Technological Pedagogical Content Knowledge (TPACK) of Science Teachers to Promote Effective Teaching of Science through Bengali Language

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Abstract

Technological Pedagogical Content Knowledge (TPACK) is considered as a valuable frame for describing and understanding the integration of technology, pedagogy & content into different educational settings including science teaching through Bengali language. There is an accumulated body of literature on TPACK among teachers engaged in different areas of education. However, some studies have stated TPACK of prospective or school science teacher for science teaching. The main purposes of the study were to know about TPACK framework and development of TPACK for science teaching on basis of literature review. Also another purpose of the study washow science teachers' TPACK promoted effective teaching through Bengali Language. For this study researcher selected two chemistry chapters of class twelve West Bengal board for science teaching through Bengali language. Chapters were Atomic structures & Chemical bonding. The study was purely qualitative in nature.

Introduction

Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006) is one of the current frameworks that is used to integrate technology, pedagogy and content in the classroom. TPACK represents a new direction in understanding the complex interactions among content, pedagogy and technology that can result in successful integration of technology, pedagogy and content in the classroom (Jang and Chen, 2010). Mishra and Koehler (2006) argue that, merely introducing technology to the educational institutions is not enough. The extent to which teachers will integrate technology in their teaching is the most important. Studied on ICT in science (Grouws & Cebulla, 2000; Keong et al., 2005; Tilya, 2008), show that the integration of technology in education has numerous advantages in science teaching and students' learning. On the other hand language is one of the important factors for science teaching. Effective teaching requires language, whether it's written in textbooks or shared orally during classroom discussions. Language is necessary even while doing practical work. Teachers must explain what

they are doing and students need to ask questions. Teachers' teaching in their mother tongue is generally thought to have an advantage. In West Bengal, students' mother tongue are Bengali. So, Bengali language plays a significant role in the formation and development of concepts. This suggests that a teacher's language is vital in teaching science and creating the condition for meaningful learning. The words that comprise the science classroom language fall into two broad components: the technical and non-technical. The former comprises technical words which are specific to a science subject or discipline like element, atom, bonding, isotopes etc. The nontechnical component is made up of non-technical words and defines or gives identity to the particular language of learning and teaching in a classroom or the language of a science text. Science is considered as a hard school subject. This is partly because pupils find science words tough or unfamiliar. They are also confused when a word that means one thing in everyday language means something different in science. "Resistance", for instance, means something totally different in everyday language and in physics. In this study, the purposes of the study were-

➢ What is TPACK and TPACK framework?
➢ How TPACK can be developed for Science Teaching?
➢ How Science teaching can be promoted by TPACK through Bengali Language?

TPACK Framework

Mishra and Koehler's (2006) developed TPACK framework. He added technological knowledge as a primary domain with PCK. When three primary domains were intersecting with each other then the areas of overlap among technological knowledge, pedagogical knowledge and content knowledge give rise to new constructs. These constructs are Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge(TPACK). Technological Pedagogical Content Knowledge (TPACK) denominates knowledge of using technology with respect to teaching approach for various types of subject matter content. Therefore, Technological Pedagogical Content Knowledge (TPACK) is a model that helps teachers'envisages how their knowledge combines effectively to teach and involve students with technology.
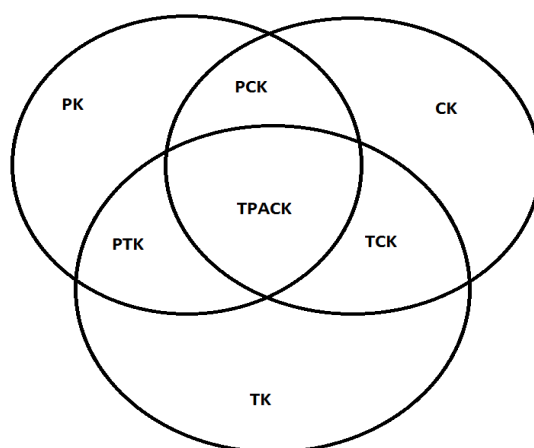
TPACK Framework proposed by Mishra and Koehler's (2006)

TPACK and Science Teaching

According to Ozgun-Koca et al (2010) "As teachers decide whether and how to use technology in their teaching, they need to consider the science content that they will teach, the technology that they will use, and the pedagogical methods that they will employ". Studied on ICT in science (Grouws & Cebulla, 2000; Keong et al., 2005; Tilya, 2008), showed that the integration of technology in education had numerous advantages in science teaching. The more teachers treated TPACK for science teaching; the students learning in science improved the students' achievements. There was a growing body of research which indicated that technologies, including graphing, and some computer based teaching programs can enhance young students' conceptual and procedural knowledge of science (Özgün-Koca, Meagher & Edwards, 2010). So, from those studies we can say that TPACK of teacher enhance science teaching. Studied (Grouws & Cebulla, 2000; Keong et al., 2005; Tilya, 2008 and Niess et al., 2009) acknowledge the importance of TPACK in science teaching. However, some studied report that the level of integration of technology, pedagogy and content was minimal in most schools (Wentworth et al 2008). An assessment of teachers' uptake of technology in science teaching indicated that most teachers were at the accepting stage.Lack of technological knowledge caused teachers' inability to integrate technology, pedagogy and content, thus inability to develop the technological pedagogical content knowledge (Pelgrum, 2001; Yuen et al., 2002). On the other side these studied lead to a conclusion that, although TPACK was reported to enhance learning in science, teachers were not yet integrating it in their teaching. The poor integration of TPACK was reported to be caused by poor technological knowledge among teachers, unavailability of technological tools and teachers' lack of motivation to use technology in teaching. So, there should be needed the development of TPACK.

