

BRIDGING A CULTURAL GAP BY TRANSFORMATIVE STEM LEARNING IN RURAL INDIA

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The importance of STEM education for the future workforce has been recognised globally. Increasing teachers' capability to teach STEM subjects is consequently essential. While the race to build STEM education in developed countries has been fast, rural areas in developing countries which are already suffering from the lack of daily resources are left further behind. A team of STEM educators from Curtin University in collaboration with a Regional Institute of Education (RIE) Bhopal conducted a professional learning program for rural teachers in India. This paper discusses the evaluation of this program. It was found that the gap between the participating teachers' understanding and skills was complex and mostly cultural. In order for this program to achieve its intended aims, this gap must first be bridged.

PURPOSE OF THE STUDY

This paper reports on a Science, Technology, Engineering and Mathematics (STEM) professional learning program conducted by a team of two researchers from Curtin University at The Regional Institute of Education (RIE), Bhopal. The aim of this program was to build the capabilities of teachers to teach STEM activities and prepare their students for the 21st century learning. Face-to-face workshops were delivered for three days, supported by online contents using Moodle as the learning management system.

The participants of this program were 44 in-service teachers from the Ichhawar Block, a village located near Bhopal in Sehore district in the state of Madhya Pradesh, India. The literacy levels of Ichhawar are 77%, which is slightly higher than the state average of 70% (Census of India, 2011). The number of men who could read and write (86%) was considerably higher than women at 67% (Census 2011). The employment rate in Ichhawar was around 35%, with only one third of females in paid employment. Agriculture is the main occupation of the population.

This paper starts with a vignette, based on lived experience of researchers on the first day of the workshop. These short vignettes are considered very important for setting the scene for readers to know the working conditions to which researchers had to adopt and has been written in first person.

***Vignette 1:** Both of us, were enthusiastically looking forward to working with teachers in RIE. Year earlier we had already worked with pre-service teachers in this campus, who were brilliant and had greatly appreciated our way of engagement and efforts. Based on our success in making*

an impact on pre-service teachers and experience of identifying gaps, we were successful in securing an Australian Government grant to create online teaching modules for science teachers. Moodle platform was thought to be best suited for this training programme, as this would allow participants to work on multiple platforms. We were aware of most adults having smart phones in India, on which the Moodle app can be downloaded.

We were escorted to the conference room, where participants were already seated. After the introductory welcome from the Principal, we were also asked to say a few words which we have sort of learnt following local protocol. This trailed participant teachers introducing themselves – their names, area and level of teaching and finally expectations from the workshop. I was expecting participant teachers from the schools of Bhopal. To my dismay most (39) teachers were from a so called tribal village, and rest of the five teachers from a constituent school called multi-purpose demonstration school on the campus of RIE, Bhopal. We realised we are in for a challenge but were determined to navigate and draw on the principles of transformative learning (Mezirow & Taylor, 2011). However how effective would it be, we questioned ourselves...without giving a whiff of what was going through our mind out?

PERSPECTIVES

Transformative Learning and Culture

The term *transformative learning* was first introduced by Mezirow in 1978 to highlight adult learning as a meaning-making personal process that leads to personal transformation and growth (Mezirow & Taylor, 2011). In its development, transformative learning evolves to include social transformation as part of personal transformation. Within transformative learning there are three core elements that are considered to be influential to the personal and social transformation, which are individual experience, critical reflection and dialogue, and holistic orientation. Individual experience forms the beliefs and understanding which learners bring into the classroom. Mezirow and Taylor further explicated that “value-laden course content and intense experiential activities offer experiences that can be a catalyst for critical reflection and can provide an opportunity to promote transformative learning” (p. 6). Critical reflection and dialogue provide the process in which existing beliefs and understanding are confronted, compared and contrasted. Holistic orientation is the link between cognitive and affective aspects of learning, or as Kolb and Kolb (2009) stated “the integrated functioning of the total person – thinking, feeling, perceiving and behaving. It encompasses other specialized models of adaptation from the scientific method to problems solving, decision making and creativity” (p. 43).

