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PREPARING TEACHERS FOR TECHNOLOGY BASED TEACHING-LEARNING USING TPACK

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ABSTRACT

Technological Pedagogical Content Knowledge (TPACK) is a conceptual framework for teachers to teach effectively using technology. This framework originates from the opinion that use of technology in educational context would be effective only if content, pedagogy and technology are aligned carefully. It implies that for teachers to use technology in their teaching, they need to be competent in all three domains. This present paper is an attempt to understand the assumptions and components of Technological Pedagogical and Content Knowledge (TPACK) as a conceptual framework. Further, the paper addresses the issues and challenges in preparing teachers with TPACK capabilities, apart from emphasizing the role of teacher educators, pre-service, and in-service teachers in understanding TPACK for effective classroom teaching and learning. Suggestions for developing TPACK competencies among teacher educators, inservice teachers, and preservice teachers were discussed. Recommendation for restructuring curriculum of teacher training programmes was also included.

Keywords: Pedagogical Content Knowledge, TPACK, Preservice Teachers, Inservice Teachers.

INTRODUCTION

Educational technology is the implementation of appropriate tools, techniques, or processes that facilitate the application of senses, memory, and cognition to enhance the teaching practices and improve learning outcomes (Hap Aziz, 2010). Teachers have been using educational technology in their classroom teaching in some form or other for a very long time. Teachers use a variety of methods and materials to make students understand the content. They may range from use of simple and versatile chalk and blackboard to advanced interactive white boards depending on the accessibility of the gadgets. Over the years, pre-service teacher training in India has been focussing on preparing teachers in the use of innovative teaching aids appropriate to the content and based on one's imagination and creativity. Apart from the traditional educational technology like charts and models, OHP, additionally, teacher training colleges are trying to introduce the use of computers to train the teacher for computer based teaching and learning. Recent call for educational reform in teacher education stresses the need for innovative teacher education restructuring to ensure that, Pre-service teachers not only understand how to use a computer, but also how to design high quality technology-enhanced lessons (Ertmer, 2010; NCFTE, 2009).

In the information age, where new knowledge is being added continuously, there is an urgent need for teachers to focus on improving their content knowledge and remain updated. Only then they will be in a position to answer the students and guide the students in meaningful discussions in the classroom. Students have enormous information at their disposal. Presenting the facts is not a responsibility of the teachers any more. Teachers' job is how to make children understand and use the information available constructively.

With the advent of the new technologies, there is a shift in method of transaction of content. Present students come to classroom with a lots of information collected from various sources. The information which the students bring with them can be utilized by the teacher to construct their

knowledge; as resource and promote thinking; and expand it which can lead to innovative ideas among students. But lack of knowledge about utilizing technology can limit the effectiveness of integrating technology into teaching (Barak, 2007). So, more concerns are raised about the preparedness of teachers to use technology in the classroom teaching and learning.

Thus, to address the challenges of use of technology, a conceptual framework known as TPACK (Technological Pedagogical and Content Knowledge) has been introduced. Technological Pedagogical and Content Knowledge (TPACK) was proposed as the synthesis that emerges from the intersection of Content, Pedagogy, and Technology (Mishra & Koehler, 2006). The TPACK is a framework to understand and describe the kinds of knowledge capabilities needed by the teachers for effective pedagogical practice in a technology enhanced learning environment.

1. Need of the Present Study

Firstly, the paper discusses the need to understand TPACK as special body of knowledge and not addition of technology to the existing body of knowledge bases. The research studies suggest that TPACK itself is a body of knowledge different from its constituent components. Moreover, it was also found that there is a significant difference in preparing the computer mediated lessons between in-service teachers, who had extensive teaching experience and knowledge of several computer programs and teachers who have less teaching experience, but have good computer skills (Valanides & Angeli, 2008). It implies that developing the knowledge bases (content knowledge, pedagogical knowledge, and technology knowledge) independently will not automatically develop the TPACK among teachers and teachers have to be specifically given instruction on TPACK. So, the study provides the need for special training for developing TPACK.

Secondly, the study discusses the challenges in developing TPACK among teachers. The concept of TPACK is essential for in-service teachers as well as preservice teachers. Developing TPACK among preservice teachers can be introduced during preservice training. Inservice training programmes should target on developing the TPACK. Thirdly, the role of teacher educators in the changing educational scenario was discussed. Finally, the need for reorienting the teacher education programmes to suit the changes in teaching-learning was presented.

