) was defined as the construction of mental models.

2.1.7.2 Interrelations of the TPCK Sub-domains

When mapping the described notion of mental models onto the TPCK framework, Brewer (1987) showed generic knowledge provides a frame of reference that guides the construction of mental models. Thus, when getting to know a new technology or planning a lesson to apply technology, prior knowledge in the basic sub-domains contributes to the construction of knowledge in the higher-level sub-domains. The prior knowledge integrated into knowledge in the higher-level sub-domains to transform the knowledge in the basic sub-domains needs to happen in a specific way in order for teachers to solve the complex task of teaching subject matter utilizing emerging technologies (cf. Calderhead, 1996 ; Leinhardt & Greeno,1991). Teachers need to combine rather independent basic knowledge domains into more interrelated aspects, in order to solve the overall lesson planning and implementation task, and they need to transform their combined knowledge into a mental model representation. It is not sufficient to merely combine the factual elements of prior knowledge; rather, elements need to be represented together with their interrelations in such a way that they can be mentally manipulated, so that inferences can be made. For example, on the one hand, a teacher may know to edit, annotate, and comment on YouTube videos (TK) the teacher may also know about constructivist approaches that support students in discovering their own understanding of a topic based source. (PK).

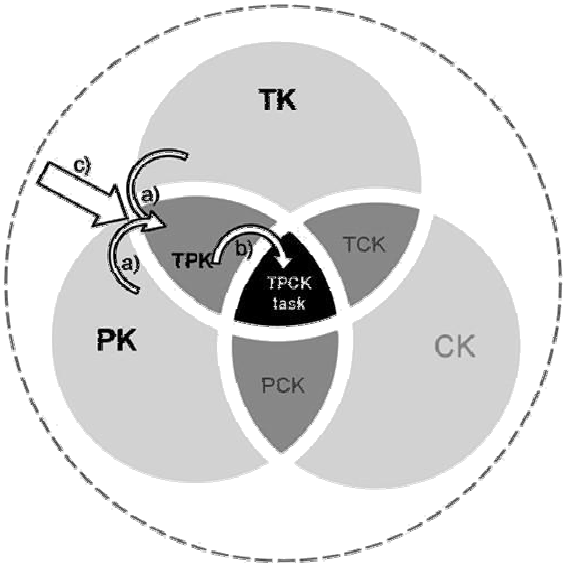


Figure 2.3: Interrelation of the TPACK Sub- domains Source:
Angeli. C. & Valanides. N. (2015, p 46)

In the above figure, the notions of independent knowledge domains (light gray), mental models (dark gray), and lesson plans (black) mapped onto the TPCK framework. Curved arrow is indicate the cognitive process for translating aspects of pedagogical and technological knowledge into mental models (a) here of TPK, as an example, and subsequently into lesson plans for concrete content and technology (b), considering that these processes might need external support(c).

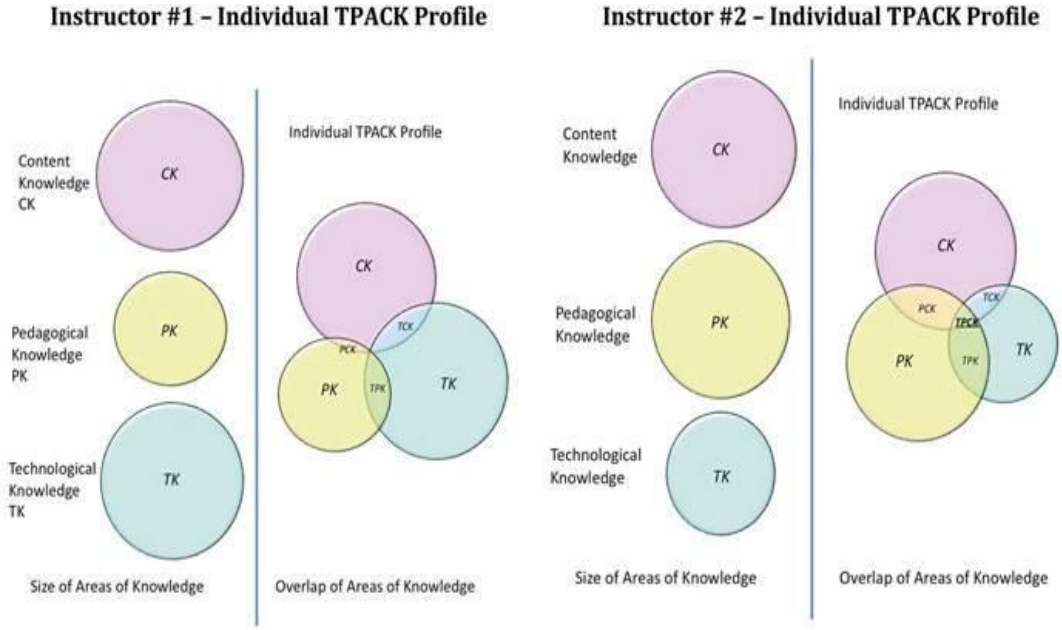
The teacher may also know about constructivist or inquiry-based approaches that supported students in discovering their own understanding of a topic based on sources (PK). In order to come up with a lesson plan that influences the potential of the YouTube functions for inquiry-based learning (arrow b in the above fig), the teacher is challenged to first construct a mental model that contains how specific technological functions open up new possibilities for students (arrow *a* in the above fig). This includes that the mental model needs to contain elements that allow inferring, whether these functions can support students‘ individual learning or whether certain potential can only be leveraged in collaborative settings, such as the collaborative annotation of a video segment influencing the discussion about the content (e.g., Zahn, Krauskopf, Hesse, & Pea 2010; Zahn, Pea et al., 2010) . However, because this mapping of technological and pedagogical information can be considered an effortful cognitive process, it is likely that this teacher requires support to be able to transform the pedagogical knowledge and technological knowledge into a mental model (arrow c above).

2.1.7.3 Second Level of Transformation: TPCK as Meta-Conceptual Awareness:

A first level of cognitive transformation of teachers' knowledge for teaching with technology from separate basic sub-domains of Technological, Pedagogical, and Content Knowledge to mental models in the overlapping sub-domains of Technological Pedagogical Knowledge, Pedagogical Content Knowledge, and Technological Content Knowledge (Krauskopf, Zahn & Hesse, 2015). The issue remains how to conceptualize the construct by integrating all these aspects of TPCK. The second theoretical claim is that TPCK can be conceptualized as meta-conceptual awareness of the demands of the teaching task, the teachers' knowledge in the sub-domains, and the context. This claim took into consideration Cox and Graham (2009), for example, who defined TPCK as knowledge of how to coordinate the use of subject-specific activities or topic-specific activities with topic-specific representations using emerging technologies, when understanding emerging technologies as not yet a transparent, ubiquitous part of the teaching profession's repertoire of tools. The definition of TPCK as knowledge of how to coordinate different knowledge domains clearly refers to the notion of a meta-conceptual construct. Harris et al. (2009) defined TPCK as concerned with the multiple interactions of the sub-domains, Koehler, Mishra, Kereluik, Shin, and Graham (2014) as the knowledge to orchestrate and coordinate the different sub-domains, and Abbitt (2011) as the knowledge of the complex interaction among the principle knowledge domains. In conclusion, all these definitions and descriptions alluded to the specific theoretical and practical value of the TPCK construct itself, as knowledge about the knowledge being at the teacher's disposal in relation to the context and the instructional task.

From the above discussion, it has been concluded that the second level of transformation was characterized by meta-knowledge of what according to the TPCK approach was necessary for mastering the domain of teaching with emerging technology. Vosniadou and others (diSessa et al., 2004; Ioannides & Vosniadou, 2002) specified that such an elaborate that scientific understanding was characterized by a meta-conceptual awareness of what a theory was about and what it was for. Therefore, we will hence refer to the knowledge representation of TPCK as a construct, as meta-conceptual awareness. The use of this term is in line with Shulman's work, who defined a teacher's knowledge about his or her knowledge and the capability of explaining their decisions, as being a central point for defining themselves as professionals.

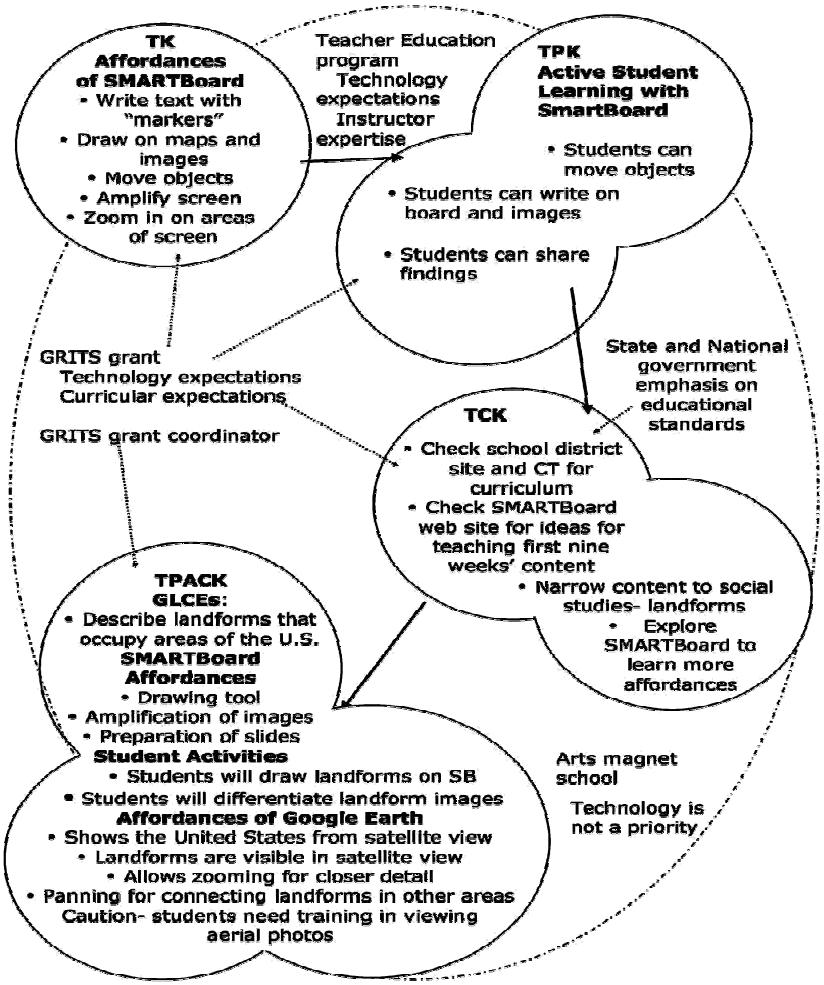
Benson, Ward, and Liang (2015) showed that if there is CK and TK is the largest input followed by smaller PK, there is no significant overlap between the three knowledge domains and the middle of TPCK. By contrast, smaller tk showed a significant overlap in the desired TPCK sweet spot area where ck and pk is larger than tk.



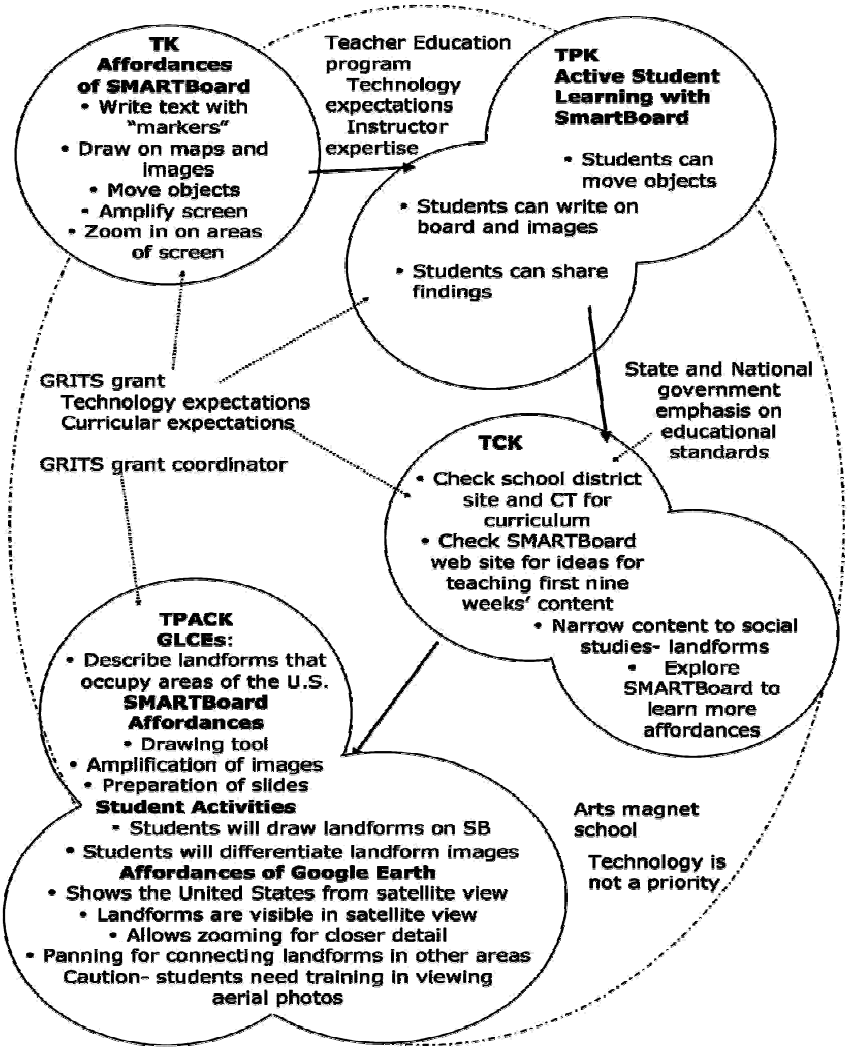
Figue 2.4:Individual instructor TPACK profiles
Source: Angeli.C. andValanides. N. (2015, p 8)

Mishra and Koehler (2010) concluded that teachers, who could negotiate the relationship between technology, pedagogy, and content, develop a form of expertise greater than the knowledge of any individual area. This integrated knowledge supported a process of understanding technology within the context of pedagogy and content rather than an isolated set of skills or knowledge. Mishra and Koehler (2010) also concluded that scholars have recognized and validated that the application of technology in teaching and learning was not context free; yet professional development centered on isolated technology skills had been prevalent. Technology skills learn in isolation might even have a negative impact on an instructor's ability to see the complex application of that technology in a pedagogical and contextual nature.

