Policy Futures in Education

Problem-Based Learning: a promising pathway for empowering pre-service teachers for ICT-mediated language teaching

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ABSTRACT Information and communication technology (ICT) has become a prominent part of education and offers numerous means of improving teaching and learning in the classroom. However, the tendency to take the teacher education curriculum for granted and the assumption that it adequately prepares teachers for the integration of ICT into their teaching practice need to be questioned. Recent studies on technology have shifted from the emphasis on technology skills alone to integrating pedagogy and content with technology, which is termed technological pedagogical content knowledge (TPACK). Deeper understanding of how TPACK can be cultivated is needed. This design-based research explored how a problem-based learning approach can help pre-service language teachers to develop TPACK and impact their teaching practices. Data was collected via self-progress surveys, ICT-mediated language lesson plans, reflections by the pre-service teachers, student-produced artefacts, records of instructional design and log entries by the facilitators. Based on the survey data, the pre-service teachers believed that they had developed TPACK. By comparing the qualitative data, it was discovered that the pre-service teachers became better positioned to use ICT in their teaching practices. The shift from teacher-centredness to student-centredness was also observed in their instructional planning. The problem-based learning approach created critical but safe opportunities for pre-service teachers to better understand that while using technology, teachers may have to re-evaluate their teaching practices and to rethink the nature and scope of the subject for which it will be used.

Introduction

Language learning is a complex process with intellectual, social and emotional dimensions. Therefore the teaching of any language is a multidimensional activity. The nature of language education differs according to the level of language learning, which adds to the complexities of language instruction.

The implementation of three language formulas recommended by the Indian Education Commission (1964-66) has necessitated the differentiated curriculum design and transaction of national, regional and foreign language instruction in accordance with the particular educational context. Unfortunately, the preparation of language teachers is hardly in keeping with this situation. As a result, the whole purpose of language education in the multilingual society of India is overlooked, and the learning of prescribed languages becomes the most frustrating and burdensome task for learners, as well as for teachers. Instead of making language learning interesting, interactive and enjoyable, efforts are concentrated on the mechanical completion of prescribed curricular activities.

In such a situation, pre-service as well as in-service teacher training should be thoroughly oriented to multilevel language teaching. Teacher education programmes should acquaint them

with the innovative research-based instructional practices of teaching languages at different levels. This study is an attempt to train pre-service Hindi, English and Marathi language teachers for teaching these languages as L2 and L3 (the second language and the third language respectively).

The swift evolution and spread of new technologies has resulted in a more widespread use of information and communication technology (ICT) in language education. Research on the crucial role of technology in language education has been conducted for more than three decades, and numerous research studies have been published over the last decade which emphasise the importance of ICT in assisting language learners at different levels. Keeping in view the role of ICT in language learning and teaching, the researchers strongly feel that it is necessary to equip pre-service language teachers with the knowledge and skills for creating an ICT-mediated learning environment for enhancing the multilevel teaching of languages as L2/L3 to learners. This study is a humble step in this direction.

The pre-service training of teachers in ICT-mediated language teaching techniques can take a variety of approaches, such as scaffolding, cognitive apprenticeship, peer mentoring and peer coaching. This study has taken a problem-based learning (PBL) approach to pre-service language teacher preparation for ICT-mediated teaching.

Historical Overview of the PBL Approach

The origin of PBL can be traced to the writings of John Dewey (1944), who emphasised the connections amongst doing, thinking and learning. According to Dewey, learning 'should give students something to do ... and the doing is of such a nature as to demand thinking or intentional connections', and PBL provides the tools for fostering this type of thinking and active learning. In addition, PBL is an instructional approach that is grounded in many of the principles of constructivist learning theory, which sees learners as actively constructing knowledge through interactions with the environment and social negotiation.

PBL was originally developed at McMaster University's medical school in Canada in the 1970s by a core group of medical educators). Barrows (1998) acknowledges in his writings that new physicians were graduating knowing a lot of information, but without the critical reasoning skills to use that information appropriately. In the medical model of PBL, learning is student-centred and takes place in small groups; teachers act as facilitators or guides; problems are the organising themes for learning; problems are the means for the development of clinical problem-solving skills; and new understanding occurs through self-directed learning (Barrows, 1996). Albanese and Mitchell (1993) have rightly described PBL as 'an instructional method characterized by the use of problems as a context for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences'.

