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Learning Together Online: Insights into Knowledge Construction of Language Teachers in a CSCL Environment

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ABSTRACT

Sociocultural perspectives of learning emphasise the role of social interaction and activity in the process of knowledge construction and foreground the social-cultural settings in which knowledge construction occurs. This paper examines how in-service language teachers co-construct technological pedagogical content knowledge (TPACK) in asynchronous discussion and explores two significant areas: 1) the critical elements of TPACK and 2) the process and strategies of knowledge construction. As such, the focus of the paper is placed on the type of knowledge that is considered significant by language teachers and the process of knowledge construction, with attention to the communicative strategies and resources. Online chats from 13 teachers are analysed using both thematic and sociocultural discourse analysis. The results indicate that TPACK mainly concerns the affordances of technology and methods to integrate technology from teachers' perspectives. In the process of co-constructing TPACK, teachers use different communicative strategies to negotiate meaning and achieve mutual understanding. Various contextual resources are exploited to facilitate and mediate the process of knowledge construction. This paper highlights the significance of context in developing knowledge, the need for providing participants with training for communicative strategies, establishing ground rules in collaborative work, giving ownership of task or topic to the participants and the importance of social talk.

Keywords: TPACK; computer-supported collaborative learning; sociocultural perspective; social interaction; contextual resources; communicative strategies

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Introduction

New technologies have been considered an integral part of second language teaching, and one fundamental argument underpinning this drive is that technology will benefit learning if integrated properly (Li, 2014; 2020). However, it is not an easy task for teachers as the realisation of the full potential of technology lies in *how* teachers use it to achieve their pedagogical goals rather than *what* tools they use (Li, 2014; 2017a; 2020). In practice, teachers often find it hard to choose the appropriate tools/materials for different learning tasks (Li, 2014; 2017a), and they are not prepared well to some extent as teacher preparation for technology use can often be inadequate, inappropriate, irrelevant, or outdated (see, e.g., Kessler, 2010; 2018; Williams et al., 2014). Thus, despite the widely shared positive attitudes towards using technology in teaching (Cummings Hlas et al., 2017; Kessler, 2006; Sert & Li, 2017), the uptake of technology in second language classrooms is low due to insufficient technological pedagogical content knowledge (TPACK), and low confidence and competence to embrace technology in their professional practice (Li, 2015). For language teachers, TPACK is critical in successful technology implementation in practice (Sert & Li, 2017). There is ample evidence to urge for the preparation and education of pre-and in-service language teachers to develop computer-assisted language learning in the 21st Century (e.g., Hong, 2010; Hubbard, 2008; Liu & Kleinsasser, 2015). Therefore, various professional development opportunities were offered to teachers to develop this knowledge and building community, among which online professional development programmes have been popular for such collaborative knowledge sharing and creation. As such, this study aims to cast light on the teachers' perspective of critical dimensions of TPACK and generate ground theoretical understanding of communicative and contextual resources in developing knowledge in a Computer Supported Collaborative Learning (CSCL) environment.

This research is significant in two aspects. First, it addresses one of the gaps in the literature regarding online learning. Much attention has been devoted to students' experience and attitudes, while little research has tapped into teacher development especially informal learning. Yoon et al. (2020) highlighted the significance of online learning for teacher development, and a similar result was reported by other studies (Parsons et al., 2019). However, there is limited research revealing the insights into online knowledge co-construction of language teachers (e.g. Pawan, et al., 2003; Yoon, et al., 2020). Second, with the development of new technologies, more efforts are required for teachers to use technology in enhancing learning. Developing TPACK will further enrich the student experience. From a teacher development perspective, understanding what aspects of TEACK is important and the process of collaborative knowledge construction is significant, as it will not only push forward the adoption of technology to support teacher development but shift teacher professional development activity from traditional lecture-type knowledge transmission to participant-oriented knowledge creation. Situated in this context, this study addresses the following questions:

- 1) What aspects of TPACK are critical from the teachers' perspective?
- 2) How do participants utilise the communicative strategies and contextual resources in constructing TPACK?

Theoretical framework

The sociocultural perspective of teacher learning

Building on the Vygotskian framework (1978), the sociocultural perspective of learning emphasises the importance of culture and the social context in

one's development, especially the role of social interaction and artefacts in mediating knowledge construction. From this perspective, teacher learning is an active meaning-making process in which they construct their cognition, knowledge and identity in practice (Golombek, 2017; Li, 2020). It is "an interactive process, where knowledge and understanding develop through collaboration with others" (Li, 2017b, p.20). In this respect, teacher learning is a complex system rather than an event, made complex by various factors such as students, the educational system, the curriculum and school culture. Thus, in order to understand teacher learning, local (cultural) knowledge, problems, routines and context all must be taken into consideration (Li, 2017b). Singh and Richards (2006) argue that good teaching is a private matter, as teachers do not make it public unless they are required to. Therefore, interaction and collaboration facilitate knowledge sharing within a community, and when such knowledge is made available, it can become shared knowledge. Furthermore, interaction promotes insights and possibilities for innovative practice (Kiely & Davis, 2010). In second language teacher education, 'collaborative dialogic reflective practice (CDRP)' where teachers could engage in a collaborative community, is considered a powerful knowledge development tool (Li, 2017b). In this process, three elements are critical to facilitate engagement and learning, namely theoretical underpinnings, analytical and reflective skills and critical colleagues. It is these elements that help teachers to develop pedagogical knowledge together.

