Integration of technological pedagogical content knowledge (TPACK) in classrooms through a teacher's lens

Mira Mishra

Assistant Professor, Department of Education, G D Goenka University, Sohna, Gurugram

Igona Gorakhnath

Assistant Professor, Department of Education G D Goenka University, Sohna, Gurugram

Parvesh Lata

Associate Professor & HOD, Department of Education, G D Goenka University, Sohna, Gurugram

Ritu Rani

Assistant Professor, Department of Education, G D Goenka University, Sohna, Gurugram

Pooja Chopra

Assistant Professor, Department of Education, G D Goenka University, Sohna, Gurugram

Abstract---Technological literacy has become an unavoidable requirement in today's classroom. The importance of incorporating technology into traditional learning settings aims to create meaningful learning experiences while also cultivating positive perspectives and relationships with technology. While technological knowledge has become indispensable in most classrooms and has been incorporated into various curriculum and frameworks, the incorporation of technology in traditional teaching is accompanied by barriers and limitations based on preconceived notions of technology, school culture, and access to technology. This paper attempts to assist teachers/educators in understanding how Mishra and Koehler's Technology Pedagogical Content Knowledge (TPACK) model can resolve issues and help them overcome the monotony of the online teaching-learning process. The goal of this paper is to provide a brief overview of the TPACK model, examples of how the framework can be

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integrated with science content, and recommendations for solutions to common barriers and limitations across other subject areas.

Keywords---integration, pedagogy, technology integration model, TPACK, science content.

Introduction

The recent outbreak of the COVID-19 pandemic has enforced the sudden mandate in the pedagogical interventions from teachers all around the world. The teachers have to integrate technology in their pedagogical interventions like never before. Overnight the teachers and the pedagogues were expected to implement technology in their teaching-learning methodologies like a maven. The majority of the teachers faced the challenges of technology integration, be it usage of the collaborative tools or development of their technology-based content. The teachers who can sail through the initial hiccups of technology integration in their pedagogical content area often face the challenges of developing a suitable lesson plan based on effective implementation of the technology, pedagogy, and content. The issue becomes more pertinent for the teachers as they need to create a constructive teaching-learning situation for the learners. To make technology integration more effective, teachers have to facilitate the smooth transition from their traditional teaching practices to a practice in which technology plays a dynamic role in students' knowledge acquisition process.

The shift from physical classes to online or hybrid classes is providing these teachers the experiences that allow them to fully integrate technology into their teaching practices. The increasing number of technological devices available in schools (Cambridge Assessment International Education 2018), aligned with curriculum guidance and policy document like the New Education Policy 2020 set an expectation for science teachers to meaningfully incorporate this available technology and devices into their teaching. The prerequisite for integrating technology into teaching practices also expects the teacher education curriculum to make modifications in the existing curriculum to give space to the integration of technology in the pedagogical courses. Thus, teacher education curriculum partakes the opportunities to prepare the pre-service science teachers to be "knowledgeable about both the technology itself and its implementation to meet educational goals" (DeCoito and Richardson 2018, p. 362).

The accomplishment of online or hybrid classes is directly proportional to the accessibility of a technological device and the internet. Usually, the teachers are relying on mobile devices such as cell phones and tablets for the teaching practices in the classroom. The possibility of using the same device in different classes makes tablets even more appealing in complementing teachers' pedagogical approaches (Cochrane et al. 2013; Goodwin 2012; Haßler et al. 2016). The paper attempts to provide teachers both in-service and pre-service to gain an insight into ways of integration of Technology in Science content. In this paper, an attempt has been made to depict the integration of TPACK with content knowledge while framing the lesson plan of science content.

Theoretical framework on TPACK Model of Integration

The TPACK model of integration was projected by Punya Mishra and Matthew Koehler (2006) through their research paper "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge". TPACK is an ellipsis for Technological Pedagogical Content Knowledge. The concept of TPACK is conceived on the Pedagogical Content Knowledge (PCK) framework primarily proposed by Lee Shulman's in 1986 in his famous work, "*Those Who Understand: Knowledge Growth in Teaching.*" Shulman's concept of the PCK model focused on the pedagogical context and the content context. The emphasis of the PCK model was on the way the educators teach (pedagogy) and what they teach (content) need to be equally represented to present the best learning experience to the learners. The TPACK framework can be elucidated in three core domains as depicted in Figure 1. The intersections of these three main domains consist of:

- *Pedagogical Content Knowledge (PCK),* representing the "pedagogy that applies to the teaching of specific content" (Koehler and Mishra 2005, pp. 133–134),
- *Technological Content Knowledge (TCK),* representing "teachers' knowledge of how a subject matter is transformed by the application of technology" (Koehler and Mishra 2005, p. 134),
- *Technological Pedagogical Knowledge (TPK),* representing "knowledge of how technology can support pedagogical goals" (Koehler and Mishra 2005, p. 134).

