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A Peer Coaching-based Professional Development Approach to Improving the Learning Participation and Learning Design Skills of In-Service Teachers

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ABSTRACT

Personalized learning based on learning analytics has become increasingly important for teachers' development via providing adaptive contents and strategies for teachers by identifying their questions and needs. Currently, most studies on teachers' professional development focus on pre-service teachers, and studies on teachers' personalized learning focus on the expert guidance approach. In this paper, a peer coaching-based personalized learning approach is proposed to help in-service teachers identify their questions and needs and adapt their teaching plans based on peer feedback as a result of interacting with their peers and reflecting on their work so as to engage in in-depth learning and transfer of knowledge to their teaching practice. In order to evaluate the effectiveness of the proposed approach, a quasi-experimental design was employed, involving 20 in-service Mandarin teachers. The experimental group teachers learned with the peer coaching-based personalized learning approach, while the control group teachers learned with the expert guidance-based personalized learning approach. The study was conducted using a quantitative approach. The instruments used were a learning participation rubric and performance assessments of the participating teachers' lesson plans and teaching videos. The findings indicated that the post-test scores of the experimental group were significantly higher than those of the control group. The peer coaching-based personalized learning approach had a much better effect than the expert guidance-based personalized learning approach on the in-service teachers' learning participation, learning design skills, and in-practice teaching abilities.

Keywords

Personalized learning, Peer coaching, Learning participation, Learning design skill, Learning analytics, Teaching ability

Introduction

The development of the prospective teachers' knowledge, skills, and dispositions is a key element for high-performing countries' success (Darling-Hammond et al., 2017). Within an education culture craving continuous improvement, schools and society have constant needs to ensure that teachers' skills, knowledge, and actions match the changing environment (Lindon, 2011). Teachers have a great influence on students' performance throughout a large span of their school careers. They can help cultivate students' habits of mind and knowledge schemes, thereby enabling them to make meaningful contributions and to prosper in the open, technological world of the future (Darling-Hammond, 2000). Improving schools, enhancing teaching quality, and improving the quality of students' study are so important that it has led to a focus on Professional Development for Teachers as an important way to achieve these goals (Opfer & Pedder, 2011). Official documents in China and reports from international institutions (Lo, Lai, & Wang, 2013; van den Bergh, Ros, & Beijaard, 2015) regard Professional Development for Teachers as an important factor in educational improvement.

To improve education quality and promote teachers' professional development, education institutions and governments at different levels have taken various measures and actions (UNESCO, 2015). Personalized learning based on learning analytics has been further pointed out by scholars as helping teachers improve their lesson plans and learning material design (Ganser, 2000). Learning analytics provides helpful suggestions to instructors and learners by analyzing learning information or educational data (Hwang, Hung, Chen, & Liu, 2014). One of the objectives of learning analytics is to identify learners' learning status or problems by analyzing their learning behaviors or interactive content, and providing adaptive and personalized learning contents, user interfaces, or practices (Hwang, Chu, & Yin, 2017). In recent years, personalized learning based on learning analytics has attracted much attention from the education field due to its characteristics of respecting the differences of individuals, emphasizing trainees' status as the subject, and the abilities to solve teachers' personalized problems (Wongsopawiro, Zwart, & van Driel, 2017). Moreover, several explorations related to personalized learning in the online context have been made, such as studies on personalized e-learning platform construction for elementary and secondary school students (Capuano et al., 2014; McLoughlin & Lee, 2010; Peter, Bacon, & Dastbaz, 2010), personalized vocational training frameworks (Mellett & O'Brien, 2014), and online personalized teacher training modes based on diagnosis of the teaching design (Li & Ma, 2014).

Holly (1989) indicated that teachers' perceptions of professionalism are mainly gained from "other teachers;" this can be achieved through peer coaching activities. In this research, we therefore combined peer coaching with teachers' personalized learning, with the aim of exploring the effects of peer coaching during teachers' online personalized learning processes. However, an overview of the global research on teachers' personalized learning also revealed several common phenomena, such as the emphasis on trainer-and-trainee interactions rather than on peer interactions (Rangel et al., 2015; Steiner, Dobbins, & Trahan, 1991), the difficulty trainers face in providing personalized suggestions to individual trainees (Dennis et al., 2018), and the poor teaching outcomes (Atueyi, 2016). That is, most previous studies related to personalized teacher development have attempted to identify the learning status or problems of the trainees and to provide recommendations or contents for them from the perspectives of the experts, while little research has been conducted which comprehensively integrates learning analytics and personalized learning from the perspectives of peers.

