



Epistemic agency, a double-stimulation, and video-based learning: A formative intervention study in language teacher education

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1. Introduction

One trend in teacher education is to provide opportunities for teachers to participate in knowledge-building practice, in which they can share, discuss and continue improving ideas within a community (Bereiter & Scardamalia, 2003; Hong & Sullivan, 2009), and relate new concepts to their specific teaching context (Darling-Hammond & McLaughlin, 1995). In language teacher education, one requirement is that language teachers need to be equipped with both general and language specific knowledge of teaching (Lo Bianco, 2009). This requires teachers to integrate the specific features of the target language in their teaching, because every language has its particular linguistic and cultural needs (Liddicoat, Parademetre, Scarino, & Kohler, 2003), requiring different amount of time of learning (Foreign Service Institute, n.d.) and different ways of teaching (Kleinhenz, Wilkinson, Gearon, Fernandez, & Ingvarson, 2007), such as character writing in Chinese. However,

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language teachers continue to be taught in generic units because of the lack of budgets for staffing, even though language teacher education course could have more than eight language backgrounds. This has been identified as the key challenge for language teacher education, causing the decline and the lack of preparedness of teachers in the Australian context (Kleinhenz et al., 2007; Liddicoat et al., 2003). The resolution to this problem would be to incorporate language specific learning materials to boost preservice teachers' epistemic agency in creating language specific teaching resources. Epistemic agency means individual or group's capacity in knowledge production and practice (Damşa, Kirschner, Andriessen, Erkens, & Sins, 2010; Miller et al., 2018). This study has drawn on a project, which created video-based language specific teaching materials for this course. Although videos have become popular in education, learning would not necessarily happen by only watching the video, but by meaningful interaction with the videos (Gartmeier & Hascher, 2016). Therefore, this project used Vygotsky's (1931/1994) double stimulation as a method to enhance some preservice Chinese teachers' epistemic agency in creating language specific resources through their video-based learning experience.

2. Literature review

Research in the field of teaching Chinese as an International Language has been rapidly increasing in the last couple of decades. However, there were relatively less empirical studies on Chinese language teacher development (Ma, Gong, Gao, & Xiang, 2017). Most have focused on exploring teacher cognition (Gong, Hu, & Lai, 2018), such as perceptions (Ma & Gao, 2017) and beliefs (Wang & Du, 2016; Yang, 2019), whereas with few intervention studies in the area of Chinese language teacher education. Meanwhile, researchers call for more empirical research on improving Chinese language teachers' pedagogy (Liao, Yuan, & Zhang, 2017; Lu, Zheng, & Lin, 2019) especially in preservice teacher education (Ma et al., 2017), and coping with the challenge of inadequate teaching materials (Wang & Du, 2016) especially for teaching Chinese character (Yang, 2019). In the Australian context, regarding the high attrition in secondary school Chinese language courses, researchers called for innovative pedagogy and resources for Chinese language teaching (Moloney & Xu, 2015; Orton, 2016).

A systematic review of the publications on teaching and learning Chinese character found that the majority of papers published in China were not empirical studies and most published outside of China used quantitative method, mostly focusing on the effectiveness of teaching approaches and strategies (Li, 2020). More diverse research paradigms and mixed-method approach are needed (Li, 2020). One suggested research perspective is to view teachers and students as agents (Gong, Gao, & Lyu, 2020). Therefore, this study used a formative intervention design with the aim to enhance Chinese language preservice teachers' epistemic agency in creating innovative resources for teaching Chinese character.

From the perspective of knowledge building model, epistemic agency refers to students' initiation of ideas, relating their ideas to others' via negotiation, and taking responsibility for improving their knowledge (Scardamalia, 2002). Studies on preservice teachers' epistemic agency is still limited (MacLellan, 2017), and most focused on science teacher education (e.g. Cripps Clark, Chittleborough, & Chandler, 2019; Cripps Clark et al., 2016). There were only a few studies exploring epistemic agency in language teacher education. For example, Kárpáti and Dorner (2012) investigated EFL student teachers' epistemic agency within a teacher education mentoring program. By mapping individual's reflection and self-satisfaction, their study revealed some indirect evidence of epistemic agency in forming learning objectives which was co-constructed between the teacher mentor, student teachers and researchers. However, more direct evidence of epistemic agency in terms of language teaching knowledge artefacts is needed. Some research also revealed that some Chinese language teachers' conception about knowledge creation still focused on individual responsibility (Tan & Tan, 2014). Similarly, Erkunt (2010) claimed preservice teachers had low level of epistemic agency due to limited opportunities for knowledge sharing with peers. Therefore, the intervention study in language teacher education should focus on student teacher's epistemic agency via collective knowledge building activity.

The double stimulation design has been found as an effective intervention in enhancing students' epistemic agency, for example in science teacher education (Cripps Clark et al., 2016, 2019) or computer-supported learning (Lund & Rasmussen, 2008; Sannino & Engeström, 2016). The design started with the first stimulus, such as critically analysis of a website for its accuracy and reliability to identify the problems (Cripps Clark et al., 2016); followed by an auxiliary stimulus, such as collaborative creation of an artefacts (e.g. a list of evaluation criteria), or sharing and reflection on new ways of thinking about science concepts. In these studies, student teachers' epistemic agency was evidenced from interview data regarding their developed knowledge and science concepts (Cripps Clark et al., 2016, 2019). More direct evidence of epistemic agency could be the knowledge artefacts, such as ideas or design, created by students (Ritella & Hakkarainen, 2012). It is necessary to enrich this area by providing more empirical data, such as the knowledge artefacts created by student teachers, and the process their epistemic agency emerged from the double stimulation design.