Literature Review

There are various studies that support the integration of PBL instruction in a number of fields. They have shown the impact of PBL on various psychological constructs, such as higher-order thinking, in-depth understanding of content (Gallagher & Stepien, 1996), interest in the subject (Lieux & Luoto, 2004) and motivation in learning (MacKinnon, 1999). It has also been shown to have a positive impact on problem-solving skills (MacIntyre et al, 2005) and judging the abilities of learners (Dochy et al, 2003). These studies do provide the grounds to think that PBL improves prospective teachers' professional practices in various ways.

A review of previous research conducted in the area of application of PBL in teacher education helps us to conclude that PBL has been successful in professional development programmes for both in-service and pre-service teacher training. The PBL approach has been successful at different levels (from early childhood to higher education) of teacher professional preparation (Levin et al, 2002; Edwards & Hammer, 2007). It has shown encouraging results for preparing teachers for special and inclusive education (Levin, 2006), and has contributed to the development of pre-service teachers' knowledge of and skills in technology use in teaching a subject (So & Kim, 2009). The PBL approach has also been shown to have a favourable impact on the instructional practices of teachers (Senocak et al, 2009). The majority of studies have shed light

on the use of PBL in science teaching (Willis, 2007; McTighe & Wiggins, 2008) or ICT training (Finkle & Torp, 1995), but there is no study available on the impact of PBL on language teachers' professional preparation.

This analysis of the background to the problem and the gap in previous research leads us to conclude that it is necessary to study the impact of PBL on pre-service teachers' preparation for ICT-mediated language teaching in order to improve the unsatisfactory condition of language education and because of the need to keep pace with the fast-changing educational scenario. Therefore the researchers decided to extend the applicability of the PBL approach to conceptualise, design, implement and research its implications for the instructional practices of pre-service language teachers.

Rationale of the Study

Training teachers solely in how to use a specific technology is not likely to improve the practice of teaching and learning (Fulton et al, 2003; Koehler & Mishra, 2005; So & Kim, 2009; Lock & Redmond, 2010). What is needed is an approach that helps teachers learn how to choose, apply, evaluate and further develop different configurations of tools and artefacts – digital and otherwise – depending on their practice, their learners, the contexts they are in, and the nature of the subject they teach. It is therefore necessary that they should be prepared to think through, critically choose or design and configure, and learn and apply technologies that will best meet the teaching and learning needs which exist within their context. If this can be done, teachers can go beyond thinking of themselves as merely passive consumers of technological tools and begin thinking of themselves as designers or purposeful users of technology specifically to facilitate students' meaningful learning.

Koehler and Mishra (2005) propose a framework to address this problem. They argue that good teaching with technology requires understanding the mutual relationship between technological, pedagogical and content knowledge in order to develop appropriate, context-specific strategies and representations. However, there is still much room for research on how technological pedagogical content knowledge (TPACK) can be cultivated to benefit teachers and students. Initial evidence suggests that successful approaches have involved providing pre-service teachers with real experiences, dealing with educational problems to be solved by technology (Koehler & Mishra, 2005). Further understanding about how TPACK can be cultivated is needed.

Hence, our efforts with pre-service language teachers focused on the design of a PBL model through which participants would be able to deepen the application of TPACK and analyse, revise and improve their own instructional practices in L2 and L3. The above discussion justifies the selection of this research area. This study aimed to (1) design a PBL model to equip pre-service teachers for ICT-mediated language instruction, and (2) study the effectiveness of the PBL model for pre-service language teachers' instructional practices in ICT-mediated teaching of L2 and L3, and the development of TPACK among the pre-service language teachers.

Objectives of the Study

The study sought to attain the following objectives: (1) orient the pre-service language teachers to ICT-mediated language teaching through the PBL model; (2) study the impact of the PBL model on pre-service language teachers' development of TPACK; and (3) study the changes in the pre-service language teachers' teaching practices after they had participated in the PBL model.

Research Questions

The study sought to answer the following research questions: (1) Does the PBL approach help to cultivate TPACK among pre-service language teachers? (2) To what extent and how do pre-service teachers' language teaching practices change after participating in a PBL model of preparation for ICT-mediated teaching?