This research used an online platform in a 5-week quasi-experiment to find out how the peer coaching-based personalized learning approach would help enhance in-service teachers' learning participation and affect their teaching design skills and teaching abilities in practice compared to the expert guidance-based personalized learning approach. We hope to provide policy-makers, instructors, and teachers with alternative, more effective approaches to teachers' future professional development.

Literature review

Professional development for teachers

Teacher education has become an essential area of government policy in many countries around the world over the last 30 years (Furlong, 2013); in particular, teacher preparation has been recognized as an important and challenging issue for most public universities in many countries (AASCU, 2016). Professional Development for Teachers is "about teachers learning, learning how to learn, and transforming their knowledge into practice for the benefit of their students' growth" (Avalos, 2011). In other words, it organizes learning to improve teachers' professional skills and knowledge of students' performance (Hill, Beisiegel, & Jacob, 2013). Professional Development for Teachers can help them build their knowledge and beliefs, address perceived problems, and develop their classroom practices (Opfer & Pedder, 2011). It can provide teachers with opportunities to develop expertise in the curriculum, instruction, and the assessment of student learning, finally resulting in improvements in students' educational outcomes (Tait-McCutcheon & Drake, 2016).

A variety of methods have been used to improve teachers' professional development. The most traditionally used method was to invite experts to teach knowledge or practices using a face-to-face approach (Zhang, Liu, & Wang, 2017). With the rapid development of internet technology, however, the method has changed from traditional face-to-face training to training in advanced online environments (Chen, Chen, & Tsai, 2009). This new approach allows trainees to interact in the online environment at anytime and anywhere that is convenient (Al-Balushi, & Al-Abdali, 2015). Online training plays a significant role in teachers' professional development (Jimenez & O'Shanahan, 2016; Kao, Tsai, & Shih, 2014), especially online personalized learning, which can provide teachers with personalized courses and materials, can adopt to their learning styles and progress, and allows them to take advantage of the online environment (Limongelli, Sciarrone, Temperini, & Vaste, 2011). This kind of learning has been found to have a positive influence on teachers' professional development (Gynther, 2016).

After a 3-month design-based study, Li and Ma (2014) built an expert guidance-based online personalized learning model for teachers' development which included three stages: diagnosis, personalized recommendation, and personalized evaluation. They also found that expert guidance-based personalized learning could promote the teachers' learning design skills. However, their research also found that the teachers did not benefit so much in terms of some high-level skills, such as applying the pedagogies in practice. Li and Ma (2014) argued that the personalized diagnosis, adaptive learning, and the interactions between the trainers and trainees may have promoted the development of the trainees' knowledge and skills, but the weak interactions between the trainees could be an important factor affecting their in-depth learning and the development of their advanced skills.

Teachers who know the teaching contents or pedagogies may not be able to apply them in their teaching practice. Expert knowledge and understandings of pedagogies are prerequisites but not guarantees that teachers will teach well. It also does not mean that they know what concepts are difficult for students, what representations are best for certain ideas, or what ways are optimal for developing conceptual understandings (Lindon, 2011). Peer

coaching might thus be an alternative powerful approach for teachers' professional improvement (Rice, 2012; Zhang, Liu, & Wang, 2017).

Peer coaching

Peer coaching generally involves two colleagues engaged in a mutually supportive relationship (Neubert & McAllister, 1993). It is a confidential process through which instructors provide one another with assistance, feedback, and support, and share their expertise, for the purpose of enhancing learning (Kohler et al., 1997). Many studies have emphasized the importance of teachers as the subjects of peer coaching (Alsaleh et al., 2017; Yu, 2003; Zhang, Liu, & Wang, 2017). For example, Alsaleh's (2017) study shared that the peer coaching enhanced teachers' professional development based on teaching practices, teacher learning, team cooperation, and teachers' self-confidence, enthusiasm, and autonomy. Meanwhile, many studies have reported the effectiveness of a learning approach and environment that involves peer coaching, peer assessment, and peer review in different fields (Hsu, 2016; Papadopoulos, Lagkas, & Demetriadis, 2017; Yu & Wu, 2016).