2. The Concept of PCK

Lee Shulman was one of the first pioneers to speak about the importance of integrated knowledge of teachers to deliver for better learning outcomes. He affirmed that pedagogy and content knowledge are basic requirements for a teacher. Shulman (1986) discussed the idea of Pedagogical Content Knowledge (PCK) for the first time in his article "Those who Understand: Knowledge Growth in Teaching". In this article, he asserts that pedagogy and content are parts of one indistinguishable body of understanding. He had discussed pedagogy and content knowledge of teachers for transforming a piece of text into instruction that their students can comprehend. He illustrated PCK with an example of a veteran English teacher who taught Moby Dick, a classic to grade ninth children. In his article, he expressed that enough focus is not given on how subject matter was transferred from the knowledge of the teacher to the content of instruction.

Content knowledge refers to the amount and organization of knowledge by itself in the mind of the teacher. Shulman (1986) suggested three categories of content knowledge needed for a teacher; (i) Subject-matter Content Knowledge, (ii) Curricular Knowledge, and (iii) Pedagogical Content Knowledge.

2.1 Subject-Matter Content Knowledge

It refers to the knowledge possessed by the teachers for transaction of the content concerned. Teachers must be in a position to explain the accepted truths in that domain. Apart from that, they must also be able to explain the significance of the content and the reasons for knowing the content. They should understand the significance of the topic and the reason for including it in that discipline.

2.2 Curricular Knowledge

Curriculum is defined as the range of programmes for teaching a particular level. An experienced and mature teacher will have knowledge of various curricular methods

available for teaching. Shulman expected that, teacher should also possess vertical curricular knowledge and lateral curricular knowledge. The vertical content knowledge relates to the topics that are proceeding or following years in schools, while lateral curricular knowledge deals with topics that are being simultaneously discussed in other classes.

2.3 Pedagogical Content Knowledge

Shulman described pedagogical content knowledge as the understanding of what makes the learning of specific topics easy or difficult. It refers to the knowledge of the teacher on how to transact the given piece of information and how to make learning of the specific topic easy for the learner. It is a well-known fact that there is no single method of presenting a lesson or topic. How a teacher transacts the lesson depends upon the teachers' understanding, creativity, expertise, and wisdom. So, teachers must be equipped with required knowledge and skills, and provide the learning experiences in a variety of forms, based on the level of the learner, difficulty of the concept, and the availability of resources. It requires, often, reorganization of the delivery mechanism suitable to the context.

3. The Concept of TPACK

TPACK (Technology, Pedagogy, and Content Knowledge) has been introduced in the field of education to understand the teachers' knowledge of content, pedagogy for effective integration of technology in teaching. TPACK builds on the core ideas of Shulman's idea of Pedagogical Content Knowledge (PCK) with the inclusion of technology as another domain. A growing body of research (Mishra & Koehler, 2006) has extended the work of Shulman (1987) offering a conceptual framework known as TPACK or Technological Pedagogical Content knowledge (Mishra & Koehler, 2006).

Initially, TPACK had TPCK as acronym. In 2007, it was changed to Technology, Pedagogy, and Content Knowledge (TPACK). According to the author, TPACK better reflected the interdependence of the three contributing knowledge domains: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technology Knowledge (TK), and easier to communicate than TPCK. In the initial stage of TPACK conceptualization, lot of discussions have come up regarding the epistemological nature of the conceptual framework. Prominently two viewpoints have gained momentum:

- The transformative viewpoint emphasises that TPACK is a synthesis that emerges from the intersection of the three domains: CK, PK, and TK and the interaction among these domains are inseparable (Gess-Newsome, 1999; Koehler & Mishra, 2005; Angeli & Valanides, 2009; Rodrigues, Marks, & Steel, 2003; Cavin, 2008).
- The integrative viewpoint emphasises that TPACK does not exist as a unique construct, but simply a combination of CK, PK, and TK that emerges during teaching-learning (Chai, Koh, & Tsai, 2010).

However, Mishra & Koehler, (2006) explained that, TPACK is a generalized construct and can lead to four major areas of research and discussion:

- The implication of TPACK for teachers' professional development;
- The implications of TPACK for developing instructional strategies for effective teaching-learning;
- Studying the changes in teachers' TPACK capabilities overtime;
- Introducing TPACK as an integral part of teacher education courses to enhance the capabilities of teacher educators, pre-service teachers, and in-service teachers.

