Pedagogic Transformation: Comparing Educational Technology in the US and India

Panchalee Tamulee
Tata Trusts, World Trade Centre, Mumbai - 400005
E-mail: ptamulee@tatatrusts.org; Tel: +917208382345

In the last 15 years, the US and India have witnessed increasing bilateral cooperation on broad and multi-sectoral matters especially in the field of education and technology. This has led to enormous policy borrowing and practice sharing in educational technology from the US. Acknowledging the contemporary strategic ties between the countries, this paper compares the historic evolution of educational technology as pedagogic transformation within the K-12 classrooms to identify the critical factors contributing to the contemporary educational technology scenario in the respective countries. The TPACK framework of educational pedagogy is used to analyze and determine the evolutionary journeys of pedagogic transformation during the Digital Phases: the personal computer and the internet. While comparing the two countries, it is found that independent socio-cultural and political factors have influenced the specific trajectory. Thereby, making the scientific investigation of the ‘contextual forces’ affecting the pedagogic transformation of educational technology within both the home (the US) and the target (India) key to policy-makers.

Key words: Education technology, Policy Borrowing, Pedagogy, India, Socio-cultural Influences, TPACK, comparative study, ICT in education

INTRODUCTION

"Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is most important." – Bill Gates (Bain and Zundans-Fraser, 2017)

The influence of technology in varied aspects of society and commerce is inevitable. It has been more than 100 years that technology integration, in the form of its earliest version of media, was introduced into the teaching and learning process. This continuous attempt of integration could be divided into three ‘ages’: 1. Pre-digital, 2. Digital phase: personal computer and 3. Digital phase: the internet (Howard and Mozejko, 2015). With the emerging urge of generating human capital in the 21st century, world education systems have been promoting digital education as a strategy for socio-economic transformation. Furthermore, in recent times with the novel Covid-19 pandemic, there has been a global increase in promoting educational technology among schools and higher education institutes (HEIs). On the other hand, by the mere introduction of educational technology, organic pedagogic change is not evident. It is the teachers and their pedagogic choices but also, as Michael Sadler articulates, ‘we should not forget that the things outside the schools matter even more than the things inside the schools, and govern and interpret the things inside’ (Sadler, 1900, p.49; Phillips and Ochs, 2003). As an experienced practitioner, I am troubled by the socio-systemic aspects that influence the integration of educational technology into pedagogy and curriculum. In this paper, I reflect on the pedagogic transformation and factors that have influenced the evolution of educational technology in the two countries: the US and India during the two Digital Phases: personal computer and the internet.

CONTEXTUALISATION

In the last 15 years, the US and India have witnessed increasing bilateral cooperation on broad and multi-sectoral matters, including commerce, defense, education, science and technology, cybersecurity, civil nuclear energy, space technology and applications, clean energy, environment, agriculture and health (MEA, 2013). This has made the US influence over the internal policies of India. One of the focus areas for policy borrowing and practice
sharing is ‘Educational Technology’. The US-India Knowledge Exchange (USIKE), established in 2017 for creating ‘Innovation and Entrepreneurship’ hubs in Indian HEIs to bring American universities (Khan, 2019) into Indian campuses endorses the latest technology-based solutions and good practices to enhance teaching and learning. Though the major focus has been higher education and skill-building, the use of technology in education has been specifically underlined. It has been agreed to collaborate with U.S. institutions to integrate Technology Enabled Learning and Massive Open Online Courses (MOOCs) inducing alterations in the teacher training programs in India (MEA, 2013). This provides the US with greater access to the Indian education system, larger responsibility on training and curriculum implementation support, and undertaking field action research on local education projects (S4, 2018). Furthermore, it has also opened the door to increasing India’s access to controlled American technologies (Telis, 2019). Acknowledging the contemporary strategic ties between the countries, this interpretative paper compares the historic evolution of educational technology as pedagogic transformation within the K-12 classrooms of the respective countries.

METHODOLOGY

The research study is based on interpretative literature review of policy documents and technical reviews on ‘Digital technology in the US and India’. The theoretical framework ‘TPACK’ as described in the next section was used to conduct the comparative analysis and discussion.