Methodology

This study has adopted a mixed-methods research paradigm with an embedded experimental research design. Keeping in view the aim and objectives of the study, the data collected was of both a quantitative and qualitative nature. The researchers felt that a mixed-methods research design was the most appropriate for this study, which may be justified by a number of reasons. First, integrating qualitative and quantitative data provides strong evidence for conclusions. Second, the appropriateness of using a mixed-methods research methodology is based on the theoretical definition of Creswell & Plano Clark (2002), according to which mixed-methods research is research that involves collecting, analysing and integrating both quantitative and qualitative data in a single study or in multiple studies in a sustained programme of inquiry. Creswell & Plano Clark have developed several mixed-methods research designs, of which the most suitable for this study was the embedded design – a mixed-methods design in which one data set provides a supportive, secondary role in a study based primarily on another type of data (Creswell & Plano Clark, 2002). The premises of this design are that a single data set is not sufficient, that different questions need to be answered, and that each type of question requires different types of data. Researchers use this design when they need to include qualitative data to answer a research question within a largely quantitative study. This design is particularly useful when a researcher needs to embed a qualitative component within a quantitative design, as in the case of the study conducted here.

In this experimental design, the researchers have included qualitative data in order to examine the emerging changes in the teaching practices of the pre-service teachers while teaching L2 and L3 in an ICT-mediated learning environment. The quantitative and qualitative data were used to answer different research questions within the study. This research was conducted using a design-based research process – an interactive, evolving process of inquiry in which the researchers collaborated with the pre-service language teachers to study the design of this learning environment, make changes to the environment, and create new designs for the learning environment based on the results and theory.

The research context: In this case, Hindi, English and Marathi languages, as L2 and L3 respectively teaching practice activities, were subject to an iterative process in which teaching practice activities were designed, developed, implemented, tested, reviewed and refined.

Participants

Fifteen pre-service language teachers participated in the study. They were recruited for the study because they volunteered to participate in the study. Of these 15 participants, eight were Hindi, four were English and three were Marathi pre-service language teachers. All of them had received their school education in the same medium and were getting teaching practice in their first language. All of the participants were computer literate and had a basic knowledge about preparing PowerPoint presentations and surfing the Internet. Four of them even had knowledge and experience of using animations and preparing documents with hyperlinks, etc. None of the participants had any teaching experience other than that of teaching practice as a required component of the practicum at the college level. Before being selected for the study, all of the participants had completed, on average, five practice language-teaching sessions in Hindi-, English- and Marathi-medium secondary schools. Taking into consideration the inadequate infrastructure of these schools, these sessions did not include any ICT-mediated instructional strategies. At the college level, these pre-service teachers had planned and delivered ICT-mediated or computer-assisted presentations. Such presentations are a compulsory component of the practicum for pre-service teachers.

Instrument

The TPACK scale was used for gathering data. This instrument was developed by Koehler and Mishra (2005). The instrument consists of 46 statements based on the following constructs:
- technological knowledge (TK);
- pedagogical knowledge (PK);
- content knowledge (CK);

- pedagogical content knowledge (PCK);
- technological content knowledge (TCK);
- technological pedagogical knowledge (TPK);
- technological pedagogical content knowledge (TPACK).

Each item response is scored with a value from 1 ('strongly disagree') to 5 ('strongly agree'). For each construct, the participants' responses were averaged. For example, the six questions under TK were averaged to produce one TK score (see Table I).

TPACK domain	Internal consistency (alpha)
TK	0.86
PK	0.87
CK	0.83
PCK	0.87
TCK	0.86
TPK	0.93
TPACK	0.89

Table I. Reliability of the scores for literacy.

Implementation

In order to identify the initial level of TPACK of the participants, the pre-survey about their TPACK data was collected. At this stage, the participants' computer-assisted presentation plans were also gathered. Further, the participants were divided into four groups in order to focus on a particular aspect of L2 and L3 teaching – namely, the teaching of grammar, poetry, prose and writing compositions. The selection of a particular language aspect was on the basis of what was felt to be needed by the participants and their interests in a particular language learning area.

Initially, each group developed five problems on the basis of a video clip of their own practice teaching lesson and videos of their peers in their group, and an interview with the subject teacher from their school. Three of the five problems were finalised on the basis of the priority problem to be solved. The problems identified by the pre-service teachers were: (a) the teaching of poetry (Marathi L3): poetry comprehension, understanding similes and metaphors, and understanding poetic imagery; (b) the teaching of prose (English L3): understanding vocabulary, reading aloud and constructing grammatically correct sentences; (c) the teaching of grammar (Hindi L2): defining terms, giving examples of the concept taught, and distinguishing between types of nouns and adjectives; and (d) the teaching of composition and letter writing (Hindi L2): distinguishing the patterns of letters, identifying the parts of letters and understanding the structure of writing paragraphs.