The lesson plan including TPCK, some began with technology knowledge; some began with content knowledge; and others with pedagogical considerations. As examples, trace Ambrosia's, Brian's, and Terese's processes of lesson design, each with a different knowledge component starting point. While other knowledge components evidenced, clearly by the end of the planning process, the unique blend TPCK, became the new knowledge operating.



Source: Angeli.C. & Valanides.N.s, 2015,p 79).
Figure 2.5:Ambrosia's map of TPACK processing



Source: Angeli.C. & Valanides.N.(Eds, 2015, pp: 80)
Figure 2.6: Terese's map of TPCK processing

2.2 Current Studies

A number of studies (Koehler, et al., 2004; Koehler, Mishra & Yahya, 2007; Cavin, 2008; Harrington, 2008; Suharwoto, 2006) showed the potential of constructivist environments to develop TPCK. Papert developed the constructionism framework, based on Piaget's constructivism, with more emphasis on learning and educational view than overall cognitive potentials (Ackermann, 2001). Papert's constructionism focused more on the art of learning and learning-through-making. According to Papert, learners engaged in social interaction with artifacts. They produced their artifact and shared their understanding through collaboration. Students developed their self-directed learning, and construct their new knowledge through these activities (Liu1, Liu2, Yu2, Li2 and Wen2, 2014). Papert's constructionism emphasized the role of tools, media, and context on development of human knowledge. In Bangladesh, Communicative Language Teaching method has been based on constructivist theory. Effective teaching builds on teachers' understanding of subject matter, teaching learning process and students. Experienced teachers can blend all forms of knowledge together to make her or his teaching comprehensible and knowledge learnable to students (Shulman, 1986). According to Dewey (1992), being capable of blending different types of knowledge is to psychologize teachers' professional knowledge. Technology application in EFL classroom is essential, EFL teachers need to technologize their professional knowledge, and in another word, to integrate technology into their PCK. Koehler and Mishra (2008) explained that the three major types of knowledge (content, pedagogy and technology) should be interacted into the teacher's professional knowledge to develop TPCK that needs for successful teaching to digitally practical students. Koehler and Mishra (2008) explained that TPCK was composed of different types of knowledge. The first component of TPCK was Technological Knowledge (TK), which played a central part in teachers' professional knowledge system. Because of the availability of boundless resources for online English learning, TK played a more significant part for EFL teaching. English as a foreign language is different from other subjects in that it is learned as a tool to facilitate study or work. So, speaking and listening abilities is the essential parts of English competence. To help students develop these abilities, the mere English linguistic and lexical knowledge is far from enough. Teachers need to create a classroom like a natural English environment where authentic English can be

experienced and practiced. Such a simulated environment can only be created if teachers are technologically competent by using audio and visual resources. The second component is Technological Content Knowledge (TCK). Content knowledge is the formal knowledge, widely referred to by educators as the knowledge base (Cochran-Smith & Lytle, 1999, p. 254). For EFL teaching, English language itself is the content knowledge. When teachers integrate technology into such knowledge as Technological Content Knowledge (TCK), they have to deep understanding of the manner in which the subject matter (or the kinds of representations that can be constructed) can be changed by the application of technology (Koehler & Mishra, 2008, p.16). This means that EFL teachers are capable of selecting, editing, applying and integrating particular technology that the best matches the content to be taught. In other words, those with strong TCK are capable of deciding what content to teach according to what technology is accessible and available. For example, with easy access to online video resources such as TED (technology, entertainment, design) video lectures, EFL teachers in China are now teaching English based on the content of TED lectures and they facilitate students discussion about the content and ideas delivered on TED lectures (Meng & Bo, 2014). The third component is Technological Pedagogical Knowledge (TPK). An experienced teacher is different from a novice one because the former knows more about how to use different teaching models and strategies and how to facilitate classroom communication (Nilsson, 2008). For EFL teaching, when Technology is integrated into teachers' Pedagogical Knowledge, the difference between a good and a bad teacher more greatly depends on teachers' good understanding of how technology can be used in teaching strategies. Mishra et al (2009) explained that TPK was a type of knowledge that was concerned with how teachers used a range of tools for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply (p. 1028). Based on PCK, TCK and TPK, teachers developed TPCK. In defining TPCK, Mishra et al (2009) explained it as follows:

> TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones (p. 1029).

The isolation of training could not make positive changes in the field of English. Recently, a number of researchers argued that keeping technology separated from content and pedagogy was a disservice to our students and propagated misuse and even disuse of educational technology (Hofer & Swan, 2008-2009). These researchers therefore proposed an expansion of Shulman's model to include the domain of technology (Hofer & Swan, 2008-2009). The overlap of these three domains content, pedagogy, and technology is a new framework known as technological pedagogical content knowledge (Cox, 2008). According to Ranasinghse and Leisher (2009), integrating technology into the classroom began when a teacher prepared lessons that used technology in meaningful and relevant ways. Technological aids should support the curriculum rather than dominate it. Ranasinghe and Leisher (2009) also said that technology should assist the teacher in creating a collaborative learning environment. An effective integration of teaching aids and methodology elevated the learning environment. Koç (2005) said that the integration of technology into curriculum means using it as a tool to teach academic subjects and to promote higher-order thinking skills. In addition to, researchers suggested that the teachers should have the competence to plan, design, analyze, assess and solve any technological problems and reshape them according to learners' needs (Mishra & Koehler, 2006; Koehler, Mishra &Yahya, 2007; Valanides & Angeli, 2008; Angeli & Valanides, 2009).

Modern technology has greatly turned to the new way of instruction. Teachers' abilities to apply the technology have become the key factor in improving the quality of education and stimulating the educational reform, though the present situation in Bangladesh is far from the desired level. In the recent years, despite the great effort that researchers and educators have made in teacher training, many instructors still lack the skills and knowledge needed to be able to teach with technology successfully (Mishra &Yahya, 2007). Therefore, based on PCK (Pedagogical Content Knowledge) raised by Shulman (1986), Mishra and Koehler (2006) came up with TPACK, which has added technical elements and emphasised the role of technology application in subject knowledge and instructional methods as well as enhanced the equality and unity of the three core elements: Technology Knowledge, Pedagogical Knowledge and Content Knowledge. This framework has overcome the limitations of technology as isolated tool. Effective teaching in TPCK means that teachers should not only know the technological operation, but also the reasons why they apply the specific technology and how they

should use it (Zhan & Ren, 2010).

The integration of ICT in education has generated enormous educational reform in recent years. Particularly the computer and internet are promoting communication, allowing unlimited to access to knowledge beyond time and locality. ICT is used to transforming traditional methods into more engaging approaches to responding to the teachers' needs. That is ICT is playing a vital role in students' educational quality which has a significant impact on a country's development. Become proficient at English (Panlian, 2006) and making the best use of ICT (Kader, 2007) is believed to be the enables to generate a work force for country's development. The TPCK-model adds this technology domain and mentions that teachers beside knowledge about pedagogy and content, also need to have knowledge about technology. In addition to, using technology can lead to changes in content or pedagogy.

Curriculum designers, teacher trainers, practicing teachers can take this model into their account to improve their education. TPCK is an important issue for language teachers, because using technology effectively and appropriately in the language classroom increases learners' performance (Donnelly, McGarr, & O'Reilly, 2011; Ertmer, 2005; Hew & Brush, 2007). Mishra and Koehler (2006) pointed out that there was no single technological solution that could be applied for every teacher, every course, or every view of teaching. Unlike conventional knowledge, a strong TPCK also requires EFL teachers to expand their professional knowledge to different stages of teaching such as curriculum planning, implementation, and evaluation processes (Coppola, 2004).

In Bangladesh, the use of technology in education is still not the most favorite part of teaching for every teacher. Sometimes teachers are forced to use technology, because the schools oblige this. Schools are in a competitive position with each other and using new technologies is a way to differentiate. Liu1, Liu2, Yu2, Li2 and Wen2 (2014) stated that the EFL teaching for communicative purpose in a nonnative speaking context was only achievable when teachers used technology to create simulated environment in the classroom for students to learn and practice authentic English. The creation of such environment required EFL teachers to be technologically competent when they decided what to teach and how to teach. The constant updating of technology in education also pushed EFL teacher educators to revise applied linguistics program so as to develop strong and practical TPCK for future EFL teachers. (Benson,Ward, and Liang, 2015). They have shown that strong Pedagogical Knowledge and growing TPK and TPCK are

the key dynamics in transformational teaching and learning experiences. With this TPACK model, it is clear that with new technologies, also attention and support must be given to teachers to help them acquired the new skills and knowledge and not only to help them how to use the technology, but also how to combine the technology within their pedagogy and content with all the changes this requires. Schools and teachers must be supported in understanding this. If teachers will be supported in using the technology in combination with their own pedagogy and own content, hopefully they will be more motivated to contribute.

Literature on TPCK studies in various areas especially like mathematics, science and social sciences have been many, but it is few in language teaching. Among the few, Archambault and Crippen (2009) revealed that the participants had high level of pedagogical content knowledge, but they have low level of confidence when technological component was added. Koçoğlu (2009) reported that Computer-assisted language learning course was confirmed as being helpful in developing pre-service teachers' TPCK and supporting them in practicing their TPCK. Lee and Tsai (2010) investigate the perceptions of pre-service teachers on TPCK while using web-based technology. The researcher found that senior teachers had less confidence towards technology. Consistent with those of Archambault and Crippen (2009), participants in New Zealand showed lower levels of TK before and after field experience than other domains of knowledge. Although the mean score for technology knowledge was the lowest mean score among the seven domains of perceptions of TPCK mastery level, results still indicated that the pre-service teachers in New Zealand perceived that they had a certain level of technology knowledge. Koh and Sing (2011) focused on the perceptions of pre-eservice teachers in accordance with age, gender and seven components of TPCK. The results of the research reported that TPACK components had significant effect on TPCK perceptions of pre-service teachers, but demographic factors like age and gender did not play a significant role in this process. In addition, among TPCK components, TPK and TCK were the determiners of TPACK. Terpstra (2009) also found that pre-service teachers' technological knowledge level was higher than technological pedagogical knowledge and technological pedagogical knowledge level was higher than technological pedagogical content knowledge. Moreover, Terpstra (2010) also emphasized that an interaction among TK, PK and CK came out after pre-service teachers have perceived the advantages of TPCK on a subject matter. On the

other hand, Ansyari (2012) developed a professional development programme for technology integration through a design-based research and 12 English Instructors participated in the study. The results suggested that all participants reported having positive experiences with the TPCK professional development programme, and weaknesses were found related to time, technology exploration, and students' engagement. Kurt et al (2013) also designed a 12-week TPACK development program for 22 Turkish pre-service English teachers in Turkey to examine their TPCK development. The pre-service teachers developed technological materials, explored various technologies collaboratively, designed technology-integrated lessons and teach in a real classroom atmosphere. Results showed that there was a statistically significant increase in TK, TCK, TPK and TPCK scores of PTs of English from the beginning to the end of the study (Solak & Ekrem, www.thejeo.com/ Archives/ Volume11Number2). According to Siping Liu1, Hong Liu2, Yong fang Yu2, Yan Li2 and Ting Wen2 (2014), the all sub factors of TPCK were quiet positive and it could be understood to the pre-service English teachers. They took into consideration the pedagogical and content characteristics while using technology. In addition to, while TPK (technological pedagogical knowledge) sub factor was at the highest level for the participants, TK (technological knowledge) sub factor was observed at the lowest level when compared with the other sub factors. This data proved that the knowledge of pre-service English teachers about the content and the technology use was at the medium level; they needed further training and assistance in terms of using more effectively. Terpstra (2009) also revealed that pre-service teachers' technological knowledge level was higher than technological pedagogical knowledge and technological pedagogical knowledge level was higher than technological pedagogical content knowledge. Terpstra (2009) also revealed that the females were better than males in Pedagogical Knowledge (PK). It can be said that females could use foreign language teaching methodology more effectively but their knowledge on technology needs improvement. It was reported that that there was a significant difference in favour of males in terms of Technological Knowledge, while there was a significant difference in favor of females in terms of Pedagogical Knowledge. Considering all TPCK factors, females could be considered better than males (Ekrem & Recep n.d). Koh, Sing and Tsai (2010) also found that males' technological and content knowledge was higher than females' on TPCK. On the other hand, in another study, Koh and Sing (2011) studied the TPCK perceptions of pre-

service teachers in terms of age, gender and the components of TPCK. No significant difference was found on TPCK perceptions in terms of gender and age. In addition, they proved that TPK and TCK were the determiners of TPCK. Xiaobin, Lijun, Huiwen, Wei (2014) stated that the teachers' incomplete knowledge structure was far from the criterion required in terms of TPCK.

In the above findings, the teachers' knowledge about technology, pedagogy and content were not found equal. In an ideal teaching learning situation, the knowledge was expected in desired level.

In the field of language learning, Krashen (1988) introduced the concepts *i*+1 in second language acquisition, where *i* is the present level and 1 is the level we can reach. We can refer the present state of English as foreign language teachers in the secondary level in Bangladesh as *i,* and 1 is where we should reach according to the goal of the National Curriculum (2012) to keep pace with the contemporary world. The National Curriculum (2012) has suggested that Communicative Language Teaching (CLT) approach as English language teaching learning methods like the earlier one where four skills would be practiced in an integrated way. In the curriculum, it has been recommended that the teachers' language skills development should be given priority over training them in teaching methodology or any such other areas (National Curriculum, 2012). According to the ongoing and prior National Curriculum, Bangladesh government has taken initiative to arrange training for the secondary EFL teachers. Different agencies have arranged teacher training programme e.g. Continuous Professional Development (CPD), Digital Content Development (DCD) programme etc. for the EFL teachers. Digital content training includes power point as a technological tool only. The DCD aims to equip the teachers with technological and pedagogical skills (Access to Information, 2010) on digital content development (DCD). The aim of the programme is to make teaching and learning more effective and enjoyable for both students and teachers using multi media. But the scenario was that the most of the EFL students were unable to use English functionally after completion of the secondary level because of poor teaching methodology and inefficient teachers. Afrose, Kabir and Rahman (2008) revealed that the conception of CLT was not clear to the English teachers in rural areas. Researchers reported that the teachers were reluctance of using English instructions and teaching aids in the classes that was the barrier of achieving EFL students' proficiency in Bangladesh (Afroze, Kabir & Rahman, 2008; Shuchona, 2010). In terms of pedagogical knowledge,

The National Curriculum (2012) reported that the teachers of Bangladesh generally did not like to adopt CLT because it demanded more hard work than GTM. The cause behind it that Bangladesh was lacking of many required training facilities for CLT teachers. The above studies showed that there was a lack of pedagogical knowledge among secondary EFL teachers in Bangladesh. Pedagogical knowledge was defined teachers' deep knowledge about the processes and practices or methods of teaching and learning (Koehler & Mishra, 2009). It also applies to understand the methods and processes of teaching and includes classroom management skills, assessment, lesson plan development, and student learning (UNESCO, 2013).