Technological Pedagogical Content Knowledge (TPACK)

Shulman (1987) defines the knowledge of teaching a subject matter as pedagogical content knowledge (PCK). Traditionally, teachers develop their PCK through formal training (e.g. pre-service education) and practice (in the format of practical knowledge) or through in-service development opportunities, including short courses, workshops and peer dialogues. Previous research suggests that PCK involves teachers' integrated understanding of pedagogy, subject matter content, student characteristics, and the environmental context of learning (Cochran et al., 1993), which cannot be learned separately but as a whole. In integrating technology into teaching, technological pedagogical content knowledge (TPACK, Mishra & Koehler, 2006) is required. TPACK is based on Shulman's (1987) work, consisting of subject matter knowledge, pedagogical knowledge, and technological knowledge, which can serve as "an analytic lens for studying the development of teacher knowledge about educational technology" (Mishra & Koehler, 2006, p.1041). TPACK emphasises (1) the dynamic relationships between content, pedagogy, and technology for teachers, and (2) successful integration of technology into teaching and in developing their knowledge and competence in the technology integration (Koehler et al., 2007; Mishra & Koehler, 2006). Although much work has been done to investigate teachers' technological knowledge and competence and their perceptions of using technology, few studies have been conducted on language teachers' TPACK (Gao & Zhang, 2020, Sert & Li, 2017; Tseng et al., 2011). This research, therefore, addresses this issue by examining how teachers develop their TPACK through online collaborative learning. It is worth noting that there is no agreed framework or model that can capture the critical elements of TPACK. Hampel and Stickler (2005) focused on the knowledge and skills teachers need for online teaching, whereas Healey et al. (2011) proposed a list of skills and standards that teachers should acquire in order to teach with technology. Given that, it would also be vital to learn the important elements of TPACK from the teachers' perspectives and understand how they develop this knowledge.

Collaborative knowledge construction and CSCL learning community

To understand collaborative learning, we must study how people appropriate and master the tools to mediate their thinking in a given culture or society (Wertsch, 1991). Collaborative knowledge construction can be viewed as a social process in which participants share information, negotiate meanings, revisit and adjust their opinions, and achieve agreement. There are a few critical

elements in achieving successful collaboration, including face-to-face interaction, positive interdependence, individual accountability, social skills and group processing (Dixson et al., 2006). Technologies, in recent years, have become an important tool to facilitate thinking, communication and collaborative learning. CSCL uses computer technologies to enhance interaction, collaboration and interactivity within a learning group (Zurita & Nussbaum, 2004). CSCL, exemplified by an asynchronous discussion, has offered positive educational potentials. For example, asynchronous online discussion allows participants to have more time to think and construct ideas and make more critical and vital contributions (e.g., Marra et al., 2004).

CSCL (e.g., discussion forums) could be considered a valuable channel for CDRP. First, the core of CSCL is joint meaning-making between participants, *intersubjective learning* (Suthers, 2005) or *group cognition* (Stahl, 2006). Concepts in knowledge building and collaborative learning in CSCL support the idea that participants can learn from each other through collaboration, meaning negotiation in a network-based community, which represents a broader learning community compared to the classroom. The process of knowledge building through dialogues and using resources/tools to appropriate knowledge is in a supportive environment. Second, CSCL provides a learning community for collaboration, and such a community provides participants with security, trust and empathy. Within the community, participants are more likely to appreciate the work of group members and treat each other sympathetically. Third, to facilitate successful collaborative learning, participants need to engage in critical and reflective dialogues. They need to acquire communicative skills in responding each other, clarifying points, developing arguments, reasoning with evidence, making justifications and so on. The communicative strategies will enable group members to understand, resonate, challenge and collaborate to improve and create new knowledge and engage in intersubjective learning.

Meaning-making, or intersubjective learning, is when different voices and perspectives encounter each other in a context. Wegerif and Mercer (1997) proposed a dialogical perspective that is “a deepening of the sociocultural paradigm which takes the emphasis on social context a little further through putting emphasis on the dynamic and interactive nature of the social construction of meaning with dialogues” (p. 53). Working with school children, Mercer (1995) and Wegerif and Mercer (1996) proposed three different types of talk that can be observed in collaborative activities: disputational talk, cumulative talk and exploratory talk.

- disputational talk: participants simply object to each other’s point of view without reasoning or further suggestions;
- cumulative talk: participants repeat, confirm and elaborate to accumulate common knowledge;
- exploratory talk: participants engage critically but constructively with each other’s ideas.

They argue that it is “in exploratory talk *knowledge is made more publicly accountable and reasoning is more visible in the talk*” (Wegerif & Mercer, 1997, p. 54). Therefore, it is exploratory talk that is more valuable and desired in order to facilitate collaborative knowledge construction.

The role of social interaction

Sociocultural perspective of learning highlights the interrelationship between language, interaction, development and community. Vygotsky (1978) posits that human beings make use of symbolic tools to both interpret and regulate the world and relationships with people around them. Language is considered the primary tool for mediation (Lantolf, 2000; Vygotsky, 1978). The

sociocultural theory also views language as a psychological tool, a 'tool for thought'. Language is "a means for engaging in social and cognitive activity" (Ahmed, 1994, p. 158). From a sociocultural perspective, learning is conceptualised as participation and negotiation, and as a result, new understanding and conception are developed (Young & Miller, 2004). In this process, language is a primary mediating tool in enabling information exchange, knowledge sharing, and, more importantly, collaborating and making meaning in a local context (Lantolf, 2000). Language exchange is understood as a tool, which facilitates meaning negotiation, the creation of a consensus between participants, and the development of new forms of knowledge. That is, learning takes place in a meaningful and authentic context where interaction facilitates learning activities.

Learning is a process of doing or being in ways that are valued and recognised, rather than acquiring a body of knowledge. The consequences for learning, therefore, can be located in the interactional details of participation and not only in the performance of traditional measures of achievement. Learning is thus defined both by how it is locally enacted (e.g., interactions, positioning) and culturally framed (e.g., achievement, participatory conventions).

Methodology

This study adopted a case study to capture the complexity of group knowledge construction in a real-life context. In this study, an in-depth understanding of the critical dimensions of TPACK from the teachers' perspective and the process of knowledge co-construction by them are the foci. The research took place in a professional development programme in a northern city in China.

As part of the continuing professional development programme, English teachers from secondary schools within the same district were offered some face-to-face seminars and workshops in ELT. These participating teachers were all nominated by their school as expert teachers who would disseminate the knowledge to their schools when they finished the programme. Their teaching experience varied from 5 to more than 20 years. The content of the professional development programme was about developing student-centred pedagogy and integrating technology into teaching. This professional development course had six guest lectures over six weeks and was further accompanied by an online discussion forum where they could share their experience, opinions and support each other. The forum aimed to provide opportunities for teachers to reflect on critical issues in their work and relate them to theories. Discussing online was recommended but not compulsory for the teachers. Therefore, participation in the forum was purely voluntary – there was no assessment or evaluation, nor were there moderations. The forum was in a closed format, and participants needed to be registered to access it.