In the process of students' engaging with the auxiliary stimulus, collaborative discussion, questioning and reflection have been used to boost student teachers' agency, which aligns with the principle of epistemic agency that the learners' intention and capacity in knowledge building are formed within a community (Stroupe, 2014). In the studies using double stimulation, students were able to negotiate and appropriate the tools for completing the task via collaboration (Lund & Rasmussen, 2008; Sannino & Engeström, 2016). The negotiation and reformation of the object of the activity also brought the transformative changes (Sannino & Engeström, 2016). In addition to science teacher education, studies using double stimulation in other areas also reported that the continuous use of the second stimulus could empower the participants' agency in making transformation, for example in the areas of education leadership (Nuttall, Thomas, & Henderson, 2018) or organisation transformation (Haapasaari & Kerosuo, 2015). It is necessary to apply this method in language teacher education to see how it

impacts students' epistemic agency in making changes in their learning and knowledge building. [Stroupe \(2014\)](#) identified five discursive moves to analyse students' epistemic agency in their discussion: questioning; making claims about science ideas in relation to the phenomenon under study; integrating science ideas with other ideas; introducing new science ideas to the public plane and assigning value to other student's science ideas. These discursive moves informed this study in analysing preservice language teachers' epistemic agency in their group discussions.

[Sannino \(2015\)](#) calls for more research exploring the connection between agency and double stimulation. The demands in the field of language teacher education and the review of relevant studies indicated the needs to: 1) apply the double stimulation design in language teacher education; 2) enhance preservice teachers' agency in creating language specific teaching resources, such as for teaching Chinese characters; 3) have more direct evidence of teachers' epistemic agency emerged from each stage of the design. Therefore, the research question this paper aims to explore is: How did the double stimulation design impact preservice Chinese language teachers' epistemic agency in creating language specific teaching resources?

3. Intervention framework: double stimulation and epistemic agency

This section explained the double stimulation method and the concept epistemic agency which framed this intervention study. Double stimulation was defined as a method of experimental investigation with "two groups of stimuli ... One group of stimuli has the function of a task toward which the activity of the experimental subject is directed, whilst the other takes on the function of signs which help to organize the activity" ([Vygotsky, 1931/1994](#), p. 208). [Vygotsky \(e.g. 1997a, p. 68; 1997b; 1999, pp. 57–59\)](#) used several terms interchangeably for this method, "experimental genetic", "instrumental or historical-genetic methods", and "the method of double stimulation" ([Engeström, 2011](#), p.604). For consistency, this paper used the term double stimulation.

In the interpretation of Vygotsky's work, double stimulation is regarded as the foundational epistemological principle for interventional research method in cultural-historical activity theory ([Hopwood & Gottschalk, 2017; Sannino, 2015; Sannino & Sutter, 2011](#)). Sannino developed a Vygotskian model of double stimulation with four sequential stages in the process of decision making: 1) conflict of stimuli, which refers to the clashed demands/expectations; 2) conflict of motives triggered by the conflict of stimuli; 3) The subject change the role of stimulus into the auxiliary motive, which means that the subject have control over their actions for their purpose/auxiliary motive; 4a) 'real' conflict of stimuli, referring to the stage that the subject takes action in connection with the second stimuli, which is the important part in forming agency; 4b) involves decision made based on the second stimulus ([Sannino, 2015](#), pp.9–10; [Hopwood & Gottschalk, 2017](#), p.24).

In the initial two stages, the subject is put in a problematic situation to experience or develop a need for new and specific knowledge ([Eriksson & Lindberg, 2016](#)). From the Activity Theory perspective, this helps them to form the object of their activity, which is motive-driven, object-related and tool mediated ([Leontiev, 1981](#)). An object/motive for learning can drive students to pursue and engage in the process of knowledge production. If the object changes, the activity also changes or is replaced by the new one ([Eriksson & Lindberg, 2016](#)). In this study, students were invited to identify the challenges in their target language teaching (Chinese language) with the purpose to raise their awareness of the need for language specific knowledge.

The second/auxiliary stimulus includes the artefact(s) used to pursue the goal ([Sannino, 2015](#)). By assigning meaning to the second stimulus, the subject could have control over their action to resolve the problem ([Sannino et al., 2015](#)). Both stimuli are integrated in to "one structure of the goal directed effort" ([Sannino, 2015; Valsiner, 2000](#), p. 80). There is a dialectical relationship between subject and the activity change ([Davydov, Zinchenko, & Talyzina, 1983](#)). The object motivates the subject to participate in the activity and possibly transform it. Meanwhile, the subject could trial with different ideas during the process of "questioning and breaking way from the constraints" in the existing activity ([Engeström & Sannino, 2010; Sannino & Engeström, 2016](#), p. 7). Here the transformation or expansion could be a new concrete object which is formed on the subject's needs and replaces the original abstract object in the initial stage ([Engeström, Puonti, & Seppänen, 2003](#), pp. 151–186; [Sannino & Engeström, 2016](#)).

In addition to conflict of motives, [Sannino \(2015\)](#) highlighted agency as another key aspect in double stimulation. The double stimulation method has a significant role in building agency and creativity in the process of problem-solving ([Engeström, 2009; Rainio, 2009; Sannino, 2015](#)), especially through appropriating the tools and resources in the second stimulus ([Van der Veer, 2001](#)). The second stimulus can also offer students agency in taking agentive actions to change the situation ([Engeström, 2011; Sannino, 2015](#)). Some researchers regarded the creation of "epistemic artefacts" such as ideas, plans and design as the evidence of epistemic agency ([Ritella & Hakkarainen, 2012](#), p.239). The study focused on exploring how preservice language teachers appropriate and/or transform these artefacts in the second stimulus for their own pedagogical design.