Begum, Khan, & Parvin recommended that specific training programme needed to be initiated on digital content for EFL teachers where would get pedagogical guidelines. But there is no guideline on desired level of teachers training on pedagogy. In terms of technology, Begum, Parvin & khan (2015) found that the most of the EFL teachers did not use technology in the secondary schools in Bangladesh. Khan, Hasan & Clement (2012) argued that lack of knowledge regarding the use of ICT and lack of skill on ICT tools and software have also limited the use of ICT tools in teaching learning situation in Bangladesh. The researchers in categorized the teachers need as language skill, technological skill and pedagogical skill but the teachers' skill is an observable competence to perform a learned psychomotor act whereas knowledge is a body of information applied directly to the performance of a function (http://en.m.wikipedia.org). On the other hand, it was defined that content knowledge was about the subject area a teacher instructs (Margerum-Leys & Marx, 2002), Koehler (2007). Shulman (1986) specified the area of teachers' knowledge which included the subject matter to be learned or taught, terms, theories, ideas, constructs, and applications specific to a content area. In the field of EFL teachers' training in Bangladesh,

The researchers in Bangladesh recommended in improving EFL teachers' skills to teach English language. But it was showed that the skills were not enough for the teachers, they needed knowledge for the EFL classes. In addition to, Morgan (1996) reported that integrating technology in the curriculum requires knowledge of the subject area, an understanding of how students learn and a level of technical expertise (Morgan 1996). According to Baran, Chuang & Thompson (2011), technological knowledge included all instructional materials from pencil and paper, to digital technologies, such as the Internet, digital video, interactive whiteboards, and software programs. In general, it

referred to a variety of technologies used in learning environments (Margerum-Leys & Marx, 2002).

In Bangladesh, the researcher did not find any research on TPCK. Khan, Begum & Parvin (2015) observed that 12.50% of the EFL teachers could integrate ICT with pedagogy in secondary level after getting training. The Continuous professional Development (CPD) and Digital Content Development（DCD）training programme continued for the secondary EFL teachers which were isolated from each other. CPD mainly included pedagogical knowledge and the purpose of launching DCD course was to equip the teachers with necessary technological and pedagogical skills (Access to Information, 2010). Though the Ministry of Education in Bangladesh has already taken actions to enhance continuous teacher training and provide more resources for EFL classrooms, the outcome has been not yet satisfactory. This has been reflected in the public examination results (TQI-SEP, 2006; MoE, 2010). Diana Ansary (2012) also reported that the teachers in Bangladesh found it difficult to implement CLT. The researcher continued that the context of the wider curriculum, traditional teaching methods, class size and schedules, resources and equipment, the low status of teachers and English teachers' deficiencies in oral English and sociolinguistic and strategic competence were the reason behind it. It indicated that the most of the teachers could not able to make students practice in speaking skills. Researchers also argued that the reason behind it that the secondary rural teachers and students were both school and board examination oriented (Afrose, Kabir, Rahmman, 2008). Though National curriculum emphasized on adding technology in classroom instruction but teachers did not find any reason behind it, because students got GPA 5 without using technology or pedagogical instruction instructed by curriculum (Afrose, kabir & Rahman, 2008). On the other hand, teachers specially government secondary school teachers were obligated to show some technology instructed class in dash board prepared by A2I, they had to practice on technology. Teachers' higher knowledge in education might change teachers' attitude to be up to date with the contemporary knowledge in education. Francis Bacon's quote is "Knowledge itself is power (Dziuban, Moskal, and Hartman, no date, secondary)".The power might influence the teachers' confidence to get access in technology. Ekrem & Recep (n.d.) reported the result revealed that although participants used internet very often, they had difficulty in integrating new technological developments into the previous one.

There is a positive relation in co-curricular activities and activities and leadership between students and teachers. Don & Raman (2016) said that this can be seen from the corner of the key role of leadership practice and commitment the involvement of distributive teacher students in extra-curricular activities towards developing human skills in the life of a student who will spearhead the country's leadership.

Bangladesh is a fast growing country, but change is not successfully embedded in the education system of Bangladesh, because it is stagnant in the unfreezing stage. The teachers are still seen to use GTM (Sudhir). So, change management has central importance to implementing CLT successfully at secondary level in Bangladesh.

2.3 Conclusion

The current literature showed that the TPCK training increased awareness about technology use integrated with pedagogy and content. According to Olphen (2008), effective and appropriate use of TPCK in the language classroom advanced students' second language competence. Extensive research on this type of knowledge has not been conducted yet (Strawhecker, 2005). In the present study, a survey is developed to determine in-service teachers' perceptions of TPCK as the first step of Krashen's (1988) *i* to go to1 for English as foreign language acquisition. In most of the research on measuring the level of TPCK, self-assessment survey instrument was used. To guide the research design, Schmidt, Baran, Thompson, Mishra, Koehler, and Shin (2009) & Shahin (2011) developed an instrument with the purpose of measuring pre-service teachers' self-assessment of TPCK and related knowledge domains included in the framework. In this study, Shahin's (2010) survey instrument of self-assessment on TPCK was used to determine TPCK and its subsets.

Chapter Three: Methodology

3.0 Introduction

Building on a history of using survey methods to assess teachers' levels of technology integration, researchers has created survey instruments that assess pre-service teachers' and in-service teachers' level of TPCK. Existing surveys have tended to focus on teachers' self-assessment of their levels of technology use (e.g., Keller, Bonk, & Hew, 2005; Knezek). For the development of the TPCK framework, researchers began to work on the problem of assessing in-service teachers' level of TPCK (Archambault & Crippen, 2009).

3.1 Overview

The purpose of this study was to explore the level of TPCK of secondary school EFL teachers in Bangladesh. Basing on these explorations, the researcher is to interpret, describe, and explain their level of TPCK. The nature of the research questions influenced the methodology selected for this research. The following chapter elaborated and explained the research approach, why the researcher selected a quantitative method study. The first part of this section outlined the rationale for the quantitative method research. The researcher presented details about the role as a researcher and the process of selecting and interacting with the research participants. Data collection and data analysis described accordingly.

3.2 Research Design

A quantitative survey study was conducted which based on reviewed literature. In this study, the survey was a means of collecting self-reported data at a specific point of time purposing of describing dependent variables of interest that is teachers' knowledge level and examining the relationship between the dependent variables and selected independent variables.

3.3 Population

The target population in this study was the secondary EFL teachers in Dhaka and outskirt of Dhaka during 2014-2015 school academic year. The population was selected purposefully. The secondary EFL trainee teachers from Dhaka city and outskirt of Dhaka who were in Teaching Quality Improvement Project, Ministry of Education, Bangladesh also included in the population. The main criteria were to select teachers who taught at least one EFL class in a secondary school in Dhaka city and out skirt of Dhaka. The respondents' response rate was 100% in hand.

3.4 Sample

As the researcher did not find the actual number of secondary EFL teachers in the Directorate of Secondary and Higher Education, Bangladesh, Dhaka. So it was not possible to make sample size methodically. The researcher was dependent on the other related research works for making sample size. A total of 120 respondents were participated in the study. The sample comprised with 55 females and 65 males secondary EFL teachers from Dhaka and out skirt of Dhaka.

3.5 Instrumentation

In order to survey the secondary EFL teachers' perception of their mastery level of TPCK, the survey instrument used in this study was used by (SAHIN, 2011) in a prior research project at Selcuk University in Turkey to survey Technological, Pedagogical and Content Knowledge (TPCK) of pre-service teachers studying English language education. The instruments were further reviewed by the experts for the reliability of the tools appropriate for Bangladesh context. The final version of TPCK survey questionnaire started with some demographical information. As mentioned above, the survey developed in the present study consisted of seven subscales forming the TPCK model: for 7 sub domains as: 1) TK, 2) PK, 3) CK, 4) TPK, 5) TCK, 6) PCK, and 7) TPCK consisted of 46 items to measure EFL teachers' perceptions of TPCK with five point Likert scale (1) strongly disagree; (2) disagree; (3) neither agree or disagree; (4) agree and (5) strongly agree.

3.6 Materials and Methods

The researcher obtained data for the research from secondary EFL teachers of Dhaka and out skirts of Dhaka. They were asked to fill up in a questionnaire in order to self-evaluate their knowledge of TPCK. The questionnaire was used only to measure the level of TPCK and its sub sets in terms of some demographical information as because the teachers' were not trained to use the model. The questionnaire was divided into several parts. These parts focused on the single areas of TPCK and teachers' beliefs and understanding about TPCK. The individual item was taken from other researches and possibly adjusted to suit the current situation of the teachers in the area.

3.7 Procedure for Analysis

For the analysis of quantitative data both descriptive and inferential statistics were carried out based on the research question of the study. At the descriptive level, frequency distributions and percentages were calculated. Depending on the objectives of this study, some bivariate analyses were calculated. Graphical representations were also used for understanding the specific consequences properly. At bivariate level, different cross tabulations based on essential demographical variables as well were carried out and consequently chi-square tests were used. All the tests were considered statistically significant at 5% level of significance. Various knowledge scores were also incorporated to identify the knowledge level of the respondents. In terms of calculation of knowledge level of the respondents a median score was calculated for different items of knowledge. If a respondent achieves a score which is as or more than median score then the respondent is considered as he/she has adequate knowledge regarding this issue otherwise he/she has no adequate knowledge about it. To find out the impact of different background variables on the knowledge level of the respondents in various sectors bivariate analysis was incorporated which also considered statistically significant at 5% level. All the analysis was performed using the software SPSS version 20.

3.8 Ethical Review

A formal letter seeking participation of secondary EFL teachers was given to head of the institutions. They were informed of their right to withdraw at any time without any consequence and also about their options to refuse to answer any question that they did not feel comfortable with. The work involved in this study was conducted after achieving the consent. After collecting the data, the researcher reviewed the findings with the participants to achieve better trustworthiness, and to be sure that the findings from the research did not undervalue their teaching and human experiences. The letter for the head of the institutions of is presented in Appendix B.

The researcher followed the recommendations of Shank (2002) who mentioned the following premises required for ethical contact: a) to not harm, b) to be open, c) to be honest and d) to be careful. In addition, Mills (2003) recommended the identification of broader social principles that defined the teacher as a contributing member of the school and of the community. In addition, Mills recommended accuracy as a central concern of research, discussed personal biases and leave no space for deception. The researcher tried to maintain the above ethical factors.

Chapter Four: Data Analysis and Findings

4.0 Introduction

Gathered information from secondary EFL teachers in Bangladesh context by self-report questionnaire were analysed and interpreted in this section.

4.1 Results

The data was tabled and the result was analised accordingly.

4.1.1 Respondents' Background Characteristics

Table one show the background characteristics of the respondents. The age group of the respondents range from 25 to 56 and the average age of the respondents is 38.83 years. The age group has been into four different groups such as ―Below 30, ―31-40, ―41-50 and ―Above 50. Among the total respondents 21.7% belongs to age group ―Below 30, 35.8% belongs to age group ―31-40, 35.0% belongs to age group ―41-50, and the rest 7.5% comprises age group ―Above 50. Almost 54.2% of the respondents were male and the rest 44.8% were female. In terms of place of residence 15.0% respondents were interviewed from rural areas and the remaining 85.0% were interviewed from the urban areas. Educational institutions were classified into two groups namely ―Private (47.5%), and ―Government (52.5%). Among the respondents majority (70.0%) of the respondents were working in the capital city, only 1.7% were working in divisional level, 6.7% were working in district level and the rest 21.7% were working in upazila level.

Table 4.1: demographic characteristics of the respondents		
Background Characteristics	**Number of respondents (%)**	
Age Group		
Below 30	26	(21.7)
31-40	43	(35.8)
41-50	42	(35.0)
Above 50		9(7.5)
Sex		
Male	65	(54.2)
Female	55	(44.8)
Place of residence		
Rural	18	(15.0)
Urban	102	(85.0)
Type of Institution		
Private	57	(47.5)
Government	63	(52.5)
Place of Institution		
Capital	84	(70.0)
Division		2 (1.7)
District		8 (6.7)
Upazila	26	(21.7)
Years of Experience		
Below 5	30	(25.0)
6-10	30	(25.0)
11-15	31	(25.8)
16-20		8 (6.7)
21-25	17	(14.2)
Above 25		4 (3.3)

In terms of years of experiences around 25.0% were less than 5 years of experiences, another 25.0% respondents were the experiences between 6 to 10 years, 25.8% were 11 to 15 years, 6.7% were 16-20 years, 14.2% have 21 to 25 years and the rest 3.3% were more than 25 years of experiences, respectively.

Table two showed the educational background/characteristics of the respondents. According to the findings of this study, around 68.3% of the respondents came from science background in their SSC examination, 24.2% respondents came from the arts background, 5.0% respondents came from the commerce background and the rest 2.5% came from others background in their SSC examination.

