Research Article

Technology – pedagogy integration by pre-service teachers during internship programme: an analysis with special focus on Science Teaching

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Abstract

The quality of school education has a positive relationship with teachers' training programme in the country. In the era of technological advancements, many strategies and pedagogical practices have been replaced by the technology driven practices. A reflection of this shift has been realized in most of the teachers training programmes; both; pre-service and in-service. However, the extent of integration of content with technology and pedagogy still needs to be studied in details. Also, there is a need to explore the ways of blending content, technology and pedagogy by the teachers in order to provide timely corrective measures. The paper analyses the current status of technological pedagogical content knowledge integration in four years integrated teachers training programme namely B.Sc. B.Ed. of Regional Institute of Education (RIE), Bhopal. It also recommends more synergy towards inclusion of technological pedagogical content knowledge (TPACK) in pre-service teachers training programmes besides suggesting ways for the same

The analysis is based on lesson plan diaries of pre-service teachers maintained during internship period. Results of the study reflect that the pre-service teachers incorporate technology – pedagogy integration in the 30percent lessons during the internship programme. None of the pre-service teachers uses this integration for assessment purpose. Analysis reflects that the prospective teachers need to be made more equipped with the skills of technological pedagogical content knowledge integration. Also, TPACK should be a compulsory component in the curriclum of teachers training programme. At the end, paper discusses difficulties faced by pre-service teachers for integrating technology with pedagogy during their intership programme. Findings of the paper may be used for improvement of pre-sevice teachers training programme with respect to technology pedagogy integration.

Keywords: Pre-service teachers, technological pedagogical content knowledge (TPACK), internship in teaching, science teaching

Introduction

Progress and prosperity of any nation has positive relationship with the quality of education and teachers' training programme of the country. Well-designed teachers training programme leads to the assurance of quality teachers for school education. The very famous quote of Kothari commission has got its relevance always in the school

education system of the country; 'The future of the country is being shaped in its classroom'. As command of the classroom lies with the teachers, it is mandatory that teachers are equipped with all essential skills for designing meaningful learning experiences for 21stcentury learners. Effective use of information communication technology is one of them. Many research studies advocates that the adequate use of ICT in teaching learning processes positively affects students' learning (Bullet, 2011 & Costley, 2014) On the other hand it also mentions a number of barriers associated with the teachers in the way of using ICT for classroom teaching (BECTA, 2004). Literature review also reveals that use of technology in education is strongly affected by teachers' personal factors (Jimoyiannis & Komis, 2008) and personal entrepreneurship is a key factor in a teachers' ability to use technology in teaching and learning (Draper, 2010).In the present context, teachers are required to equip with the essential skills to make best use of technology by integrating it with suitable pedagogy for specific content area (TPK). In the present context teachers are supposed to possess essential skills for integration of content with adequate pedagogy (PCK) and content with suitable technology (TCK). Still, there is a challenge ahead which demands adequate blend of technology with pedagogy and content knowledge. This integration of technology, pedagogy and content knowledge is referred as TPACK (technological, pedagogical content knowledge) (Mishra & Koehler, 2006). The TPACK is not a simple combination of technology, pedagogy and content. Rather it demands interactions and connections of technology with pedagogical content knowledge (Koehler & Mishra 2009). The idea of TPACK has got emergence in the year 2006 by Punya Mishra and Matthew J. Koehler in their work titled "Technological Pedagogical Content Knowledge: A Framework for Teachers Knowledge" (Mishra & Koehler, 2006). According to the TPACK framework, specific technological tools (hardware, software, applications, associated information literacy practices, etc.) are best used to instruct and guide students toward a better, more robust understanding of the subject matter. The three types of knowledge – TK, PK, and CK – are thus combined and recombined in various ways within the TPACK framework (Kurt, 2018).

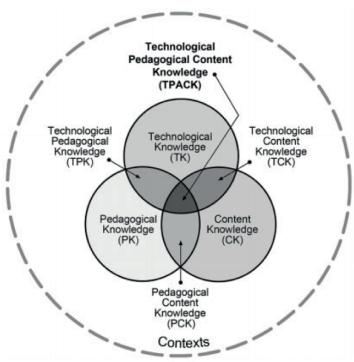

Figure - 1: Technological pedagogical content knowledge model

Need and significance of the research work

It is observed that teachers have initiated the integration of technology with content and pedagogy at various levels of schooling through their own ways. However, the extent of technology, pedagogy, content integration is not clear. In the same manner, pre-service teachers also have been found to take

care of this integration during internship programme. There is an urgent need to realize the extent of content, technology, pedagogy integration being practiced by the teachers so that the required input can be provided for further improvement in this area. Further, there is a need to identify the difficulties felt by the teachers and address them timely. Research studies conducted in this area also suggest the need of exploring the current trends of TPACK in the field of science education (Setiawan, 2019).