THEORETICAL FRAMEWORK

In the education system, the classroom is an intricate space of interaction where pedagogy, the approach to teaching and learning, come to action to deliver the curriculum. Teachers possess what Shulman (1987) termed pedagogical content knowledge (PCK) which refers to the intersection of three types of body of knowledge: knowledge of subject matter (content knowledge), knowledge of how to teach (pedagogic knowledge), and knowledge of the learners (Bekker, 2013). Developing on this theory, Koehler (2014) introduced the TPACK framework to understand and explain teachers’ use of technology while integrating technological knowledge (TK) with Content Knowledge (CK) and Pedagogic Knowledge (PK). These components co-exist depending upon teachers’ experiential knowledge on interacting with them, which when interact create pedagogies described below:

1. Technological Content Knowledge (TCK) refers to knowledge of the relationship between technology and content.
2. Pedagogical Content Knowledge (PCK) is understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction (Shulman, 1987)*

3. Technological Pedagogical Knowledge (TPK) refers to an understanding of technology that can constrain and afford specific pedagogical practices.
4. Technological Pedagogical Content Knowledge (TPACK) refers to knowledge about the complex relations among technology, pedagogy, and content that enable teachers to develop appropriate and context-specific teaching strategies.

Diagram 1: The technological pedagogical content knowledge (TPACK) framework (Koehler, et al., 2014)

The framework elaborates on three trends of pedagogic change based on the style of teachers’ use of technology in teaching and learning:

1. PCK (Pedagogical Content Knowledge) to TPACK where existing teaching-learning strategies are supported and enhanced with the integration of technology.
2. TPK (Technological Pedagogical Knowledge) to TPACK where exiting technical strategies are used to enhance context-specific teaching and learning methods.
3. PCK and TPACK Simultaneously where teachers develop concurrent practices on pedagogy, and integration of technology in curriculum and instruction.

The framework highlights the importance of the use of educational technologies in teaching and learning, having equal value with pedagogical and content knowledge for a 21st-century teacher (Bray, 2018). The first emphasis on pedagogic transformation is designed effective teaching using PCK which can be enhanced through effective use of technology (Koehler, et al., 2014). It further suggests teacher training as a prerequisite to developing teachers’ pedagogic choices for determining the integration of educational technology into teaching. It does provide a theoretical structure acknowledging the importance of teachers understanding the relationships between teaching and technology (Phillips, 2019) and translating
these interactions into pedagogic practice within classrooms. However, it does not elaborate on geo-social or cultural factors affecting teacher choices for adapting TPACK into the classroom.

DISCUSSION

Comparing Historic Evolution of Education Technology Pedagogy:

The Digital Age demonstrates pedagogic transformations; each age can be associated with a specific trend. The mid-1900s saw the advent of a digital era characterized by the ‘personal computer’ emphasizing on using tutoring programs, games, electronic reference materials, word processing, and database tools to facilitate teaching. This is what Koehler, et al. (2014) called ‘TPK’ style of pedagogy where teachers developed their ‘instructional practices, strategies, and methods to promote students’ learning by appropriate use of technologies’. With teachers being encouraged to use computers, computer applications, and equipment like projector, smartboard to conduct classes, there was a visible advancement of the ‘TPK’ pedagogy. However, the degree of student involvement remained restricted as the students remained as recipients of technology. In the Digital era: ‘internet’, teaching is considered to be dynamic where teachers build on their ‘PCK’ and ‘TPK’ to develop unconventional methods of posing authentic conceptual problems for scientific or historical inquiry, which follow specific learning objectives and path of investigation using a range of online resources (Howard and Mozejko, 2015). This typically reflects a TPACK style of pedagogy.

The global progression of the digital era has influenced the US and the Indian public-school systems; pedagogic transformation has emerged in both countries. The case illustrations below would detail the US and India policies and programs encouraging the growth of educational technology. This paper further reflects on these independent journeys of transformation and the influencers in facilitating the journey.