Table 4.2: Educational characteristics of the respondents

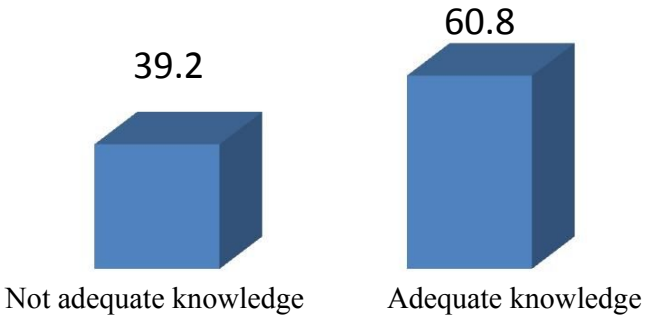
Background Characteristics	**Number of respondents (%)**
SSC Background	
Science	82 (68.3)
Arts	29 (24.2)
Commerce	6 (5.0)
Others	3(2.5)
HSC Background	
Science	51 (42.5)
Arts	52 (43.3)
Commerce	14 (11.7)
Others	3 (2.5)
Bachelor Background	
Bachelor of Science	51 (42.5)
Bachelor of Arts with English	52 (43.3)
Bachelor of Arts without English	14 (11.7)
Bachelor of Commerce	3 (2.5)
Masters Background	
Masters with English	61 (50.8)
Masters without English	38 (31.7)
No Master Degree	21 (17.5)
Type of Educational Institution at	
Tertiary Level	
Public	47 (39.2)
Private	19 (15.8)
National	54 (45.0)
Participated in Co-curricular Activities	
Yes	40 (33.3)
No	80 (66.7)

In terms of HSC examination, around 42.5% of the respondents came from science background, 43.3% respondents came from the arts background, 11.7% respondents came from the commerce background and the rest 2.5% came from others background. This study found that 42.5% respondents completed their Bachelor degree with science background, 43.3% respondents completed their Bachelor degree with arts background with English, 11.7% respondents completed their Bachelor degree with arts background without English and the rest 2.5% respondents completed their Bachelor degree with commerce background. Among the respondent around 50.8% completed their Master degree with English, 31.7% completed their Master degree without English and the remaining 17.5% respondents did not have any Master degree. In terms of educational institution at tertiary level around 39.2% respondents completed their education from public universities, 15.8% respondents completed their education from private universities and the remaining 45.0% respondents completed their education from national universities. This study also found that around 33.3% respondents participated in co-curricular activities and 66.7% respondents had not participated in co-curricular activities.

4.1.2 Respondents' Technological Knowledge (TK)

To find the knowledge level about technology, this study used 15 different questions related to technology. The response categories of this entire questionnaire strongly agree, neither agree nor disagree, disagree and strongly disagree. In terms of calculation of knowledge score, in each and every questions respondents are given 0 score if he/she disagree/strongly disagree about it, the respondents are given 1 score if he/she neither agree nor disagree about it and a score 2 is given if he/she agree/strongly agree about it. The scores of all questions regarding the technological knowledge have been sum up to find the knowledge level of the respondents. The respondents who achieved at least median score treated as he/she has adequate knowledge about technology. On the other hand the respondents who achieved lower than median score treated as he/she has not adequate knowledge about it. This study has found that around 60.8% respondents had adequate knowledge regarding technology (TK) and the rest 39.2% respondents did not have adequate knowledge about it (see Appendix C).

Figure 4.1: Technological knowledge (TK)



To find out the level of knowledge regarding technology (TK) by different background variables, bivariate analysis has been performed. To find out the significant association of different background variables with knowledge level, chi-square test has been performed which are also considered statistically significant at 5% level. This study found that, types of institution, place of institution, place of residence and types of training obtained have significant association ($p<0.05$) with the knowledge level of the respondents. According to the findings of this study, the respondents who worked in government organizations had significantly higher technological knowledge compared to the respondents who worked in private organizations. In terms of place of institution, the respondents who worked in the capital city had significantly higher knowledge regarding technology compared to their counter groups (Table: 3).

Table 4.3: Technological Knowledge (TK) by different background Characteristics

Characteristics	No Knowledge (%)	Have Some Knowledge	p-value
		%	
Age Group			
Below 30	38.5	61.5	0.518
31-40	46.5	53.5	
41-50	35.7	64.3	
Above 50	22.2	77.8	
Sex			
Male	40.0	60.0	0.839
Female	38.2	61.8	
Years of			
Experience			

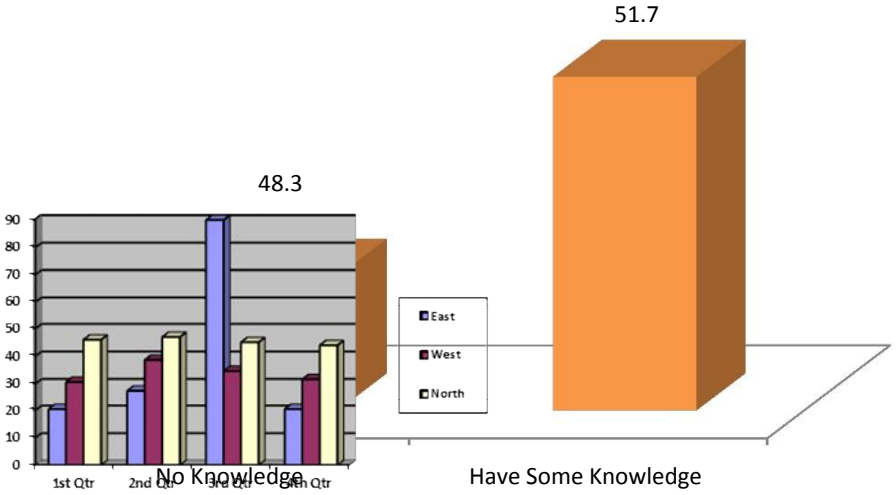
Table 4.3: Technological Knowledge (TK) by different background Characteristics			
Characteristics	No Knowledge (%)	Have Some Knowledge	p-value
Below 5	33.3	66.7	0.088
6-10	40.0	60.0	
11-15	54.8	45.2	
16-20	50.0	50.0	
21-25	11.8	88.2	
Above 25	50.0	50.0	
Type of Institution			
Private	49.1	55.9	0.034
Government	30.2	69.8	
Place of			
Institution			
Capital	32.1	67.9	0.021
Division	100.0	0.0	
District	75.0	25.0	
Upazila	46.2	53.8	
Place of Residence			
Rural	66.7	33.3	0.010
Urban	34.3	65.7	
Types of Training			
B Ed	37.7	62.3	0.009
Diploma in	100.0	0.0	
Education			
M Ed	20.8	79.2	
Others	50.0	50.0	
Type of Educational Institution at Tertiary Level			
Public	31.9	68.1	0.429
Private	47.4	52.6	
National	41.5	58.5	
Participated In co Curricular Activities			
Yes	42.5	57.5	0.597
No	37.5	62.5	

On the other hand, the respondents who lived in the urban areas had significantly higher knowledge compared to their urban counter groups. In addition to, the respondents who achieved M Ed training program have significantly higher knowledge compared to the respondents who achieved Bed or other training programs (Table: 3).

4.1.3 Respondents' Pedagogical Knowledge (PK)

To find the knowledge level about technology, this study used 5 different questions related to technology. The response category of all these questionnaire strongly agree, agree, neither agree nor disagree, disagree and strongly disagree. In terms of calculation of knowledge score, in each and every questions respondents were given 0 score if he/she disagree/strongly disagree about it, the respondents were given 1 score if he/she neither agree nor disagree about it and a score 2 was given if he/she agree/strongly agree about it. The scores of all questions regarding the pedagogy knowledge have been sum up to find the knowledge level of the respondents. The respondents who achieved at least median score treated as he/she has adequate knowledge about pedagogy. On the other hand the respondents who achieved lower than median score treated as he/she has not adequate knowledge about it. This study has found that around 51.7% respondents had adequate knowledge regarding pedagogy (PK) and the rest 48.3% respondents did not have adequate knowledge about it (see Appendix D).

Figure 4.2: Pedagogical Knowledge (PK)



To find out the level of knowledge regarding Pedagogical Knowledge (PK) by different background variables, bivariate analysis has been performed. To find out the significant association of different background variables with knowledge level, chi-square test has been performed which are also considered statistically significant at 5% level. This study found that, types of institution and place of institution obtained have significant association ($p<0.05$) with the knowledge level of the respondents. According to the findings of this study, the respondents who worked in government organizations have significantly higher pedagogical knowledge compared to the respondents who worked in private organizations. In terms of place of institution, the respondents who worked in the capital city had significantly higher knowledge regarding pedagogy compared to their counter groups (Table: 3).

Table 4.4: Pedagogical Knowledge (PK) by different background characteristics

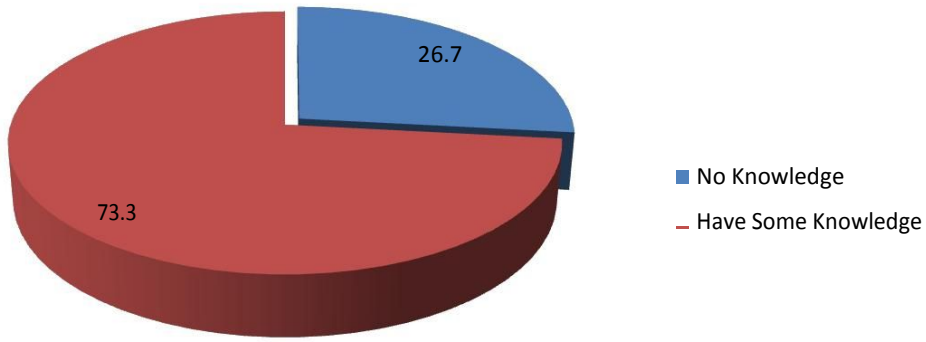
Characteristics	No Knowledge (%)	Have Some Knowledge (%)	p-value
Age Group			
Below 30	53.8	46.2	0.335
31-40	53.5	46.5	
41-50	45.2	54.8	
Above 50	22.2	77.8	
Sex			
Male	50.8	49.2	0.562
Female	45.5	54.5	
Years of Experience			
Below 5	53.3	46.7	0.626
6-10	40.0	60.0	
11-15	58.1	41.9	
16-20	50.0	50.0	
21-25	35.3	64.7	
Above 25	50.0	50.0	
Type of Institution			
Private	64.9	35.1	0.001
Government	33.3	66.7	
Place Institution			
Capital	35.7	64.3	0.000
Division	100.0	0.0	
District	100.0	0.0	
Upazila	69.2	30.8	
Place Of Residence			
Rural	45.1	54.9	0.091
Urban	66.7	33.3	
Types of Training			

B Ed	47.5	52.5	0.164
Diploma in	80.0	20.0	
Education			
M Ed	29.2	70.8	
Others	50.0	50.0	
Type of Educational Institution at Tertiary Level			
Public	38.3	61.7	0.235
Private	52.6	47.4	
National	54.7	45.3	
Participated In Co-Curricular Activities			
Yes	37.5	62.5	0.093
No	53.8	46.3	

4.1.4 Respondents' Content Knowledge (CK)

To find the knowledge level about content, this study used 6 different questions related to content. The response category of all these questionnaires strongly agree, agree, neither agree nor disagree, disagree and strongly disagree. In terms of calculation of knowledge score, in each and every questions respondents are given 0 score if he/she disagree/strongly disagree about it, the respondents are given 1 score if he/she neither agree nor disagree about it and a score 2 is given if he/she agree/strongly agree about it. The scores of all questions regarding the content knowledge have been sum up to find the knowledge level of the respondents. The respondents who achieved at least median score treated as he/she has adequate knowledge about content. On the other hand the respondents who achieved lower than median score treated as he/she has not adequate knowledge about it. This study found that around 73.3% respondents had adequate knowledge regarding Content (CK) and the rest 26.7% respondents did not have adequate knowledge about it (see Appendix E).

Figure 4.3: Content Knowledge



To find out the level of Content Knowledge (CK) by different background variables, bivariate analysis has been performed. To find out the significant association of different background variables with knowledge level, chi-square test has been performed which are also considered statistically significant at 5% level. This study found that, types of institution and place of residence obtained have significant association ($p<0.05$) with the knowledge level of the respondents. According to the findings of this study, the respondents who worked in government organizations had significantly higher content knowledge compared to the respondents who worked in private organizations. In terms of place of residence, the respondents who lived in the urban area have significantly .higher knowledge compared to their rural counter groups (Table: 4).

Table 4.5: Content Knowledge (CK) by different background characteristics

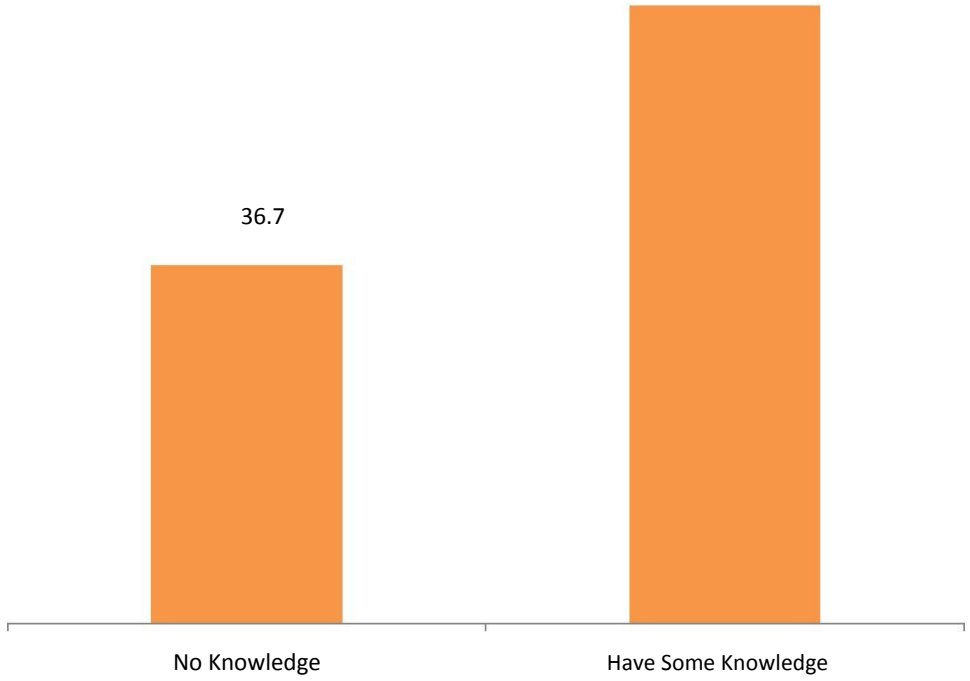
Characteristics	No Knowledge (%)	Have Some Knowledge (%)	p-value
Age Group			
Below 30	38.5	61.5	1.00
31-40	20.9	79.1	
41-50	31.0	69.0	
Above 50	0.0	100.0	
Sex			
Male	32.3	67.7	0.129
Female	20.0	80.0	
Years Of Experience			
Below 5	33.3	66.7	0.480
6-10	20.0	80.0	
11-15	32.3	67.7	
16-20	37.5	62.5	
21-25	17.6	82.4	
Above 25	0.0	100.0	
Type of Institution			
Private	36.8	63.2	0.017
Government	17.5	82.5	
Place Of Institution			
Capital	21.4	78.6	0.073
Division	0.0	100.0	
District	25.0	75.0	
Upazila	46.2	53.8	
Place Residence			
Rural	21.6	78.4	0.003
Urban	55.6	44.4	
Types of Training			
B Ed	24.6	75.4	0.132

Diploma in	60.0	40.0	
Education			
M Ed	16.7	83.3	
Others	0.0	100.0	
Type of Educational Institution at Tertiary Level			
Public	29.8	70.2	0.493
Private	31.6	68.4	
National	20.8	79.2	
Participated in Co-curricular Activities			
Yes	27.5	72.5	0.884
No	26.3	73.8	

4.1.5 Respondents' Technological Pedagogical Knowledge (TPK)

To find the knowledge level about Technological Pedagogical Knowledge (TPK), this study used 4 different questions related to technological Pedagogical Knowledge. The response category of all these questionnaires strongly agree, agree, neither agree nor disagree, disagree and strongly disagree. In terms of calculation of knowledge score, in each and every questions respondents are given 0 score if he/she disagree/strongly disagree about it, the respondents are given 1 score if he/she neither agree nor disagree about it and a score 2 is given if he/she agree/strongly agree about it. The scores of all questions regarding the technological pedagogical knowledge have been sum up to find the knowledge level of the respondents. The respondents who achieved at least median score treated as he/she has adequate knowledge about technological pedagogical. On the other hand the respondents who achieved lower than median score treated as he/she has not adequate knowledge about it. This study has found that around 63.3% respondents had adequate knowledge regarding Technological Pedagogical Knowledge (TPK) and the rest 36.7% respondents did not have adequate knowledge about it (see Appendix F).