Objectives

- To find out the status of technology – pedagogy – content knowledge integration in science subject (at upper primary and secondary level of school) by pre-service teachers during internship programme.
- To find out difficulties faced by pre-service teachers for technology – pedagogy - content knowledge integration in science subject during internship programme.
- To provide suggestive measures for technology – pedagogy - content knowledge integration in science subject for pre-service teachers.

Methodology

The study analyses the present status of technology pedagogy integration in pre-service teachers training programme. This analysis is based on randomly selected 25 lesson plan diaries of pre-service teachers (maintained for Internship in Teaching Programme during July – September, 2019) in the subjects namely; Teaching of Physical Science and Teaching of Biological Science at upper primary and secondary level of schooling. The lesson plan diaries were analysed with the intention to identify the lessons where teacher trainees have tried to integrate technology with the pedagogy with the help of a self-prepared tool. Further, extent of technology - pedagogy integration was analysed with special focus on mode of integration and type of technology used. Pre-service teachers were interviewed to know about the difficulties they face in order to practice the idea of technological pedagogical content knowledge.

Samples

After the completion of internship programme, pre-service teachers are required to submit their learning situation notes (lesson plan diary) in the institute. A number of 25 lesson plan diaries were randomly selected for this study. Randomly selected 25 lesson plan diaries of pre-service teachers (students of B.Sc. B.Ed. course of Regional Institute of Education, Bhopal, Madhya Pradesh). 20 pre-service teachers for focus group discussion (regarding difficulties faced by them for integration of technology, pedagogy and content knowledge) were randomly selected.

Result and Discussion

Internship is an important activity of pre-service teachers training programme of Regional Institute of Education, Bhopal. All essential theoretical inputs for real classroom teaching are provided from first semester onwards to the pre-service teachers. As a requirement of syllabus, pre-service teachers (B.Sc.

B.Ed. students) in their seventh semester (4th year) are required to create a total of 40 learning situations in the identified schools. Prior to this, students are exposed to rigorous preparation for teaching in real classroom situation through Core training Programmes I and II. During fifth semester (third year), they are exposed to various activities of the schools under 'School exposure programme'. In the sixth semester they are provided opportunities for development of essential skills for integration of pedagogy with content knowledge. In semester VII (fourth year) students are again exposed to Pre Internship Training Programme before they actually go to the schools for Internship. As a requirement of syllabus, students maintain 02 lesson plan diaries; one each in their 2 selected pedagogical subjects (ref.; syllabus for four year integrated B.Sc. B. Ed. Course, RIE, Bhopal). An analysis of such 25 randomly selected lesson plan diaries (in teaching subjects namely; Teaching of Physical Science and Teaching of Biological Science) having 20 learning situation notes in each diary was done.

Table-1 shows the practices adopted for technology, pedagogy and content integration by pre-service teachers in the schools during internship.

Table-1: Practices adopted for technology, pedagogy and content integration in the learning situations

S. No.	Content	Class	Practices adopted for technology-pedagogy integration
1	Crystallization (Separation Method) Ionic Compound	VII	Video on purification of salt Video showing transfer of valence electrons from metal to non-metal
2	Thunderstorm & Cyclone	VII	Video of Thunderstorm & Cyclone
	Destruction caused by cyclone	VII	Images on after effect of destruction by cyclone
3	Climate, Adaptation	VII	Photographs of different regions (polar, desert) & of penguins
4	Nervous Tissue	IX	Animation of working of nerve system
5	Cell	VIII	Comparative image of animal & plant cell
6	Tissue	VII	Images of types of tissue
7	Structure of Atom	IX	Animation showing structure of atoms and spins of electrons
8	Friction : a necessary Increasing & reducing friction	VIII	Video on how friction works
9	Soil Profile	VII	Images of layers of soil
10	Percolation rate of Soil	VII	Video on percolation, how soil absorbs or holds water