Development of TPACK for science teaching

According to Niess et al (2009), the development of TPACK took several steps. The stages were:

Recognizing (knowledge): Teachers were able to use the technology and recognize the alignment of the technology with science content yet did not integrate the technology in teaching and learning science.

Accepting (persuasion): Teachers formed favourable and unfavourable attitude towards teaching and learning science with technology.

Adapting (decision): Teachers engaged in activities that lead to a choice to adopt or reject teaching and learning science with appropriate technology.

Exploring (implementation): Teachers actively integrated teaching and learning of science with an appropriate technology.

Advancing (confirmation): Teachers evaluated the results of the decision to integrate science teaching and learning with appropriate technology.

Jang and Chen (2010): developed a model. The model helped pre-service teachers developed technological pedagogical methods and strategies of integrating subject-matter knowledge into science lessons, and further enhanced their TPACK.

Science teaching through Bengali Language

In this section, Science teaching through Bengali language will be introduced and discussed. In West Bengal, Bengali language is mother tongue. The medium of instruction that is Bengali promote science teaching of Bengal students. So, students learn about their language. Principles of language learning are general components that have to be included in order to promote language learning in the classroom. Brown& Roger (2002) proposed that there were at least twelve general research-based principles on which classroom practice was grounded.

➢ **Automaticity:** The capacity of acquiring fluency in the target language.
➢ **Meaningful learning:** It was the teachers' aim to create an ideal environment where students could use and connected the language with their background knowledge, and finally achieve meaningful learning.
➢ **Anticipation of rewards:** It was connected to human beings' desire of obtaining something in return when they behave in a certain way.
➢ **Intrinsic motivation:** Personal interest in learning a language.
➢ **Strategic investment:** Time that students invest in order to learn the language.
➢ **Language ego:** When a person learnt a second language, one developed a "new model of thinking, feeling, and acting - a second identity".
➢ **Self-confidence:** Learners feel capable to accomplish tasks regarding the target language.
➢ **Risk taking:** Learners' capacity to face new challenges regarding the target language.
➢ **Language-culture connection:** The inseparable connection between language and culture.
➢ **Native language effect:** Learners' native language (LI) may affect them in the second language.
➢ **Inter-language:** Type of language system that learners developed in the process of learning a second language.
➢ **Communicative competence:** It was the final goal of language teaching: to promote the use of authentic language in real contexts with authentic materials.

Teachers use Bengali language as a medium of instructor for science teaching. Students understand their mother tongue. They know how to speak, read and write Bengali language.

➢ **Speaking activities:** discussion, presentation and Debates for science teaching.
➢ **Listening activities:** Drawing a figure or design, Locating routes in a map, Performing body movements. Operating a piece of equipment and Making Predictions etc. for science teaching.
➢ **Writing activities:** Write a description of the content
➢ **Reading activities:** Previewing the text, Answering questions, Exploring key vocabulary etc.

TPACK and Bengali language to promote science teaching

A conceptual design was developed for science teachers' TPACK to promote science teaching through Bengali Language class twelve students of west Bengal board. Only two chapters were selected. One was Atomic structure and another was Chemical Bonding.This conceptual design was validated by six secondary school chemistry teachers and two teacher educators of chemistry pedagogy.

Chapters	TPACK			Language used
	CK	PK	TK	
Atomic Structure	Concept of Atom	Lecture method	Power point presentation	Bengali
	Electron, Proton &Nutron	Lecture method	Power point presentation	
	Rathurford Atomic Model	Demonstration method	Computerized 3D model	
	Bohr Atomic Model	Demonstration method	Computerized 3D model	
	Debrogile theory & Hisenberg Uncertainty principle	CAI	Power point presentation	
	Aufbau principle and Hunds rule	Demonstration method	Computerized 3D model	
	Electronic configuration of atom	CAI	Power point presentation	
	Isotope, Isober and Isotone	Demonstration method	Power point presentation	
Chemical Bonding	Concept of Ionic Bonding	Lecture method	Power point presentation	Bengali
	Explain some structure of Ionic Compound	Demonstration method	Computerized 3D model	
	Lattice energy	Discuss method	Power point presentation	
	Concept of Covalent Bonding	Lecture method	Power point presentation	
	Explain some structure of Covalent Compound	Demonstration method	Computerized 3D model	
	Concept of Coordinate Bonding	Lecture method	Power point presentation	
	Explain some structure of Covalent Compound	Demonstration method	Computerized 3D model	
	Hybridization theory	Multiple method	Power point presentation	
	VSEPR Theory	Multiple method	Power point presentation	

Conclusion

TPACK of a science teacher is important for science teaching. To promote science teaching of two chemistry chapters of class eleven, combination of three knowledge is important. This conceptual design improved science teachers' TPACK to promote science teaching. Ultimately it promoted students learning.

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