Figure 4.4: Technological Pedagogical Knowledge (TPK) 63.3



To find out the level of knowledge regarding Technological Pedagogical Knowledge (TPK) by different background variables, bivariate analysis has been performed. To find out the significant association of different background variables with knowledge level, chi-square test has been performed which are also considered statistically significant at 5% level. This study found that, place of institution, types of training and participated in co-curricular activities obtained have significant association ($p<0.05$) with the knowledge level of the respondents. According to the findings of this study, the respondents who worked in the capital city had significantly higher knowledge regarding technological pedagogical compared to their counter groups.

The respondents who achieved M Ed degree have significantly higher knowledge compared to the respondents who achieved B Ed or other training programs. In terms of participated in co-curricular activities, the respondents who participated in co-curricular activities had significantly higher knowledge regarding technological pedagogical Knowledge compared to their counter groups (Table: 5).

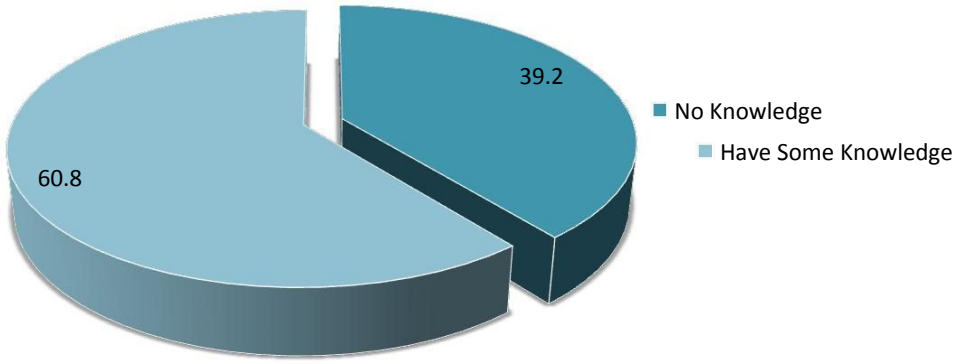
Table 4.6: Technological Pedagogical Knowledge (TPK) by different background Characteristics			
Characteristics	No Knowledge (%)	Have Some Knowledge (%)	p-value
Age Group			
Below 30	38.5	61.5	0.582
31-40	41.9	58.1	
41-50	28.6	71.4	
Above 50	44.4	55.6	
Sex			
Male	33.8	66.2	0.486
Female	40.0	60.0	
Years Of Experience			
Below 5	43.3	56.7	0.156
6-10	36.7	63.3	
11-15	48.4	51.6	
16-20	12.5	87.5	
21-25	23.5	76.5	
Above 25	0.0	100.0	
		54.4	
Type Of Institution			
Private	45.6	71.4	0.053
Government	28.6	54.4	
Place Of Institution			
Capital	28.6	71.4	0.023
Division	50.0	50.0	
District	75.0	25.0	
Upazila	50.0	50.0	
Place Of Residence			
Rural	36.3	63.7	0.832

Urban	38.9	61.1	
Types Of Training			
B Ed	44.3	55.7	0.027
Diploma In	60.0	40.0	
Education			
M Ed	16.7	83.3	
Others	0.0	100.0	
Type Of Educational Institution At Tertiary Level			
Public	31.9	68.1	0.611
Private	36.8	63.2	
National	41.5	58.5	
Participated In Co- Curricular Activities			
Yes	17.5	82.5	0.002
No	46.3	53.8	

4.1.6 Respondents' Pedagogical Content Knowledge (PCK)

To find the knowledge level about Pedagogical Content Knowledge (PCK), this study used 7 different questions related to Pedagogical Content Knowledge. The response category of all these questionnaires were strongly agree, agree, neither agree nor disagree, disagree and strongly disagree. In terms of calculation of knowledge score, in each and every questions respondents are given 0 score if he/she disagree/strongly disagree about it, the respondents are given 1 score if he/she neither agree nor disagree about it and a score 2 is given if he/she agree/strongly agree about it. The scores of all questions regarding the pedagogical content knowledge have been sum up to find the knowledge level of the respondents. The respondents who achieved at least median score treated as he/she has adequate knowledge about pedagogical content knowledge. On the other hand the respondents who achieved lower than median score treated as he/she has not adequate knowledge about it. This study has found that around 60.8% respondents had adequate knowledge regarding Pedagogical Content Knowledge (PCK) and the rest 39.2% respondents did not have adequate knowledge about it (see Appendix G).

Figure 4.5: Pedagogical Content Knowledge (PCK)



To find out the level of knowledge regarding Pedagogical Content Knowledge (PCK) by different background variables, bivariate analysis has been performed. To find out the significant association of different background variables with knowledge level, chi-square test has been performed which are also considered statistically significant at 5% level. This study found that, types of institution, place of institutions, place of residence and types of training obtained have significant association ($p<0.05$) with the knowledge level of the respondents. According to the findings of this study, the respondents who worked in government organizations had significantly higher Pedagogical Content Knowledge (PCK) knowledge compared to the respondents who worked in private organizations. In terms of place of institutions, the respondents who worked in the capital city had significantly higher knowledge regarding Pedagogical Content Knowledge (PCK) compared to their counter groups.

Table 4.7: Pedagogical Content Knowledge (PCK) by different background characteristics			
Characteristics	No Knowledge (%)	Have Some Knowledge	p-value
		(%)	
Age Group			
Below 30	38.5	61.5	0.518
31-40	46.5	53.5	
41-50	35.7	64.3	
Above 50	22.2	77.8	
Sex			
Male	40.0	60.0	0.839
Female	38.2	61.8	
Years of Experience			
Below 5	33.3	66.7	0.088
6-10	40.0	60.0	
11-15	54.8	45.2	
16-20	50.0	50.0	
21-25	11.8	88.2	
Above 25	50.0	50.0	
Type of Institution			
Private	49.1	50.9	0.034
Government	30.2	69.8	
Place of Institution			
Capital	32.1	67.9	0.021
Division	100.0	0.0	
District	75.0	25.0	
Upazila	46.2	53.8	
Place of Residence			
Rural	34.3	65.7	0.010
Urban	66.7	33.3	
Types of Training			

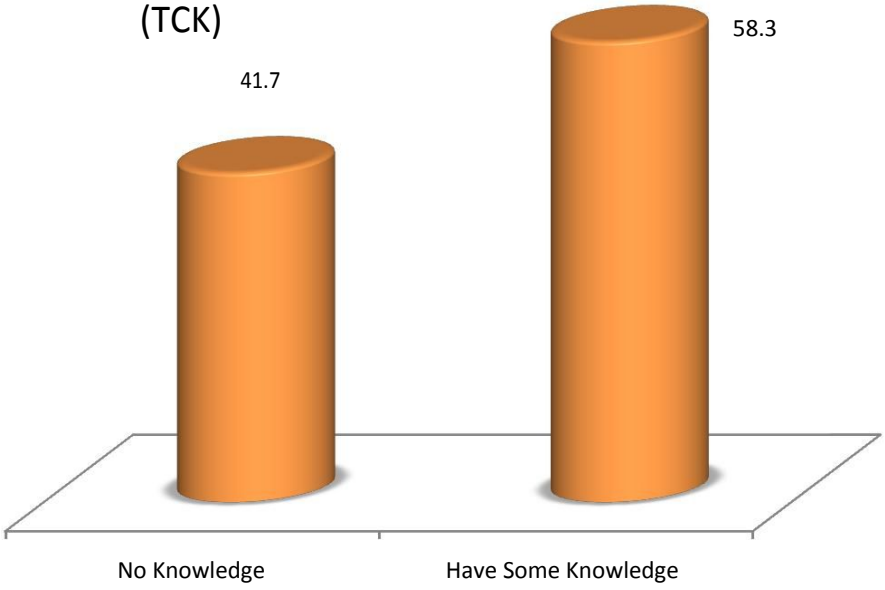
B Ed	37.7	62.3	0.009
Diploma in	100.0	0.0	
Education			
M Ed	20.8	79.2	
Others	50.0	50.0	
Type of Educational Institution at Tertiary Level			
Public	31.9	68.1	0.429
Private	47.4	52.6	
National	41.5	58.5	
Participated In Co-Curricular Activities			
Yes	42.5	57.5	0.597
No	37.5	62.5	

On the other hand, the respondents who lived in the rural areas had significantly higher knowledge compared to their rural counter groups. The respondents who achieved M Ed training program had significantly higher knowledge compared to the respondents who achieved B Ed or other training programs (Table: 6).

4.1.7 Respondents' Technological Content Knowledge (TCK)

To find the knowledge level about Technological Content Knowledge (TCK), this study used 4 different questions related to technological content. The response category of all questionnaires: strongly agree, Agree, neither agree nor disagree, disagree and strongly disagree. In terms of calculation of knowledge score, in each and every questions respondents are given 0 score if he/she disagree/strongly disagree about it, the respondents are given 1 score if he/she neither agree nor disagree about it and a score 2 is given if he/she agree/strongly agree about it. The scores of all questions regarding the technological content knowledge have been sum up to find the knowledge level of the respondents. The respondents who achieved at least median score treated as he/she has adequate knowledge about technological content. On the other hand the respondents who achieved lower than median score treated as he/she has not adequate knowledge about it. This study has found that around 58.3% respondents had adequate knowledge regarding Technological Content Knowledge (TCK) and the rest 41.7% respondents did not have adequate knowledge about it (see Appendix H).

Figure 4.6: K Tehnological Content Knowledge (TCK)



To find out the level of knowledge regarding Technological Content Knowledge (TCK) by different background variables, bivariate analysis has been performed. To find out the significant association of different background variables with knowledge level, chi-square test has been performed which are also considered statistically significant at 5% level. This study found that, only age group have significant association ($p<0.05$) with the knowledge level of the respondents. According to the findings of this study, the respondents who were at age of 50+ have significantly higher Technological Content Knowledge (TCK) knowledge compared to the rest respondents (Table-7).

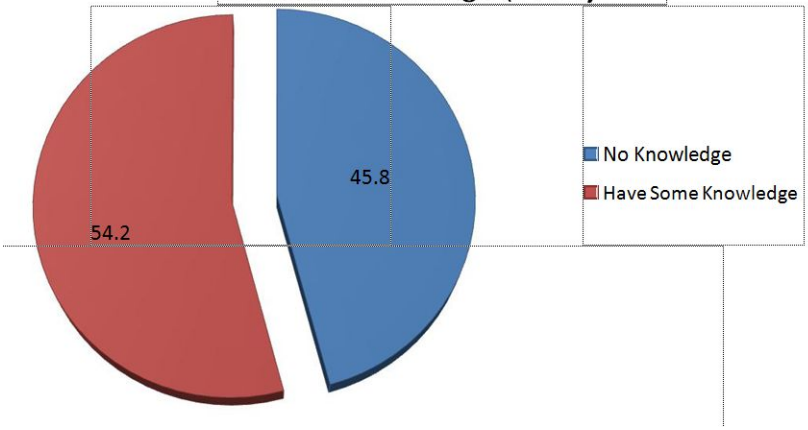
Table 4.7: Pedagogical Content Knowledge (TCK) by different background Characteristics			
Characteristics	No Knowledge (%)	Have Some Knowledge (%)	p-value
Age Group			
Below 30	38.5	61.5	0.025
31-40	30.2	69.8	
41-50	59.5	40.5	
Above 50	22.2	77.8	
Sex			
Male	40.0	60.0	0.687
Female	43.6	56.4	
Years of Experience			
Below 5	33.3	66.7	0.326
6-10	36.7	63.3	
11-15	48.4	51.6	
16-20	75.0	25.0	
21-25	35.3	64.7	
Above 25	50.0	50.0	
Type of Institution			
Private	42.1	57.9	0.926
Government	41.3	58.7	
Place of Institution			
Capital	40.5	59.5	0.051
Division	100.0	0.0	
District	75.0	25.0	

Table 4.7: Pedagogical Content Knowledge (TCK) by different background Characteristics			
Upazila	30.8	69.2	
Place of Residence			
Rural	41.2	58.8	0.795
Urban	44.4	55.6	
Types of Training			
B Ed	39.3	60.7	0.315
Diploma in	80.0	20.0	
Education			
M Ed	50.0	50.0	
Others	50.0	50.0	
Type of Educational Institution at Tertiary Level			
Public	38.3	61.7	0.871
Private	42.1	57.9	
National	43.4	56.6	
Participated in Co- curricular Activities			
Yes	45.0	55.0	0.600
No	40.0	60.0	

4.1.8 Technological Pedagogical Content Knowledge (TPCK)

To find the knowledge level about Technological pedagogical Content Knowledge (TPCK), this study used 5 different questions related to technological pedagogical content. The response category of all questionnaires: strongly agree, Agree, neither agree nor disagree, disagree and disagree. In terms of calculation of knowledge score, in each and every questions respondents are given 0 score if he/she disagree/strongly disagree about it, the respondents are given 1 score if he/she neither agree nor disagree about it and a score 2 is given if he/she agree/strongly agree about it. The scores of all questions regarding the technological pedagogical content knowledge have been sum up to find the knowledge level of the respondents. The respondents who achieved at least median score treated as he/she has adequate knowledge about technological pedagogical content. On the other hand the respondents who achieved lower than median score treated as he/she has not adequate knowledge about it. This study found that around 54.2% respondents had adequate knowledge regarding Technological Pedagogical Content Knowledge (TPCK) and the rest 45.8% respondents did not have adequate knowledge about it (see Appendix I).