In the past decades, peer coaching has been one strategy espoused by teacher education programs around the world to enhance the experience and development of teachers, and has also been evidenced in the literature as being helpful in various aspects of field-based experience (Lu, 2010). For instance, Goker (2006) implemented peer coaching in pre-service TEFL teacher education. He found that the student teachers' instructional skills and self-efficacy were significantly improved compared to those just receiving traditional supervisor visits. Some studies have reported the effectiveness of reflection in peer coaching and peer assessment strategies. A study on technology-enhanced peer reviews provided evidence that the review "giver" perspective is a vital option for peer reviews (Papadopoulos, Lagkas, & Demetriadis, 2017). Hwang, Hung, and Chen (2014) reported the effectiveness of adopting the peer-assessment approach in terms of helping students make reflections on and improve their digital storytelling projects. Peer coaching enriches teachers' reflections on their practices, and thus enhances and invigorates teachers' teaching skills.

Meanwhile, more studies have been reported involving pre-service teachers than in-service teachers in the peer coaching and peer assessment field (Lu, 2010). Peer coaching in pre-service teacher education has its unique advantages, such as the similar experience and knowledge levels of the student teachers, the same courses or time frame that the student teachers are engaged in, as well as the cost efficiency in the program curriculum (Lu, 2010). All these advantages that could sustain the feasibility and serve as a rationale for the incorporation of peer coaching in pre-service teacher education, also imply the possible challenges and obstacles of in-service teacher education. Till now, there has been very little scholarship regarding whether peer coaching could be implemented in a regular teacher training program.

Therefore, in this study, a peer coaching-based personalized learning approach is proposed for in-service teachers. A quasi-experiment was also conducted to investigate the effectiveness of the proposed approach regarding the development of the teachers' learning participation, learning design skills, and their in-practice teaching abilities.

Research questions

In this study, a peer coaching-based personalized learning approach is proposed for in-service teachers. It was expected that the proposed approach could benefit in-service teachers in terms of improving their online learning participation and promoting their learning design skills and their in-practice teaching abilities. Accordingly, the following research questions were investigated:

- Does the peer coaching-based personalized learning approach benefit in-service teachers more than the expert guidance-based personalized learning approach in terms of online learning participation?
- Can the peer coaching-based personalized learning approach promote in-service teachers' learning design skills in comparison with the expert guidance-based personalized learning approach?
- Does the peer coaching-based personalized learning approach benefit in-service teachers more than the expert guidance-based personalized learning approach concerning the advanced abilities to apply the teaching knowledge and skills in practice?

Peer coaching-based personalized learning system for in-service teachers

In this section, the personalized learning system which can support the expert guidance approach and peer coaching approach is demonstrated.

Online personalized learning system for in-service teachers

By referring to the online personalized learning model for teachers established by Li and Ma (2014), an online personalized learning system for in-service teachers was developed (see Figure 1) in this study. The system contained four main modules, namely object analysis, personalized diagnosis, personalized recommendation, and personalized evaluation. In the first stage, trainees enter the system and complete the surveys, such as their basic information and ICT literacy. Each trainee needs to submit a lesson plan which is used for the object analysis and the next stage. In the second stage, through analyzing each trainee's lesson plan based on the diagnosis framework, problems are identified for each trainee. Then, personalized learning contents and activities are recommended for each trainee in the third stage. In this stage, the trainees can learn individually online following their own personalized learning contents and activities. The last stage is the evaluation and feedback stage for the trainees. They could make self-reflections at this stage.

For the expert guidance-based personalized learning approach, the trainees can get support from the experts throughout the whole learning process. For the peer coaching-based personalized learning approach, the trainees can interact with their peers and get support from each other.