The participants were trained in the PBL process in a scaffolded way in the form of selected reading, mini-lectures, discussions on research-based strategies for dealing with the problems through ICT mediation, and the modelling of the process by the facilitators. After this, the IDEAL model, as suggested by Bransford and Stein (2002), was implemented for the planning and management of the PBL process. The PBL process based on the IDEAL model consists of five primary components: (1) identify problems and opportunities; (2) define goals; (3) explore possible strategies; (4) anticipate outcomes and act; and (5) look back and learn.

Each group worked collaboratively on three cases. It was difficult to take more cases because of the already hectic schedule of the initial teacher education programme for secondary level (the Bachelor of Education programme) and a lack of time. The participants worked on each case for one week. During this time, they went through the following cycle: they identified the context of the problem and defined the problem; they worked on solutions and proposed a solution; they implemented the selected solution in a pilot or full-blown situation and further evaluated its effectiveness; and, finally, they presented the process and outcome of the entire learning cycle and discussed it with the other groups.

During the PBL process, the data was gathered through the lesson plans of the participants, their reflections after every cycle and the log entries of the researchers, as well as documents, records and artefacts that reflect the overall instructional design. It is necessary to mention that the facilitators were available for the participants on the college campus and provided guidance for them. But due to the organisational complexities of the teaching practice activity, they could not observe the ICT-mediated lessons given by the participants in the schools. It is therefore the lesson plans with ICT use that were analysed as a document of the intended teaching practices. But it is also essential to mention that all of the participants' lessons were video-recorded and watched by the facilitators. In addition, the daily reflections of these participants and peer observations were collected and used to triangulate the data.

At the end of the study, a post-survey of the participants' TPACK was conducted. Their post-model lesson plans were also collected. The quantitative data was analysed and interpreted by using appropriate descriptive and inferential statistical techniques. The qualitative data was coded and analysed iteratively based on saturation (Glaser & Strauss, 1967; Lincoln & Guba, 1985). Further, this data was displayed using the contextual matrix. This assisted the analysis of the data and conceptualisation of the findings in terms of emerging themes. In this study, credibility was addressed with the techniques of triangulation, prolonged engagement, persistent observation and referential adequacy.

Results

The data collected through the pre- and post-surveys of the pre-service language teachers' TPACK was analysed quantitatively, and the impact of the PBL model on the pre-service language teachers' teaching practices (intended teaching practices) was studied by analysing their pre- and post-ICT-mediated lesson plans qualitatively.

The following presents the results of the quantitative and qualitative data analysis.

Development of the Pre-Service Language Teachers' TPACK

In order to answer the first research question, the following hypothesis was formulated: 'There is no significant difference between the pre-survey and post-survey test scores of the TPACK of the pre-service language teachers'. The technique used to test this hypothesis was the t-test. Table II shows that the obtained $t = 2.26$ for the differences between the pre-survey and post-survey scores of the pre-service language teachers' TPACK is more than the calculated value of 2.16 at the .05 level of significance. Therefore, the null hypothesis is rejected at the .05 level of significance. The statistical analysis helps us to conclude that there is a significant difference between the pre-survey and post-survey TPACK scores of the pre-service language teachers: 12.02% of the variance in TPACK is associated with the pre- and post-survey.

	Mean before	Mean after	Mean difference
TK	19	22.87	3.87
PK	26	27.47	1.47
CK	43.53	46	2.47
PCK	13.87	14.87	1
TCK	13.27	15.73	2.46
TPK	37.40	37.40	0
TPACK	15	14.67	-0.33

Table II. Summary of the statistics of the pre-service teachers' TPACK.

In order to answer the second research question, the researchers analysed the pre- and post-ICT-mediated lesson plans of the pre-service teachers qualitatively on the basis of the following seven aspects of lesson planning:

Learning goals. Learning goals give clear directions for preparing a road map for a content transaction. But the pre-lesson plans of the pre-service language teachers showed that they were

very rigid and had a narrow understanding of the concept of teaching a particular language component. For example, the learning goal of a lesson on the biography of a very famous Marathi writer was restricted to acquiring knowledge about the biographical details and a list of his literary contributions. The learning goals of grammar lessons were limited to giving definitions of terms and examples of the same. But the post-lesson plans included wider learning outcomes. For example, a lesson on prose expected the learners to suggest a new ending to a story and to enact the characters. A poetry lesson had as a goal to visualise the word 'picture' and for students to express the feelings that the poetic imagery evoked. The comparison of the learning goals mentioned in pre- and post-lesson plans shows that during pre-teaching practices the pre-service teachers focused only on the mastery of knowledge and skills in a predetermined sequence, but during the post-lessons the focus seemed to have shifted from mere mastery of knowledge and skills to the construction of knowledge. Here, the pre-service teachers have moved towards the higher level of the learning objectives in the taxonomy and even shifted from the cognitive domain to the affective domain.