The double stimulation design often incorporated group discussion for exchanging ideas within the community of their profession/subject area, because social interaction including education dialogue, is regarded a collective construction of knowledge, including proposing, justifying and exchanging ideas to reach joint understanding ([Muhonen, Rasku-Puttonen, Pakarinen, Poikkeus, & Lerkkanen, 2017; Mercer, 2008](#)). Bakhtin's dialogic theory was regarded as an epistemological approach to study language and mind, including agency ([Markova, 1994](#), pp. 27–46) and is complementary with Vygotsky's theory in terms of knowledge building via social interaction ([Koschmann, 1999](#)). The dialogue could enrich individual and collective understanding of the issue (Wells, 2002). Based on these key elements and features, this pedagogical intervention

study was designed following the double stimulation method and explore preservice teachers' epistemic agency from their new ideas, plans and the creation of teaching materials for their language teaching design.

4. Methodology

4.1. Research context

The study was conducted in a secondary teacher education program at a university in Australia with ethics approval from the university. The participants of this study were preservice Chinese language teachers from a generic language teaching methodology course including both undergraduate and postgraduate preservice teachers. In the year of data collection, this course had around 45 preservice language teachers from 9 language backgrounds with 20 in the area of Chinese language teaching. As mentioned in the introduction, the key challenge of language teacher education was that the generic language teaching methodology course failed to cover some language specific issues. As the lecturer of this course, the author noticed that students expressed their needs for language specific teaching in their course evaluation every year. To cope with the conflict between students' needs and the constraints of the structure of this course, the project which this paper drew on adopted a formative intervention design. In the first phase of the project, the project team recorded four experienced language teachers' (Chinese, French, Indonesian and Japanese) classroom teaching and edited into some short video clips. The video clips for each language covered 1–2 topics identified by the teachers as the key challenges for teaching that language. For instance, the focus of this paper was how to teach Chinese characters. In the second phase, preservice language teachers engaged with these video-based materials through a series of activities underpinned by a double stimulation design. This intervention was introduced and incorporated into the course in 2019. Meanwhile, the data were collected for research purpose to explore how this design enhanced the participants' epistemic agency in creating language specific pedagogical artefacts. The data of this paper was from the second phase, focusing on some Chinese language teachers' engagement with these video-based materials through double stimulation design and their epistemic agency in creating language teaching artefacts in their lesson plan design. The structure of the design is illustrated in [Table 1](#).

Students who volunteered to participate this study could 'pick and choose' to participate in one or more of the data collection activities. Students who gave consent for group discussions were grouped together generally based on their language areas (some groups have mixed language areas). Their group discussions, completed worksheets and assignments were collected as data.

4.2. Data collection

The structure of the design and the participants are listed in [Table 1](#): Activity1. Online survey.

Table 1
Structure and process of data collection.

Data collection stages	Activities (Students choose to participate in any or as many of the following as they choose)	Data collected	Participants included in this paper
Activity 1 – online Survey the 1st stimulus	The students completed the online questionnaire on the challenges in teaching their target language, anonymously.	Students' anonymous response to the online survey.	20 preservice Chinese language teachers
Activity 2 – 2nd stimuli	Presented a problem/issue to the student e.g. <i>Brainstorm some ideas on how to teach character writing in your target language</i> ; Discussion group will take place during seminar/tutorial as a normal classroom activity for around 5 min	Audio-recorded group discussions and completed discussion worksheets.	Participants gave consent: Three preservice Chinese language teachers:
Activity 3 – 2nd stimuli	Watch the short video of an experienced language teacher's classroom teaching		Amy (Japanese);
Activity 4 – 2nd stimuli	Post-video discussion questions provided in the worksheet: 1. Which part of the teaching in the video do you like most and which is most useful? Why? 2. Which part of the teaching in the video do you think needs further improvement? Why and how? 3. Which aspect of the teaching in the video could be adapted for teaching the writing system in your target language? And how?		Betty (Chinese); Charlie (Chinese)
Activity 5 New practice	Every student needs to design a three-linked lesson plan for teaching their target language at stage 4&5 in a high school context and include a short rationale for their design.	The participants' lesson plan assignments of those who gave consent to retrospective work sample analysis were collected after the marks were released.	Betty gave consent for work sample analysis

An anonymous online questionnaire was conducted at the start of the project, with the aim of investigating the participants' perceived challenges in teaching their target language. This presented the genuine problems for students to explore, and act with agency to resolve the problem (Davydov, Slobodchikov, & Tsuckerman, 2003). The online survey included 12 items, with the first question asking about their language area and the other 11 items covering the key aspects in language learning: spelling, character writing, pronunciation, tone, stress, gender system, vocabulary, sentence structure, tense, conjugation, and value of language learning. Each item has 4-point Likert scale options (1. Not applicable to your target language; 2. The least challenging; 3. The medium challenging; 4. The most challenging) for participants to identify the degree of the challenges. This paper reported the anonymous responses from 20 preservice Chinese language teachers who volunteered to participate in the survey and focused on the issue rated as the key challenge for Chinese language teaching.

Activity 2. Pre-video discussion.

Based on the key challenge identified by the preservice teachers in Activity 1, they had a 5-min pre-video discussion to brainstorm possible resolutions for coping with the issue, with the aim to reveal the conflict of motives. In this paper, the selected issue was how to teach Chinese characters using appropriate resources. Group discussion gave students an opportunity to make reasoned judgements and exchange their ideas. The undergraduate Chinese language teachers who gave consent for audio-recorded group discussion: Amy, Betty and Charlie (pseudonyms), were arranged into one group. Amy is a heritage Chinese speaker and her teaching area is Japanese. She has basic knowledge in recognising and writing Chinese characters. Betty and Charlie are native Chinese speakers and chose Chinese as their teaching area. Their knowledge and proficiency of Chinese language are at the native-speaker level. Their audio-recorded group discussion and completed worksheets were collected as the data.

Activity 3 Watching the video.

