Use of TPACK Framework to Enhance the Efficacy of Online Learning in Higher Education

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ABSTRACT

Online learning is an innovative tool, which can make the teaching-learning process more learner-centered, more flexible and more exciting. Though, online education is a boon to the education system of any country, but without proper use of technology, it is not proved to be fruitful. For online teaching-learning process, *n* numbers of technologies are available. All of these technologies are not user-friendly, since they create many difficulties while using them. The difficulties or problems include issues with installation of software, login problems, problems with downloading or uploading and problems related to clarity of audio or video. Many students complain that online learning is boring and un-engaging for them. Hence, a teacher without proper technical knowledge faces problems of using technology in online learning particularly at higher level of education. The selection of proper technology for the teaching- learning process is also not an easy task since every technology has its potentialities and limitations for the accomplishment of specific learning tasks (Koehler and Mishra, 2009). Standing at this juncture, a question arises – how can a teacher integrate technology in his/her teaching effectively? And how to integrate technology, pedagogy and content knowledge in the teaching-learning process? From these, the idea of Technology, Pedagogy and Content Knowledge (TPACK) framework has been evolved. In this paper an attempt has been made to explain how TPACK framework is very much crucial in the online learning to fix many issues related to online learning at higher education level with a few recommendations at concluding section.

Keywords: Content, Higher education, Online learning, Pedagogy, Technology, TPACK framework

The dawn of the 21ˢᵗ century has experienced several changes in every sphere of human life due to the advent of technology. Education is not an exception to it. Teaching is no more limited within the confines of the four walls of an educational institution. The rapid growth of internet usage forced education to undergo a paradigm shift in many ways; one out of those is the mode of teaching learning from traditional offline to online. The effect of this paradigm shift has brought education into the palms of everyone. The course material, pedagogical styles, evaluation mechanisms, etc. are made digitalized to offer education through online mode. According to Digital around the World Report, 2020, roughly 4.66 billion people, i.e. around 60% of the world population uses the internet by October 2020. More than 321 million new users came online within last one year, which is a drastic change in the growth rate of internet usage. The report says, at an annual rate of more than 7% internet users are growing world-wide. The average time spend by individual on online per day is 7 hours. Keeping this drastically growing rate of online users in mind, and some other reasons like present pandemic situation, most of the educational institutions across the world have come out with online learning modalities. The idea of online learning is not very new to the arena of education. In the year 1960, the University of Illinois, USA used to provide first online education in the history of world education through interlinked computer terminals since internet was not invented then. However, the first-ever complete online course in its real sense was offered by the University of Toronto, Canada in 1984. The journey of online distance learning in the world was started in the early 1990s by the Open University in Britain (Sarkar, 2020). The demand for online learning is growing day by day, especially during the present pandemic situation. However do the learners get equally benefitted through online learning as that of traditional face to face mode? Do the educators able to follow the same pedagogical techniques as that of face to face mode in online learning? Do the learners, as well as educators; properly use technology in online learning? Furthermore, many research questions may be framed in this context.

Online Learning and its Principles

Online learning is an innovative tool, which can make the teaching-learning process more learner-centered, more flexible and more exciting. Online learning provides learning experiences in both synchronous and asynchronous environments. Mobile phones, computers (both desktop and laptop) with internet access are used to provide online learning. The online learning environment provides opportunities to the learners not only to learn but also to interact with their teachers from anywhere (Singh & Thurman, 2019). Most of the terms like online learning, computer-mediated learning, web-based learning, etc., have common characteristics, i.e. a computer connected to a network provides opportunities for the learners to learn from anywhere, anytime in any rhythm and with any means (Cojocariu *et al.* 2014). So online learning is a web-based learning process in which computer or mobile phones are

used to provide learning experience without the physical presence of teachers and students face-to-face. It is also called e-learning.

Principles of Online learning

Online learning is based on the following principles:

(a) *Multimedia principle:* In online learning, different electronic media, i.e. radio, TV, Computer (both desktop and laptop) and smart phones are used to provide instructions. Researches show learning through graphics, video and audio-video (multimedia effect) is more effective than merely aural listening. This principle is followed in online learning. Combining any two of the three most common elements, i.e. relevant graphics, audio narration and explanatory text work better than just using one or all three (Wikipedia).

(b) *Modality principle:* Learning becomes more significant when graphics (used in online materials) are explained by audio narration instead of on-screen text. Better learning occurs when the words of the text on the screen are presented with audio narrations simultaneously (Wikipedia). This is the second principle, followed in online learning.

