Interplay of Cognitive, Affective and Ecological Factors Influencing Teachers' Technology Integration Beliefs: A Contextualized Model

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Abstract: Teachers' beliefs change have been studied by many researchers and there are multiple models of belief change. Even though most of them agreed that cognitive, affective and contextual factors play a crucial role in forming beliefs, less attention is given to the contextual factors and the complex nature of interactions that happens within the ecology of teachers. Similarly, none of them developed by taking into account the Indian context. So, to fully capture the complex cognitive-affective-ecological factors that influence teacher beliefs about technology integration, we are trying to come up with a new model by identifying important factors relevant to the Indian context and augmenting them with the existing models. In order to identify India-specific factors, we designed a qualitative multi-case study. The study is ongoing, so far we have completed data collection with 14 secondary and high school science teachers from the Thrissur district of Kerala, India. Data is analysed using a thematic analysis method to extract themes.

Keywords: Teachers' beliefs, Technology integration, Belief change, Learning ecosystem

1. Introduction

The broad Goal of this thesis is to understand how factors connected to individual characteristics and context contribute to teachers' beliefs about technology integration and its change. My motivation to choose this area is mainly because of two reasons. First of all, being a teacher educator involved in providing various professional development programmes to school teachers, I have noticed a lot of differences in the ways teachers experienced the same learning content and the variations in the implementation of this knowledge in their actual teaching practice. Secondly, literature shows that teachers' decisions to adopt and frequently use technology in the classroom are mediated by their attitudes and beliefs toward technology (Russell et al., 2003). So, identifying teachers' beliefs, understanding the process of belief change and the role played by the individual characteristics and contextual factors have implications for teacher educators and researchers working on effective integration of technology-focused solutions in the classroom and designing teacher professional development programs.

While most researchers agree that beliefs form and change through a dynamic interplay of cognitive, affective and ecological factors, existing models of belief change are predominantly focused more on the individual characteristics of the teachers and inadequate to account for the complex interactions happening between teachers and the ecosystem of the school. This creates a crucial gap in our understanding of the belief change process. Similarly, none of the existing models of belief change is constructed by taking into account the peculiarities of the Indian context. In our work, we will try to address this research gap by capturing essential factors influencing teachers' beliefs about technology integration from the literature and augmenting them with Indian context-specific factors identified through our studies. This will help us to

come up with a new model of teachers' beliefs about technology integration. Following are the research questions of this thesis (1) What are the factors that influence teachers' beliefs about technology integration? (2) How do cognitive, affective and ecological factors contribute to the change in teachers' beliefs and practices about technology integration?

2. Theoretical Framework

2.1 Teachers' Beliefs about Technology Integration

Teachers' beliefs in general and teachers' beliefs about technology integration in specific have been studied extensively by researchers (Park & Ertmer, 2007). According to Russell et al. (2003), teachers' decisions to adopt and frequently use technology in the classroom are mediated by their attitudes and beliefs toward technology. Miller et al. (2003) consolidated various studies and found that teachers' beliefs about technology are comprised of three components: pedagogical beliefs about teaching and learning, self-efficacy beliefs for using technology, and beliefs about the value of the use of technology. The studies conducted by Taimalu & Luik (2019) reiterated that these three components were found to be the main predictors of teachers' use of technology for pedagogical purposes.

2.2 Models of Teachers' Belief Change

To analyse the process of change in teachers' beliefs about technology integration and to understand the role of cognitive, affective and contextual factors in this process, we use the model of conceptual change. Even though the models of conceptual change were primarily developed to analyse knowledge acquisition, they could also be applied to analyse changes in beliefs (Gill et al., 2004; Posner et al., 1982). From the literature review, we have identified the integrated model of Language Teacher Conceptual Change (LTCC) by Kubanyiova (2012) as a potentially appropriate model for our analysis.
The LTCC model is an updated version of the Cognitive-Affective Model of Conceptual Change (CAMCC), which integrates cognitive frameworks of belief change with motivational and affective factors (Gill, 2003).

2.3 Learning Ecosystem

The idea of the ecology of human development was popularized by Bronfenbrenner (1979). According to him, an ecological approach is useful to explore the interrelations between the individual and the changing contexts in which development is embedded (Bronfenbrenner, 1979). Barron (2006) defined a learning ecology as "the set of contexts found in physical or virtual spaces that provide learning opportunities. Each context is made up of unique activities, resources, relationships and the interactions that result from them". Hecht & Crowley (2020) used the term learning ecosystem to emphasize the systems and presented an argument to decentre the focus on individuals to enable new ways of thinking about the learning ecosystem. The researchers Zhao & Frank (2003) in their study of technology use in 19 schools found that an ecological perspective can provide a powerful analytical framework for understanding technology uses in schools. To use the learning ecosystem as a lens to view our study, we adopt the metaphorical equivalents established by Zhao & Frank (2003): (a) schools are ecosystems, (b) technology use are living species, (c) teachers are members of a keystone species, (d) reform inputs are invasions of exotic species.

