Exploring teacher development in an ICT programme through the TPACK framework

Sriranjani Ranganathan and Gurumurthy Kasinathan, IT for Change

Table of Contents

1 Context

The Indian “National Curricular Framework for Teacher Education, 2009[1]“ (NCFTE, 2010), has recommended teacher development programmes that are need-based, self-directed and supporting peer learning and continuous professional development. The “National Curricular Framework NCF 2005“ speaks of building higher order skills of learning, conceptual understanding, developing scientific temper and building a just and humane society, besides building on skills of literacy and numeracy. Integrating technology into the educational processes has also been emphasized by these documents to improve the quality of education.

The ICT programmes implemented by the government, however, have had several difficulties. The

1 The NCFTE is a landmark document on teacher-education from the Indian National Council for Teacher Education available on http://www.ncte-india.org

implementation of this programme has been outsourced to vendors in most states. Technology integration in teaching learning has ranged from training teachers in making powerpoint presentations, to supplying educational videos to beaming educational content through satellite TV. With the lack of a formal ICT curriculum, until recently, teachers have often been perceived to be unable or unwilling to learn technology for their own learning or for teaching learning. With the formulation of the National ICT Policy and the ICT curriculum, the emphasis on ICT in education has been on teachers‘ creation and sharing of digital learning resources.

In educational theory, the intersection between pedagogy and content has been well developed. The more recent Technological Pedagogical Content Knowledge framework talks of content, pedagogy and technology as three domains of teacher knowledge. TPACK[2] has been theorised as a framework for looking at teacher knowledge and practice. The intersections of technology-content, technology-pedagogy and technology-content-pedagogy are useful to consider while designing ICT programmes.

It is in this context that the state of Karnataka implemented the Subject Teacher Forum program with the core principles of integrating technology tools for teaching learning, creating resources and building collaborative networks for learning and sharing. Implemented over 5 years, the program demonstrated[3] that teachers are able to use technology for their own learning as well as for teaching learning and creation of digital learning resources. Based on the experience of this program, the state of Telangana decided to take up an ICT implementation program, focusing on resource creation and teacher training and the development of an ICT syllabus for the state.

Through a case study of the Telangana ICT program (referred to as IT@Schools), the paper seeks to explore teacher development in an ICT program through the TPACK framework.

2 Description of the Telangana program

The Telangana IT@Schools programs had three components

1. Creation of digital content, as Open Educational Resources (OER) by a core group of teachers
2. Creation of Master Resource Persons for forming technology enabled professional learning communities, integrating ICT for subject teaching and for resource creation creation
3. Design and development of ICT student text book and teacher hand book, in line with the NCERT ICT curriculum

2 TPACK Development in Teacher Education: A Longitudinal Study of Preservice Teachers in a Secondary M.A.Ed. Program, Mark Hofer

3 Case Study by Prof Rajaram Sharma on the STF – KOER program

2.1 Development of digital content workshops

Objectives

These workshops were the pilot initiated by the Telangana education department for ICT integration in schools. These workshops were conducted with mathematics, science and social science teachers for creating digital resources for teaching learning for classes 6-10.

The objectives of the programme were:

i. Creation of a core group of teachers who would create digital content

ii. Introduction to different subject based and generic resource creation tools for digital resource creation, in a free and open source software (FOSS) environment

iii. Demonstrating models of ICT Integration in teaching learning processes with appropriate digital content, and an introduction to the Technological Pedagogical Content Knowledge framework

iv. Introduction to methods of leveraging technology to build communities of learners

Workshop curriculum and processes

Two workshops were conducted for a combined cohort of mathematics and science teachers and two workshops were conducted for social science teachers. All the workshops were for a duration of 5 days. In addition, for a select group of teachers, there was also an introductory workshop held on introduction to tools for creating animations, also for 5 days. The workshops were conducted between March – June 2015. All the workshops were conducted in computer labs. IT for Change acted as the resource institution for these workshops and the authors led this program.

The agenda of the workshops focused on training on basic digital literacy, learning FOSS educational applications and generic authoring tools for OER creation and for subject teaching and using technology for connecting and learning. The agenda also included integration of ICT in teaching learning processes. The participants were also introduced to the principles of OER and open licensing.