Data collection

Focusing on how teachers collaboratively construct knowledge in a forum is enabled by the quantity and quality of data available. Not only is there an abundance of message threads, topics and contributions, but, most importantly, the message board postings themselves represent unique, raw data that is produced by teachers. Teachers were contacted to explain what the research was and to gain consent for using their online discussion threads. With teachers' consents, online discussion trails were exported to a word document for analysis. In total, nine topics were proposed, but only three topics attracted common interest, among which 'technology-enhanced language teaching' is the most popular one. This topic concerns how teachers develop their TPACK, and fifty-six messages from thirteen teachers constitute the dataset for this study.

Table 1
Communicative Strategies (based on Aravja, 2007, p.138)

Communicative strategies	Description
Declarative	Making a viewpoint or taking a stance
Referencing	Refer to other participants' posts, other forums, academic and cultural resources and their own contributions.
Justificational	Justifying the viewpoint, a piece of information, suggestion or example
Elaborative	Expanding the previously made point or information, suggestion or example to general situations
Generalization	Generalizing their views and opinions
Exemplification	Giving examples
Summarising	Summarising a previously offered piece of information, suggestion, examples or article.
Argumentative	Disagreeing with other participants' viewpoints, suggestions or examples by offering different opinions, using counterargument, providing negative evaluation, comparing or contrasting, and making explanations and hypothesis.
Social	Performing social functions, like greetings, expressing facial expressions and gestures, joking to express feelings, emotions and expectations.
Positive judgemental	Providing support or agreement to the information, suggestion or example offered
Responsive	Giving responses (or responsive questioning), answering questions or making clarification.
Interrogative	Asking questions to request a piece of opinion, information, suggestion or clarification or challenging an idea proposed by other participants
Informative	Giving relevant information (e.g. books, articles, websites)
Suggestive	Offering a suggestion
Constructive criticism	Criticising peers or self
Reasoning	Reasoning about knowledge

Teachers used Chinese in their discussions. Therefore, the messages were translated into English, and a great effort was made to ensure the accuracy of the translation by doing backwards-translation, checking and rechecking transcripts against the translated interpretations during analysis and synthesis (Lyons & Coyle, 2007). To protect the anonymity of the participants, names that appear later in transcription are pseudonyms.

Data analysis

Both quantitative and qualitative analyses were carried out to display overarching trends and insights. Data were treated like spoken discourse as participants engage in a continuous dialogue. There are three steps involved in the analysis procedure: first, content analysis of the messages was conducted to explore the thematic networks of the messages. The questions that guided the analysis included: what knowledge or information is handled here and how participants work together to share the knowledge/information. This process not only helps to generate the main themes across messages but also provides insights into the nature of collaborative work among teachers.

Second, exploratory talk features are used to identify collaborative talk. Specifically, within each theme, sociocultural discourse analysis was applied to look at how teachers construct knowledge and whether participants engage critically but constructively with each other's ideas. To reveal insights into knowledge construction, further analysis was carried out focusing on communicative strategies and contextual resources based on Aravja's framework (Aravja, 2007). In this analysis, the focus was placed on how participants communicate using language strategies, interactional features and contextual resources. The messages were read to match with the communicative strategies, and new strategies were added if a message did not fall in an existing one (Table 1). This process went through several times to make sure each utterance was coded with a strategy. If more than one strategy was identified in one utterance, the utterance was labelled with all the strategies it entailed. Then, a similar procedure was employed to identify resources teachers drew upon in meaning-making. Again, the contextual resources were modified in the data coding process. For example, the course material from Aravja's framework was not presented in this

dataset, whereas three new types of contextual resources emerged, namely common knowledge, academic resources and cultural resources.

Once the communicative strategies and contextual resources were identified, data were dealt with at both quantitative and qualitative levels. The descriptive analysis was used to offer a general picture of what appeared to be going on in the process of meaning-making and identify what communicative strategies and resources were employed in the knowledge co-construction and whether there were any differences among different topics. Then an example of the exchange was analysed at a micro-analytic level to offer details of the process of knowledge construction.

Findings

Critical dimensions of TPACK from the teachers' perspective

The first RQ addresses the critical dimensions of TPACK from the teachers' perspective. Two distinctive themes emerged from the messages, namely, technology affordances and methods of integrating technology into teaching.

Technology affordances The study revealed that teachers were concerned about the affordances of technology in facilitating language learning when reflecting on critical issues in their pedagogical practice. Affordance can be defined as the material constraints of technology and its specific applications (Hutchby, 2001) and has been broadly interpreted by teachers as benefits and limitations in this study. As shown in Figure 1 below, technology affordances concern the benefits and drawbacks of technology at knowledge, material and affective dimensions.

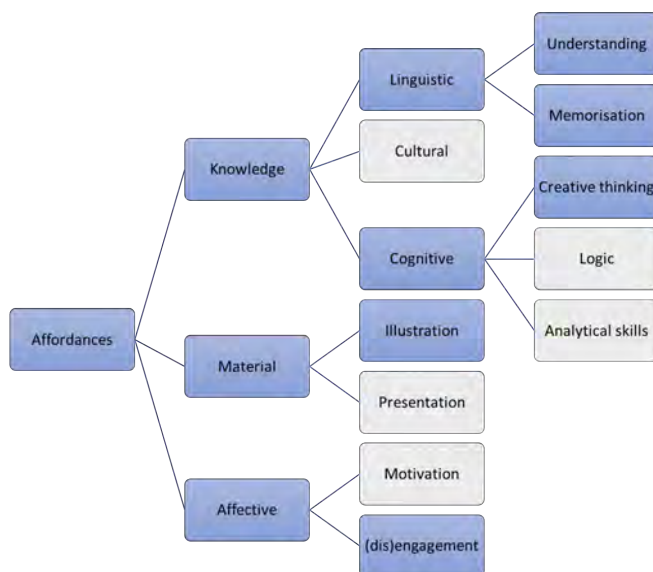


Figure 1. Technology Affordances from Teachers' Perspectives (light shaded boxes=positive views; dark shaded boxes=mixed views)

- Knowledge dimension: linguistic, cultural and cognitive development

From teachers' perspectives, technology potentially influenced knowledge development in linguistic, cultural and cognitive aspects. In the linguistic aspect, teachers shared beliefs that technology could enhance understanding of abstracts concepts, foster memorisation of grammar rules and vocabulary. Two teachers' comments illustrated this view:

Chen: I think it helps students to understand the meaning of new words. I use images, sound and videos – it's great!