4. Components of TPACK

Several research studies in Western countries were carried out using TPACK to contextualise the teaching-learning process. In Asian countries, only limited attempt is made to apply TPACK framework as an ICT-integrating construct, while in India, no attempt is made to study the Teacher Knowledge capabilities by applying TPACK framework either as a unique construct or an ICT-integrating construct. Keeping in view the lack of empirical research on TPACK in India, an attempt is made in this paper to highlight the major components and features of TPACK. Further, the paper tries to explore the issues and challenges in adopting the TPACK construct in Indian context.

Seven components of TPACK represented in Figure 1 are

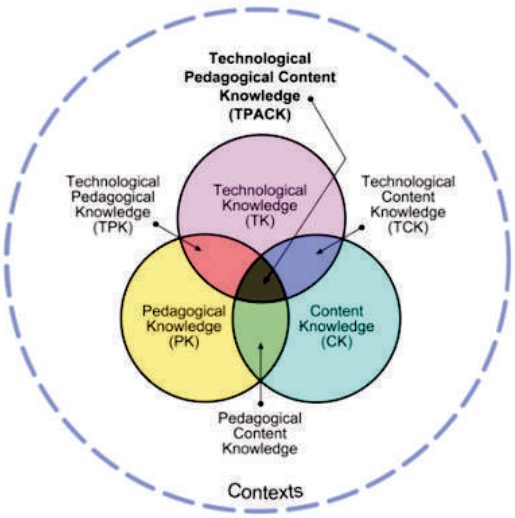

Figure 1. TPACK Model, Koehler and Mishra (2008)

briefly discussed here:

4.1 Technology Knowledge (TK)

It refers to the knowledge of various technologies ranging from simple hand-made charts to digital technologies, such as internet, software programmes, etc.

4.2 Content Knowledge (CK)

It refers to the subject-matter or discipline-based content that is to be taught and learned by the teacher and student, respectively. The teacher should have the understanding of nature of content which is going to be taught. A clear and in depth knowledge of content in the concerned discipline is important for a teacher.

4.3 Pedagogical Knowledge (PK)

It includes classroom management, developing appropriate lesson plans, teaching aids, learning experiences given to the students, level of students, assessment and evaluation.

4.4 Technology Content Knowledge (TCK)

It refers to the knowledge of use of technology for providing better learning experience while teaching the content. It suggests that knowledge of application of various available technologies and using them in teaching depending on the nature of the content and to change that the ways learners understand the concepts.

4.5 Technology Pedagogical Knowledge (TPK)

It refers to knowledge of how various technologies can be used in teaching and in what different ways technology can be used by the teacher in practice. It is to understand how teaching-learning change when particular technologies are used. It requires deeper understanding of constraints and affordances of using particular technologies and finding the context in which teaching works at best.

4.6 Pedagogy Content Knowledge (PCK)

It refers to the content knowledge that deals with the teaching process (Shuman, 1986). PCK differs in various disciplines of subjects. The idea is that pedagogy content knowledge helps to develop better teaching practices in the content area.

4.7 Technology Pedagogy Content Knowledge (TPACK)

It refers to the knowledge required by the teacher to integrate technology in the respective content areas. Teachers with their understanding of the interaction between the basic components of knowledge of content in the subject area and the knowledge of pedagogy, use appropriate technologies to deliver the content.

5. Features of TPACK

- It serves as a conceptual framework to understand and describe the kinds of knowledge needed by teachers for effective pedagogical practice in a technology enhanced learning environment.
- It facilitates in identifying the nature of knowledge required by teachers for use of technology in their teaching, while addressing the complex, multifaceted, and situated nature of teacher knowledge.
- It introduces the relationships and complexities between CK, PK, and TK that are required for teaching with technology.
- It explores the complex relationships that exist between content, pedagogy, and technology knowledge areas and help teachers to identify organizational requirements for effective use of technology for teaching-learning.
- It is more than simply adding ICT to traditional approaches. It depends upon deep knowledge of how ICT can be used to access and process subject-

matter (TCK) and understanding of how ICT can support and enhance learning (TPK) in combination with PCK.

- It is a framework for designing teacher education programs and helps addressing the problems arising from overemphasis on theoretical technological knowledge and as against practical knowledge in designing lessons using technology.
- It is a framework that relies on effective use of technology for teaching specific content or subject-matter by negotiating the relationships between the three components: Technology, Pedagogy, and Content.
- The TPACK capabilities of teachers are different from their subject knowledge, knowledge of technology, and pedagogical knowledge. It addresses the teacher's capabilities in manoeuvring pedagogy and suitable use of technology on the subject taught.
- It helps in optimum utilisation of technology in various disciplines taught.
- It is an organizing framework for the development of educational technology in professional development programs for teacher educators, pre-service as well as in-service teachers.