The workshops comprised presentations from the resource persons, demonstrations and hands-on work by the participants. They were also required to present their portfolio of resources for sharing and peer review. Participant information was collected at the beginning of the workshop and participant feedback was collected at the end of the workshop.

2.2 Teacher training workshops

Objectives

The IT@Schools program decided to strengthen the resource creation through a professional learning community[4] approach and extend the technology training to all the teachers in the state. This required the creation of resource persons who would do the training in the districts[5] across the state. Keeping in view the available infrastructure, it was decided to take up the training for mathematics and science.

The objectives of the programme are :

i. Creation of a pool of resource persons who could conduct the teacher training across the state

ii. Introduction to different subject based and generic resource creation tools for digital resource creation,in a free and open source environment

iii. Demonstrating models of ICT Integration in teaching learning processes with appropriate digital content, and an introduction to the Technological Pedagogical Content Knowledge framework

iv. Introduction to the methods of leveraging technology to build communities of learners

Workshop curriculum and processes

Two workshops each were conducted for mathematics and science teachers. All the workshops were conducted in computer labs. All workshops were for a duration of 5 days and were conducted during December 2015. A core group of teachers trained in the earlier resource creation workshop, co-facilitated this with the resource persons from IT for Change, led by the authors.

The agenda of the workshops focused on training on basic digital literacy, learning FOSS educational applications and generic authoring tools for subject teaching. The workshop also trained teachers on using internet and email for accessing resources and connecting with one another respectively. The curriculum was built along three strands – technology for connecting, technology for creating and technology for teaching learning.

The workshops comprised presentations from the resource persons, demonstrations and hands-on work by the participants. They were also required to present their portfolio of resources for sharing and peer review. Participant information and feedback was collected during the workshop.

4 A case study by Prof Rajaram Sharma, finds that a professional learning community of teachers can engage with technology and has the possibility of creating resources

5 At the time the program was conducted, Telangana had 10 districts

2.3 Curriculum development

To support the effective implementation of ICT integration in teaching learning processes, the Telangana education department decided to develop a curriculum for the students and a supporting curriculum for teachers. In a planning meeting in February 2016, the state along with Central Institute of Educational Technology (CIET) and IT for Change decided to adopt the National ICT curriculum for its ICT textbook as well as take up the creation of OER in the state. It was also proposed to develop the textbook in a participatory and collaborative manner.

Objectives

1. Formation of a core group that would lead the implementation of the new ICT syllabus in the state, including text book / hand book implementation as well as guide the OER creation and publishing
2. Developing activities for the textbook and notes for the handbook in a collaborative way with a select group of teachers
3. Developing the textbook, handbook and the processes for OER creation, OER review and curation and OER publishing
4. Developing a training plan for teachers for the implementation of the text book

Workshop curriculum and processes

The agenda included a familiarisation and overview of the National ICT curriculum and the possible adaptations to be done by the state. A roadmap for OER adoption was also presented as a draft for the state to finalize. Participants in the workshop included senior teachers, many of who were textbook writers and were recognized for their academic and pedagogic understanding, as well as officers from the SCERT and faculty from the State Institute of Education Technology.

A process note was developed for the textbook development and OER processes and discussed in the first workshop in September 2016. Based on this, a draft textbook with outlines for chapters and activities was discussed in a workshop in October 2016. The chapters were refined in this core group and also was discussed in a review with CIET. Subsequently the textbook chapters were reviewed and the OER processes were finalized in another workshop in November 2016. The initial consultation was for 2 days while the other two workshops for 5 days each. The workshop included presentation, demonstations, hands-on work and discussions by participants.

2.4 Approach of this paper

This paper examines, through a case study of this program, how teacher development along the

different domains in the TPACK framework has been observed during the program processes. The analysis is based on the authors‘ participation and observations in the workshop and a review of transcripts of presentations, discussions, resources created and participant feedback forms submitted. The analysis will attempt to delineate the different strands of TPACK and also to explain teacher attitudes and beliefs about technology and teaching learning. This paper investigates if teachers carry ideas about pedagogy and technology integration, in addition to their beliefs and theories on the nature of learners, which affect the way they explore digital technologies. The selection of teachers who participated in the training and resource creation workshops was based from a pool of “tech-savvy” teachers and therefore, there is reason to believe that teachers have had enough technology expeience to have beliefs about technology use.