Content organisation. The content organisation in the pre-lesson plans was more hierarchically sequenced and presented as a linear procedure – that is, the curriculum was structured such that all students followed the same sequence of activities in the lesson. For example, in a prose lesson about a well-known Hindi poet, Amir Khusro, the content was sequenced as birth, education, literary works, etc. However, in the post-lesson plans, efforts were made to have a whole-language approach to the content organisation and for the provision of multiple learning paths for the learners through a variety of resources and activities, such as building a character sketch, relating video clips to the content of the poetry, and enlarging the scope of the same by linking it to the emotional experiences of the learners. For example, teaching on the literary work of a famous writer included excerpts from plays written by him followed by discussion of the same.

Learning activities. The post-lesson plans of the pre-service language teachers had a variety of learning activities compared to the pre-lesson plans. The pre-lesson plans mainly included activities such as lectures, question and answer sessions, giving illustrations and practice exercises. The activities were mainly of an individual nature. However, the post-lesson plans included many group activities, such as playing language games, filling in worksheets, preparing group presentations, etc.

Assessment strategies. A variety may also be observed in the assessment strategies used by the pre-service language teachers. Their pre-lesson plans mentioned mainly oral question and answer sessions, and written assignments for homework. However, their post-lesson plans included many forms of assessment. For example, a poetry lesson plan included a musical recitation of poetry, while a prose lesson plan included a word game as a form of assessment. Most of the pre-lesson plans involved tests, but the post-lesson plans seemed to focus on performance-based assessment, such as enacting a character, solving puzzles, etc.

The use of ICT. The comparative analysis of the pre- and post-lesson plans shows that the pre-service language teachers introduced many changes with respect to the use of ICT. In the pre-lesson plans, all of the participants mentioned using ICT only for PowerPoint presentations. PowerPoint presentations were used only to display the content points that the teacher would be teaching in the classroom. Of course, efforts were made to make the slides look colourful. Apart from the focus on aesthetic considerations, the pre-service teachers did not seem to have given much thought to improving the learnability of the content, such as by providing hyperlinks for additional information, space for vocabulary, etc. However, in the post-lesson plans, a greater variety of technology was used for student learning. For example, in a grammar lesson, students were asked to recompose a paragraph with the help of appropriate adjectives from a list of options. There was provision for feedback on the students' performance. The pre-service teachers made wide use of films and games with animated effects in order to foster students' learning. They used email in order to discuss the design and implementation of the learning activities.

The teachers' role. The teachers' roles in the pre-lesson plans were mainly characterised by teacher-centredness. They were shown as transmitters of knowledge, expert sources and directors of skills/developers of concepts through structured experiences. For example, in the pre-lesson plans, there were sentences such as the following in relation to teachers' activities: 'The teacher explains, the teacher asks the students to read the passage, the teacher asks the following questions, the teacher describes/compares, etc.'. However, the post-lesson plans depicted them as facilitators

of learning and even as co-learners. For example, in prose lessons, teachers were seen to facilitate cooperative learning among the students. They were also helping students to generate knowledge through the inductive presentation of concepts of grammar.

The students' role. All of the pre-service language teachers' pre-lesson plans reflected the students' role as that of passive recipients of knowledge. They involved students only by asking them questions in order to test their basic understanding of content. The students' role was limited to receiving information, demonstrating competences and following teachers' instructions. But in the post-lesson plans, several group activities were mentioned for students. For example, a grammar lesson involved a word puzzle which was to be solved in groups. The prose lesson plans also involved the students in cooperative learning. The post-lesson plans were also found to include active learning strategies, such as doing mini-presentations, making a concept map or writing a conversation.

This comparative analysis of ICT-mediated lesson plans shows that the pre-service language teachers have slowly but clearly moved from teacher-centredness to student-centredness in their intended teaching practice. We can observe their shifting inclination towards creating constructivist learning situations.

Discussion

The purpose of this research was to study the impact of PBL on pre-service language teachers' TPACK and their intended teaching practices presented in their detailed lesson plans.