FINDINGS

Country Case Illustration - The United States of America:

The digital era in the US education system began in the 1980s with the setting up of computer labs, and the increasing urge to make future-ready students. Though the earliest attempt was in the 1950s with the introduction of computer-assisted instruction (CAI) by IBM, there was no recorded significant change in the overall education system. The early 1980s saw a steady increase in technology infrastructure. The Survey of ‘School Uses on Microcomputers’ reported computers being available for instructional purposes in more than 40% of all elementary schools and more than 75% of all secondary schools (CSOS, 1983). On the contrary, the use was reported as inadequate stating classroom instances of ‘primary school teachers making students practice mathematics using computers and secondary school teachers making students practice typing over the MS-word’. This direct replacement of notebooks with computer applications was the beginning of the pedagogic transformation from existing ‘PCK’ to ‘TPK’.

The 1990s saw the outbreak of the internet; its enticing prospect was widely discussed across the business and politics spheres. Consequently, the US education system had an enormous adaptation with 90% of schools having internet access (Anderson & Ronnkvist, 1999). Teachers used online resources to strengthen their lesson plans. The 1998 National Survey stated though the student access to the internet was limited (Reiser, 2001), the teachers used computers and the internet for assisting their teaching. It was expected that with the interactive nature of computers and internet teachers would adapt to interactive classrooms and provide engaging learning. This would evolve pedagogic choice from the existing TPK pedagogy into TPACK. On the contrary, the integration of technology into teaching and learning was attributed to poor training or lack of proper training (Reiser, 2001). The use of technology was limited to teachers and students continued to be passive consumers of educational technology content.

With the advent of the 21st Century, the US education system witnessed a systemic pressure for the active involvement of the student as creators of knowledge, using apt technologies. Internet and interactive technologies were introduced in classrooms. By 2006, the P21 framework was developed by a coalition of the US Department of Education, businesses including Apple, AOL, Microsoft, Cisco, and SAP, and organizations involved in education such as the NEA called the Partnership for 21st Century Learning (P21 Network) (Anon., 2016). The P21 elaborated on the role of a teacher as a facilitator rather than an instructor. According to the P21 document’s definition (2009), teachers were to provide opportunities for the student to apply skills across core subjects by integrating the use of supportive technologies, inquiry- and problem-based approaches, and higher-order thinking skills (P21, 2009). In other words, the US education system was proposing a pedagogy transformation promoting TPACK. The Department of Education released the revised ‘National Education Technology Plan (NETP)’ 2017 with a focus on integrating technology to transform learning experiences for providing greater equity and accessibility (OET, 2017); teachers were central to this transformation plan. The National Council for Accreditation of Teacher Education (NCATE) affirmed the coupling of content, pedagogy, technology, and practice as a core principle to the redesign of teacher professional development (NCATE, 2010); thereby urging schools for a pedagogic shift towards
TPACK. In 2011 Society for Information Technology and Teacher Education (SITE) conference through 32 sessions exhibited how teachers in US schools made rich connections among technology, the subject matter, and pedagogical choices (Wetzel & Marshall, 2012) explaining the pedagogic transformation into using TPACK pedagogy within the US classrooms. Harris and Hofer (2017) highlighted the way TPACK emerged and continues to be implemented as a connector, a check-and-balance, an instructional planning tool, a technological focus, a compass, and a collaborative process for addressing learning objectives.

Factors affecting the evolution

The evolution of education technology (PCK – TPK – TPACK) within the US classrooms illustrates pedagogic transformation. Undoubtedly, infrastructure development and policy reforms have influenced the pedagogic transformation. Additionally, the adaptation of TPACK has been attributed to the strong influence of the local context and culture of the schools (Harris & Hofer, 2017). Koh and Lim (2008) in their work on ‘the emergence of Information Technology (IT) for educational purposes’ emphasized on the importance of culture in developing educational technology. It is how the overall cultural redefinition of education influenced the changing pedagogic choice and specifically the integration of educational technology. Similarly, Niki Davis (2003) reinstates how technology has been embedded within the US culture (Macionis, 2002) leading to the mass implementation of educational technology as a pedagogic practice beginning with programmed learning/behaviorism. Gradually, localized efforts were made by US schools to adapt to embrace educational technology. In Brianwood County, shifting student demographics with an increasing number of English language-learning students, encouraged the Technology Director to negate “one-size-fits-all” approach and identify teacher leaders with different expertise (e.g., content experts, special education teachers, instructional technology resource teachers) (Harris & Hofer, 2017) to develop individualized educational plan for meaningful technology-enabled language learning. In 2001, a federal program ‘Preparing Tomorrow’s Teachers to use Technology’ provided special localized e-rates for equitable internet access for poorly resourced schools (Davis, 2003). The 2005 national ICT teacher training is a contributing factor in pedagogic transformation. The joint systemic efforts for infrastructure development, localized adaptation, and teacher professional development enabled the evolution of PCK to TPK and further to practice TPACK for integrating educational technology. Despite such pedagogic transformations like constructive use of educational technology within classrooms or e-learning, the programs on pedagogy training on integrating educational technology continued to diverge from the educational needs and reach of the populations that are historically Black, Hispanic, and Tribal (Davis, 2003). This exposed cultural digital equity as a remaining predominant challenge to pedagogic transformation. Being cognizant of the growing digital divide, influenced by cultural elements of language and social hierarchies — the disparity between the use of technology to create, design, build, explore, and collaborate and simply use technology to consume and follow media passively (OET, 2017; Fishman & Dede, 2016; Purcell, et al., 2013), the US policy continues to promote TPACK as pedagogic practice for closing the digital divide.