(c) *Coherence principle:* Unnecessary video clips, music, graphics, and narration should not be included in online instruction. These divert the attention of the learners. Required items of the instruction should be included in online content in an attractive manner. As a result, the learners will be able to focus on the content that they need to learn. This will also help to minimize the cognitive load imposed on the memory of the learners.

(d) *Contiguity principle:* Related piece of information should be arranged in sequential order. The information may be organized through pictures, charts, graphics, text with narrations, etc. and kept in a sequence. This will help the learners to relate their presently acquired knowledge to previously acquired knowledge. There must be a provision of immediate feedback to learners' responses.

(e) *Segmenting principle:* Learning occurs more effectively when a large amount of content is broken into small pieces. This principle is followed in programmed learning also. In online learning, large lessons are broken into several short lessons.

(f) *Signaling principle:* To draw attention of the learners to the critical elements of a lesson, visual, auditory and temporal cues may be used. For text presentation on screen, arrows, circles, highlighting and bolding texts are used as standard techniques. For audio narration, due stress on a particular word or a sentence, intonation and proper pausing should be given. These are called signaling cues which include in the online learning as the signaling principle (Wikipedia).

(g) *Learner control principle:* Learning becomes more effective when the learners have the scope to control the rate at which they move forward through segmented content. They can pause, forward, or reverse the material if required. It provides the freedom to the learners to learn according to their cognitive capacity. In online learning, this principle is strictly followed.

(h) *Personalization principle*: In texts with narrations, voice quality has more significant role to play. Good quality of voice with proper stress, intonation and pause brings the sense to the learner that someone is talking directly to them, when they listen to the narration. This social presence should be strengthened to make learning more effective.

(i) *Pre-training principle*: Learning becomes effective when key concepts of the lesson are presented before presenting the entire content. When a teacher is going to present a multimedia explanation, he/she must be sure that the learners not only recognize each major component but name and describe the major state changes of each component also (Mayer, Mathias, and Wetzel, 2002).

(j) *Redundancy principle:* When content or words of the content are familiar to the learners, lesson graphics will be explained by audio narrations alone. This will help to occur deep learning rather than presenting audio narration and on-screen text simultaneously (Wikipedia). This is called the redundancy principle.

TPACK: An Overview

A teacher always faces various questions before and during the teaching-learning process. They are: *What to teach? How to teach? Why to teach? When to teach? And, where to teach? Etc.* Among these questions, the first three are more vital. The answers to those first three questions, i.e. what to teach, how to teach and why to teach are content or subject matter, methods and objectives, respectively. Since, there are numerous methods to teach a particular content, methodology, or broadly saying pedagogy varies from teacher to teacher. To make teaching more enjoyable as well as easily comprehensible to the learners, teachers use different Teaching Learning Materials (TLMs) as well as take the help of technology. However, using technology is not only a complicated task but also challenging since new technologies are coming day by day (Koehler and Mishra, 2009). Beginning from the use of a chalkboard or a pencil for writing, a calculator for the calculation to modern software applications in computer come under technology in education. Nevertheless, there is a difference in a particular aspect, i.e. stability of the technological devices. Pencil and chalkboards are not changed as a great deal over time, whereas computer software changes frequently. A teacher without proper technical knowledge faces problems of using technology. The selection of proper technology for the teaching- learning process is also not an easy task since every technology has its potentialities and limitations for the accomplishment of specific learning tasks (Koehler and Mishra, 2009).

Standing at this juncture, a question arises – how can a teacher integrate technology in his/her teaching effectively? How to integrate technology, pedagogy and content knowledge in the teaching-learning process? From these, the idea of Technology, Pedagogy and Content Knowledge (TPACK) framework has been evolved. Punya Mishra and Matthew J. Koehler of Michigan University, USA, are the pioneers of the framework. According to them, the framework is built on Shulman's (Lee S. Shulman, 1986) description of Pedagogical Content Knowledge (PCK) in which Shulman has given equal importance to Pedagogical Knowledge as well as Content Knowledge in the teacher preparation process.

Mishra and Koehler (2006) described how teachers' understandings of educational technologies are required to interact with PCK to produce effective teaching with technology in their TPACK framework. According to the TPACK framework, to teach students effectively, a teacher must be able to use specific technological tools (both hard ware and software) along with relevant content and appropriate pedagogy.

Components of TPACK and their use in Online Teaching-learning Process

In the TPACK framework, three types of knowledge, viz. Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK) are combined and recombined. The brief outline of different types of knowledge and their use for online learning are discussed below:

1. Content Knowledge (CK)

Content Knowledge (CK) is the knowledge of subject matter to be taught or learned. The very fundamental element of teaching is content on which a teacher must have explicit knowledge and understanding. The content of different subjects are different, but some of the common elements of any content are knowledge of central facts, theories, concepts, rules of the shreds of evidence and proofs, etc. (Shulman, 1986). The nature of knowledge and inquiry in different fields must be known to the teachers to teach different subjects effectively, otherwise, students will receive incorrect information and misconceptions about the content.