The strands examined in this paper include Technology Knowledge, Technology Content Knowledge (TCK), Technology Pedagogy Knowledge (TPK) and the development of TPACK and teacher beliefs on each of these. The findings are presented for the teacher training and resource creation workshops and the curriculum development workshops, compared wherever applicable.

3 Technology Knowlege

In the teacher workshops, the focus was on using different technologies. Participants had been users of a proprietary software environment before and their participation in the workshop seemed to be significantly influenced by this experience. While teachers were more confident about using technology, based on their prior experience, their progress varied depending on the length of technology use.

In the curriculum development group, the focus was on understanding the possibilities of different technologies and the participants did not practice as much with creation using different applications. The group also had relatively lesser exposure with technology as compared with the teachers‘ groups.

3.1 Technology learning vis a vis educational processes

In the resource creation and technology training workshops, teachers tended to see technology learning as an independent activity. For the most part, their imagination of their role as teachers did not seem to include technology as a domain of learning. Some teachers were however exploring tools and technology. Technology was largely seen as an instrumental.

The curriculum development group, tasked with developing a curiculum on technology and its possibilities, was able to understand that different technologies could be methods for delivering

educational objectives. For example, the building of a resource library, using the global digital library of the internet, was seen as an educational process which involved the learning of using a browser and accessing the internet. They could see that a building of a portfolio was a form of designing a formative assessment. It is interesting to note that they were able to make the connection without actual hands-on practice of using the internet or downloading information.

3.2 Technology learning is seen as tool learning

Some teachers were open to exploring a new technology environment while others seemed to need more time; this was correlated with their years of prior technology use. Teachers with experience of using technology tended to look for similar tools and features in the new environment. "Let us learn technology first" seemed to be the approach taken by the teachers; learning technlogy was fascinating for many; they focused more on the tool features and less on the underlying processes of resource creation. This was also articulated in discussions during the workshops. Teachers appeared to be more interested in the mechanics of how to use a file or a video or a simulation than examining what are the aspects of video making that can make it relevant for a given situation.

On the other hand, the curriculum development group was focused on defining processes of learning and was able to fit technology solutions for those processes. For example, the ideas of making a pictionary, comic strip and an illustrated, audio read-aloud book were seen as expressions of language competence. These processes were then mapped to the ICT competencies sought to be developed.

3.3 An appreication of the FOSS environment

Teachers created resources using text editors, concept mapping tools, Geogebra, screencast recorders and image and video editors. They also engaged with the socio-political issues surrounding technology in terms of relevance of Free and Open Source software as well as Open Educational Resources (OER). While teachers understood OER, they did not necessarily make the connection between creation of OER and the use of FOSS tools. Many teachers who had been using proprietary applications before were attempting to recreate their resource ideas using FOSS. We also observed OER processes of revision and remixing in the workshops as teachers accessed existing resources from the internet, modified them and combined different formats of resources. The core group involved in the curricular and OER development were very aligned to the idea of FOSS and OER. This allowed this group to suggest and articulate ideas like collaborative creation in classroom activities and cumulative portfolios to assess learning.

4 Technology content knowledge

Teachers created resources either to explore the functionality of a tool or to recreate the content from the textbook to have a digital representation for use in classrooms. They also looked for specific tools and resources for supporting an existing pedagogic practice.

Some examples of resource creation are described in the box below.

Identifying resources for known requirements

Teachers identified an existing classroom practice (constructions in geometry) as difficult and accessed resources for demonstrating this to a large class. Teachers also learnt to use spreadsheets for data and record keeping.

Subject specific tools – use of Geogebra and simulations

Teachers created resources using Geogebra to illustrate different concepts in mathematics (geometry) and for visualizing proofs and exploring concepts. Some resources were also being created to get famiiar with the tool. Many teachers in this workshop did not use simulations to create resources.