Country Case Illustration - India

Digital technologies in the Indian education system commonly referred to as ‘ICT in Schools’ was first introduced during the 1990s. The National IT Task Force on Information Technology and Software Development (1998) recommended the introduction of Information Communication and Technology (ICT) within Indian public schools. A joint action plan for schools was drafted along with various public sector facilities like railways, banking operations, and commercial undertakings (Bajwa, 2003). The main objective was to computerize these services including curriculum and instruction. This became the guiding principle for the headway for educational technology into the Indian public schools. In 2000, the Task Force on Human Resource Development in IT was set up to prepare a long-term strategy that envisaged the role of education at the primary, secondary, and tertiary levels of paramount importance (Bajwa, 2003). However, until this period, digital technology remained a concept of high appreciation among policy-makers without any school-level implementation actualization. Unlike the US counterpart which vigorously worked on infrastructure development and pedagogic integration, Indian departments struggled to implement ICT policies owing to economic and social constraints (Delponte, et al., 2015). Nevertheless, with the high political zeal and implementation roadmaps, the ‘ICT in school’ program began in 2004. India was about 20 years behind the developed nation in introducing technologies (ICT) in public schools. The initial years of this program concentrated on setting up of ‘computer labs’ in selected secondary public school with maximum focus on providing digitized content through these labs, instead of pedagogic integration. In a study to measure the effectiveness of the ‘ICT in School’ program, the report highlighted the availability of computers in 80% schools in the states of Delhi, Kerala, Gujarat, Maharashtra, Tamil Nadu and Puducherry (EQFI, 2012). On the contrary, only 28% of teachers reported using ICT equipment and material for teaching subject content. Though the Indian policymakers envisioned the introduction of ICT to produce educational benefits catering to the diverse schoolchild population (MHRD, 2010), it was limited to infrastructure development and limited ICT training as an optional subject. PCK for core subjects existed in parallel PCK for ICT as a subject; there was no evidence of TPK.
In the year 2010, the 'revised ICT in schools' program revisited the need for infrastructural development, including establishing SMART classrooms. It expanded the scope of educational technology into using digital tools for teaching, developing e-content, and teacher training (MHRD, 2016). The Indian public schools were introduced with learning software, teaching hardware, internet, and ubiquitous technologies (Goswami, 2014) which promoted the knowledge relationship between pedagogy and technology (TPK). However, pedagogic transformation does not automatically follow with the mere introduction of ICT as digital tools or teacher education curriculum (Beri & Sharma, 2019). The field stories within the Indian public school classrooms continued to narrate access and availability tussles to integrate educational technology, indicating the digital divide influenced by geo-social factors widening this digital gap (Tamulee, 2020). Byker (2014) cites an example of rural Indian schools, and that how cartons of computer devices were never opened owing to no electricity. The digital divide is not limited to rural-urban location but layered by geographical terrain, socio-economic status, and gender. Many such reflections are anecdotal as a consequence of the lack of empirical research in the use of ICT within Indian public schools (Byker, 2014). In midst of this digital inequity, the flagship program 'Digital India' envisaging to ‘transform India into a digitally empowered society and knowledge economy‘ (Gol, 2015) provided a favorable policy environment for enabling digital accessibility. In its attempt to promote the global belief on learner-centered approaches enhancing students’ experiences in schools (Schweisfurth, 2013), the National Curriculum Framework (2005) highlighted the need for facilitating computational thinking and scientific temper through the integration of educational technologies; Computer Science continued to be a separate optional subject for high school students. This guiding policy document appealed for a change in teacher professional development and pedagogy transformation within Indian classrooms. This was the beginning of a pedagogic dialogue on TPACK. Miglani and Burch (2019) elaborates on rising efforts on professional development among government teachers through pilot initiatives on continuous educational technology training by the government departments and a host of non-state actors (foundations, philanthropic organizations, consulting, development organizations and a range of for-profit or not-for-profit NGOs). The teacher training conducted by TESS – India, Tata Institute of Social Sciences, TeachNext, Khan Academy, MathsLab, Next ERP to name a few, show simultaneous inclusion of concepts of PCK and TPACK, online technologies, open education resources and pedagogic inputs to integrate ICT into curriculum delivery (Wolfenden, 2015; Yadav, et al., 2018 ). Beri and Sharma (2019) in their study on ‘TPACK among teacher educators in Punjab region’ point out the augmentation of using TPACK by teacher-educators and teachers. Educational technology in the form of TPACK is a growing pedagogic choice among government school teachers but little has been researched on pedagogic transformation within the classroom.