Figure 4.7: Technological pedagogical Content Knowledge (TPCK)



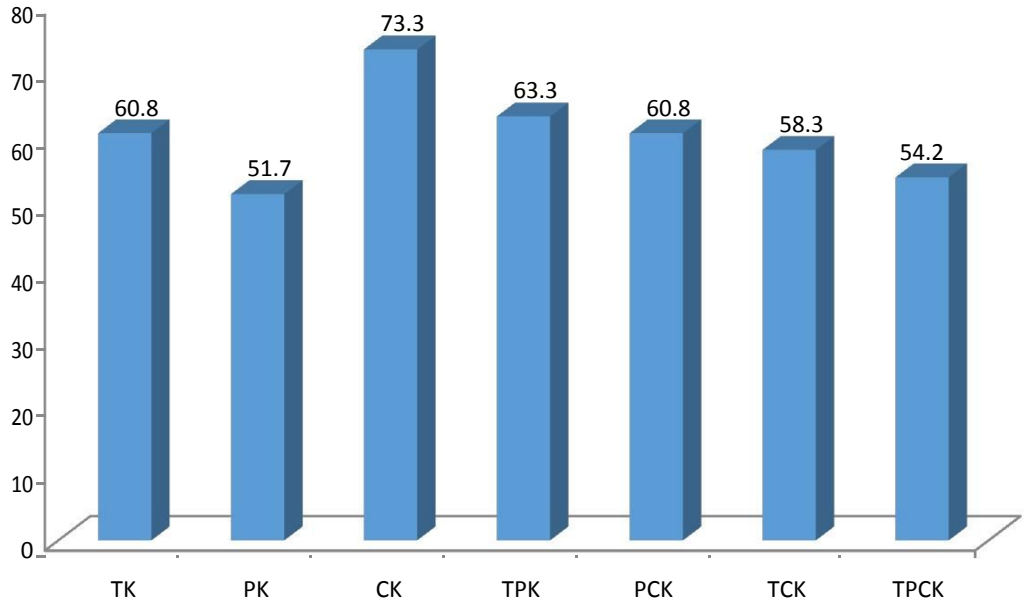
To find out the level of knowledge regarding Technological pedagogical Content Knowledge (TPCK) by different background variables, bivariate analysis has been performed. To find out the significant association of different background variables with knowledge level, chi-square test has been performed which are also considered statistically significant at 5% level. This study found that, age group, sex, years of experience, types of institution and types of training obtained have significant association ($p<0.05$) with the knowledge level of the respondents. According to the findings of this study, the respondents who were at age 41-50 years had significantly higher knowledge than other categories. Male respondents had significantly higher knowledge than female. Again years of experience had significant effect on their respective knowledge.

Table 4.7: Pedagogical Content Knowledge (PCK) by different background Characteristics			
Characteristics	No Knowledge (%)	Have Some Knowledge	p-value
		(%)	
Age Group			
Below 30	38.5	61.5	0.000
31-40	23.3	76.7	
41-50	73.8	26.2	
Above 50	44.4	55.6	
Sex			
Male	35.4	64.6	0.013
Female	58.2	41.8	
Years of Experience			
Below 5	33.3	66.7	0.003
6-10	26.7	73.3	
11-15	54.8	45.2	
16-20	100.0	0.0	
21-25	58.8	41.2	
Above 25	50.0	50.0	
Type of Institution			
Private	35.1	64.9	0.025
Government	55.6	44.4	
Place of			
Institution			
Capital	44.0	56.0	0.470
Division	100.0	0.0	
District	50.0	50.0	
Upazila	46.2	53.8	
Place of Residence			
Rural	44.1	55.9	0.369
Urban	55.6	44.4	
Types of Training			
B Ed	39.3	60.7	0.001
Diploma in	80.0	20.0	
Education			
M Ed	79.2	20.8	
Others	0.0	100.0	
Type of Educational Institution at Tertiary Level			
Public	57.4	42.6	0.106
Private	31.6	68.4	
National	41.5	58.5	
Participated in Co- Curricular Activities			
Yes	50.0	50.0	0.517
No	43.8	56.3	

The respondents who worked in government organizations had significantly higher Technological Pedagogical Content Knowledge (TPCK) knowledge compared to the respondents who worked in private organizations. The respondents who achieved M Ed training program have significantly higher knowledge compared to the respondents who achieved B Ed or other training programs (Table: 8).

4.2 Conclusion:

The overall findings of the level TPACK and its sub factors in this study are shown below in a bar chart (Figure 4.8).



Knowledge in Different Levels

The graph shows that the EFL teachers' overall level of TPCK knowledge and its sub factors were adequate but it was still in mid- level. Though primary CK was in the highest level, it was decreased when correlated with technology and pedagogy in the first level of transformation. Again TCK, TPK and PCK were decreased to form TPCK in second level of transformation.

The above findings have been placed in the next chapter for discussion in relation to other research findings on TPCK.

Chapter Five: Discussion, Recommendation and Conclusion

5.0 Introduction

The final stage of this research has been presented in this chapter. The discussion has been placed basing on analysis and interpretation of the previous chapter.

5.1 Discussion:

It was observed in the study that the in-service English teachers' level of TPCK and its sub sets were in mid-level. Among them, 51.7% respondents had adequate Pedagogical Knowledge but it was the lowest level response in the study. Afrose, Kabir & Rahman, (2008) reported that the teachers who taught English reluctant to teach the lesson following appropriate pedagogy. Similarly, Parvin & Haider (2012) revealed that the EFL teachers in secondary level in Bangladesh had a tendency of avoiding some recommended teaching practices such as preparing lesson plan, using warm ups, teaching vocabulary in contexts, using pair/group work etc. In terms of Technological Knowledge (TK), it was adequate also (60.8%) in terms of median sore. The findings was similar to Hussein (2015, p, 123). Khan, Hasan & Clement (2012) argued that lack of knowledge regarding the use of ICT and lack of skill on ICT tools and software have also limited the use of ICT tools in teaching learning situation in Bangladesh. The study also found that the respondents had adequate Content Knowledge (73.3%). It was the highest knowledge level compared to the other primary knowledge. The findings was similar to Husseini (2015, p 124) and different from Parvin & Haider (2012). Parvin & Haider showed that the teachers were not proficient in English.

In the first level of transformation within TPCK, the respondents' TK (60.8) correlated with PK (51.7%) and formed a new knowledge TPK (63.3) which was adequate also. In addition to, TPK (63.3%) was at the highest level mental knowledge compared to the others'. In TPK, PK (51.7%) increased while adding TK (60.8%). To increase TPK more, planning, preparation and implementation could be more emphasized (Fig 2, Components of TPCK- in- Practice). Accordingly, in transformed knowledge PCK (60.8%) and TCK (58.3%), primary knowledge CK (73.3%) decreased its level. So it was observed that the teachers' primary content knowledge (CK) could not keep its highest level while adding PK and TK. In PCK, it is necessary to turn content into instruction, like presenting a subject in different ways or adapting instructional materials, based on student needs and alternative ideas which support the links between curriculum,

assessment, and pedagogy (Shahin, 2011). In Bangladesh, the teachers do not know why they use pair work and group work in the classes. It was not explained in the teacher training manual. So they do not find any reason to implement it in the classes. On the other hand, in TCK, teachers' need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology or vice versa (Koehler & Mishra, 2009). In the ongoing teachers' training programme in Bangladesh, teachers should have scope to practice on the integrated and transformed knowledge adequately which the teacher can easily transfer to the students.

The present study also showed that the teachers who worked in government secondary schools had significantly higher TK, PK, CK and TPK, TCK, PCK compared to the respondents who worked in private secondary high schools. In addition to the teachers who worked in urban areas had high TK, PK, CK and TPK, TCK, PCK compared to their rural counter groups. Researchers found that the secondary teachers who worked in urban and rural area were both school examination and board examination oriented (Afrose, Kabir, Rahmman, 2008). Though National curriculum emphasized on adding technology in classroom instruction but the teachers did not find any reason behind it, because students got GPA 5 without following curriculum (Afrose, kabir & Rahman, 2008). On the other hand the teachers specially secondary school teachers in urban area were obligated to show technology instructed class in dash board prepared by A2I. So, monitoring might make them careful practiced in the area. In addition to, secondary government school teachers had adequate scope of training and they were under monitoring of Education Ministry, Bangladesh. On the other hand, in terms of place of institution, the respondents who worked in capital city had significantly higher knowledge regarding technology, pedagogy and content knowledge compared to the rural area. It was also found that the respondents who achieved M Ed degree have significantly higher technological knowledge compared to the respondents who achieved B Ed or other training programs (Table: 3). Bacon's quote is "Knowledge itself is power." The knowledge might influence the teachers' confidence to get access into technology.

The study also revealed that around 54.2% respondents had adequate knowledge about TPCK in terms of median score. It was similar to Archambault and Crippen (2009) and different from Angeli & Valanides (2015, p8). The researchers reported that TPCK

would grow when CK level would be the highest, PK level would be medium and TK would be the lowest level of primary knowledge.

The researcher revealed that the participants' first level of transformed knowledge TPK (63.3%), PCK (60.8%) and TCK (58.3%) was higher than second level transformed and complex knowledge TPCK (54.2%). It was found that the knowledge level was decreased when it was transformed into more complex knowledge which prepared for the class. The TPCK level of the teachers was also found adequate in terms of median score. On the other hand, the teachers' age range 41-50 had significantly higher knowledge than other categories. Years of experience had significant effect on their respective knowledge also. It was different from Lee and Tsai (2010). The reason of the findings might be the influence of experience, teachers' recruitment policy of that time or their educational values. The experienced teacher might be selected as key teacher to train up the other teachers in the secondary schools. In addition to, male teachers had significantly higher knowledge than females'. The result was similar to Koh, Sing & Tsai (2010) and different to Ekrem & Recep, n,d). In another study, Koh and Sing (2011) showed that there was no significant difference in terms of age, gender and the components of TPCK. ‘

The study showed that 80% secondary EFL teachers in Bangladesh had English in their bachelor degree. It was different to Parvin & Haider (2012). The researchers showed that 20% of EFL teachers had English in their bachelor degree. The scenario of the teacher's background degree was seen satisfactory. In addition to, the study also showed that the most of the teachers had masters in English. But the researchers showed that English was a week area of secondary EFL students in Bangladesh (Afroze, R., Kabir, M. M., & Rahman, A.; 2008, Parvin & Haider; 2012, Kabir, 2014). It was seen that there was a disconnection between teachers' knowledge and students' proficiency level. In addition to, the study also showed that the teachers completed master degree from National University, Bangladesh. In a report on National University, World Bank (2014) found that there was a gap between what was taught in colleges and what is required by the labor market. In the study, it was also found that the teachers who had masters from National University, they did not perform well in the classroom. Similarly, after attending training on CLT or ICT, the teachers still used GTM in the classes. Shidur (2015) found that the participation of teachers and students in the change process to CLT from GT method was not adequate; because it was stagnant in the unfreezing stage. So,

change management has a central role to implementing CLT successfully in Bangladesh. In the desired change process, there was no clear the objective or guideline about teacher training in the National Curriculum (2012). In addition to, there was no monitoring or assessment was seen after the teachers' achieved in-service training. The teachers were reluctant to use CLT (Parvin & Haider 2012) because students got GPA 5 without achieving English language proficiency. The study also showed that the most of the teachers did not participate in co-curricular activities. It was found that the teachers students involvement in extra-curricular activities developed human skills in the life of a student who will lead the country (Don & Raman, 2016). School leaders' vision and understanding had an impact of pedagogical using ICT in the curriculum Allan (n.d.). The Constructivists also believe, instead of confronting student teachers with simplified (schematic) problems and basic skills drills they should rather have to deal with complex real-life situations as demonstrated in co-curricular activities leadership (Marais, 2011). There were no age and gender difference regarding TK, CK and TPK, PCK. Only 50+ teachers had more knowledge in terms of TCK. It might be the influence of training, experience and the teachers' attitude also.

The discussion showed that there was disconnection among national curriculum, teacher training, classroom practice and secondary students in Bangladesh. The situation was stagnant. Now the country need a system which will break the ice and make the system in action. In contemporary education world, the highly knowledge transformative model TPCK has drawn a great attention to the field of teacher training. So the researcher interested to find out the level of existing level of TPCK and its sub factor before thinking about its implementation. The secondary EFL teachers' level of TPCK and its sub sets were in mid -level which was adequate in terms. So it could be said that the teachers' knowledge level was adequate to involve in a new process of knowledge transformative teacher training including TPCK model for improving the students' proficiency level high.

5.2 Recommendation

In this chapter, some recommendations have been placed for the improvement of the teaching learning process in English as a foreign language teaching in secondary level in Bangladesh, these are:

1. Secondary EFL teachers' training programme should be integrated, knowledge based and transformative which would help teachers' to be more knowledgeable, and

transformative to the EFL students in Bangladesh.

2. Highly transformative and integrated knowledge based teacher training model TPCK should be introduced in the field of secondary EFL teachers' training in Bangladesh which could help to break the ice in the teaching learning situation.

3. In the teachers' training programme, teachers' content knowledge should be practised in an integrated manner.

4. The experienced teacher should be selected and trained accordingly as key teacher for monitoring the transformation process in the classroom.

5. There should be a complete guideline in the National Curriculum for secondary EFL teachers' desired knowledge level and the training should be designed accordingly.

6. The examination system should be changed which could assess the four skills of secondary EFL students, so that the students would be motivated to be proficient in English.

7. To improve the teachers' quality, the National University of Bangladesh should improve its curriculum according to the labour market's need.