Xiao: I like to use a matching game to foster vocabulary acquisition. Students can remember those words when playing a game. So why not?

Not all would agree on the benefits of technology in linguistic knowledge enhancement as it could become too complicated. Some online messages showed this view.

QQ: Yes, it might help with vocabulary understanding but isn't there a more straightforward way to do that? For example, using L1?

Dora: I don't use technology to foster memorisation as it's just a waste of time. If memorisation is the key, then we just ask students to spend more time learning it by heart after class.

On the other hand, teachers were more convinced of the value of using technology to enrich cultural experience and knowledge. Technology, especially the internet and multimedia material, were believed to offer students a unique experience with different cultures and traditions. This view was widely shared among teachers.

QQ: Videoclips are really useful to show the life and culture of another country. That's what I mostly use the internet to do. That's the best resource for the units concerning festivals, traditions and lifestyle.

Apart from cultural knowledge, teachers discussed how technology could facilitate or hinder the development of thinking skills, especially creative thinking. In general, teachers believed that technology might develop analytical skills and logic, but they were not convinced that technology was effective in developing creative thinking. One of the reasons is that language is art while technology is science, and they are not compatible, as evidenced by the following comment.

QQ: I am against using technology...it hinders students' creative thinking skills.

Different understanding or conceptualisation of thinking skills also led teachers to have different viewpoints. One teacher wrote:

Wind: I know there are lots of claims that technology enhances thinking skills, but maybe in developing analytical skills or logic, rather than imagination.

- Material dimension: illustration and presentation

The second type of affordance of technology that seemed to be critical was that how technology and the technological environment was utilised by the teachers. Again, there was a mixed view about using technology for illustration purposes. Some teachers believed technology (images, videos and animations) would be useful to illustrate abstract concepts in vocabulary learning. Nevertheless, this view was not shared by others.

Citylife: I think it is great to illustrate the abstract or unknown concept to students. For example, when teaching 'descend'.

Tina: Why can't you use folk story Chang'e? as suggested by others. I think it's more straightforward.

In terms of presentation, all teachers shared the view that technology had more advantages than traditional tools such as handouts. PowerPoint slides, for example, were considered 'neater and more efficient' (Wind). A related benefit of technology was its efficiency in teaching. One teacher's post illustrated that view.

Fo: after we correct students' work, each of us uploads examples to the shared space in the intranet. Then in class, we can all access the examples to show error correction.

- Affective dimension: motivation and (dis)engagement

For teachers, motivation was critical in developing student engagement and technology was recognised as a way to raise students' interest and enhance their involvement. This view was widely recognised by teachers.

Dora: ...displaying pictures can help motivate students, especially young learners. For example, I find my students talk more and participate more actively in class when I use PPT to display relevant pictures.

Wind: displaying pictures and playing videos definitely can lead to more interest. But not too much.

Nevertheless, teachers had concerns when using technology to engage students as some of them raised a concern that technology could distract students.

Liang: technology does have a value in increasing group work, participation but it needs to be used properly. I mean, we need to consider the function of technology, and we shouldn't use it blindly and hope it will add value.

Tina: I agree technology motivates students, but motivation doesn't always lead to engagement. When I do student projects, I find students can be distracted when they have access to the internet.

Methods of integrating technologies into language teaching

The second important area of TPACK emerged from the data concerned how teachers understood their practice with technology in teaching. As evidenced in the data, this knowledge could be classified as practical personal knowledge that was accumulated, developed and modified in their professional context through working with students and colleagues. Figure 2 captures the main resources and methods regarding how teachers used technology to address pedagogical goals, and six areas of work were observed in the data.

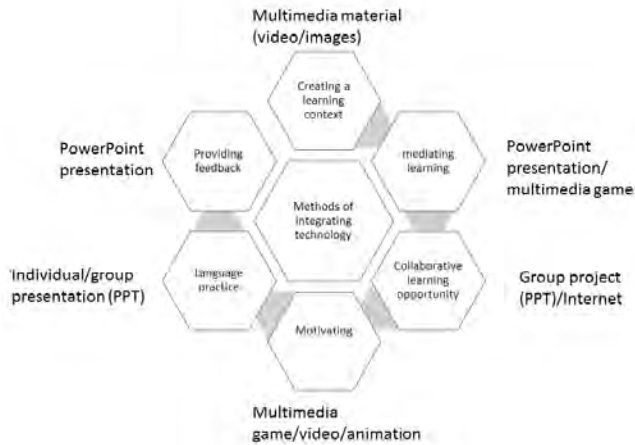


Figure 2. Methods of Integrating Technologies in Language Teaching

- Creating a learning context

Teachers used multimedia material such as videos and images to create a learning context for students. Clearly, this strategy was shared among participants as good practice at the lead-in stage and generate student participation.

Shuji: My colleagues and I have created an image bank that includes cartoon pictures. We started with one topic, and gradually the bank contains quite a lot. Using images is effective when introducing a topic.

Yoyo: I use PowerPoint but with videos – short ones. And I don't always use English ones as I want to use some familiar material to introduce the topic and provide background information. So, I think it's ok to use Chinese videos as well.

- Mediating learning

Technology was considered by participating teachers as a mediational tool to help learners to regulate the learning process. For example, subtitles and video captions were used as a mediator to facilitate L2 vocabulary learning and comprehension. In terms of the format of technology, the most frequently referred mediational method was the PowerPoint slide.

Yoyo: It depends on the teaching objective as I use PPT as a learning point. Students pay attention to the form, the spelling, the images associated with the vocabulary and the collocation.

- Providing collaborative learning opportunity

Collaboration in language classes was often referred to as group work, but some teachers went beyond that to offer students the opportunity to do a student-led project. The underlying assumption was that a collaborative project would enable students to transit from language learner to language user.