The content in online learning occupies equal importance as in face-to-face learning. However, the nature of content and process of content preparation for online learning is different from face-to-face learning. A teacher must have sufficient knowledge of content and the process of its preparation for the online transaction to it.

2. Pedagogical Knowledge (PK)

Pedagogical Knowledge (PK) is the knowledge of the teacher about different methods, and approaches of teaching and learning. Pedagogical knowledge also includes teacher's knowledge to process students' learning, skills of classroom management, techniques of lesson planning, and mechanisms of the assessment of student's performance, etc. To know the construction

of knowledge by the students, process of habit formation and students' positive disposition towards learning, in-depth pedagogical knowledge of the teacher is required.

The pedagogical styles of face-to-face learning and online learning are different. Since students are not present physically, the teacher has to plan the lesson differently. He/she has to choose appropriate mechanisms to present the material effectively. The online class management will also be different. Therefore, a teacher has to acquire a number of pedagogical approaches to teach online classes.

3. Pedagogical Content Knowledge (PCK)

On the basis of the content of different subjects, pedagogical approaches will also be different. For example, pedagogical approaches used to teach mathematics will differ from the pedagogical approaches for teaching languages. There are also different approaches to teach a single subject. Pedagogical content knowledge also includes the process of preparing contents for presentation, basic principles of teaching and learning, the process of curriculum transaction, and mechanisms of assessment in relation to contents.

In the online teaching-learning process, a teacher must prepare the material suitable for online presentation. He/ She must break the larger units into small parts for easy understanding of the learners. Though chalkboard and other facilities for effective presentation of content material are not available in online learning, teachers have to prepare slides for power point presentation or pre-recording videos/audios for effective transaction of the curriculum.

The three components, i.e. Content Knowledge, Pedagogical Knowledge and Pedagogical Content Knowledge with their interrelations may be seen from the following Fig. 1.
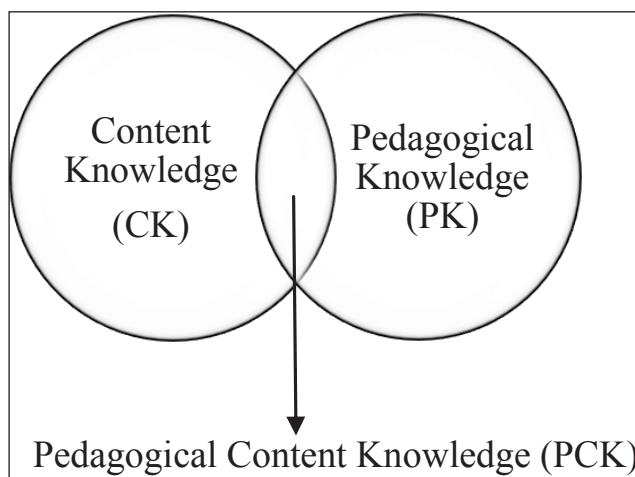

Fig. 1: Pedagogical Content Knowledge

4. Technology Knowledge (TK)

The working knowledge about different technology tools and ability to use them in teaching learning process may be defined as Technology Knowledge (TK). Since technology is changing very fast day by day, a teacher must update his/her technology knowledge. For information processing, effective communication and problem solving, the teacher must have mastery of information technology.

Technology knowledge is very much crucial in the online teaching-learning process. A teacher may be very efficient and loved by his/her students but without technological knowledge he/she will not be capable of taking online classes. Different virtual platforms, social media, groups for communication by messages, etc. are used in the online learning process. The computers (both desktop and laptop), tablets and mobile phones are used to provide online learning experiences. If a teacher is not techno-savvy, he/she may not be able to take online classes.