3. Research Methodology

The central endeavour in the present thesis is to understand the beliefs and subjective world of the teachers' experience in integrating technology into their teaching-learning process. Teachers construct meanings as they engage with the world, based on their historical and social perspectives. We consider teachers' actions as potential resources to understand the hidden meanings and intentions. Hence the thesis follows a

constructivist worldview. Similarly, we use a multi-case study research design to develop an in-depth analysis of each teacher. Collecting data involves semi-structured interviews with individual teachers, classroom observation, eliciting teacher reflections, survey questionnaires and observing teachers' continuing professional development (CPD) programmes. The philosophical worldview, the research design that is related to this worldview, and the specific methods of research informed us that our thesis tends to be a more qualitative approach (Creswell, 2014).
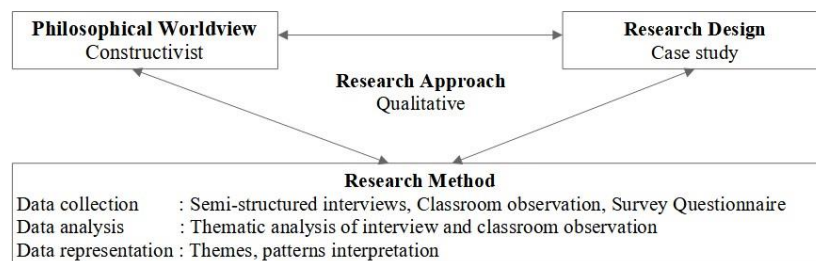

Figure 1. Overview of Research Methodology

3.1 Exploratory Study

A multi-case study was conducted among two secondary school teachers in the state of Kerala, India. This study was conducted during the covid pandemic and began in mid-2020, a few months after the lockdown in India. The study found that the teacher who had undergone training in the use of technology did not change his beliefs as much as the teacher who had low training in technology use. The support from colleagues, concern for students' future and a sense of community played a significant role in this observation. Overall, the study helped to focus on context and its role in the development of teachers' beliefs about technology integration and unpacking contextual factors. The results are published at the 16th International Conference of the Learning Sciences 2022 (Nandan & Murthy, 2022).

3.2 Primary Study

The objective of this study is to identify factors influencing teachers' beliefs about technology integration which are highly important in the Indian context and augment these factors with the essential factors extracted from the literature. The outcome of this study would be a model for explaining how teachers' beliefs about technology integration change and the role of cognitive, affective and ecological factors. The study uses a multiple-case design and follows a theoretical replication logic (Yin, 2018).

3.2.1 Participants

The study has been designed for secondary and high school science teachers from different types of schools (government and government-aided-private) in the Thrissur district of Kerala. Teachers who are going to participate in the continuous professional development (CPD) programme on integration of technology, conducted by Kerala Infrastructure and Technology for Education (KITE), are selected. We used a 'maximum heterogeneity sampling' strategy (Patton, 2015), to maximize sample variation.

3.2.2 Data Collection Procedure

Stage 1 - Before teachers attend the CPD programme: The study description and consent forms will be provided to teachers, and an overview of the study goals will be explained. Semi-structured interviews will be conducted with the teachers to elicit the overall experience of using technology and the factors affecting this process. Similarly, Teachers' Beliefs Regarding Technology Use Survey-TBTUS (Park & Ertmer, 2007) will be used to identify the current status of teachers' beliefs about technology integration.

Stage 2 - After teachers attend the CPD programme: The researcher will visit teachers at three-month intervals and stay with them for 3-5 continuous days. The researcher will probe teachers by asking them to use a particular technology for a particular topic (teacher should feel that the researcher recommends it very naturally when sitting in the lesson planning phase). The teachers are expected to express their ideas about using or not using suggested technology in their classroom and the rationale behind their choice. This may act as a lens for understanding teachers' underlying beliefs about technology integration. Teachers' actual classroom practice will be observed using an observation schedule. Field notes will be prepared to collect details about contextual factors and the affective states of teachers.

3.2.3 Analysis of Data

The recorded interviews will be transcribed into Malayalam text and then translated into English for further analysis. We will use the learning ecosystem as a lens and the model of belief change as an initial 'coding frame' for structuring transcribed data (Schreier, 2012). We will do a thematic analysis of the interview and observation data and present the analysis in the form of themes and their interconnections. The results of the survey questionnaire will be analysed and the results will be augmented with the results of interviews and observations.

4. Ongoing and Future Work

The study is ongoing and so far we have completed stage 1 of data collection with 14 school teachers. Data is transcribed into Malayalam and translated into English. Analysis of the data is progressing. Stage 2 of data collection will be carried out simultaneously with the data analysis. Once the thematic analysis of complete data is over and come up with themes which are specific to the Indian context, we will try to augment the themes with the existing models and come up with a modified model. We will also do the expert validation of the model.

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