The first activity in the second stimuli was to watch a video of teaching Chinese characters (around 3–4 min), including the classroom practices of a Chinese language teacher and her explanation. The key content of the video includes:

- 1) Explanation of the formation of Chinese characters: stroke, radical, and then characters, with the aid of magnetic strokes (shown in Fig. 1)
- 2) Introducing a website for students to research the development of Chinese character

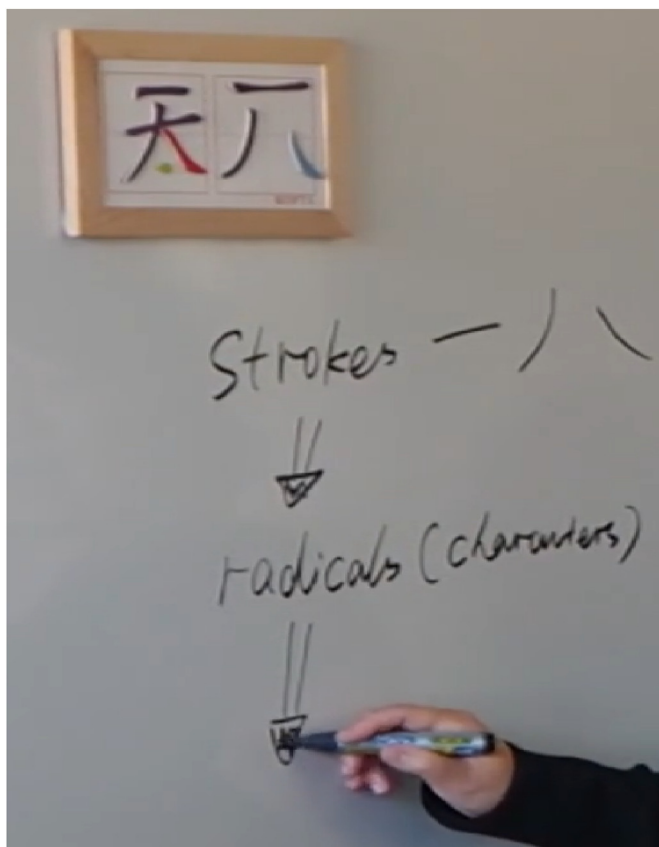


Fig. 1. The magnetic strokes for teaching stroke order demonstrated in the video.

- 3) Introducing an app showing the animation of stroke order and the Grid Worksheet (田字格 *Tián zì gé*) for students to practice.

4.3. Activity 4 post-video discussion

After watching the video, the students have a 5-10-min post-video group discussion following the discussion worksheet to analyse, evaluate and reflect on the video and connect with their own design. As reflection is regarded as essential for interaction, it is necessary to integrate reflective practice with dialogical interaction (Collin, Karsenti, & Komis, 2013; Sorensen & Brooks, 2018). The open-ended questions in both pre- and post-video worksheets provided scaffolding for them to retrieve prior knowledge, reflecting on the issue, expressing opinions, questioning and reasoning (Gillies, 2013; Muhonne et al., 2017), which can help with problem-solving and conceptual understanding (Mercer, 2008). Both the audio-recorded discussion and completed worksheets were collected as data.

Activity 5 Retrospective assignment analysis.

In this study, the task was to design three-linked lesson plans for teaching a foreign language for Stage 4 students following the New South Wales (NSW) Languages K-10 syllabus. The NSW Languages K-10 syllabus is underpinned by Task-based learning approach. The syllabus outcome for Chinese character writing was: LCH4-6U a student demonstrates understanding of key aspects of Chinese writing conventions (NESA, 2017). Retrospective analysis of student assignments included purposively coding new ideas, practice, and the creation of teaching materials for their language teaching design emerged from the double stimulation design. These could be taken as the signs of their epistemic agency and knowledge production for these students (Eriksson & Lindberg, 2016). Among the participants, Betty gave consent for the retrospective work sample analysis. Therefore, this paper focused detailed analysis of her assignment.

4.4. Data analysis

The survey results were entered into a spreadsheet to present the percentage of students who identified the key challenges for learning and teaching their target language. As for the qualitative data, the transcription of the group discussion, the worksheets and participant's lesson plan assignment were entered into NVivo for two rounds of thematic and axial coding and analysis. The first round of analysis included the coding and analysis of three themes: pre-video discussion, post-video discussion and assignment analysis. The transcripts of students' discussion were analysed based on the Scheme for Educational Dialogue Analysis (SEDA) with eight clusters of coding schemes (Table 2) (Hennessy et al., 2016).

The second round of analysis focused on the cross-stage comparative analysis and the emergence of any conflict of motives and epistemic agency, which were identified as the key principles of double stimulation design (Sannino, 2015). The analysis identified the evidence of the participants' new knowledge in Chinese language teaching design.

5. Results

5.1. Survey on the challenges in Chinese language learning

In order to explore students' epistemic agency in the double stimulation design, the survey aimed to reveal the conflict of motives which could boost their agency in knowledge sharing in the following activities. There were 45 preservice teachers participated in the anonymous survey on the challenges in language teaching. Among them, 20 participants indicated that

Table 2
SEDA clusters (Hennessy et al., 2016; Vrikki et al., 2019, p.187).

Cluster name	Brief description
I: Invite elaboration or reasoning	Invite others to build on or respond critically through explanation, justification, argumentation, analogy, use of evidence, speculation
R: Make reasoning explicit	Make reasoning explicit through explanation, justification, argumentation, analogy, making distinctions, use of evidence, exploration of possibilities, prediction, speculation, hypothesizing, extrapolation
B: Build on ideas	Building on, adding to, reformulating or clarifying one's own or other's contributions
E: Express or invite ideas	Make a relevant contribution not covered in other categories (e.g. short responses to closed questions), or invite others to express opinions or ideas without reference to prior contributions, ideas or artefacts
P: Positioning and coordination of ideas	Take a position/stance in the dialogue by challenging or evaluating different ideas, stating (dis)agreement, proposing resolution or synthesizing ideas
C: Connect	Make explicit links to ideas/arguments/artefacts/prior contributions or knowledge from contexts beyond the immediate dialogue or make trajectories of learning explicit
G: Guide direction of dialogue or activity	Take responsibility for shaping and directing dialogue or activity, including encouraging student-student dialogue, offering thinking time, providing informative feedback or other scaffolding strategies
R: Reflect on dialogue or activity	Explicit self or group evaluation or metacognitive reflection on purposes/processes/value/outcome of learning or activity or invitation to engage in this

their target language teaching area was Chinese language. Their responses were selected and summarised from the survey results as shown in Fig. 2.