Reusing resources

A teacher identified a video shared as Creative Commons and made a revision[6] to add text and a narrative in local language; this was a video on human reproduction.

Combination of resources to tell a story

Teachers combined images/ photographs to create video stories of concepts/ ideas. A teacher collected photographs of farms/ farm processes and created a video on agriculture. Another teacher wrote a poem, composed the music and identified objects to be photographed and actions to be video recorded for a lesson on perimeter

4.1 Techno-deterministic view of content

Teachers‘ ideas of content creation were often driven by their technology comfort. The more comfortable a teacher is in technology, the more they saw content in terms of the tool‘s universe of possibilities. As a corollary, if a particular content was possible to produce with a tool, teachers went ahead with it, the primary purpose being mastery of the tool to creaete content. An evaluation if such a content representation was necessary or useful was not made before the creation of content. A related aspect is the belief that teachers often expressed that a good technology resource

6 With an awareness of sharing-revision under Creative Commons, as OER

can make the content easier to understand. For example, in a case of explaining perimeter of a figure by creating styrofoam balls and counting them, a teacher time creating powerpoint animations of styrofoam balls. The teacher did not use Turtle Art or Geogebra for explaining perimeter. Teachers saw technology learning as an enabler and did not distinguish between the use of technology learning (this includes digital literacy in terms of tools, processes and the socio political aspects) and technology for learning. The idea that technology altered the content to be learnt was contested by the teachers during our discussions on TPACK in the workshops. For example, the use of a tool called Turtle Art to develop the skill of computing was not considered important by the teachers.

The textbook development workshop, on the other hand, had used a wikibook[7] platform to develop the textbook. Wikibook was chosen to demonstrate through a technology platform, the idea of collaborative creation of the textbook. For example, a web-based organization of resources allows one to see a clear integration of various digital possibilities and resources as against a simple text document with links. A wiki allows the teachers to see possibilities of connecting to multiple topics and allows to visualize a collaborative creation environment. The core group‘s conception of how content can be built was influenced by this choice of method.

4.2 Technology can reinforce the textbook culture

"E-content to support pedagogy" was the main theme of the teacher workshops. The teachers had a very strong sense of pride about their textbook and the digital methods were only sought to replicate and support the physical activities described in the textbook. Teachers seemed to prefer static content that reflected the textbook. E-content was for transmission, Both the digital content and teacher training workshops saw this.

The textbook development group was very critical of the resources developed by the teachers which tended to be digital replications of the textbook. They were quite categorical that such a replication does not build creativity and voiced their opinion that content created in the classroom is true knowledge and were keen that the ICT program and syllabus develop such competencies. They were able to see how a classroom can create content together and generate knowledge when an appropriate platform is chosen.

7 This is a Mediawiki extension which allows an idea to be presented in a sequential, hierarchical way rather than in a hyperlinked way

5 Technology pedagogy knowledge

5.1 Technology to support current pedagogic practices

Teachers tended to create resources largely to support their current processes of teaching learning. Traditional classroom methods involve telling and an explanation by the teachers which the students are expected to understand. The visualization provided by technology was seen as supplementing their teaching learning processes and support comprehension. Teachers‘ hidden belief was that they knew how to teach and that technology was merely to help students understand and grasp better. Lesson planning was still imagined as per the current textbook. For example, on a time-elapsed video about the properties of yeast, the questions framed by the teacher included the following - (i) what is the name of the organism in this, (ii) where else was it used? Some of theese questions could not be answered from the video. It is evident that the teacher was not using the video to construct a lesson on actually building an understanding around the fermentation process but rather as a digital illustration of an activity already given in the textbook.

The textbook for the state emphasizes projects, however, teachers did not seem to connect these projects to technology. For example, students making a Geogebra sketch to visualize a problem or work with simulations to construct their knowledge was not something they could relate to. One possible reason that the pedagogic intersection of technology could be limited is due to the availability of adequate ICT infrastructure, in the absence of which technology was seen as something that was an add-on.