Lastly, the intersection of TK, PK, and CK represents Technological Pedagogical Content Knowledge (TPACK), meaning "the knowledge required by teachers for integrating technology into their teaching in any content area" (Schmidt et al. 2009, p. 125). The major contribution of Mishra and Koehler (2006) is that they have differentiated TPACK from PCK not only in its present-day requirements but also in its specificity to the profession and complexity of its nature. TPACK, like PCK, is a craft knowledge that can be defined as the wisdom that teachers develop from their teaching practices, which guides their instructional actions (van Driel, Verloop, & de Vos, 1998).
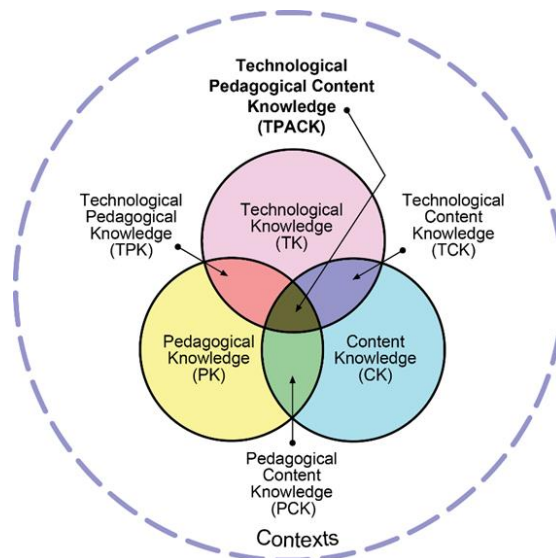
Fig 1.1. The TPACK Model. Adapted from Mishra & Koehler (2006)

School Teacher and Technological Pedagogical Content Knowledge (TPACK)

The emerging modes of teaching both blended and online expect the school teachers to be well versed not only in Content Knowledge (CK) and Technological Knowledge but also in Technological Pedagogical Knowledge (TPACK). For example, if a science teacher delivers a science content to the students via a learning management system (LMS). Even if she has sufficient knowledge of the content that she is teaching (CK) and of LMS (TK), she might still focus the entire online course on text-based PDFs or Documents (.docx) files. Even though the aforementioned is an adequate display of both content and technical knowledge, she might receive feedback at variance that it is not enhancing the learning experience of the students. However, if the teachers could present the content effectively in more interactive and engaging digital mediums e.g., video, class discussion, games, jam board, an online quiz like *Kahoot, quizezz, Show and Tell me App, Kutuki,* etc., and recognized how to make that happen via Learning Management System (LMS), then the teacher has understood the effective application of Technical Content Knowledge (TCK) in her pedagogical intervention.

The professional development of teachers both in service and pre-service initiates with being equipped with professional knowledge about the content to be taught, the pedagogy and assessment necessary to assist their students' learning outcome, and the technology required to further integrate that in teaching and learning process. These knowledge sets interact to produce a blended technological-pedagogical-content knowledge set (Mishra & Koehler, 2006). TPACK for school teachers may include knowledge regarding representations, science curricula, students' understanding of science, various educational contexts, affordances of ICT tools, etc. (Angeli & Valanides, 2009; Jimoyiannis, 2010; Magnusson, Krajcik, & Borko, 1999).

Planning a lesson using TPACK model of Integration

It is pertinent for the school teachers to absorb the art of integration of technology while planning the lesson plan. Intertwining technological, pedagogical content knowledge (TPACK) together to enhance the activities of the traditional lesson plan demands expertise from the teachers.

Sample of a Science lesson plan using TPACK model of integration

Topic: Cell Biology
Class: VII
Time: 35 Minutes

Steps of TPACK Integration in the lesson plan

For this activity, the teacher would divide the class into small groups and ask them to collaborate on completing a Test your Knowledge on Cell Biology quiz via the available learning management system (LMS).

- The quiz items may include an interactive question that provides a diagram of a cell with blank labels and involves students to drag and drop the proper labels in the correct place from the answer section.
- Each group of the student is asked to use the available device (smartphones, Tablet or Laptop/ Desktop and internet connection) with recording capabilities and each member of the group are asked to choose a cell organelle to personify.
- The other group member would record each other explanations about the varied roles of the cell organelles and their functions.
- Finally, the students are asked to upload their videos to a media album so that the peer students can watch each other's videos on their own time and leave comments.
- To make most of the TPACK integration the science teacher may ask the students to compare the cell organelles of animal and plant cells and make conclusions regarding the differences they find.
- The teacher should facilitate each group to construct an artifact of their research by creating a one-page brief in Google Drive or Microsoft OneDrive, a flowchart comparison, or a video explanation.
- This can also be turned in via an assignment in the (Learning Management System) LMS for evaluation purposes.
- At this stage, the students have mastered the art of integration so the teacher might move to a higher level of the cognitive skills and facilitate the students to analyse the connections between different animals and plants in their natural habitats. The groups need to deduce what might happen when one animal or plant is placed in a habitat other than its natural one or the consequences of the ecosystem if all the producers are destroyed from our environment.
- Lastly, the groups should compile evidence to make their case (articles, videos, etc.) using Padlet, Evernote, or another similar tool.

Conclusions and Future Recommendations

The TPACK model of integration is well suited to the growing needs of smart pedagogical interventions of school teachers across the globe. The TPACK model proposes the ideal combination of pedagogical, content, and technological competencies required for teachers to provide the most comprehensive educational experiences to students. The model's approach is promising because it is based on the constructivist paradigm; however, a number of barriers and obstacles prevent proper technology integration in the classroom. As it stands, teachers are constantly being stretched thin to meet curriculum standards, participate in extracurricular activities, overcome institutional barriers, and manage large classes to name a few of their daily burdens (Ertmer, 1999). Based on the similar lesson plan discussed in the paper the teacher can seamlessly implement the same or modified integration of technology in online or blended learning in other subject areas such as Mathematics, Social Science, Languages, and so on.

It is important to identify the role TPACK model as an ideal solution in this present scenario to wade off the monotony of online education. To overcome the barriers that hinder the implementation of the TPACK model in the science teaching-learning process the goals for integration have to be attainable. The teachers should incorporate technologies that are inexpensive, easily accessible, free to the user, as well as ones that are intuitive and easy to learn for both the teachers and the learners. It is imperious for educators to evaluate technology-based tools before implementing them into their classroom to ensure that learning is augmented through the use of technology rather than simply acting as a resonating hope.

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