As indicated in Fig. 2, within the 20 Chinese language teachers, 12 participants (60%) rated character writing as the most challenging aspect in learning Chinese, followed by pronunciation, tone, vocabulary and tense, which were identified by nine out of the 20 participants (45%). Based on the result, the pre-video discussion question *How to create resources for teaching Chinese characters* and a video on teaching Chinese characters were chosen to as the second stimuli for students to discuss and extend to their own design.

5.2. Group discussions on Chinese teaching video

5.2.1. Pre-video discussion on the Chinese teaching video

In the pre-video discussion about how to teach Chinese characters, the group brainstormed four strategies as shown in the screenshot of their worksheet:

As shown in Fig. 3, the students drew an image of the character 木 (wood) as the example of using image to teach the word tree. Their group discussion transcript shows that there was some disagreement emerged in the group discussion:

Excerpt 1.

Turn	Name	Talk	SEDA coding schemes
1	Amy	How to teach characters? Well, you have to teach it explicitly, such as the stroke order	Making reasoning explicit
2	Betty	You know there is a kind of worksheet which shows each step of the stroke order ... you just practice writing again and again	build on ideas; connect
3	Amy	But that's pretty boring	Positioning and coordination of ideas (disagreement)
4	Charlie	I can think of using the symbolic meaning and image of the radical, such as what does each radical means	Make reasoning explicit; connect
5	Amy	I think many students are confused with the stroke order ...	Guide direction; Positioning and coordination of ideas
6	Betty	Yes	Positioning (agreement)
7	Amy	We could model this process of writing strokes	Build on ideas
8	Betty	Modelling [writing it down on the worksheet]	Positioning (agreement)
9	Amy	I think we should teach character writing in the context of meaning.	Positioning and coordination of ideas
10	Charlie	I still think modelling is important ...	positioning
11	Amy	I still do not know how to write some characters	Positioning and coordination of ideas
12	Charlie	We need to teach them the writing rules, such as from top to bottom, left to right, inside to outside	Make reasoning explicit; connect

Amy firstly gave an explicit explanation for the question on how to teach characters by suggesting teaching stroke order (Turn 1). Based on her ideas, Betty suggested the use of worksheets for teaching stroke order (Turn 2), which was a sign of connecting the problem with her prior knowledge. Amy challenged this idea by saying that it was quite boring (Turn 3). Then, Charlie gave another suggestion, which connect the discussion on stroke order to teaching imagery and symbolic meaning of radicals (Turn 4). However, Amy directed the topic back to how to teach stroke order and suggested modelling (Turns 5&6). Both Betty and Charlie agreed with that and added the explicit teaching of the writing conventions which guide the stroke order (Turn 12).

During the discussion, the object of their discussion was narrowed down from teaching character to a more specific issue of teaching stroke order. This was formed through posing questions through explicit statements, showing agreement/

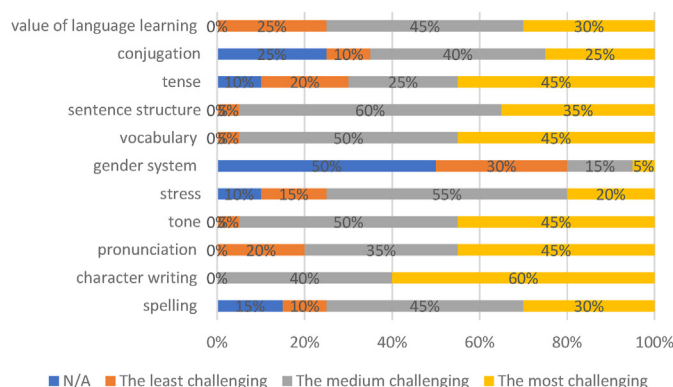


Fig. 2. Survey on the challenges in Chinese Language learning.

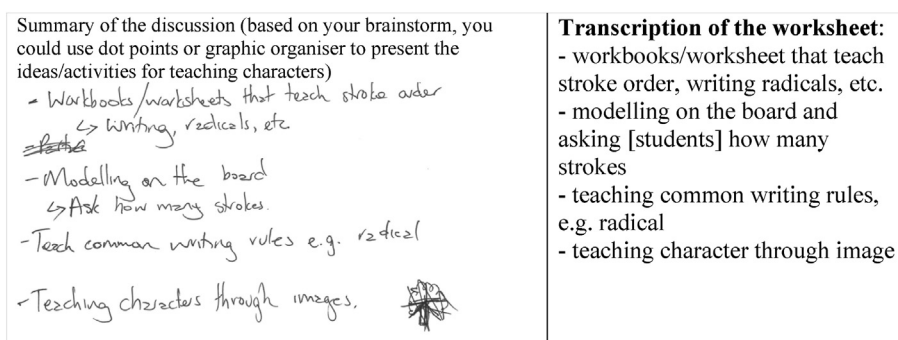


Fig. 3. The pre-video discussion worksheet and script.

disagreement, making connection with prior knowledge and other ideas, and reasoning. When Amy expressed disagreement with the repetitive drill practice with worksheets suggested by Betty, it could be interpreted as a conflict of motives between their existing knowledge of drill practice and their desire for more engaging teaching. Their tentative idea was to modelling stroke order and the need to connect character writing with the content and meaning. Although they were not clear how modelling is more engaging than the worksheet, they showed their initiative to make claims by relating their ideas to other ideas such as writing conventions and content. This seemed to be a flow of discussion developed from a broad topic (how to teach characters), to a specific one (e.g. stroke order), linking with some principles, such as modelling and writing conventions. These could be viewed as evidence of their epistemic agency in raising questions and reformulating the object.