8. The scope of co-curricular activities should be increased. It would create leadership quality between teachers and students which would influence their teaching and learning quality.

9. There should be an intensive teacher training programme for both secondary EFL teachers in rural area, and in private schools to make them equal to the government and urban teachers.

10. The EFL teachers should have higher degree in Education which help them to be more knowledgeable and confident in the class.

5.3 Limitation

A few studies on TPCK were found in English as foreign language teaching area. So far it was known, the study was the first research about TPCK in Bangladesh. So the research her did not find any prior reference on TPCK in Bangladesh context. In addition to, there is no accurate information about the total number of EFL teachers in Dhaka and outskirt of Dhaka city according to the Directorate of Secondary and Higher Education in Bangladesh. So the researcher could not apply any method for sample size in the study. The researcher collected data from the EFL teachers of outskirt Dhaka city when they were in CPD training in Dhaka city.

5.4 Conclusion

Professional development solely focused on the development of technology knowledge will not lead to effective technology integration; technology will not work in a vacuum. Misconceptions can form that lead instructors to believe that narrow technology training can equip them to successfully integrate technology in complex and transformative ways. When these initiatives fail, most look to the technology as the point of breakdown, when in fact it is usually the absence of focus on pedagogical, content, or implementation strategies which lead to the lack of perceived success. TPACK is critical to the process of integrating technology for transformative teaching and learning in the twenty-first century. Universities, schools, and agencies are looking to technology to make strides toward transforming teaching and learning need to ensure that the implementations include discussions and professional development focused on increasing the technological, pedagogical content knowledge of the instructors in integrated, authentic real-world ways, to ensure TPCK growth for all.

5.5 Further Research

Future studies can build on the result of this study to enrich the existing knowledge in the area being investigated. Based on the literature review and findings of the study, the following recommendation is presented for further research:

-Why experienced secondary EFL teachers are more competent in
Technology than other teachers: A study in Bangladesh context.

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Appendices

Appendix A: Request Letter

Date:

To

……..
…….
…….

Subject: Request for providing support to M Phil

researcher Dear Sir

It is my pleasure to introduce one of my M Phil researcher Mst. RozinaParvin, Roll: 181 of session 2011-2012 to you. She has undertaken a research entitled ―Tracing the level of TPACK among the secondary EFL teachers: A study in Bangladesh context‖ for fulfillment of the requiredof the M Phil programme. She needs cooperation, guidance and assistance from you in collecting data and information for her study. Collected data will be used only for the researchand all information related to respondents will not be disclosed anywhere.Moreover, researcher will maintain standard research ethics.

I am requesting you to help her in this regard.

Sincerely yours

Signature
Dr Mahbub Ahsan
Khan Professor
Department of Language Education
Institute of Education and research
University of Dhaka

Appendix B: Questionnaire

	I have knowledge in …	Strongly disagree	Disagree	Neither Agree or disagree	Agree	Agree Strongly agree
	solving a technical problem with the computer					
	basic computer hardware (eg., CD-Rom, mother-board, RAM) and their functions					
	basic computer software (eg., Windows, Media Player) and their functions					
	recent computer technologies					
Technology	using a word-processor program (eg., MS Word)					
Knowledge	using an electronic spreadsheet program (eg., MS Excel)					
(TK)	communicating through Internet tools (eg. e-mail, MSN Messenger)					
	usinga picture editing program (eg.Paint)					
	using a presentation program (eg. MS PowerPoint)					
	saving data into a digital medium (eg., Flash Card, CD, DVD)					
	using area-specific					

	software					
	using printer					
	using projector					
	using scanner					
	using digital camera					
	I have knowledge in …	Strongly disagree	Disa gree	Neither agree nordisagre e	Agr ee	Stron gly agree
Pedagogy Knowledge (PK)	assessing student performance					
	eliminating individual Differences					
	using different evaluation methods and techniques					
	applying different learning theories and approaches (eg, Constructivist Learning, Multiple Intelligence Theory, Project-based Teaching)					

	possible student learning difficulties and misconceptions					
Content Knowledge (CK)	English language (eg.reading,writing,speaking, listening, literature)					
	developing class activities and Projects following recent developments and applications in my content Area recognizing leaders in my content area					
	following up-to-date resources (eg., books, journals) in my content area					
	following conferences and activities in my content area					
Technological Pedagogical Knowledge (TPK)	choosing technologies appropriate for my teaching/learning approaches and strategies					
	using computer applications supporting student learning					
	to select technologies useful for my teaching career					
	evaluating appropriateness of a new technology for teaching and Learning					
	I have knowledge in…….	Strongly	Disagree	Neither agree	Agree	Strongly

		disagree		nor disagree	agree	Strongly agree
Pedagogical Content Knowledge (PCK)	selecting appropriate and effective teaching strategies for my content area					
	developing evaluation tests and surveys in my content area					
	preparing a lesson plan including class/school –wide Activities					
	meeting objectives described in my lesson plan					
	making connections among related subjects in my content Area					
	making connections between my content area and other related Courses					
	supporting subjects in my content area with outside (out - of-school) activities					
Technological Content Knowledge (TCK)	using area-specific computer Applications					
	using technologies helping to reach course objectives easily in my lesson plan					
	preparing a lesson plan requiring use of instructional Technologies developing class activities and					

	projects involving use of instructional technologies					
Technological Pedagogical And Content Knowledge (TPACK)	integrating appropriate instructional methods and technologies into my content Area					
	selecting contemporary strategies and technologies helping to teach my content Effective					
	teaching successfully by combining my content, pedagogy, and technology Knowledge					
	taking a leadership role among my colleagues in the integration of content, pedagogy, and technology knowledge					
	teaching a subject with different instructional strategies and computer applications					

Age:

Gender:

Experience:

Position:

Type of institution: Private/ Government

Place of institution: Capital/ division/ district/upazila

Place of residence: Urban/Rural

Training: Bed/ Diploma in Education/ Med/ Others (Please specify) Professional Training with duration and frequency:

Background of education:

SSC—Science/Arts/Commerce/others (please specify) HSC--

Science/Arts/Commerce/others (please specify) Bachelor--

Science/Arts (with English/without

English)/Commerce/others(specify)

Masters (specify subject):

Type of educational institute of the tertiary level: public/ private/national

Participating in Co-curricular activities **(**mention if any**):**

Technology Knowledge (TK)

Knowledge score1			
Frequency	Percent	Valid Percent	Cumulative Percent
47	39.2	39.2	39.2
73	60.8	60.8	100.0
120	100.0	100.0	

Custom Table

		knowledge_score1					
		No Knowledge		Have Knowledge		Total	
		Count	Row N %	Count	Row N %	Row N %	Total N
age_cat	Below 30	10	38.5%	16	61.5%	100.0%	26
	31-40	20	46.5%	23	53.5%	100.0%	43
	41-50	15	35.7%	27	64.3%	100.0%	42
	Above 50	2	22.2%	7	77.8%	100.0%	9
Gender of Respondent	Male	26	40.0%	39	60.0%	100.0%	65
	Female	21	38.2%	34	61.8%	100.0%	55
experience_cat	Below 5	10	33.3%	20	66.7%	100.0%	30
	6-10	12	40.0%	18	60.0%	100.0%	30
	11-15	17	54.8%	14	45.2%	100.0%	31
	16-20	4	50.0%	4	50.0%	100.0%	8
	21-25	2	11.8%	15	88.2%	100.0%	17
	Above 25	2	50.0%	2	50.0%	100.0%	4
Type of Institution	Private	28	49.1%	29	50.9%	100.0%	57
	Government	19	30.2%	44	69.8%	100.0%	63
Place of Institution	Capital	27	32.1%	57	67.9%	100.0%	84
	Division	2	100.0%	0	0.0%	100.0%	2
	District	6	75.0%	2	25.0%	100.0%	8
	Upazila	12	46.2%	14	53.8%	100.0%	26
Place of Residence	Urban	35	34.3%	67	65.7%	100.0%	102
	Rural	12	66.7%	6	33.3%	100.0%	18
Training	Bed	23	37.7%	38	62.3%	100.0%	61
	Diploma in Education	5	100.0%	0	0.0%	100.0%	5
	Med	5	20.8%	19	79.2%	100.0%	24
	Others	2	50.0%	2	50.0%	100.0%	4
Type of Educational Institute of the Tertiary Level	Public	15	31.9%	32	68.1%	100.0%	47
	Private	9	47.4%	10	52.6%	100.0%	19
	National	22	41.5%	31	58.5%	100.0%	53
Participating in Co-curricular Activities	1	17	42.5%	23	57.5%	100.0%	40
	2	30	37.5%	50	62.5%	100.0%	80

Pearson Chi-Square Tests

		knowledge_score1
age_cat	Chi-square	2.274
	df	3
	Sig.	.518

Gender of Respondent	Chi-square	.041
	df	1
	Sig.	.839
experience_cat	Chi-square	9.581
	df	5
	Sig.	.088[a]
Type of Institution	Chi-square	4.517
	df	1
	Sig.	.034[*]
Place of Institution	Chi-square	9.690
	df	3
	Sig.	.021[a,*,c]
Place of Residence	Chi-square	6.721
	df	1
	Sig.	.010[*]
Training	Chi-square	11.476
	df	3
	Sig.	.009[a,*]
Type of Educational Institute of the Tertiary Level	Chi-square	1.691
	df	2
	Sig.	.429
Participating in Co-curricular Activities	Chi-square	.280
	df	1
	Sig.	.597

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.
a. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.
c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

Appendix D
Pedagogy Knowledge (PK)

knowledge_score2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Knowledge	58	48.3	48.3	48.3
	Have Knowledge	62	51.7	51.7	100.0
	Total	120	100.0	100.0	

Custom Table

		knowledge_score2					
		No Knowledge		Have Knowledge		Total	
		Count	Row N %	Count	Row N %	Row N %	Total N
age_cat	Below 30	14	53.8%	12	46.2%	100.0%	26
	31-40	23	53.5%	20	46.5%	100.0%	43
	41-50	19	45.2%	23	54.8%	100.0%	42
	Above 50	2	22.2%	7	77.8%	100.0%	9
Gender of Respondent	Male	33	50.8%	32	49.2%	100.0%	65
	Female	25	45.5%	30	54.5%	100.0%	55
experience_cat	Below 5	16	53.3%	14	46.7%	100.0%	30
	6-10	12	40.0%	18	60.0%	100.0%	30
	11-15	18	58.1%	13	41.9%	100.0%	31
	16-20	4	50.0%	4	50.0%	100.0%	8
	21-25	6	35.3%	11	64.7%	100.0%	17
	Above 25	2	50.0%	2	50.0%	100.0%	4
Type of Institution	Private	37	64.9%	20	35.1%	100.0%	57
	Government	21	33.3%	42	66.7%	100.0%	63
Place of Institution	Capital	30	35.7%	54	64.3%	100.0%	84
	Division	2	100.0%	0	0.0%	100.0%	2
	District	8	100.0%	0	0.0%	100.0%	8
	Upazila	18	69.2%	8	30.8%	100.0%	26
Place of Residence	Urban	46	45.1%	56	54.9%	100.0%	102
	Rural	12	66.7%	6	33.3%	100.0%	18
Training	Bed	29	47.5%	32	52.5%	100.0%	61

	Diploma in Education	4	80.0%	1	20.0%	100.0%	5
	Med	7	29.2%	17	70.8%	100.0%	24
	Others	2	50.0%	2	50.0%	100.0%	4
Type of Educational Institute of the Tertiary Level	Public	18	38.3%	29	61.7%	100.0%	47
	Private	10	52.6%	9	47.4%	100.0%	19
	National	29	54.7%	24	45.3%	100.0%	53
Participating in Co-curricular Activities	1	15	37.5%	25	62.5%	100.0%	40
	2	43	53.8%	37	46.3%	100.0%	80

Pearson Chi-Square Tests

		knowledge_score2
age_cat	Chi-square	3.392
	df	3
	Sig.	.335[a]
Gender of Respondent	Chi-square	.337
	df	1
	Sig.	.562
experience_cat	Chi-square	3.481
	df	5
	Sig.	.626[a]
Type of Institution	Chi-square	11.950
	df	1
	Sig.	.001[*]
Place of Institution	Chi-square	20.593
	df	3
	Sig.	.000[a,*,c]
Place of Residence	Chi-square	2.850
	df	1
	Sig.	.091
Training	Chi-square	5.108
	df	3
	Sig.	.164[a]
Type of Educational Institute of the Tertiary Level	Chi-square	2.894
	df	2
	Sig.	.235
Participating in Co-curricular Activities	Chi-square	2.820
	df	1

Sig.	.093

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.
a. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.
c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

Appendix E

Content Knowledge (CK)

knowledge_score3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Knowledge	32	26.7	26.7	26.7
	Have Knowledge	88	73.3	73.3	100.0
	Total	120	100.0	100.0	

Custom Table

		knowledge_score3					
		No Knowledge		Have Knowledge		Total	
		Count	Row N %	Count	Row N %	Row N %	Total N
age_cat	Below 30	10	38.5%	16	61.5%	100.0%	26
	31-40	9	20.9%	34	79.1%	100.0%	43
	41-50	13	31.0%	29	69.0%	100.0%	42
	Above 50	0	0.0%	9	100.0%	100.0%	9
Gender of Respondent	Male	21	32.3%	44	67.7%	100.0%	65
	Female	11	20.0%	44	80.0%	100.0%	55
experience_cat	Below 5	10	33.3%	20	66.7%	100.0%	30
	6-10	6	20.0%	24	80.0%	100.0%	30
	11-15	10	32.3%	21	67.7%	100.0%	31
	16-20	3	37.5%	5	62.5%	100.0%	8
	21-25	3	17.6%	14	82.4%	100.0%	17
	Above 25	0	0.0%	4	100.0%	100.0%	4
Type of Institution	Private	21	36.8%	36	63.2%	100.0%	57
	Government	11	17.5%	52	82.5%	100.0%	63
Place of	Capital	18	21.4%	66	78.6%	100.0%	84