Teacher professional learning as adult learning activities seeks to adopt transformative learning if it is to be effective. Professional learning programs are designed to entrench the three core elements by recognising teachers’ previous learning, cultivating critical reflection and dialogue, and addressing the cognitive and affective learning processes (Berry & Forgasz, 2016; Meijer, Kuijpers, Boei, Vrieling, & Geijssels, 2017; Sprow Forte & Blouin, 2016).

Within the theory of transformative learning, culture is deeply embedded. Culture strongly influences all three

core elements of transformative learning, hence it could help or hindrance learning. Hofstede, Hofstede, and Minkov (2010) explicated the layers of culture in the national level, religion/ethnic/region/linguistic affiliation level, gender level, generation level, social class level and organisational level. Cultural identity formed from these levels creates unique individuals who in fact belong to different groups. As long as there is no friction between these groups, an individual's cultural identity can remain indistinct. Cultural identity forms the way we learn; it directs the way we think, feel, perceive and behave.

The national level of culture creates the national cultural identity. While the broadness of this level means there are generalisations made in identifying the cultural aspects. (Hofstede, Hofstede, and Minkov, 2010) categorised six dimensions of national cultures: power distance, individualism, masculinity, uncertainty avoidance, long-term orientation and indulgence. Power distance indicates how hierarchical the society is; individualism is defined as the opposite of collectivism; masculinity represents gender-related attachment on professions, earnings and others; uncertainty avoidance indicates the way the society deals with uncertainties of the future; long-term orientation suggests that the society tends to plan for the future and places less value on preserving traditions; indulgence refers to the value the society places on happiness and enjoyment. Figure 1 illustrates how Australia and India were measured on these six dimensions. <https://www.hofstede-insights.com/product/compare-countries/>

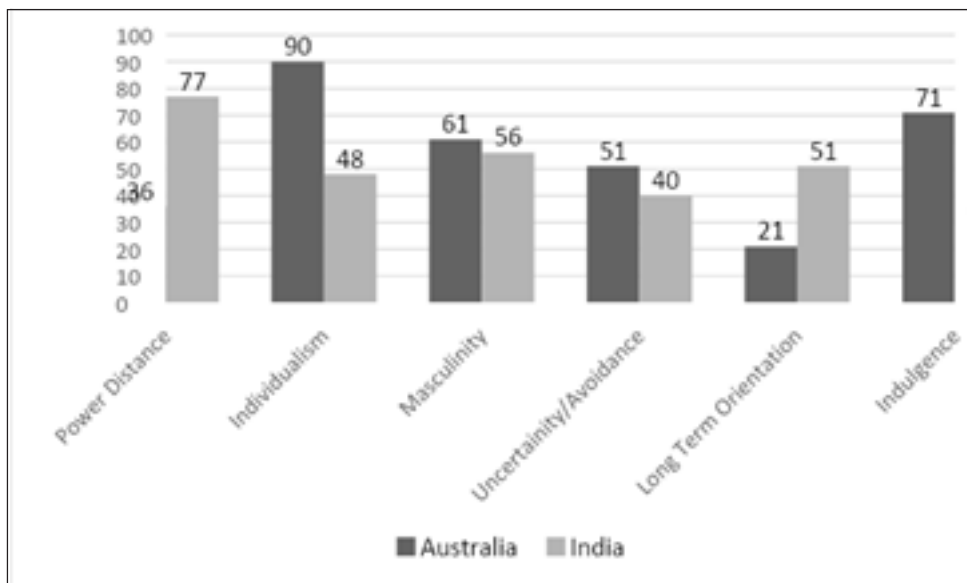


Figure 1. Australia-India country comparison (Hofstede, 2019)

Vignette 2: We enter a room roughly 6meters by 6meters dimensions, furnished with chairs and desks and 40 desktop computers on the desks. There is a screen and a desktop for the instructor (us) in the front as well. Each piece of furniture is closely placed to accommodate every piece of furniture in this reasonably small room leaving very little space for moving around. We have

three of RIE's technical staff helping with getting participants started. Participants were asked to log on to the Moodle site for which they should have received an invitation e-mail from us. To our dismay most of them didn't know anything about it, instead expected us to give them their e-mail passwords. This was a second jolt, were we making teachers question their self-efficacy which has potential to impact their professional beliefs?