6. Preparing Teachers in TPACK Capabilities: Issues and Challenges

Theoretically, the idea of TPACK sounds encouraging and promising and highly valuable to the educational administrators and policy makers and all those who are in the field of education. There are some prerequisites to prepare teachers for TPACK. Some of them are discussed as follows.

6.1 Teachers' Competency

The paradigm shift in teaching may pose challenge to teachers and teacher educators. Those who have minimum knowledge or no knowledge of computers may find it increasingly difficult to teach with technology (Harris & Hofer, 2009).

Teachers who have basic understanding of computers and are conversant in using them for various other purposes may also face problem in using them for pedagogical purpose. With the increased utilization of technology in the classroom, in-service educators face many new organizational factors in their decision making process of how to select appropriate, contextually authentic tools that best serve the learning process.

Since teaching with computer technology is a new concept, teacher educators may face challenge of introducing technology in pre-service training. It includes, preparing lesson plans, combining pedagogy with technology as an integral part of decision making, thorough understanding of the principles of learning, affordances of technology, and deep content knowledge along with expertise and experience.

6.2 Training Facilities

Training the in-service teachers, teacher educators, and pre-service teachers is of foremost importance for the right use of technology which can go with the content and pedagogy. Training a teacher in using ICT is more crucial than acquiring a large number of computers. Teachers have to be trained to facilitate the learning process which is real, achievable, exciting, and nonthreatening. Deciding on what is appropriate for a particular discipline/grade/in a particular context is a matter of subject to deal with. Individual teachers' experience and beliefs may differ which may influence idea of TPACK. Large scale workshops with personnel experienced in educational technology, human cognition, different learning styles, or different ways of processing information and teachers with extensive teaching experience would help in developing TPACK capabilities among teachers.

6.3 Availability of Infrastructure

Availability of essential infrastructure to train the teachers is an important concern. Sufficient number of computers with connectivity is an important limitation in the developing countries where continuous power supply is a rare commodity.

6.4 Availability of Trained Personnel

Since the use of computers is relatively new in the field of education, getting resource persons who are competent in all the three areas content, pedagogy and technology and TPACK is a major concern.

6.5 Effect of the New Practice

Any innovation takes time to get infused into the system, accepted by the people, and show its outcome. In the initial stages of the implementation, the new way of teaching may lead to difficulty in classroom management for the teachers (Yinger, 1979). Teachers' inappropriate planning due to lack of understanding on how a new method works or deviation from the established methods may cause some problems. While evaluating the performance of the students, it is possible that it may result in under achievement of the students in some cases. It may even lead to the failure of educational objectives in exceptional cases.

7. Suggestions for Developing TPACK Capabilities

The recommendations are presented here separately for teacher educators, in-service, and pre-service teachers, teacher education programme and in-service training; because they are at different levels in their level of understanding and adopting the technology in their teaching.

7.1 Teacher Educators

It is a common practice that people tend to do things the way they learnt it. This is applicable in teacher education also. Since, use of digital technology in teaching being a recent innovation, the current teacher educators wouldn't have used it during their training period. So, they have the dual responsibility of updating themselves on ways of using digital equipment in optimal utilization for teaching-learning process along with passing the information and implementing it in the pre-service education. Teacher training programme has to make needed changes by incorporating the new methodology.

Teacher educators need to explicitly teach how the unique features of a tool can be used to transform a specific content domain for specific learners and teachers need to be taught about the interactions among technology, content, pedagogy, and learners (Angeli & Valanides, 2009).