This has an impact on their own professional development as well. For example, if the emphasis is on technical competence to use a browser, teachers will take a longer time to come to the idea of a personal digital library for their own professional development.

5.2 Role of pedagogy in technology learning

Technology learning was often seen as a non-academic activity and the real “pedagogy“ was determined by the experts. Technology was merely a tool and was not seen as either requiring a pedagogy or as a possibility to alter pedagogy. In a subsequent development of the digital content creation, teachers have been scripting video lessons of 40 minute duration, suggesting a very strong inclination to keep the existing processes.

During one of the workshops, the authors presented the TPACK framework and demonstrated a lesson in Geogebra where students explored triangles starting from three intersecting lines. The session did not get much participation from the teachers, suggesting perhaps that this line of thinking about teaching learning is new to them. While TPACK with demonstrations was

conducted in all workshops, it is with the curriculum group that this could be explored in terms of the way content is being developed and the implications on pedagogy. Some of the ideas articulated by this group that could bring the elements of TPACK include local resource creation, creating to express themselves, and portfolio learning. Such a group was more readily accepting of the technology possibilities, though they themselves used technology much lesser than the teachers.

The textbook development committee on the other hand visualized a textbook that is situated in doing by the students. The entire textbook was conceived as a set of student activities to explore different dimensions of ICT learning as well as ICT for learning. Recognizing the need to have teachers understand this approach, the committee insisted on a teacher handbook development that brought in the ideas of using technology for supporting student learning by doing including using a digital portfolio based system of assessments. The digital artefacts were suggested to be produced individually and in groups are seen as a curricular resource and a cumulative portfolio was selected as the method of assessment for the ICT textbook.

6 Factors that can influence the understanding of TPACK

6.1 Teachers' philosophical beliefs and experiences in technology

Teachers hold beliefs about the relevance and possibilities of technology in schools. These are often driven by their own learning paths of working with technology. Technology is seen as something that is not really basic and can be fit into existing content and current processes. Specifically teachers view technology primarily to address diffculties in content and are often sceptical about technology replacing real skills. For example, one concern expressed by mathematics teachers is that use of Geogebra will impact hands-on work by the students. Typing is assumed to take away writing skills. Such beliefs reflect a different view of the educational processes of writing or mathematical constructions. Addressing this is an important aspect of teacher development.

6.2 Teachers' philosophical beliefs about education

Technology can disrupt legacy methods of teaching; by allowing participation, collaboration. Teacher may not be seen as the only authority in the class. If the purposes of education are understood in terms of knowledge transmission and the teacher genuinely believes that instructing is important for concept acquisition, teachers may not see the value of a technology integration that allows students to set up an inquiry based project for exploring an idea. For example, if community knowledge is seen as relevant by the teacher, documenting the knowledge will form an important aspect of the pedagogies and digital story telling will fit very appopriately as the pedagogic choice.

6.3 Curriculum as a vehicle to drive the TPACK integration

Curriculum development was identified as important to launch the program; this decision about a directionality of implementation itself of great pedagogic value. Processes of learning, how these can be mapped to different technologies and how to learn the technologies were discussed as part of the textbook development. A syllabus that articulates the integration of technology in teaching learning and makes demands of changing pedagogies can support movement in the direction.

6.4 Strength of teachers' pedagogy content knowledge

Teachers' strength of pedagogical content knowledge can influence the understanding of technology in education. If teachers are able to situate learning through processes and projects, demonstrating how technology fits in, we may be able to see more practices with TPACK emerge. However, the deepening of PCK itself may require an engagement with technology to allow teachers to connect and learn, create an collaborate.

7 Conclusion

It is too nascent to conclude about the effectiveness of training programs in developing TPACK among teachers. However, it seems that a stronger understanding of the learning processes could lead to more effective instantiation of TPCK. On the other hand, it can also be argued that as teachers interact with technology more, they are likely to be able to abstract areas of effective integration in teaching learning. It would seem a contradiction in terms to deliver a training program on TPACK. Rather designing an ICT training program that allows teachers to experience the various affordances of technology in terms of connecting with each other, learning and creating could help evolve the TPACK knowledge in teachers.