5.2.2. Post-video discussion on the Chinese teaching video

After watching the short video, they gained some new ideas, evidenced from the post-video discussion and worksheet. Excerpt 2.

Turn	Name	Talk	SEDA coding schemes
1	Amy	I really like the animation (apps) showing the stroke order	Build on ideas
2	Betty	Yes, it is interesting and it can save the teacher's time in explaining that [stroke order]	Build on ideas; making reasoning explicit
3	Charlie	The Tianzige Grid with shadow strokes can help as well ...	Build on ideas
4	Charlie	I still think we need to teach the seven writing rules	Positioning and coordination of ideas; connect
5	Amy	Yes, explicitly	Build on ideas

It seems that they believed that the Apps with the stroke order animation was a good resolution to the challenges of teaching stroke order raised in the pre-video discussion (Turn 1). This is a sign of assigning value to others' ideas. Betty further explained the advantage of using Apps (Turn 2). Relating to the reshaped object of how to teach stroke order in an interesting way, their agreement indicated the connection they made to the second stimulus. As the teacher in the video also explained the writing conventions, this confirmed the need for the explicit teaching of writing conventions, demonstrated in Charlie's firm statement (Turn 4), and Amy's further agreement on that (Turns 5). The dialogue shows that they not only agreed with the strategy showed in the video, but also developed new ideas through reasoning and connecting to other ideas, which was presented in their completed worksheet in Fig. 4.

As shown in Fig. 4, they regarded the apps and grids as useful strategies. The presentation of 'ICT + writing' plus their reasoning and agreement with it (response to Q2) indicated their meaning making of the second stimulus (the video). This was a sign of the formation of their agency. However, Charlie, who introduced the suggestions of using images to teach Chinese characters, now realised that this may not work for all characters (response to Q3). This shows that they had made a critical evaluation of their own ideas and had awareness of the limitations of some teaching strategies. As shown in the transcript and worksheet, their beliefs about explicit teaching of writing conventions was consolidated after watching the video. The teacher in the video also introduced the concepts of stroke, radical and character with examples. The participants related it to the more comprehensive writing conventions. This was another sign of epistemic agency by integrating their learning with other ideas.

5.3. Assignment analysis

Betty designed three linked lesson plans for teaching Chinese language for a group of Year 8 students on the topic of 'sport'. The analysis of Betty's lesson plan assignment showed that there were two types of learning emerged from this formative intervention. One is direct learning, which means that the participants adopted and applied the strategies from the video into the context of the lesson plan design. The second type of learning is evidenced by the creation of a new activity or adaptation of strategies in a new teaching context.

1. Which part of the teaching in the video do you like most? Why?

- Apps

2. Which part of the teaching in the video do you think most useful for your teaching? Why?

Apps = ICT + writing, saves teachers time, students can revise themselves

田 grids and the shadow grids

3. Which part of the teaching in the video do you think needs further improvement? Why and how?

- Introducing 木 in conjunction with 林 and 森, doesn't work for other characters.

- 7 writing rules ~~also~~ should be made explicit

Transcription of the worksheet:

1. Apps

2. Apps = ICT + writing, saves teachers time, students can revise themselves

田 grids and the shadow grids

3. - Introducing 木 in conjunction with 林 and 森, does not work for other characters.

- 7 writing rules should be made explicit

Fig. 4. The screenshot of the post-video discussion worksheet and script.

5.3.1. Direct adoption

One direct learning was the incorporation of the animation of stroke order for teaching Chinese characters (Fig. 5).

Betty also justified the use of the animated stroke order (Fig. 5) and the explicit teaching of the writing conventions with the link to the syllabus outcome (Fig. 6). This also aligns with the claim from their group discussion about their agreement with the Apps of showing stroke order and the necessity to teaching the writing conventions. Moreover, she incorporated the grid worksheet (Fig. 5) for practising stroke order as homework for her students, which was her suggestion in the group discussion.

5.3.2. Evidence of adaptation and new creation

One evidence of Betty's epistemic agency in creating new practice is the incorporation of embodied practice in teaching stroke order (Fig. 7).

In addition to the teachers' verbal explanation and visual demonstration of character writing, students' embodied practice of using figure writing characters in the air would activate their kinesthetics intelligence and enhance their memory. Betty's justified this design as: "students remember and learn vocabulary quickly by generating and utilising visual, auditory and kinesthetics senses" (Betty's lesson plan assignment, 2019).

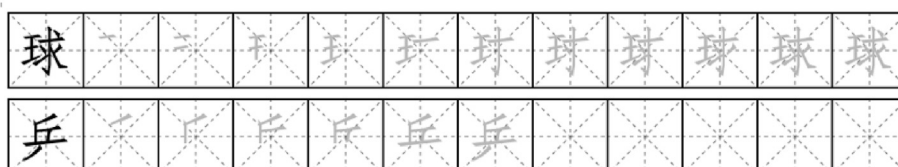


Fig. 5. The animation and worksheet of stroke order (screenshot from Betty's lesson plan materials).

For both lesson one and two, students learn and practice character writing by watching animated demonstration of stroke order first so the importance of stroke order is emphasised. Then, the teacher will explain the structure and key radical of each character, which facilitate their understanding of key aspects of Chinese writing conventions to meet syllabus outcome LCH4-6U (NESA, 2018).

Fig. 6. Betty's justification for including animated stroke order demonstration (screenshot from Betty's lesson plan justification).