Wind: I ask students to do some small projects, for example, something related to the topic they learn and then present in class. They like it, and they are very creative – some make really good PPT slides with music and animations.

- Motivating students

Interestingly, ‘motivation’ was heavily referred to in the chat, and teachers displayed varied ideas to engage and motivate students, such as using multimedia games, videos and animation. Apart from using relevant multimedia material to make learning fun and interesting, some teachers also considered technology as a stimulus or entertainment.

Shuji: I also show them a short video in class just because I think they are tired, and I want to entertain them.

Citylife: multimedia games are fun – I always reward them in class if they behave themselves. Occasionally, I organise a competition between groups just to arouse their interest, especially on Friday afternoon. You cannot have a worse time than that for an English lesson.

- Language practice

To these teachers, students lacked opportunities to practise English in real-life situations. Thus, active participation meant more than answering questions in class and doing pair work. Some teachers engaged in innovative practice to facilitate more language use by offering students an opportunity to do a presentation to the whole class. Mojo’s comment illustrated this view.

Mojo: The best thing I do is to give a student 5 minutes to do a short presentation on a topic of their choice. A story, a news report or an opinion. Whatever they like is fine with me. I ask them to create two slides with multimedia material and keywords. They cannot write a lot on the slide. This gives them a chance to practice English. I think students like it.

- Providing feedback

Although the technology was not directly used by these teachers to provide feedback, they used PPT to advance the effectiveness of giving feedback to facilitate group learning.

Moon: I select the sentences with mistakes from their writing tasks and then present them to the class. I will give feedback, and sometimes I invite students to correct these sentences too. I like it when they identify the sentence as being their own.

Process and resources for knowledge construction

In order to shed light on the process of collaborative knowledge construction, two layers of data analysis were performed. First, communicative strategies and contextual resources were identified and examined using descriptive statistics. Then, microanalysis of interaction between participants was conducted using sociocultural discourse analysis (Mercer, 2004).

Communicative strategies

Sixteen communicative strategies were identified in the knowledge co-construction talk, totalling 590 times of strategies use. Overall, some communicative strategies were used more than others in sharing knowledge or achieving consensus. For example, responsive, informative,

exemplification and argumentative talk were the most widely used communicative strategies (14.6%, 11.4%, 10.3% and 9.2%, respectively). Responsive talk was the most used communicative function, reflecting the nature of the collaboration, the commitment and engagement of the individuals towards the topic, acknowledgement of other's opinions, and willingness to build on each other's contributions. Informative talk and exemplification were also key to knowledge co-construction as providing information, giving concrete examples and elaborating one's views and opinions facilitated the collaborative and responsive talk. Social talk also was one type of major talk in this collaborative task (5.4%), and it was predominantly about showing feelings and emotions to responses, bringing social cohesion by 'oiling the wheel'.

There were also two types of talk not widely observed in the literature in a collaborative talk: argumentative talk and constructive criticism. In the data, the argumentative talk was one of the most widely used communicative strategies whereby participants presented criticality in their thinking and ultimately created new knowledge collaboratively (9.2%). Constructive criticism, although only taking up a small percentage (2.7%), could provide participants with an opportunity to take different perspectives and reflect, which is possibly related to the Chinese culture of engaging in peer criticism in learning. These two types of the talk were clearly connected to exploratory talk as teachers engaged critically but constructively with each other's ideas.

Analysis of the messages showed that the topic influenced the use of communicative strategies. More communicative strategies were identified in 'technology affordances' than 'methods of integrating technologies into language teaching' (352 vs 238). Though these sixteen strategies were all generally used, the weight of communicative strategies in these two themes was different (see Figure 3). For example, declarative talk, which was when a participant offered a statement, took a stance or expressed one's viewpoint, was dominant in the theme of 'technology affordances' (11.1%) but less so when participants talked about 'methods of integrating technologies into language teaching' (5.0%). Referencing was another communicative strategy that was substantially used in the former theme rather than in the latter (11.1% vs 2.1%). On the other hand, exemplification was used more in discussing 'methods of integrating technologies into language teaching' than 'technology affordances' when participants related to their teaching and gave examples of using technologies.

This evidence suggested how participants oriented themselves to the content they talked about and employed different communicative strategies to engage in different types of discussion. There was a possibility that participants, by and large, viewed 'technology affordances' as more theoretical, hence the substantial use of referencing and declarative talk (11.1% vs 5.0% and 11.1% vs 2.1%, respectively). While the topic of 'methods of integrating technologies into language teaching' was perceived as a practical element which was classroom-based and practice-oriented, therefore, participants used more exemplification talk (12.6% vs 8.8%).

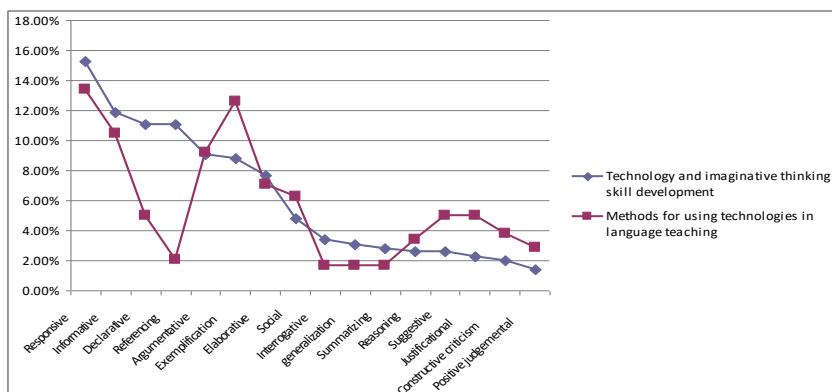


Figure 3. Communicative Strategies Used in Different Themes

Contextual resources

The results indicated that teachers used various contextual resources to facilitate and mediate the process of knowledge construction.

Contextual resources were the artefacts participants make use of in building knowledge. Arvaja (2007) proposed five broad resources student teachers used in web-based discussion, namely course material, own ideas, own conceptions, own experience, and co-text. Data from this research study suggested teachers used seven types of resources, including co-text, own ideas, own conceptions, own experience, common knowledge, academic resources and cultural resources (see Table 2). In total, contextual resources were used 495 times, with 308 times for 'technology affordances' and 187 times for 'methods of integrating technologies into language teaching'.