Institution	Division	0	0.0%	2	100.0%	100.0%	2
	District	2	25.0%	6	75.0%	100.0%	8
	Upazila	12	46.2%	14	53.8%	100.0%	26
Place of Residence	Urban	22	21.6%	80	78.4%	100.0%	102
	Rural	10	55.6%	8	44.4%	100.0%	18
Training	Bed	15	24.6%	46	75.4%	100.0%	61
	Diploma in Education	3	60.0%	2	40.0%	100.0%	5
	Med	4	16.7%	20	83.3%	100.0%	24
	Others	0	0.0%	4	100.0%	100.0%	4
Type of Educational Institute of the Tertiary Level	Public	14	29.8%	33	70.2%	100.0%	47
	Private	6	31.6%	13	68.4%	100.0%	19
	National	11	20.8%	42	79.2%	100.0%	53
Participating in Co-curricular Activities	1	11	27.5%	29	72.5%	100.0%	40
	2	21	26.3%	59	73.8%	100.0%	80

Pearson Chi-Square Tests

		knowledge_score3
age_cat	Chi-square	6.240
	df	3
	Sig.	.100
Gender of Respondent	Chi-square	2.308
	df	1
	Sig.	.129
experience_cat	Chi-square	4.501
	df	5
	Sig.	.480[a]
Type of Institution	Chi-square	5.748
	df	1
	Sig.	.017[*]
Place of Institution	Chi-square	6.966
	df	3
	Sig.	.073[a,c]
Place of Residence	Chi-square	9.037
	df	1
	Sig.	.003[a,*]
Training	Chi-square	5.613
	df	3
	Sig.	.132[a,c]

Type of Educational Institute of the Tertiary Level	Chi-square	1.414
	df	2
	Sig.	.493
Participating in Co-curricular Activities	Chi-square	.021
	df	1
	Sig.	.884

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.
a. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.
c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

Appendix F

Technological Pedagogical Knowledge (TPK)

knowledge_score4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Knowledge	44	36.7	36.7	36.7
	Have Knowledge	76	63.3	63.3	100.0
	Total	120	100.0	100.0	

Custom Table

		knowledge_score4					
		No Knowledge		Have Knowledge		Total	
		Count	Row N %	Count	Row N %	Row N %	Total N
age_cat	Below 30	10	38.5%	16	61.5%	100.0%	26
	31-40	18	41.9%	25	58.1%	100.0%	43
	41-50	12	28.6%	30	71.4%	100.0%	42
	Above 50	4	44.4%	5	55.6%	100.0%	9
Gender of Respondent	Male	22	33.8%	43	66.2%	100.0%	65
	Female	22	40.0%	33	60.0%	100.0%	55
experience_cat	Below 5	13	43.3%	17	56.7%	100.0%	30
	6-10	11	36.7%	19	63.3%	100.0%	30
	11-15	15	48.4%	16	51.6%	100.0%	31
	16-20	1	12.5%	7	87.5%	100.0%	8

	21-25	4	23.5%	13	76.5%	100.0%	17
	Above 25	0	0.0%	4	100.0%	100.0%	4
Type of Institution	Private	26	45.6%	31	54.4%	100.0%	57
	Government	18	28.6%	45	71.4%	100.0%	63
Place of Institution	Capital	24	28.6%	60	71.4%	100.0%	84
	Division	1	50.0%	1	50.0%	100.0%	2
	District	6	75.0%	2	25.0%	100.0%	8
	Upazila	13	50.0%	13	50.0%	100.0%	26
Place of Residence	Urban	37	36.3%	65	63.7%	100.0%	102
	Rural	7	38.9%	11	61.1%	100.0%	18
Training	Bed	27	44.3%	34	55.7%	100.0%	61
	Diploma in Education	3	60.0%	2	40.0%	100.0%	5
	Med	4	16.7%	20	83.3%	100.0%	24
	Others	0	0.0%	4	100.0%	100.0%	4
Type of Educational Institute of the Tertiary Level	Public	15	31.9%	32	68.1%	100.0%	47
	Private	7	36.8%	12	63.2%	100.0%	19
	National	22	41.5%	31	58.5%	100.0%	53
Participating in Co-curricular Activities	1	7	17.5%	33	82.5%	100.0%	40
	2	37	46.3%	43	53.8%	100.0%	80

Pearson Chi-Square Tests

		knowledge_score4
age_cat	Chi-square	1.955
	df	3
	Sig.	.582
Gender of Respondent	Chi-square	.486
	df	1
	Sig.	.486
experience_cat	Chi-square	7.999
	df	5
	Sig.	.156[a]
Type of Institution	Chi-square	3.743
	df	1
	Sig.	.053
Place of Institution	Chi-square	9.576
	df	3
	Sig.	.023[a,*,c]
Place of Residence	Chi-square	.045
	df	1

	Sig.	.832
Training	Chi-square	9.181
	df	3
	Sig.	.027[a,*]
Type of Educational Institute of the Tertiary Level	Chi-square	.984
	df	2
	Sig.	.611
Participating in Co-curricular Activities	Chi-square	9.492
	df	1
	Sig.	.002[*]

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.
a. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.
c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

Appendix G

Pedagogical Content Knowledge (PCK)

knowledge_score5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Knowledge	47	39.2	39.2	39.2
	Have Knowledge	73	60.8	60.8	100.0
	Total	120	100.0	100.0	

Custom Table

		knowledge_score5					
		No Knowledge		Have Knowledge		Total	
		Count	Row N %	Count	Row N %	Row N %	Total N
age_cat	Below 30	10	38.5%	16	61.5%	100.0%	26
	31-40	20	46.5%	23	53.5%	100.0%	43
	41-50	15	35.7%	27	64.3%	100.0%	42
	Above 50	2	22.2%	7	77.8%	100.0%	9

Gender of Respondent	Male	26	40.0%	39	60.0%	100.0%	65
	Female	21	38.2%	34	61.8%	100.0%	55
experience_cat	Below 5	10	33.3%	20	66.7%	100.0%	30
	6-10	12	40.0%	18	60.0%	100.0%	30
	11-15	17	54.8%	14	45.2%	100.0%	31
	16-20	4	50.0%	4	50.0%	100.0%	8
	21-25	2	11.8%	15	88.2%	100.0%	17
	Above 25	2	50.0%	2	50.0%	100.0%	4
Type of Institution	Private	28	49.1%	29	50.9%	100.0%	57
	Government	19	30.2%	44	69.8%	100.0%	63
Place of Institution	Capital	27	32.1%	57	67.9%	100.0%	84
	Division	2	100.0%	0	0.0%	100.0%	2
	District	6	75.0%	2	25.0%	100.0%	8
	Upazila	12	46.2%	14	53.8%	100.0%	26
Place of Residence	Urban	35	34.3%	67	65.7%	100.0%	102
	Rural	12	66.7%	6	33.3%	100.0%	18
Training	Bed	23	37.7%	38	62.3%	100.0%	61
	Diploma in Education	5	100.0%	0	0.0%	100.0%	5
	Med	5	20.8%	19	79.2%	100.0%	24
	Others	2	50.0%	2	50.0%	100.0%	4
Type of Educational Institute of the Tertiary Level	Public	15	31.9%	32	68.1%	100.0%	47
	Private	9	47.4%	10	52.6%	100.0%	19
	National	22	41.5%	31	58.5%	100.0%	53
Participating in Co-curricular Activities	1	17	42.5%	23	57.5%	100.0%	40
	2	30	37.5%	50	62.5%	100.0%	80

Pearson Chi-Square Tests

		knowledge_score5
age_cat	Chi-square	2.274
	Df	3
	Sig.	.518
Gender of Respondent	Chi-square	.041
	Df	1
	Sig.	.839
experience_cat	Chi-square	9.581
	Df	5
	Sig.	.088[a]
Type of Institution	Chi-square	4.517
	Df	1
	Sig.	.034*

Place of Institution	Chi-square	9.690
	Df	3
	Sig.	.021[a,*,c]
Place of Residence	Chi-square	6.721
	Df	1
	Sig.	.010[*]
Training	Chi-square	11.476
	Df	3
	Sig.	.009[a,*]
Type of Educational Institute of the Tertiary Level	Chi-square	1.691
	Df	2
	Sig.	.429
Participating in Co-curricular Activities	Chi-square	.280
	Df	1
	Sig.	.597

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.
a. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.
c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

Appendix H

Technological Content Knowledge (TCK)

knowledge_score6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Knowledge	50	41.7	41.7	41.7
	Have Knowledge	70	58.3	58.3	100.0
	Total	120	100.0	100.0	

Custom Table

	knowledge_score6		
	No Knowledge	Have Knowledge	Total

		Count	Row N %	Count	Row N %	Row N %	Total N
age_cat	Below 30	10	38.5%	16	61.5%	100.0%	26
	31-40	13	30.2%	30	69.8%	100.0%	43
	41-50	25	59.5%	17	40.5%	100.0%	42
	Above 50	2	22.2%	7	77.8%	100.0%	9
Gender of Respondent	Male	26	40.0%	39	60.0%	100.0%	65
	Female	24	43.6%	31	56.4%	100.0%	55
experience_cat	Below 5	10	33.3%	20	66.7%	100.0%	30
	6-10	11	36.7%	19	63.3%	100.0%	30
	11-15	15	48.4%	16	51.6%	100.0%	31
	16-20	6	75.0%	2	25.0%	100.0%	8
	21-25	6	35.3%	11	64.7%	100.0%	17
	Above 25	2	50.0%	2	50.0%	100.0%	4
Type of Institution	Private	24	42.1%	33	57.9%	100.0%	57
	Government	26	41.3%	37	58.7%	100.0%	63
Place of Institution	Capital	34	40.5%	50	59.5%	100.0%	84
	Division	2	100.0%	0	0.0%	100.0%	2
	District	6	75.0%	2	25.0%	100.0%	8
	Upazila	8	30.8%	18	69.2%	100.0%	26
Place of Residence	Urban	42	41.2%	60	58.8%	100.0%	102
	Rural	8	44.4%	10	55.6%	100.0%	18
Training	Bed	24	39.3%	37	60.7%	100.0%	61
	Diploma in Education	4	80.0%	1	20.0%	100.0%	5
	Med	12	50.0%	12	50.0%	100.0%	24
	Others	2	50.0%	2	50.0%	100.0%	4
Type of Educational Institute of the Tertiary Level	Public	18	38.3%	29	61.7%	100.0%	47
	Private	8	42.1%	11	57.9%	100.0%	19
	National	23	43.4%	30	56.6%	100.0%	53
Participating in Co-curricular Activities	1	18	45.0%	22	55.0%	100.0%	40
	2	32	40.0%	48	60.0%	100.0%	80

Pearson Chi-Square Tests

		knowledge_score6
age_cat	Chi-square	9.333
	Df	3
	Sig.	.025*
Gender of Respondent	Chi-square	.162
	Df	1
	Sig.	.687
experience_cat	Chi-square	5.797

	Df	5
	Sig.	.326[b]
Type of Institution	Chi-square	.009
	Df	1
	Sig.	.926
Place of Institution	Chi-square	7.776
	Df	3
	Sig.	.051[b,c]
Place of Residence	Chi-square	.067
	Df	1
	Sig.	.795
Training	Chi-square	3.547
	Df	3
	Sig.	.315[b]
Type of Educational Institute of the Tertiary Level	Chi-square	.275
	Df	2
	Sig.	.871
Participating in Co-curricular Activities	Chi-square	.274
	Df	1
	Sig.	.600

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Appendix I

Technological Pedagogical and Content Knowledge (TPCK)

knowledge_score7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Knowledge	55	45.8	45.8	45.8
	Have Knowledge	65	54.2	54.2	100.0

	Total	120	100.0	100.0	

Custom Table

		knowledge_score7					
		No Knowledge		Have Knowledge		Total	
		Count	Row N %	Count	Row N %	Row N %	Total N
age_cat	Below 30	10	38.5%	16	61.5%	100.0%	26
	31-40	10	23.3%	33	76.7%	100.0%	43
	41-50	31	73.8%	11	26.2%	100.0%	42
	Above 50	4	44.4%	5	55.6%	100.0%	9
Gender of Respondent	Male	23	35.4%	42	64.6%	100.0%	65
	Female	32	58.2%	23	41.8%	100.0%	55
experience_cat	Below 5	10	33.3%	20	66.7%	100.0%	30
	6-10	8	26.7%	22	73.3%	100.0%	30
	11-15	17	54.8%	14	45.2%	100.0%	31
	16-20	8	100.0%	0	0.0%	100.0%	8
	21-25	10	58.8%	7	41.2%	100.0%	17
	Above 25	2	50.0%	2	50.0%	100.0%	4
Type of Institution	Private	20	35.1%	37	64.9%	100.0%	57
	Government	35	55.6%	28	44.4%	100.0%	63
Place of Institution	Capital	37	44.0%	47	56.0%	100.0%	84
	Division	2	100.0%	0	0.0%	100.0%	2
	District	4	50.0%	4	50.0%	100.0%	8
	Upazila	12	46.2%	14	53.8%	100.0%	26
Place of Residence	Urban	45	44.1%	57	55.9%	100.0%	102
	Rural	10	55.6%	8	44.4%	100.0%	18
Training	Bed	24	39.3%	37	60.7%	100.0%	61
	Diploma in Education	4	80.0%	1	20.0%	100.0%	5
	Med	19	79.2%	5	20.8%	100.0%	24
	Others	0	0.0%	4	100.0%	100.0%	4
Type of Educational Institute of the Tertiary Level	Public	27	57.4%	20	42.6%	100.0%	47
	Private	6	31.6%	13	68.4%	100.0%	19
	National	22	41.5%	31	58.5%	100.0%	53
Participating in Co-curricular Activities	1	20	50.0%	20	50.0%	100.0%	40
	2	35	43.8%	45	56.3%	100.0%	80

Pearson Chi-Square Tests

		knowledge_score7
age_cat	Chi-square	22.646
	Df	3

	Sig.	.000[*,b]
Gender of Respondent	Chi-square	6.237
	Df	1
	Sig.	.013[*]
experience_cat	Chi-square	17.978
	Df	5
	Sig.	.003[*,b]
Type of Institution	Chi-square	5.050
	Df	1
	Sig.	.025[*]
Place of Institution	Chi-square	2.529
	Df	3
	Sig.	.470[b,c]
Place of Residence	Chi-square	.806
	Df	1
	Sig.	.369
Training	Chi-square	16.737
	Df	3
	Sig.	.001[*,b]
Type of Educational Institute of the Tertiary Level	Chi-square	4.495
	Df	2
	Sig.	.106
Participating in Co-curricular Activities	Chi-square	.420
	Df	1
	Sig.	.517

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c. The minimum expected cell count in this sub table is less than one. Chi-square results may be invalid.