7.2 In-service Teachers

Two crucial tasks are ahead of teachers for achieving and using TPACK: (a) updating themselves with new technologies, and (b) change in the method of delivering the content with the use of newly emerging technologies. As multiple advancements in the information and communication technologies have occurred, the instruction in the development of TPACK must recognize and take advantage of a more advanced teacher knowledge gained through their teaching experiences. Harris and Hofer (2009), found that in-service teachers need learning experiences in:

- Selecting and using learning activities and technologies in a more conscious, strategic, and varied manner;
- Instructional planning that is more student-centred, focussing on students' cognitive engagement;
- Making planned decisions for more judicious use of educational technology.
- Get upto date knowledge in their discipline of teaching through professional development courses and latest technologies;
- Peer group discussion and sharing of information among the teachers;
- Try different methods, making calculated / intelligent guesses;
- Get in touch with professional organizations which are involved in promoting technology use in teaching;
- Take the help of veteran teachers who can suggest different ways of using technology in consonance with available pedagogical techniques;
- Preparing a database of use of TPACK or its related aspects by the veteran teachers and making it available as models for novice teachers to get some ideas;
- Taking a feedback from students on the effectiveness use of TPACK on a range of topics across the disciplines.

7.3 Pre-service Teachers

- Pre-service teachers should strive for strong knowledge of content, technology, and pedagogy;
- Getting updated with emerging new technologies;
- Going through the literature on effective and time

tested practices of teaching;

- Peer learning through exchange of ideas, information, and observation.

7.4 Teacher Education Programmes

- Student-teachers need to be given sufficient opportunities during their training to develop adequate pedagogical reasoning and become confident and competent in infusing technology in their teaching (Angeli, 2005);
- Teacher education programs must provide rich learning experiences for pre-service teachers across the curriculum and offer them with opportunities to reflect on these experiences (Mullen, 2001);
- Revision of the content of the respective disciplines should be given consideration. As knowledge of content gained as student is different from the format of imparting it to the students.

7.5 Inservice Training Programmes

- Periodic content enrichment programmes have to be conducted as content knowledge is the heart of good teaching;
- Conducting training programmes on the availability of new technologies and their affordances for possible use by teachers;
- Showing exemplary demonstrations which will consolidate the thoughts and ideas of teachers.

8. Discussion

Education is a dynamic process and demands appropriate changes in the education system from time to time. In a technology led environment, it is important that teachers need to equip with the skills necessary to be at par with their contemporaries from other parts of the world. In the developed as well as developing countries, the governments have been investing on providing computer infrastructure in the schools. Both central and state governments in India are investing considerably on infrastructure development in schools for technology mediated teaching. Many software companies are also contributing towards training the teachers in computer skills and preparation of customized lessons for students in various disciplines. What is more important is, as the research studies indicate that technical skills alone are not sufficient for effective teaching with computers, to make the training constructive, there is a need to redesign the training strategies. The training should include the three fundamental types of knowledge mentioned, the TPACK.

Policies may compel the teachers to use technology, but it is the teachers who should take responsibility of updating their knowledge and strive to find appropriate ways of using technology for improving the teaching-learning process. Individual teachers should involve themselves in understanding and developing TPACK capabilities to make the teaching purposeful.

Many teachers believe that computers are used only to make the content look attractive and appealing to the children. They need to realize that in 21st century, access to information is not hard, instead organizing, sharing, and collaborating become necessary skills. Hence, ICT is not merely presenting information, rather interact, share, and thus learn. ICT provides meaningful, absorbing media that makes teaching-learning more productive. But this information can become true knowledge only when the teacher makes it meaningful. Here the use of digital technologies would make a difference to make the lesson more comprehensible.

Developing TPACK capabilities is not one time activity. It is a process where teachers continuously have to evolve new ways of teaching, recording their observations, interacting with the peers to find reliable and tested ways of using the technology.

TPACK framework does not necessarily mean that new technologies must be introduced, instead provides a framework for teachers to organize their knowledge of Technology, Pedagogy, and Content for effective use of available technologies in a given teaching-learning context.

Successful technology integration in schools require time and effort. Student-teachers would develop competencies to teach with technology when,

- The curriculum offers an opportunity to teach with technology with a practical approach;
- The teacher educators make sustained efforts to give

inputs on infusing technology in an effective way, and

- The teacher trainees gain mastery of knowledge of all the three domains of knowledge: Technology, Pedagogy and Content Knowledge (TPACK).

Among in-service teachers, it is the individual responsibility of the teacher to combine the content knowledge which he/she has been acquiring and the knowledge of ICT which is learning how to make intelligent connections keeping the subject and the level of the student in the background.

Conclusion

Teachers have to understand that TPACK is not just addition of ICT to traditional teaching rather it is integrating the advantages of using ICT in a way that is appropriate to the discipline concerned and nature of the topic dealt. TPACK requires thorough understanding of PCK, knowledge of how ICT can be used to access and process subject matter and also the combination of both to transform the way the content is presented for enhanced learning.

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