TPACK of the Pre-service Language Teachers

The first research question about the impact of PBL on the TPACK of the pre-service language teachers shows that there was statistically significant improvement in the TPACK of the pre-service language teachers as presented in Table I. Their understanding of the relationship between pedagogy and content knowledge (PCK), the relationship between technology and pedagogical knowledge (TPK), and the relationship between technology, pedagogy and content knowledge (TPACK) all improved over time. In other words, the interrelated areas of TK, PK and CK showed marked progress from before to after the project.

It is not surprising that the pre-service teachers' knowledge about the interaction between pedagogy and content knowledge showed more improvement compared to other dimensions. The reflections of the pre-service language teachers also supported the fact that they seriously reconsidered their pedagogical practices, as well as the nature of the subject they taught. This must have happened as a result of the fact that, during their off-campus teaching practice, they are trained to focus on the interrelationship between pedagogy and content, and very rarely on other relationships. Taking into consideration that the project was about practical applications of ICT in the teaching and learning of language, this finding was encouraging. The project in which the pre-service language teachers were involved cultivated deeper knowledge of how technology related to other aspects of teaching, specifically content and pedagogy.

In spite of statistically significant improvement in the TPACK average scores overall, it is surprising to see that the TCK scores were the lowest among the dimensions (13.27), and there is no change in the scores before and after the project. The TPACK scores as a dimension even indicate a slight decrease in post-scores compared to prior scores (14.67 compared to 15). Based on the qualitative data collected through the pre-service teachers' reflections, there may be two possible explanations for this. First, their explicit awareness about their indirect learning of technology in itself was not as high. Second, the project was designed to emphasise how technology can be used more effectively in relation to the intended learning outcomes, the pedagogical practices of the teacher, and how students are responding to the changes in these components in the classroom. As a result, some of the pre-service teachers learned nothing new with respect to the use of ICT skills. For example, one group of English language teachers ($n = 4$) already knew how to prepare e-worksheets, supply hyperlinks and prepare animations. The other pre-service teachers had also learned technology indirectly during work with peers, and not in a formal manner. Perhaps some other factors are also responsible for this phenomenon, which

requires further exploration. Thus, we can conclude that the PBL approach did have a marginal impact on the development of the TPACK of the pre-service teachers.

Intended Teaching Practices of the Pre-service Language Teachers

The qualitative analysis of the pre-service teachers' pre- and post-lesson plans shows that the pre-service teachers changed their intended teaching practices in teaching, learning and technology more towards a student-centred-learning approach. In-depth examination of the changes in the pre-service teachers' intended teaching practices demonstrated a shift towards student-centredness mainly in four aspects – namely, learning goals, learning activities, the use of ICT and assessment strategies. The pre-service language teachers' experiences during the PBL activities and their observations of the teacher educators' modelling seemed to have affected their intended teaching practices – that is, during the period of the project, they participated in solving an authentic problem, observed exemplary teachers' practices in simulated situations in on-campus activities, and engaged in group work, discussion, reflection and presentations. Many of the pre-service language teachers' post-lesson plans reflected the innovative ideas demonstrated by their teacher educators. For example, a participant from the English L3 group wrote in her reflections: 'I got the idea for making the interactive presentation for letter writing from our language methods professor'. A participant from the Marathi L3 group mentioned in her reflections that: 'Making video clips for the explanation of the poetic imagery was suggested to us by our language professor'. Another participant from the Hindi L2 group gave credit for successfully creating animations and multilinear PowerPoint presentations to her peers and discussions with her language professors. The active engagement in PBL seemed to have impacted pre-service teachers' ideas of their own teaching practices, which were described in their detailed lesson plans. The results of this study provide guidelines for the effective use of PBL to impact teachers' TPACK and their future teaching practices.

Conclusion

This exploratory study examined the impact of PBL on pre-service language teachers' TPACK and their intended teaching practices. The findings of this study support earlier research suggesting that PBL impacts pre-service teachers' TPACK (Meng & Shuh, 2011). The findings of this study seem to suggest that a PBL class design with an emotionally and academically conducive milieu to stimulate pre-service teachers' journey from socialisation to internalisation can help teachers cultivate TPACK. The pre-service teachers demonstrated more understanding of the complex interplay between the three basic components of knowledge – content, pedagogy and technology. The qualitative analysis also showed the changes in the intended teaching practices of the pre-service teachers. Nevertheless, it is still uncertain whether the pre-service teachers will actually carry out their lesson plans based on their newly acquired ICT-mediated learning techniques when they resume their duties as teachers. The researchers therefore feel that there is a need for a longitudinal study which examines how pre-service teachers take their constructivist experiences into their future classrooms.

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