TEACHERS' PROFESSIONAL BELIEFS

Teachers' professional beliefs have been found to closely influence their instructional practice (Buehl & Beck, 2015; Schraw & Olafson, 2015; Tondeur, Van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). Furthermore, teachers' self-efficacy, or their perception on their ability to perform professionally, has also been correlated with their competency as well as their willingness to integrate new components to their teaching (Kavanoz, Yüksel, & Özcan, 2015; Keser, Karaoglan Yilmaz, & Yilmaz, 2015).

Digital Divide and Culture

It has been around 25 years from when the term *digital divide* became increasingly popular to highlight the gap in terms of computer ownership, internet access, or information access (https://wiki.p2pfoundation.net/Digital_Divide, http://www.newworldencyclopedia.org/entry/Digital_divide;). When this term was first used, there were growing concerns that the gap would create even bigger gaps in economic growth, social structure, productivity, political participation and all the other aspects of human life (Hacker, Mason, & Morgan, 2009; Warschauer, 2004). Digital divide was predicted to create inequalities.

Now, 25 years from then, the digital divide and the inequalities it created have grown much more complex and were evident in the workshop we were about to deliver. We as researchers are entering a cultural space not fully unknown to us but still had taken certain factors like all teachers would be using e-mails for granted, and our host although informed that the workshop involves using an online platform should have been careful in choosing the participants. So we had to slow down the pace of instruction and also abolish some of the planned content in the training modules.

THE FRAMEWORK

This study adopted an evaluation framework that considers the participating teachers' readiness and beliefs as influenced by the local and national cultures as important aspects that affect the impact of the program.

Teacher Beliefs are considered as the product of personal experience and learning. These professional beliefs are constructed from their technological, content and pedagogical knowledge as well as their self-efficacy. Their readiness to explore and learn from the program are informed by their professional beliefs and their technology affordances. The professional learning program was expected to upscale their pedagogical knowledge and instructional practice in the classroom, their understanding of STEM subjects and activities and their experience in technology integration in teaching and learning.

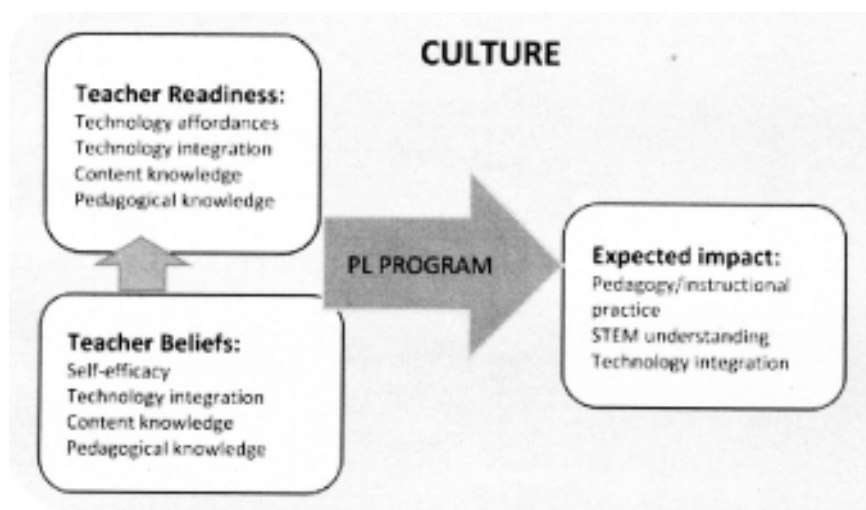


Figure 2: The program's framework

METHODOLOGY

This paper examines the effectiveness of the professional learning program, by probing into the taken for granted practices between the participants and workshop deliverers. The case study research inquiry method is adopted to analyse data obtained from the observation and pre- and post-questionnaire to build an understanding on teachers' transformational learning in rural India. The factors that were considered important to address are:

- Teachers' affordances of technology
- Teachers' self-efficacy in STEM teaching
- Impact of workshop

44 teachers from Ichhawar village, Madhya Pradesh participated in the professional learning program. Among these 44 teachers, there were 30 male teachers and 14 female teachers. Most of them were experienced upper primary science teachers with only one beginning teacher. The teachers' English skills were low to intermediate, thus required instructions and in Hindi while completing the questionnaire.

Pre workshop and post workshop survey was completed by all participating teachers on the current practices on use of technology in their teaching and their perceived usefulness of the workshop.