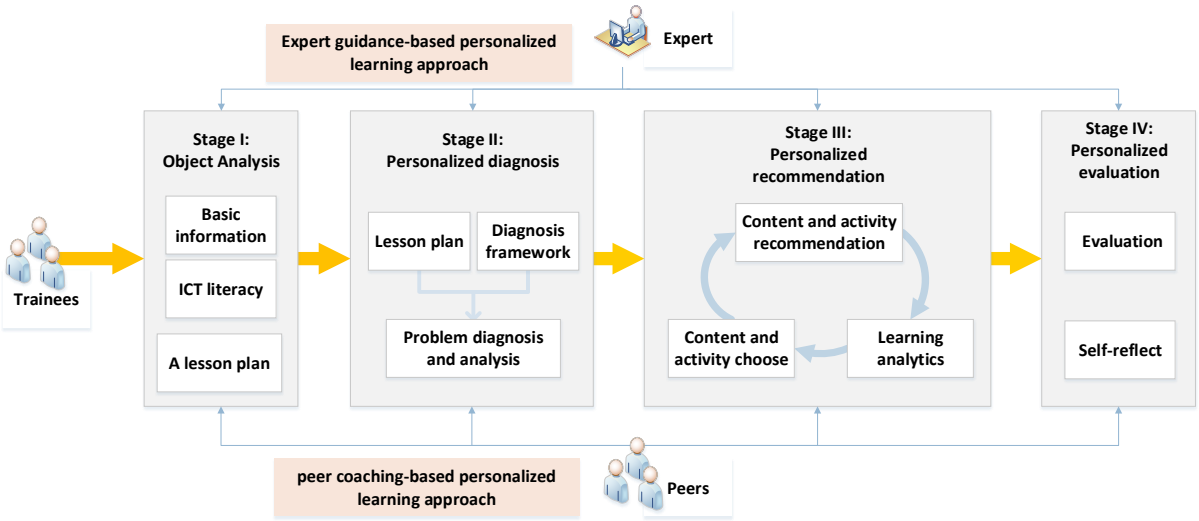

Figure 1. Online personalized learning system for in-service teachers

Peer coaching activities in the personalized learning system

According to the social cognitive theory, Stahl (2000) divided the knowledge-building process into two parts, namely personal understanding and social knowledge building; these two aspects contribute to the development of each other. Stahl (2004) pointed out that a system or an activity to support collaborative knowledge building should include functions that can support collaboration, social awareness, knowledge building, and knowledge management. Swafford (1998) also argued that peer coaching activities for teachers should provide chances for them to discuss, analyze, and reflect on their classroom instruction. On the basis of the above studies, this research adopted the following principles to design the peer coaching activities: (1) providing the teachers with opportunities to face specific teaching problems posed by their peers and by themselves; (2) promoting the teachers' experience by sharing among peers; (3) providing opportunities for the teachers to solve problems among themselves; and (4) promoting the teachers' real-time reflection. Following these principles, we organically integrated the peer coaching activities in the process of object analysis, personalized diagnosis, personalized recommendation, and personalized evaluation in teachers' online personalized learning, as shown in Figure 2.

In this system, the peer coaching activities during the online personalized learning process consist of the following aspects.

(1) Meeting and greeting virtual team members. Building trust is the basis for peer coaching. At the beginning, the teachers do not know each other in the cyberspace. By greeting each other, posting their photos and other related information, they can get to know each other, bridge the gap, and build a sense of belonging and trust. This will help to develop the follow-up peer coaching activities.

(2) General content learning and peer diagnosis. Before the peer diagnosis, learning about the general theories, pedagogies, and the usage of the Instructional Design Diagnosis Framework is very important. After that, teachers can review the lesson plans in groups, diagnose problems, and give some feedback to each other according to the diagnosis framework. They can download the lesson plans, check the diagnosis framework, learn the general content, give suggestions, take notes, and so on, as shown in Figure 3. Based on the diagnoses and suggestions teachers give each other, the system can build a recommended learning contents and activities list for every teacher.

(3) Personalized content learning and peer experience sharing. After the peer diagnosis, every teacher was given a personalized learning contents and activities list. They could learn individually and share their experiences during this learning stage.