Character writing	20mins	The teacher introduces Chinese character writing and teaches how to write the characters of 球、兵、网、板、足 and 蓝。The teacher explains the meaning of each character and asks the students to pay attention to the characters' structure and their radicals. Students use their fingers to follow the stroke order and write each character in the air. During the first time, they are allowed to see the character, however, in the second time, they are asked to close their eyes to write the character. Then the teacher hands out worksheet 1 and students may practice writing each character once or twice. The teacher invites students to write the character on the whiteboard. The others need to identify which character it is.	Powerpoint slide and worksheet 1
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Fig. 7. The character writing activity (screenshot from Betty's lesson plan).

Another evidence of her creation was that she borrowed the Hangman game from English language teaching into Chinese character writing (Fig. 7).

Betty explained the reason for including this game was that “some student may find it boring to learning Chinese characters. I would like to implement a game to enhance their motivation.” (Betty's lesson plan assignment, 2019). Relating to their pre-video discussion where Amy thought the Grid worksheet suggested by Betty was quite boring, Betty took this conflict of motive into consideration and demonstrated her agency in creating the resolution in her lesson plan.

6. Discussion

Regarding the research question of how the double stimulation design impacted preservice Chinese language preservice teachers' epistemic agency in creating language specific teaching resources, Table 3 illustrated the development of their epistemic agency in each phrase of the double stimulation design. This section discussed the development of their epistemic agency firstly from each phase of the intervention design and then from their pedagogical design.

6.1. The development of epistemic agency in the double stimulation design

The elements of the double stimulation design in this study confirmed that “the conflict of motives shifts in time” (Vygostky, 1997b, p.215). The conflict of motives has been re-shaped and further changed their activities and engagement with the stimuli. The contradiction between the constraints of the course structure and expectations for language specific teaching was manifested as the initial conflict of motives (2a), triggered by students' self-identified challenges in their target language teaching via the survey (1a), such as teaching Chinese characters in this paper. This was also the initial object of the activity. During the pre-video discussion as the second stimulus (3a), the conflict between their existing knowledge of teaching stroke order (drill practice) and the desire to make teaching interesting formed a new conflict of motives (1b–2b). The reshaped conflict of motives was displayed in expressions of disagreement, argumentation, and divergence (Engeström & Sannino, 2011) in their discussion. Thus, the abstract object (how to teach characters) was shaped to a more specific one (how to teach stroke order in an interesting way) (3b), which was a sign of their agency in forming a specific object of their activity

Table 3

Elements of the double stimulation in this study.

Apparatus 1 decision for forming	Details
1a. Conflict of stimuli	Expectations for language specific teaching knowledge vs. a generic language methodology course covering all language areas
2a. Conflict of motives	The need vs. perceived challenges in language specific teaching design (e.g. teaching Chinese characters)
3a. Auxiliary motives + second stimuli	Pre-video discussion about how to teach Chinese characters: ideas and disagreement
1b. Conflict of stimuli	drill practice worksheet for modelling and teaching stroke order
2b. Conflict of motives	Initial ideas about teaching stroke order vs. desire to make teaching interesting
3b. Auxiliary motive	Teach stroke order in an interesting way
4a. Real conflict of stimuli	Discussion and agreement with some ideas: using Apps + grid for teaching stroke order + explicit teaching of writing conventions
4b. Closure of a conditioned connection between an external stimulus and the decided reaction	Based on the discussion about the video, created their own teaching activities in the lesson plans: Apps + embodied modelling + grids worksheet + game

mediated by dialogue. The reformation of the object was regarded as the sign of agency in transforming the activity (Sannino & Engeström, 2016).

With this specific object, during the engagement with the following stimuli (the video and post-video discussion), they not only built on the ideas learned from the video, but also consolidated their ideas for explicit teaching of writing conventions with reasoning. This was the process in which the subject “change in the functional role of a stimulus and its conversion into an auxiliary motive” (Sannino, 2015, p.10). Comparing with their initial ideas in the pre-video discussion (e.g. drill practice and modelling), at this stage they had more developed ideas for this specific object, such as using Apps with grid worksheet and explicit teaching of writing conventions (4a). This was an evidence of making connection to the stimulus and “using the power of things or stimuli, controls his own behaviour through them, grouping them, putting them together, sorting them makes them serve his own purposes” (Vygotsky, 1997b, p. 212). This was a sign of their collective epistemic agency. After that, these ideas were implemented into more concrete artefacts creation, shown in Betty’s lesson plans (4b).

This process showed a dialectical relationship between the subject and the activity (Davydov et al., 1983). They were motivated to participate in the discussions by their self-identify need for learning and gradually shaped the object of the activity through exchanging ideas (Engeström et al., 2003, pp. 151–186). Their agency were formulated through negotiating and collaborating in the dialogues (Sorensen & Brooks, 2018) and manifested in some discursive moves similar to those revealed in the Stroupe (2014) study: questioning; making claims/statement; integrating their ideas with other ideas (prior experience; syllabus outcome); assigning value to other’s ideas; incorporating new ideas in the pedagogical design. This was a process of taking agentive actions in “questioning and breaking way from the constraints” in the existing activity (Engeström & Sannino, 2010; Sannino & Engeström, 2016, p. 7), when they created new ideas for coping with the issue.