RESULTS

Vignette 2: First day of workshop was hard work, largely stressful and we had to pitch down the contents planned for delivery. On second day when we enter the workshop venue 41 of 44 participants are busy surfing something on their phones – all of them had downloaded Moodle app and were surfing the workshop website, accessing the resources provided and each one of them had questions for us.

A small effort on our part was the start of a huge learning curve for these participants. Their learning was not going to stop at this website, instead they were introduced to art of Curating which would help in professional learning.

Teachers' affordances of technology

Responses on teachers' affordances of technology indicated that most of the participating teachers have not had much access to technology aside from mobile phone. Internet access is also mostly limited to their mobile data. Among the 44 teachers, more than 25 did not own a computer, laptop or tablet but only three did not own a mobile phone. Their use of technology was very limited, Facebook and WhatsApp was used by all in possession of a smart phone. None of them had access to computer, thus were unaware of any of the computer programs which includes basic computer navigation skills. Most teachers felt limited self-efficacy in STEM teaching skills. Teachers recognised importance of STEM skills in curriculum.

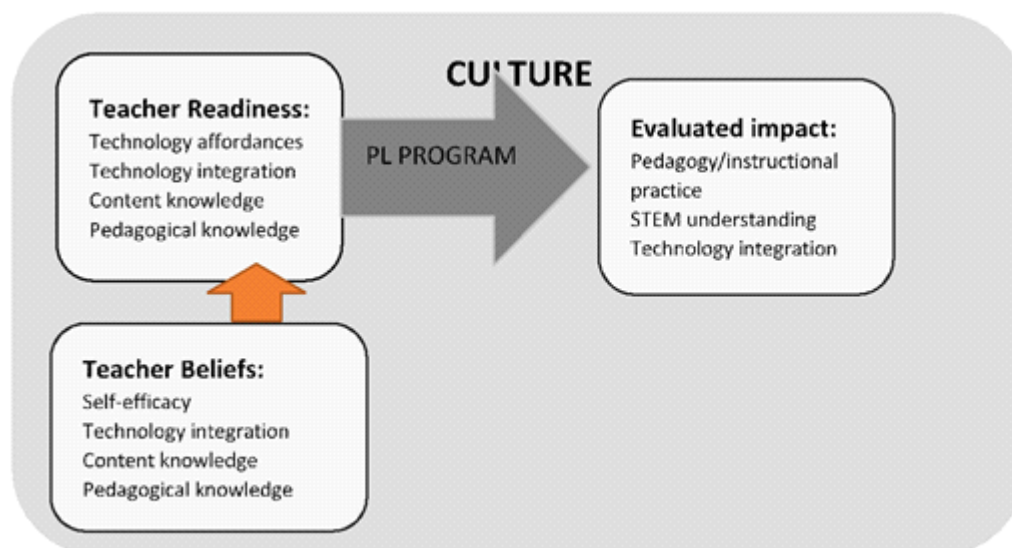


Figure 3: Bridging the gaps

All participants agreed with positive impact of following four factors on teaching outcome expectancy: (i) teacher exerting extra effort; (ii) taking responsibility for students' learning; (iii) students' learning being directly related to their teacher's effectiveness in teaching and (iv) minimal student learning generally being attributed to teachers.

Teacher Leadership attitudes identified as the teacher taking responsibility for learning, communicating vision, using a variety of assessment data throughout the year to evaluate progress, using a variety of data to organize, planning and setting goals, establishing a safe and orderly environment and empowering students. Most participants were not aware about the STEM careers and found the workshop impactful in increasing their confidence to teach STEM subjects. After the workshop, teachers felt more knowledgeable about STEM international, project based and problem based.

SIGNIFICANCE OF THE STUDY

Teachers' experience from the workshop was generally, "good experience", "enhancing teaching" and the ability to use email and computer. Findings from data analysis indicated that there were gaps between the professional learning program and the participating teachers' cultural identity, beliefs, instructional practice and technology affordances. Figure 3 illustrates these gaps in contrast with the program framework, which need to be taken into consideration by a large country like India.

Through this professional learning programme the participants were introduced and inducted into use of technology (mostly mobile phones) for if only the digital divide was abridged impact would be many-fold.

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