Factors affecting the evolution

The Digital era and Educational Technologies in the Indian education system have witnessed a delayed but steady growth. It has predominantly been dominated by infrastructure development instead of a pedagogic dialogue. From the 1990s until recent times, Indian policymakers emphasized on computer technology delivering educational benefits (Byker, 2014); however, the Indian societal realities have highly challenged the evolution of digital technologies. The basic idea of personal ownership was alien to Indian families with a record low of 0.6 per 100 inhabitants with personal computers (Pernia, 2008). In comparison to the US, ICT infrastructure provisioning and development within schools was important because of limited access to technology at home, yet challenging due to the existing geo-socio and cultural factors. India has around half a million software developers and is second only to the US but 26% of the population living below the poverty line and 35% illiterate (Singh, 2010). Singh (2018) counted the complexity of challenges that includes infrastructural hindrances, cultural issue i.e. language and attitude, lack of trained teachers, and technologically challenged parents. Undoubtedly, the political fervor towards educational technology was evident in forms of ICT policy reforms, departmental investments and non-state collaborations on ICT infrastructure, and improved continuous teacher professional development. However, despite these attempts, physical and cultural barriers persist to exist (Byker, 2014) reinforcing the digital gap in access and ability to use ICT. The digital divide is significant between rural and urban India (Singh, 2007; Mahajan, 2003). However, this geographical divide is complimented by cultural passiveness towards using computers and the internet. Singh (2010) describes the disassociation of India rural people including teachers with the benefits of the Internet and other communication technologies. Linguistic barriers add to this struggle to integrate technology. The e-content is mostly available in English or Hindi with few being reproduced in local languages (Karnati, 2008). Thirumurthy and Sundaram (2003) explains how the scarcity of ICT resources affect teachers’ attitude about using such resources making teachers view the use of technology in the curriculum as an ‘additional work’. This attitudinal barrier further influences the pedagogic choice towards adapting TPACK into curriculum delivery. The teacher training and in-school support have facilitated pedagogic transformation from PCK to TPK/TPACK. Still, the geo-cultural factors clubbed with teacher attitudes towards educational technology have slowed the process of pedagogic transformation.

CONCLUSION

The review of the secondary literature reveals that the evolution of educational technology viz-a-viz pedagogic transformation within the US education system is well-researched and documented. The journey of the US education pedagogic transformation provides evidence
that this developed nation has policies informed by the knowledge created by social research with special attention to teacher education (Spiel, et al., 2019) which has contributed in escalating them as one of the global leaders in educational technology and pedagogic transformation. On the contrary, the Indian education system has seen a slow pedagogic transformation with the contemporary addition of educational technology as a pedagogic choice among the Indian teachers. As an experienced practitioner specializing in educational technology in India, I am aware that pedagogic transformation in integrating technology is not an independent isolated decision of the teacher. The pedagogic choice is influenced by the topographical positioning, socio-economic demographics, and culture varying the process of integrating and societal adaptation of technology through the digital ages. Thereby, it makes educational technology a complex process of pedagogic transformation exposing the distinct equity issues in the respective countries.