5. Technological Content Knowledge (TCK)

The plethora of the advent in technology has significantly influenced content of different subjects. Technology has provided new perspectives to understand a phenomenon. The complex calculations of mathematics, astronomy, space science, genetic science, nano-science, etc. have been possible due to advent of technology. The treatments of data of any quantitative research work as well as experiments of scientific researches become possible due to the use of various technological tools. A teacher must have sufficient knowledge of subject matter as well as a deep understanding of the manner in which the subject matter can be changed by application of particular technology (Koehler & Mishra, 2006). The knowledge about content and knowledge about technology incorporated content is different in the context of online

Fig. 2: Technological Content Knowledge

learning. A teacher must have in-depth knowledge about technology-mediated content for online learning. He/she must know how to incorporate different technological tools to make content attractive as well as easily comprehensible for the students. The three components, i.e. Content Knowledge, Technology Knowledge and Technological Content Knowledge with their interrelations may be seen from the Fig. 2.
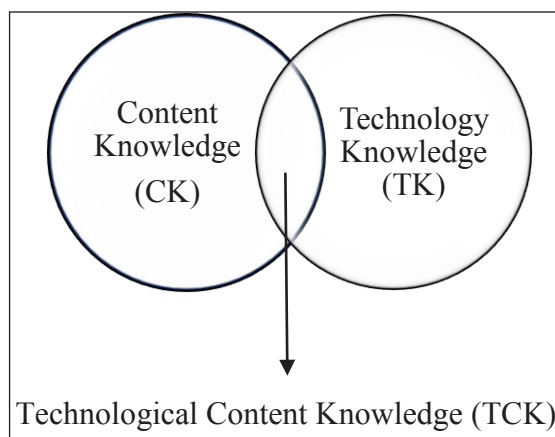
6. Technological Pedagogical Knowledge (TPK)

There is a vast difference between teaching with technology and teaching without technology. Technological Pedagogical Knowledge (TPK) refers to the understanding of a teacher about the effect when different technologies are used in the teaching-learning situation. The teacher must know the pros and cons of using technology in the pedagogical process. The teacher must be aware of the different constraints and affordances of technologies on the pedagogical process.

Fig. 3: Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge is very much crucial in the online learning since most of the software programmes are not solely designed for educational purposes. In this regard, a teacher must be able to select, customize and reconfigure software that will be used for the online teaching-learning process. The teacher must understand the difficulties faced by the learners while using technology in the online classes. The three components, i.e. Pedagogical Knowledge, Technology Knowledge and Technological Pedagogical Knowledge with their interrelations may be seen from the Fig. 3.
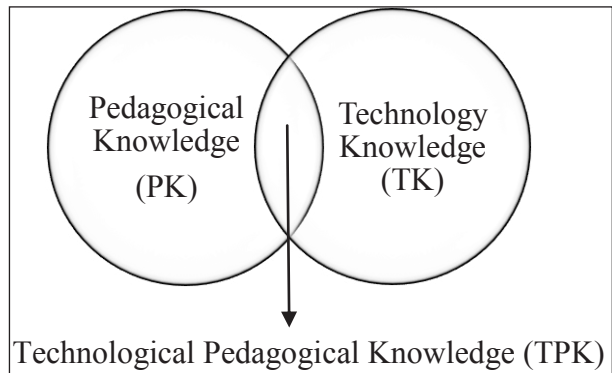
7. Technology, Pedagogy And Content Knowledge (TPACK)

Technological Pedagogical Content Knowledge (TPCK) or presently as it is called Technology, Pedagogy and Content Knowledge (TPACK) emerged from the interaction among three types of knowledge, i.e. Content Knowledge, Pedagogical Knowledge and Technology Knowledge. TPACK is the basis of representation of concepts with the help of technologies; effective teaching model with technologies, pedagogical techniques used for teaching different content in a constructive way; use of technology to redress some of the problems faced by the students related to learning; application of technologies to develop new knowledge based on learners' existing knowledge. TPACK helps to develop good content in which three sources of knowledge, i.e. content, pedagogy and technology, are incorporated. The TPACK framework says there is neither single technology nor pedagogy useful for every teacher in every subject. However, TPACK will help the teachers to understand complicated relationship between content, pedagogy and technology. The diagram of TPACK framework is given in Fig. 4.
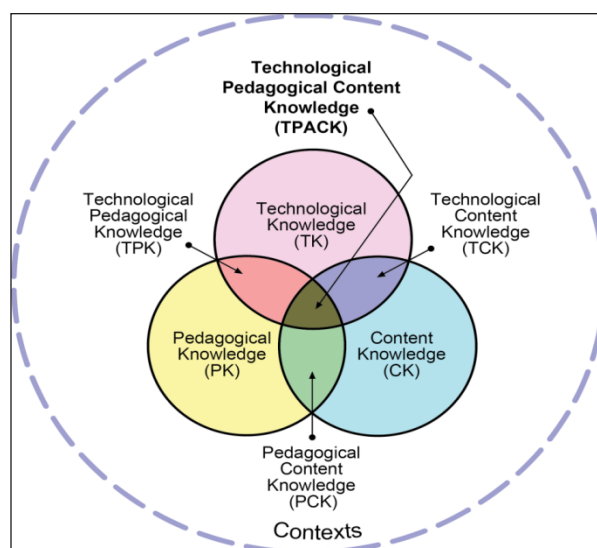
Fig. 4: Technology, Pedagogy and Content knowledge (TPACK)

Source: http://tpack.org

How to represent content on the Web, how to connect students with subject matter (Peruski and Mishra, 2004) are key concerns in the online teaching which, can be addressed with the TPACK. It will help a teacher to incorporate technology in online learning, keeping in mind the various principles of online learning discussed earlier.