11	Blood Vessels, Heart	VII	Video on how blood flows in heart and vessels
12	Digestion in Human: Mouth & Buccal Cavity	VII	Images of interior of mouth and buccal cavity
13	Cell : Introduction	VIII	Image of first cell discovered, microscopic image of cork cell
14	Some Plant Fibres: Cotton, Jute, Spinning, Cotton yarn	VI	Video on how different fibres are obtained
15	Plastics: characteristics of plastics	VIII	Video on how we can use plastics efficiently & why should we avoid using plastics
16	Evaporation and condensation process	VI	Videos on process of condensation and evaporation
17	Saturated Solution	VI	Videos of solution preparation
18	Water Cycle	VI	Videos on water cycle
19	Molecule and ion	IX	Video on how molecule and ions are formed
20	Daltons & Atomic Theory	IX	PowerPoint presentation
21	Sources of Water	VI	Images of different sources of water
22	Methods of Separation	VI	Videos on different methods of separation
23	Magnesium	VII	Video of Burning of magnesium
24	Method of separation	VII	Video of winnowing
25	Thunder storms & cyclone	VIII	Pictures of the natural calamities
26	Wind, storm & cyclone	VIII	Video of cyclone
27	Story of coal	VIII	Images of natural resources
28	Types of coal	VIII	Images of different types of coal
29	Polar regions	VII	Images of animal living in polar regions
30	Tropical rainforest	VII	Images of animals
31	Conservation of plants & animals	VIII	Images of area of forest before and after
32	Conservation of plants & animals	VIII	PPT & video of national parks & animals living there
33	Climate, whether & adaption	VII	Video- animals adopted to particular area
34	Climate, whether & adaption	VII	Video – animal living in tropical region
35	Body movement	VI	Video regarding movement of earth worm, fish & snail

36	Dell structure & function	VIII	PPT for comparison b/w plant & animal cell
37	Living organism & their surrounding	VI	Video (animals and their surroundings)
38	Reproduction in animals	VIII	PPT male reproductive system
39	Reproduction in animals	VIII	PPT female reproductive system
40	Transportation in humans	X	Circulation of blood (Video)
41	Plastids & Vacuoles	IX	Video showing plastids & Vacuoles
42	Plant tissue	IX	Video showing types of tissues
43	Animal nervous system	X	Video of conduction of nerve

The outcomes of the analysis of lesson plan diaries and discussions with students are presented in the subsequent paragraphs.

Review of lesson plan diaries

The pedagogy and content are the indistinguishable part of each other (Shulman, 1986). For each piece of content, pedagogy is must for teaching. PCK (pedagogical content knowledge) of pre-service teachers is found satisfactory. After analysis it is found that all the pre-service teachers (100percent) have tried to incorporate technology with content (TCK) during their internship programme. However, this integration is observed only in 30percent learning situations which mean that out of total 20 learning situations, integration is practiced only for 6 learning situations. Also, the finding reflects that extent of technology content integration is not very appropriate. For example, while teaching about separation methods, a video on crystallization of salt was shown. It is found that video was shown in the isolation after the explanation of the concept. In this case it is expected that after the completion of video, teacher will hold a discussion about crystallization and relate it with various known examples from students surrounding. Also, video may be paused in between and students may be given opportunity to share their understanding about the concept. Further, paused-time may be used by teacher to provide additional inputs to the students. In the same manner, teacher has explained the concept of ionic compounds and after that she shown the video about transfer of valence electrons from metal to non-metal. In this case also an adequate blend of technology with pedagogy is lacking. Another example of inappropriate timing of use of technology in the class includes a video on burning of magnesium. Video was shown in the beginning of the lesson. In the later part of lesson, during discussion about the properties of metal, teacher fails to establish a connection between the video shown and the concept (properties of metals). In this case too, teacher was not able to establish a strong connection of used technological means with pedagogically

appropriate timing and with content. Further, pre-service teachers are not able to select an appropriate technological tool for a specific content and blend it with appropriate pedagogy. This is another important area which needs to be addressed by pre-service teachers. Power point presentation (without any animation) is used for class IX students for teaching of Dalton's Atomic Theory which is not very appropriate to the content and to the cognitive level of learners. Instead, some other more effective tools have been used at this stage where students are just introduced about atom and other related sub-concepts.

Although students have used some power point presentations, videos, etc. during the teaching of a particular concept but they fail to establish a connection of that concept with slide presentation or video at appropriate time. It is found that various technological means were used in isolation during teaching and were not integrated with the concepts properly. In most of the cases, it was observed that various technological means were used only for the sake of using technology during teaching. Majority of students use images, GIF images, power point presentations, animated videos and videos of real life situations (self-recorded), etc. for integrating content with pedagogy. None of the students has used technology for assessment purpose. With respect to TPACK (technology, pedagogy and content knowledge), it was found that pre-service teachers fail to integrate and interrelate technology and pedagogy with content knowledge meaningfully.