Based on the case illustrations, table 1 provides a comparative interpretation of the pedagogic transformation of these two independent countries during the digital era.

Table 1: Comparing the two countries: pedagogic transformation

<table>
<thead>
<tr>
<th></th>
<th>The United States of America</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 1980s – 1990s (Digital Era: Personalised Computers)</td>
<td>Use of computers as a teaching aid</td>
<td>Pedagogic Transformation: PCK to TPK</td>
</tr>
<tr>
<td></td>
<td>Pedagogic Transformation: PCK to TPK</td>
<td>Policy introduction to educational technology, no classroom usage</td>
</tr>
<tr>
<td>The 1990s – 2000 (Digital Era: Internet)</td>
<td>Use of internet for developing teaching content or lesson plans</td>
<td>Pedagogic Transformation: Parallel existence of PCK and TCK, no TPK</td>
</tr>
<tr>
<td></td>
<td>Continued use of computers as a teaching aid</td>
<td>Continued with TPK pedagogy</td>
</tr>
<tr>
<td></td>
<td>Continued with TPK pedagogy</td>
<td>Infrastructure development and teacher professional development; using computers and the internet as a teaching aid</td>
</tr>
<tr>
<td>2000 – Contemporary (Digital Era: Internet)</td>
<td>Using Interactive Technologies for learner-centered teaching</td>
<td>Pedagogic Transformation: Introduction to TPACK, limited classroom implementation</td>
</tr>
<tr>
<td></td>
<td>Pedagogic Transformation: TPK to TPACK</td>
<td>Policy introduction to educational technology, no classroom usage</td>
</tr>
</tbody>
</table>

The US digital divide is correlated to the style of technology use; whether teachers assist passive or active use of educational technology is the main defiance. In India, despite high political appreciation for technology and infrastructural development, the digital divide to access and availability of resources and content among government teachers and students exist. The distinct digital inequalities influenced by specific physical and cultural factors have established different educational technology pathways for these two countries.

WAY FORWARD

The US is an international strategic partner influencing the Indian policy development and program implementation; educational technology is inclusive of this tactical alignment. Though innovation-led global approaches see higher education lagging in the race with technology, even in the US of today (Spiel, et al., 2019), Indian government look up to borrowing TPACK practices from the US universities and organizations to incorporate educational technology within HEIs for teacher professional development and further accelerate the pedagogic transformation within the schools. However, Indian policy-makers ought to be cognizant of the US contextual influencers that have prescribed the progression of educational technology, which otherwise might lead to superficial mobilization of pedagogic practice (Takayama, et al., 2017). The Indian realities within and beyond the schools reinforcing pedagogic transformation are more complex than the US. The US policy and practices aimed at closing the digital divide through meaningful ICT usage; the Indian ICT program tussles with prerequisites for access confronting barriers of geo-social, cultural, and economic factors. Thereby making the scientific investigation of the 'contextual forces' affecting the pedagogic transformation of educational technology within both the home (the US) and the target (India) important to policy-makers, this is to identify the foci of attraction— aspects of educational technology policies and practices that can be borrowed (Phillips & Ochs, 2003).

REFERENCES


Bajwa, G. S., 2003. ICT policy in India in the era of liberalisation: its impact and consequences.. GBER.


Bray, O., 2018. Digital Technology In Scottish secondary schools: how school leaders can harness its potential to drive both school- and system- wide improvement. Glasgow: University of Glasgow.


CSOS, C. f. S. O. o. S., 1983. School uses of microcomputers: Reports from a national survey, Baltimore, MD: Johns Hopkins University, Center for Social Organization of Schools..


Mahasheva, 2017. REVIEW OF ICT POLICIES IN INDIA, BHARTIYAM INTERNATIONAL JOURNAL OF EDUCATION AND RESEARCH, 7(1).


Pedagogic Transformation: Comparing Educational Technology in the US and India


Accepted 17 July 2020


Copyright: © 2020: Tamulee P. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are cited.