CONCLUSION

Online learning is one of the most life-changing innovations of the present century. Education is perhaps the biggest asset of the modern era and online learning has provided a medium to disseminate it among the entire population (Sarkar, 2020). Online education is a boon to the education system of any country due to the following advantages:

❖ Online education is comparatively cost-effective than traditional face-to-face mode of teaching-learning.

❖ It includes wide variety of courses from which students have huge alternatives to choose.

❖ It facilitates the sharing of ideas and knowledge among the students across the globe.

❖ Online education is more flexible than offline modes concerning time and location of the teachers and learners.

❖ In online education, less physical infrastructure is required, which saves huge amount of public funds of a developing country like India.

❖ Since there is the scope of the evaluation of any of the online materials by anybody, there is a possibility of maintaining a reasonable standard of quality.

Though there are many benefits of online education, it is not free from challenges to meet. When different aspects of Indian higher education, i.e. admission, teaching-learning process, examination, etc. will shift from offline to online mode; the students from rural areas with the low economic background will suffer most. They are not always able to afford electronic gadgets like smart phones, desktops, laptops, etc.; they may not have sufficient access to internet connectivity, and many of them may do not have even an electricity supply. The Scheduled Tribe (ST) students, students living in remote geographical areas and students with less technological knowledge will be the worst sufferers. It is seen from the newspapers how students are struggling to get network connectivity by climbing tall trees and sitting on the rooftops of buildings. The major problem is getting accessibility to networks and lack of electronic gadgets like desktop, laptop and smart phones in the Indian context.

For online teaching-learning process, n numbers of technologies are available. All of these technologies are not user-friendly, since they create many difficulties while using them. The difficulties or problems include issues with installation of software, login problems, problems with downloading or uploading and problems related to clarity of audio or video. Many students complain that online learning is boring and un-engaging for them. In the online teaching-learning process, communication becomes one-way, since the students hardly communicate with their teachers. Moreover, teachers cannot give personal attention to the students in the online teaching-learning process. Online learning is mostly theory oriented hat provides little scope to the learners to practice what they learn. Therefore, learning process cannot reach its full potential. Maintaining the quality of course content is also a crucial issue in the online learning. Lack of the presence of peer group or student community, technical problems and difficulties in understanding as well as achieving instructional goals are the major obstacles to the online teaching-learning process (Song *et al*. 2004 in Dhawan, 2020). Researches show that students are unable to balance their social lives, family and work with their study live in the online learning process. The Students are not well prepared for various academic-type as well as e-learning competencies. It is also observed that concerning the usage of Learning Management Systems (LMS), students' preparedness is low (Parkes et al., 2014) in the online learning.

Many issues are attached to online education, but a teacher may fix some of them with the help of the TPACK as follows:

❖ Technical difficulties like poor network connectivity or slow internet speed can be solved through prerecording video lectures, uploading notes and content materials, etc. In this regard, TPACK will be helpful.

❖ Online courses should be made dynamic, exciting and interactive as much as possible with the help of TPACK.

❖ Teachers may use apps like Google Classroom and Google Calendar, etc. to set time limits and reminders for students to make them alert and attentive for the academic activities where TPACK has a role to play.

❖ Efforts should be made by the teachers to humanize the learning process to the best extent possible with the help of TPACK.

❖ TPACK will help to use social media like Facebook, WhatsApp and Twitter, etc. to communicate with students in online learning.

❖ When the teachers think about and adopt innovative techniques to make online learning more effective, the TPACK framework will be useful to them.

❖ For the management of online classes, to get feedback from the students as well as to finalize different assessment mechanisms for students' progress, the TPACK will be essential for them.

❖ Teachers must prepare qualitative online contents under the light of TPACK framework.

In a single line, it can be concluded that TPACK framework has numerous benefits for teachers, especially during the online teaching-learning process. More importance has been given to pedagogy in our teacher education programme till now. However, time has come to give equal importance to technology or technological pedagogy in our teacher preparation process. The competent authorities must look after the matter and take essential initiatives to equip the teachers with TPACK.

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