(4) Self-revision. The teachers could review and revise their pre-lesson plans by themselves based on the knowledge they gained through the personalized learning and peer experience sharing.

(5) Peer revision. After the self-revision of the pre-lesson plans, the teachers could share their plans in groups again and give each other comments. An online tool with the function of sharing documents and joint editing was provided for the teachers. They could review and make comments on every lesson plan, check others' comments, discuss and negotiate regarding the comments, rethink the knowledge that they had learned, and accumulate practical experience of how to apply the knowledge in practice.

(6) Raising questions and exchanging ideas. The system provides an interaction tool for teachers to raise questions and to communicate throughout the whole learning process. It also encourages the teachers to give explanations, reply to the questions, and engage in deep discussion with a function for making notes and joint editing online, as shown in Figure 4. That is, teachers raise questions first. Then, they can discuss with their peers and help each other to solve the problems. In this case, the trainee acts as both a participant and a training expert, correcting the imprecise or inaccurate opinions, and also playing the role of an expert in the online personalized learning.

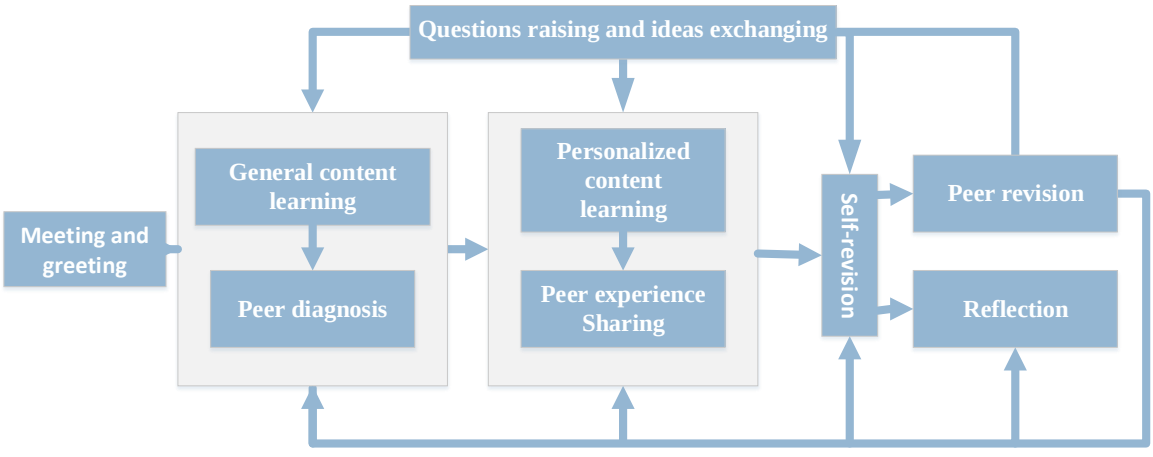

Figure 2. Peer coaching activities in the personalized learning system design

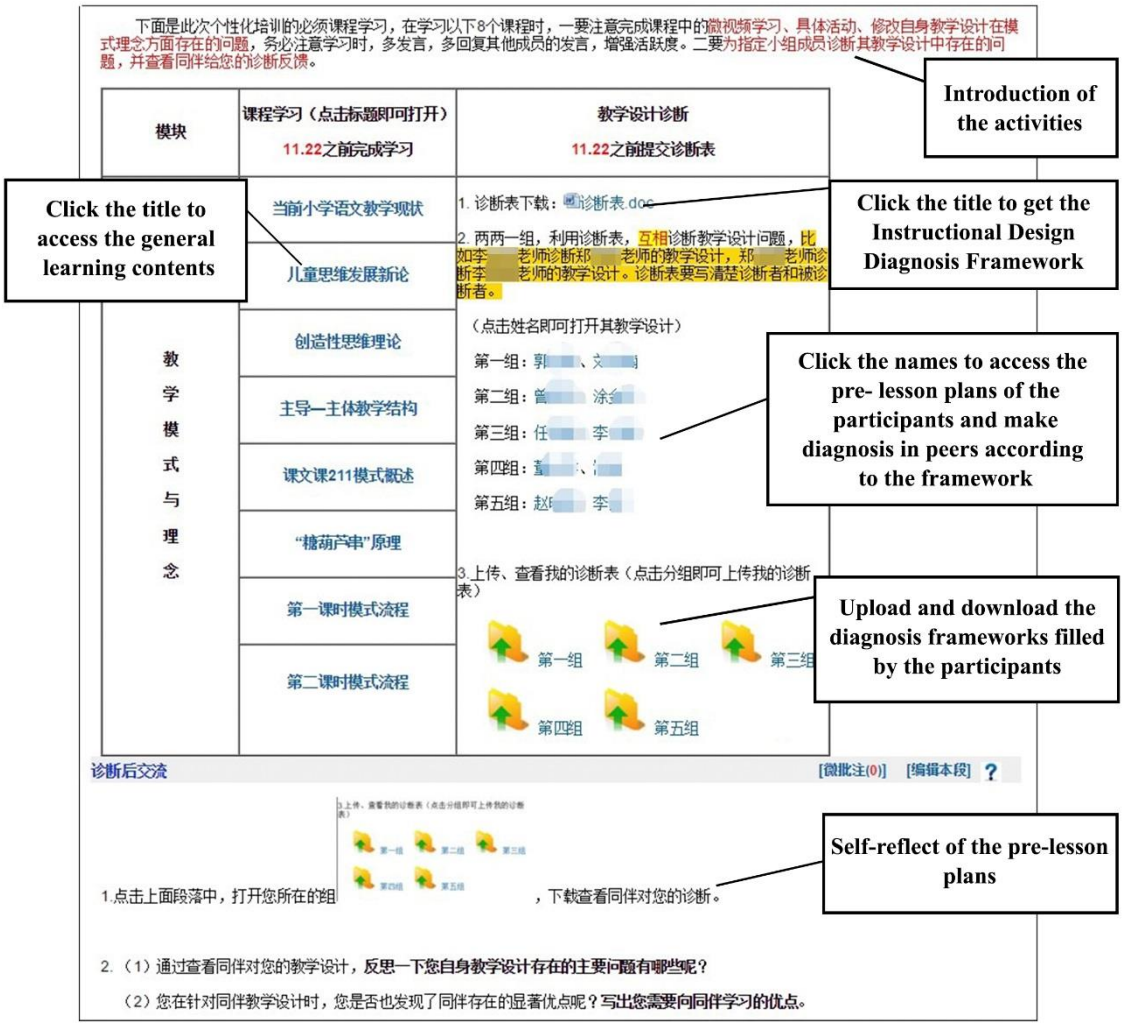

Figure 3. Interface of diagnosis in peers

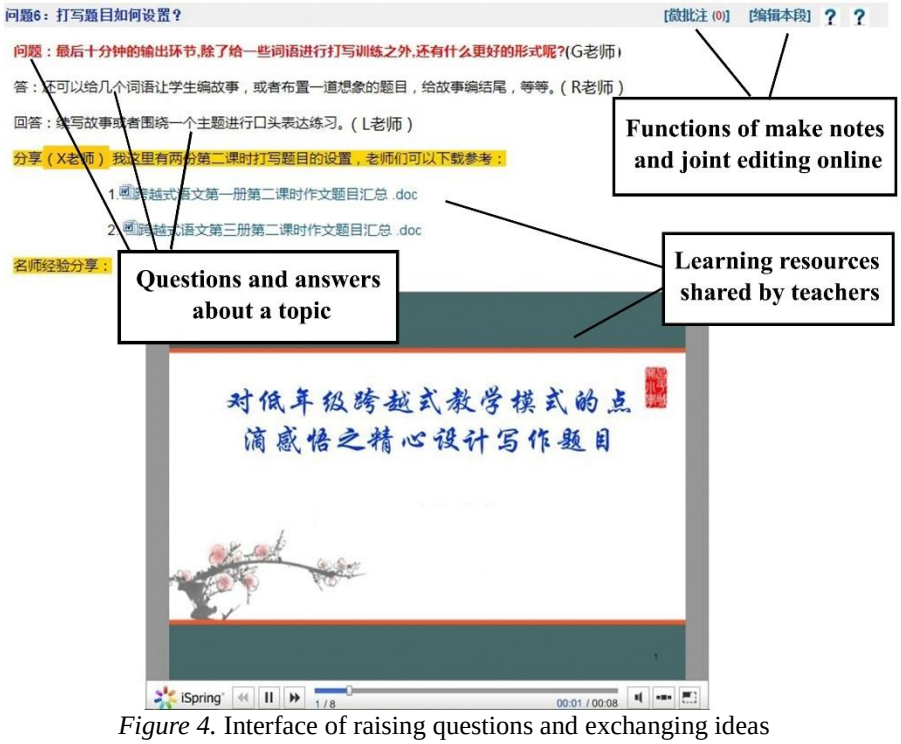

Figure 4. Interface of raising questions and exchanging ideas

Methodology

Based on the above personalized learning system, a quasi-experimental design was conducted involving in-service Mandarin teachers. The objectives of the course were to foster the teachers' learning design skills and their abilities of applying their knowledge and skills in their teaching practice.

Participants

The participants were 20 in-service teachers (all females) who had taught the Mandarin course for 7.16 years on average in elementary schools. The average age of the teachers was 31.56 years old. All the participants had previous experience of online learning.