6.2. Adoption of the second stimulus

In addition to the ideas constructed in the dialogue, another sign of epistemic agency was the epistemic artefacts created in the individual’s final product, the lesson plans. One type of epistemic artefacts involved the process of de-contextualising and then recontextualising the learning from the second stimulus. For example, in the pre-video discussion, the participants came up with the idea of using the grid worksheet to teach stroke order. After watching the video, they all agreed with the teacher’s practice of using the animation to teach stroke order. Furthermore, Betty recontextualised this practice in her design combined with the grid worksheet. This finding was in line with Lund and Rasmussen’s (2008) observation that some learners went through a process of de-contextualising a practice and then recontextualising it. This also showed that the second stimulus gave students agency in giving meaning to knowledge and skills (Cripps Clark et al., 2016). From the Vygotskian theory’s view, imitation is not just copying of actions, but “sensible imitation based on understanding the imitative carrying out of some intellectual operation” (Vygotsky, 1997a, p. 202). When a student applied the activity to a different context, this involved a scientific concept that covered both their action and ability to act and make meaning from the action (Fleer, 2019). Their response in the post-video discussion worksheet ‘Apps = ICT + writing’ indicated the concept they synthesised from the video. Afterwards, Betty incorporated the grid for practising stroke order with the animation, which was a sign of extension of the learning by combining her idea with others’. This strategy confirmed the positive results of presenting characters in animation revealed in some research (e.g. Lu, Hallman, & Black, 2013; Xu, Chang, Zhang, & Perfetti, 2013).

6.3. From collectively formed conflict of motives to individual creation

Another type of artefacts of the participant’s epistemic agency was the creation of new ideas driven by the conflict of motives and formed from their group discussions. For example, regarding the concern that drill practice worksheet was boring, although Betty did not come up with a solution in the group discussion, the post-video discussion developed more ideas for this problem and later was further expanded in her lesson plans. For instance, the incorporation of embodied activity (Fig. 7) and game (Fig. 8) in Betty’s lesson plans made the modelling of stroke order more interesting. This was in accordance with other research findings regarding the effectiveness of using embodied approach of teaching characters (Lu et al., 2013). These artefacts could be viewed as the outcome of the specific object and resolution to the issue. Her justification demonstrated that her agency was in “breaking away from the given frame of action and taking the initiative to transform it” (Sannino & Engeström, 2016, p.60). This was in accordance with the claim that the conflict of motives could motivate the participants to explore new ideas and take agentive actions in appropriating tools for problem-solving (Wertsch, 1998; Ritella & Hakkarainen, 2012; Sannino, 2015; Thorne, 2015).

Hangman of Chinese character for revision	4mins	The teacher thinks of one Chinese character that is in the homework. Students in groups of four compete with each other. If it is correct, the teacher writes out the stroke and gives one point for the group. If not, teacher wipes out one
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Fig. 8. The activity of Hangman (screenshot from Betty’s lesson plan).

Betty's lesson plans demonstrated both adaptation and transformation of the tools to meet the needs of her activity (Ritella & Hakkarainen, 2012). However, the adaptation and transformation were not just the individual activity but developed from collective appropriation and creation of ideas through the process of interpreting, questioning, evaluating and reflecting, which were also the processes of problem-solving (Ritella & Hakkarainen, 2012). While double stimulation has been studied primarily with individual experimental subjects (Sannino, 2015), one double stimulation model of the waiting experiment tested with multiple participants revealed that the collective setup impeded "individual's attempts at overcoming the conflicts of motives and engaging with second stimuli" (Sannino, 2016, p.171). This study revealed that the collaborative dialogue of exchanging responses and making judgements helped the internalisation of the learning at the individual level. There were transformations at both the collective activity and individual level actions (Engeström & Sannino, 2010).

7. Conclusions

This study could draw a conclusion that the engagement with the first and second stimuli enabled the agentic actions in initiating new ideas and creating new artefacts, which is in line with Sannino and Engeström's (2016) claim that the double stimulation intervention could enable students' epistemic and transformative agency. In addition, the initial conflict of motives provided opportunities for collective purposeful conversation (Nuttall et al., 2018). Meanwhile, the video and discussions which were used as the second stimuli, not only provided preservice teachers with the opportunity to have reflection and professional dialogue (Cripps Clark et al., 2019), but also shaped and specified the object and the development of ideas. Their agency in organising their existing knowledge and skills, and re-contextualising the skills in their teaching area was expanded through the multistep design and collaborative activity.

Due to the small sample size, the findings from this paper may not be generalisable to other contexts. However, theoretically, the findings would enrich the field of formative intervention design, especially in terms of how agency has been enhanced at both collective and individual level through double stimulation (Sannino, 2016). Considering the paucity of research on language teacher's epistemic agency, this study revealed the detailed process of the emergence of students' epistemic agency in transforming the initial object during the process of negotiation, further developing their ideas via engagement with the second stimuli and creating new resources for teaching.

On a methodological level, as a study based on authentic classroom activities, the formative intervention design and scaffolding materials which nurtured and enhanced learners' epistemic agency could be applied to different subject areas, especially video-supported teaching and learning. The study had a detailed qualitative analyses of student teachers' discussion and work samples. This study also revealed three types of artefacts evidenced students' epistemic agency. This contributed direct evidence for language teachers' epistemic agency.

Pedagogically, this study has some implications for teacher education regardless of language areas in focus. First it is necessary to activate learners' awareness of their conflict of motives and help them to form the object of learning. Second the auxiliary stimuli could be arranged in multi-level as the support for learners to achieve the initial object and align with the task features. Thirdly, embedding video in the second stimuli could provide students generalisable tools in coping with the challenges in their learning and also enhanced their agency in knowledge creation. The last but not least, it is necessary to provide space and guidance for learners to have collective discussion in appropriating the second stimuli. The discussion worksheets in this study integrated reflection and collaboration, which was essential for developing students' agency. The reflection also covered their prior learning, current issue and design for future teaching. This responded to the challenges that language teachers lacked awareness and practice of collective knowledge construction. Areas for future research are to explore whether the double stimulation design could enhance students' agency in transferring the learning to different language areas, with different technologies, and students' emotional aspects in the double stimulation.

CRedit authorship contribution statement

Hongzhi Yang: Conceptualization, Methodology, Data curation, Writing, Visualization, Investigation, Writing - review & editing.

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