Table 2

Contextual Resources (based on Arvaja, 2007, p. 139)

Contextual resources	Description
Co-text	This refers to the fact that participants build their thoughts on other participants' views, examples, argument, statement, idea, experiences and so on. This also refers to the incidents when participants quote other participants' contributions or refer to other forum posts or contributions.
Own conceptions	Teachers' own understanding about a concept or idea.
Common knowledge	This includes common beliefs, values and assumptions shared by the group.
Own ideas	This refers to the idea developed by individual participants, also in instances when participants refer to their own posts.
Own experience	Teachers' own experience (life, teaching and learning).
Cultural resources	Chinese literature and philosophies, including the use of popular magazines. This also includes folk sayings and proverbs.
Academic resources	This refers to professional development course materials, academic articles teachers read.

The most used resource was co-text (31.0%), which was an important feature of collaborative knowledge construction. The use of co-text suggested participants elaborated and developed ideas together by building upon each other's contributions and opinions. Co-text, therefore, could be considered as a feature of a collaborative rather than an individual activity. Participants also relied on their own conception as a key resource (17.2%), when individuals provided their own understanding about a certain concept or idea, either as a further development of their own or elaboration of others'. Data suggested that common knowledge was another useful resource that participants used in knowledge co-construction activity (15.6%) when teachers relied heavily on the shared understandings or common beliefs about teaching and learning. Other key resources participants employed during this activity were their own idea (14.7%) and own experience (11.5%). Cultural resources including Chinese literature and philosophies and academic resources were the two least-used resources.

Again, topics influenced what resources participants used (Figure 4). Own conception was more substantially used in 'technology affordances' than in 'methods of integrating technologies into language teaching' (26.6% vs 1.6%). Participants oriented themselves to these two themes differently, with the former more theory-based and the latter more practice-oriented. Thus, demonstrating understanding of a concept was important in discussing theories and principles. Co-text and own experience were more evident in practice-oriented talk (32.8% and 22.6%, respectively). Particularly, when talking about 'technology affordance', own experience was the least-used resource in knowledge co-construction of (4.9%). On the other hand, academic resources were only used in 'technology affordances' (8.1%). Common knowledge where participants used folk stories, famous saying and their shared understandings about classroom issues was used more in 'methods of integrating technologies into language teaching' (24.2%) than in 'technology affordances' (10.4%).

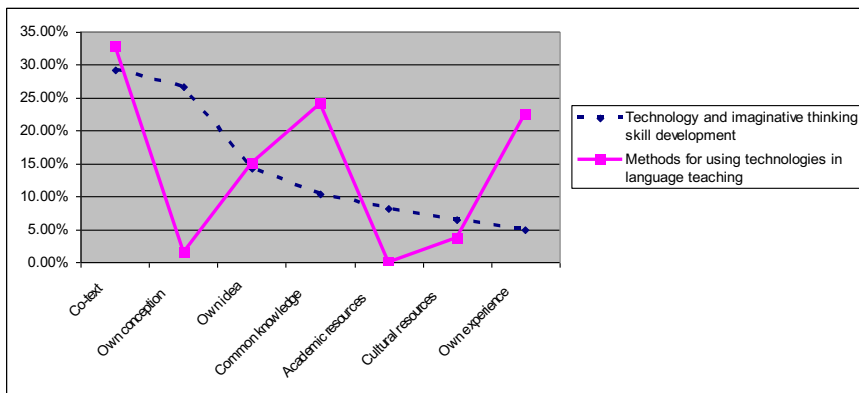


Figure 4. Contextual Resources Used in Different Themes

To understand how participants utilised the communicative strategies and contextual resources in the process of knowledge building and shed light on intersubjective learning, I provide an example of teachers discussing 'technology and creative thinking skills'.

1 Author: QQ Title: technology hinders creative thinking skills

1-1	I am against using technology to teach English, especially when using it to display images.	Declarative
1-2	One of the many reasons is it hinders students' creative thinking skills.	Justificational
1-3	Language is art; what we as teachers do is to help students experience the art and develop their creativity in using the language, rather than trying to teach them a fixed idea or grammar rule, or vocabulary, which is what I believe ALL of us do in our classrooms.	Elaborative
1-4	For example, in teaching the word 'descend', what I would do is to let students relate this word to the folk story 'Chang'e descending to the moon'...and ask students to relate this story or other concepts to the word, and develop their creative thinking skills.	Exemplification experience
1-5	In a word, I believe language (story) can develop broader and freer imagination compared with pictures and images.	Summarising

2 Author: Wind

2-1	I do agree with you	Positive judgemental
2-2	Recently I've been thinking about the same issue and feel we don't use technology for the sake of learning but technology itself.	Elaborative; declarative
2-3	I know there are lots of claims that technology enhances thinking skills, but maybe in developing analytical skills or logic, rather than imagination.	Elaborative; reasoning

3 Author: Dora

3-1	You might be too extreme.	Constructive criticism
3-2	Just joking 😊	Social
3-3	But seriously, I think there IS a place for technology in teaching English.	Declarative
3-4	Even displaying pictures can help motivate students to stay with the teacher, especially with young learners.	Informative; elaborative
3-5	For example, I find my students talk more and participate more actively in class when I use PPT to display relevant pictures.	Exemplification

The above exchange was part of the thread when teachers discussed their views regarding technology and creative thinking. In this exchange, QQ shared his viewpoint and employed his own idea as a contextual resource (1-1). Then he provided a justification for his argument (1-2). Further elaboration was displayed through using common knowledge/understanding about the nature of language and the teacher's responsibility (1-3). Here, QQ successfully established a common ground through articulating a shared understanding of the current practice of English teaching - a professional context. It is also worth noting that he used his own conception here. This was followed by the exemplification of teaching vocabulary (1-4), where QQ used a well-known folk story to illustrate how technology might restrict students' creative thinking skills. Here he used a different type of common knowledge, which could be acknowledged and recognised by people from different contexts. He concluded by summarising his point, using his own ideas.

Wind responded to QQ's post by providing positive comments to show his agreement (2-1). Then he further elaborated upon QQ's idea, noting 'the same issue' here was used to recognise and acknowledge QQ's post. This positioning was followed by further elaboration (2-3). Co-text here was the main contextual resource, and Wind's contribution was largely based on QQ's. Wind also indirectly used academic resources by using the academic word 'claims' (2-3).