Findings of the focus group discussion

A discussion with the prospective teachers brings their difficulties on the surface. It has emerged from discussion that they are not able to understand the complex interrelationship between the technology used by a teacher, instructional methods and understanding of subject matter. Majority of pre-service teachers are well versed with the existing technological advancements but they find it difficult to establish a meaningful interrelationship between technology, pedagogy and content to be taught. Though pre-service teachers use technology in several ways such as video, presentation and images, etc. However, they fail to relate these effectively with the content. Another important point which has emerged from discussion is about identification of appropriate timing to use technological tools during teaching learning processes. Sometimes they use the technology during teaching just for sake of using. Most of the pre-service teachers have technical knowledge and understanding of pedagogical aspects of science teaching but they lack the knowledge to integrate technology, pedagogy and content knowledge (TPACK). Majority of pre-service teachers consider lack of proper guidance for integration of technology, pedagogy, and content knowledge as a major difficulty. Another barriers point to lack of training for creating their own technological teaching-learning resources, lack of infrastructure in majority of schools during their internship period, shortage of timing during pre-internship phases and difficulty in selection of suitable

pedagogical strategy for a specific content.

In a nut shell, it is reflected from the analysis that 100percent pre-service teachers try to integrate technology with pedagogy in their class during internship programme in the schools. Teachers having internships in KendriyaVidyalayas and NavodayaVidyalays reflect better evidences for integration of technology with pedagogy and content knowledge. This may be because of better infrastructural facilities and guidance of teaching staff of these schools as mentors and cooperative teachers... Further, pre-service teachers tried the idea of integration in very less number of learning situations (6/20 which is 30percent). This seems more disappointing when viewed in relation with science subject which provides many opportunities for utilizing the idea of TPACK.

Extent of technology – pedagogy integration is also not very appropriate. Though pre-service teacher use technology in their teaching but are not able to integrate it with pedagogy and content knowledge. Majority of pre-service teachers treat technology separately from pedagogy and content. All of them use images, GIF images, power point presentations, animated videos, videos of real life situations etc. for integrating knowledge with pedagogy. But they fail to integrate their content knowledge with technology. Science teaching provides very vast scope for integrating technology for assessment purposes. In the present analysis such integration is nil.

Conclusions

The analysis reflects the demand for more concrete efforts on the part of science teacher educators in the direction of TPACK. There is a strong need to incorporate the concept of TPACK in the teachers training programme in order to equip prospective teacher to meet with the future challenges in class rooms.

Analysis reveals that pre-service teachers are able to integrate technology with content up to some extent (30percent only). However, they fail to integrate technology and pedagogy with content for effective classroom experiences for their students. Technological tools used by pre-service teachers are also common. Majority of them used images, GIF images, power point presentations, animated videos and videos of real life situations (self-recorded), etc. in their classes. The prospective teachers need to be more sensitized and equipped with required skills to practice technology, pedagogy and content knowledge integration in the classroom settings.

Way forward

In this technological driven society, not only teachers are required to be aware of latest technological advancements but to be able to integrate PCK (pedagogical content knowledge) with the upcoming technology. For this purpose, TPACK should be incorporated in the syllabus of teachers training programme (Apau, 2017). Pre-service teachers need to be provided adequate learning opportunities to internalize concept of TPACK (technological pedagogical content knowledge) not only theoretically but to practice it properly before they placed for internship in

various schools. Also, there should be proper opportunities to develop required set of skills to design learning experiences using technological, pedagogical content knowledge in the routine classrooms in schools. Science teacher educators should model TPACK in such a way so that pre-service teachers have better opportunities for learning through observation throughout the entire course. The greatest value to the science teaching in the class rooms can be added only when the teacher has a high technological pedagogical content knowledge. Expectations and training needs of pre-service teachers are also to be taken into consideration for designing syllabi comprising TPACK components and for identification of training strategies

Teacher training programmes are considered as the backbone of education system in India. Future of country depends on the quality of education in the schools. Quality of education is directly proportional to quality of school teachers. In order to meet the future challenges of the classrooms and the demands of the new age learners, teachers should be able to design adequate learning experiences by generating technological, pedagogical content knowledge integration for their learners. Training on TPACK should be incorporated in the curriculum of teachers training programme. An analysis of difficulties faced by teacher educators related to TPACK may also be done. This analysis can help the science teacher educators for better understanding of their learners' difficulties. Identification of grey areas in this regard will provide focused directions for better use of TPACK for science education.

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