In responding to both QQ and Wind, the third participant, Dora, made a constructive criticism (3-1) and then a joke (3-2). Note that the social function of her talk (3-2) and the emoji, to some extent, lightened the atmosphere. Then she declared her position by stating her opinion and emphasising that there *is* a place for technology in teaching English (3-3). The word choice of

'seriously' also suggested that she had repositioned herself to switch from social to institutional talk. Then she provided further information (3-4), and elaborated her opinion by providing an example, using her own experience.

This example illustrated how participants oriented to each other and built on each other's contributions. There was also evidence that in such a knowledge co-construction process, all participants were able to build on each other's opinions and acknowledge other contributions by using various communicative strategies and contextual resources.

Discussion and implications

Although research in teachers' perceptions of technology-enhanced pedagogy is prevalent in the L2 educational context, as mentioned, very few studies focused on TPACK. Thus, this study responded to a gap in the literature by expanding research into this domain and also by exploring how teachers collaboratively defined and constructed TPACK. Importantly, the current study sheds light on the communicative strategies and contextual resources that teachers used to collaboratively build this knowledge.

From teachers' perspectives, TPACK concerned two major aspects, as evidenced in their discussion: the affordances of technology and methods of appropriately using technology. Teachers considered TPACK in relation to their professional needs and students' learning needs. This is in line with the previous research examining teachers' considerations when integrating technology in teaching (Ottenbreit-Lefvich, 2010; Li, 2014). From teachers' perspectives, affordances of technology included benefits and constraints at three different dimensions: language knowledge, material and affective aspect. First, teachers considered the impact of technology on knowledge, which included subject knowledge (linguistic acquisition), cultural knowledge and cognitive development. The study suggested that teachers demonstrated a mixed view regarding the positive impact of technology on linguistic knowledge development. This might be due to the limited understanding of what linguistic acquisition entailed in the local sociocultural context. Similarly, teachers cast doubt on the role of technology in developing creative thinking but were positive in developing logic and analytical skills. This study highlights the importance of investigating the ties between technology and the development of creative thinking in language learning. On the other hand, there was a shared view of the advantages of technology in enhancing cultural knowledge. This positive view might be due to the limited means to develop students' cultural knowledge and the internet was generally considered a useful tool to facilitate culture exchange (O'Dowd, 2006; Ryshina-Pankova, 2018). In this sense, technology is considered a source of input. In the material dimension, it seemed teachers restrict themselves to the entry-level of using technology, that is, using technology to illustrate concepts or present material, which was also observed in previous studies in China (Li, 2015). However, as Li (2015) cautions, we need to gain a more in-depth understanding of the role of the technology underpinning the teachers' practice, as teachers might find it challenging to articulate and theorise their practice, and we (researchers) might miss the sophistication of technology use by teachers in addressing pedagogical goals. In this regard, considering how teachers use technology through microanalysis of classroom activities would be beneficial. In the affective dimension, teachers considered it critical to use technology to motivate students, and this corresponded to the existing literature (Chik, 2014, 2018; Stockwell, 2013). Nevertheless, teachers were aware of the potential drawback of technology to distract or disengage students.

The findings suggest knowledge about affordances of technology constitutes a major part of TPACK. Therefore, it is important to examine both benefits and constraints of technology from teachers' perspectives when developing teachers' competence and confidence in integrating technology into teaching. Specifically, attention needs to be placed on how technology enhances/restricts subject knowledge development, material use and affective aspects in learning. For teachers, developing an integrated knowledge about the usefulness of technology is critical.

The second area of TPACK was about methods of using technology for teaching. In a nutshell, teachers considered both the tools and roles of technology. In summary, technology was perceived as having the following functions.

- Creating a learning context: teachers contextualise the learning content by using various multimedia materials such as images and videos.
- Mediating learning: technology (PowerPoint) can act as a mediator to facilitate a 'triadic interaction' (Van Lier, 2002) or enhance understanding.
- Providing collaborative learning opportunities: technology is considered as a combined output that requires collaborative work.
- Motivating learners: technology (e.g., games) can raise participants' interest in the topic, material and language.
- Enhancing language practice: technology is used by learners as a tool to enable language practice (e.g., presentation)
- Providing feedback: technology is used as a shared resource that facilitates teacher feedback.

The findings suggest that teachers collaboratively explore the rationale, advantages and disadvantages in their own professional context. Thus, TPACK is contextualised and practice-oriented and is established within their community of practice. In terms of teacher learning, knowledge sharing is an effective way. Still, more importantly, teachers need to engage in a collaborative dialogic reflective practice (CDRP) to assess how possibly that practice will work in their context (Li, 2017b). The findings highlight the significance of teachers' own experience and lessons from peers because they need to see how different ways of technology use can be linked to their immediate context. This means teacher training programmes need to consider some context-specific material and raise teachers' awareness of critically evaluating digital materials and practice. The focus on practical methods of integrating technology into teaching is a context-specific professional issue; it is in this process that teachers contribute to the refinement of professional knowledge and experiential resources (Garton & Richards, 2008).

In the process of co-constructing knowledge, teachers employed sixteen different communicative strategies, which resembled discourse features in both knowledge sharing and knowledge construction. Particularly, responsive, informative, declarative and argumentative talk, together with referencing and exemplification, were largely used by participants, which also shared similarities with exploratory talk. According to Mercer (1996), exploratory talk is beneficial for collaborative knowledge construction. In the exploratory talk, partners engage critically but constructively with each other's ideas. Statements and suggestions are offered for joint consideration. These may be challenged and counter-challenged, but challenges are justified, and

alternative hypotheses are offered. In the exploratory talk, knowledge is made more publicly accountable, and reasoning is more visible in the talk. This study suggests that cumulative talk also plays a role in knowledge construction as participants usually build positively but uncritically on what the others have said. Cumulative discourse is characterised by repetitions, confirmations and elaborations. Different from previous studies (e.g., Arvaja, 2007), this study demonstrated the value of argumentative talk and constructive criticism, which could take talk from cumulative to exploratory. Argumentative talk and constructive criticism suggest teachers can engage in critical analysis and argumentations from different perspectives. There are two implications here for teacher learning: first, collaborative knowledge construction benefits teachers as active learners and critical thinkers; however, knowledge co-construction will not happen automatically when simply putting a group of teachers together. Training can be beneficial in raising teachers' awareness of strategies in communicating through computer-mediated communication tools. Communicative strategies need to be explicitly taught to teachers if they are expected to participate actively and establish a shared understanding. Second, exploratory talk is the kind of conversation that mostly promotes deep learning, understanding and knowledge construction, and it is the kind of conversation that should be promoted and supported in collaborative learning. However, argumentative talk and constructive criticism is difficult for participants in any learning environment; therefore, building trust and a sense of belonging (Brown & Duguid, 2002) is critical. Trust can be developed through continued interaction, developing common values and a shared understanding (Gibson & Manuel, 2003).

In terms of contextual resources, this study confirms Arvaja's (2007) study that co-text, own conception, own idea, and own experience as key resources that participants draw upon in the discussion, but also suggests common knowledge and cultural resources are useful, in particular establishing a sense of belonging to the community. Culture impacts on the ability of the members to develop a shared understanding and the trust and openness of the group (Gannon-Leary & Fountainha, 2007). Ways of working and stories within the practice of their classrooms, language and even the educational background/experience exert a strong influence on how members can develop a repertoire on which shared knowledge is based. This perhaps is one of the obstacles that cross-cultural collaboration faces because cultural understanding adds complexity and challenges, although at the same time, value to collaborative knowledge construction. Equally, common knowledge plays an important role in the process of knowledge construction. Common knowledge, based on shared experiences within team practices, offers resources for rapid joint decision-making (Middleton, 1996). This study echoes this view that common knowledge plays a key role in the process of knowledge construction. Based on the above analysis, one practical implication is introducing ground rules for collaborative knowledge construction, including discourse, materials and cultural awareness. The establishment of ground rules can be the orientation of the knowledge co-construction activity, in which the participants establish their own rules and work culture.

Similarly, the study illustrated how social talk contributed to knowledge building (e.g. jokes). In collaborative work, Paulus and Roberts (2006) observed that the more successful group engaged in more socialising and supportive discourse. In this study, participants embed their social talk in argumentative talk. Arguably, it is the social talk that helps the participants ease off the tension and create a cohesive community. In many learning environments, social talk is considered an indicator that students are not engaged. However, social talk can add value to trust and, therefore, can contribute to the success of knowledge development. In a CSCL environment, participants do not only learn from each other but also constantly look for affiliation, support and affirmation (Kreijns et al., 2003). As shown in this study, social talk might help teachers to develop 'critical collegueship' (Lord, 1994), which will contribute to the continuity of professional development in a learning community (Kiely & Davis, 2010).

Topic presents an influential factor contributing to communicative strategies and contextual resources participants employed. From teachers' perspectives, the theme 'technology affordances' perhaps was considered more controversial and debatable than 'methods of integrating technologies into language teaching'. Thus, communicative strategies participants used were more towards exploratory talk and knowledge construction discourse in the former theme, whereas in the latter, communicative strategies were more like cumulative talk and knowledge sharing discourse. Similarly, the former theme might be interpreted by participants as more theory-oriented whereas the latter more practice-focused, thus different contextual resources were drawn upon. That is, academic resources (e.g. referencing) and own conceptions were very common in the former, whereas personal experience was dominant in the latter theme. What this study suggests is how participants interpret the theme and orient to the talk can highly influence communicative strategies and contextual resources in the process of meaning-making or intersubjective learning. Therefore, in designing teacher training programmes, contextual resources need to be closely linked to knowledge types. When teachers engage in CDRP, they need to be consciously using these resources to participate, reflect and collaborate rather than just talk about their own understandings. In this way, the focus of learning can be switched from knowledge accumulation to critically knowledge appropriation and construction (Li, 2017b).

Conclusion

TPACK is critical for effective implementation of technology in instruction, and how best to empower teachers to develop this knowledge merits further research, especially in the foreign language contexts, where innovative technology use is varied. This paper explored what constitutes critical elements of TPACK for language teachers and examined the communicative strategies and contextual resources they used to co-construct this knowledge in a CSCL environment. The findings of the current study showcase the key elements of TPACK from teachers' perspectives: affordances of technology and methods of integrating technologies into language teaching. More specifically, the benefits, constraints, techniques of integrating technology into teaching constitute the most important dimensions of TPACK.

Given that the present study is a small-scale exploratory study, there are certain limitations. First, due to the nature of the study, it is difficult to generalise the findings. However, what this study offered is insightful knowledge about the process and resources that teachers utilised to collaboratively build TPACK. This said, it would have been useful to have more participants as the current study focused on the online interaction of a particular group of teachers. Second, the insights would be richer if multiple data were collected and analysed. Nevertheless, this study has unpacked the critical elements of TPACK and revealed how teachers develop that knowledge collaboratively. The findings have added a significant value to the existing literature in collaborative teacher learning and the knowledge construction process. The paper argues the importance of a grounded approach to conceptualise TPACK from the teachers' perspective and gain insights into the process of collaborative knowledge co-construction in a social-cultural context. In addition, this study is one of its first kinds to investigate the process of knowledge co-construction among teachers online and how they have developed TPACK collectively in their context. Thus, it lays the foundation for future research to explore TPACK. It is widely acknowledged that social interaction is critical to the in-depth understanding of the process of meaning-making, and this paper illustrates how knowledge co-construction is achieved through communicative strategies and contextual resources. It is important that we realise the significant value of communicative strategies such as responsive, informative, exemplification and argumentative talk, and how the nature of topics influences the communicative strategies. Further research should look at how these strategies can be developed for language teachers for their professional development. Equally, there are various issues that have emerged from this

study, including the need for the training of communicative strategies, establishing ground rules, and the role of social talk in establishing trust and facilitating a sense of belonging for participants. These issues are essential elements of successful CSCL deserving further study in different social-cultural contexts. Further research should also look at the nuanced interactional strategies and resources in both formal and informal teacher learning settings. That is, how they can be integrated in teacher education programmes to facilitate TPACK development.

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