Learning activities and experimental procedure

A quasi-experimental design was used to compare the learning participation, learning design skills, and in-practice teaching abilities of the in-service teachers who learned with the peer coaching-based personalized learning approach and those who learned with the expert guidance-based personalized learning approach. Figure 5 shows the procedure of the experiment.

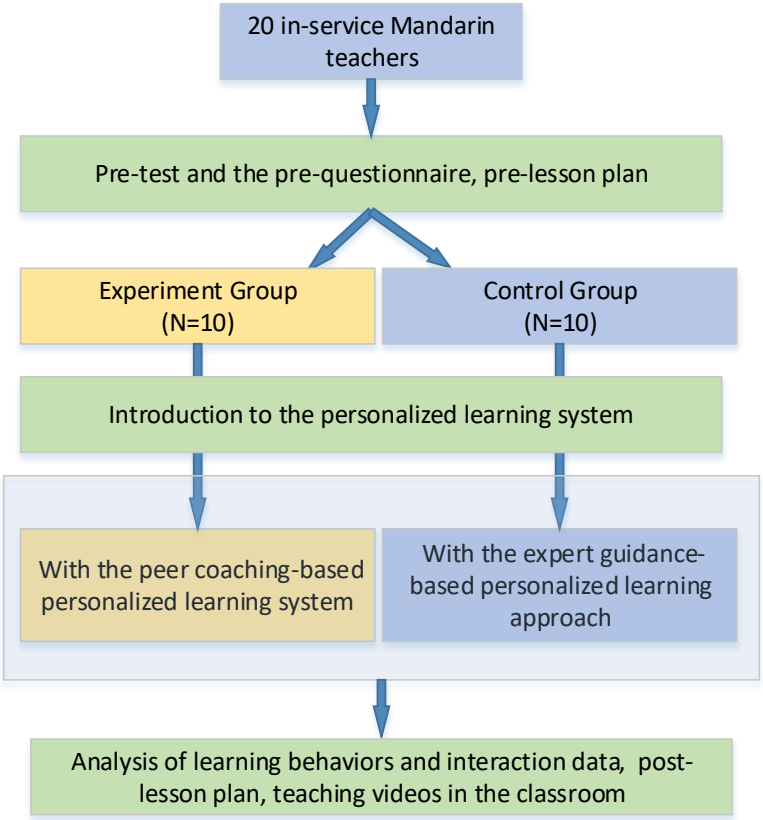

Figure 5. Procedure of the experiment

At the beginning of the experiment, a questionnaire about the in-service teachers' basic information, such as their age, number of years teaching, grade that they teach, and experience of online learning was conducted. Every teacher was asked to write and submit a lesson plan according to a specific topic. According to the quality of the lesson plan and their basic information, the participants were divided into two groups at the same initial level. Using purposive sampling, we randomly selected one group as the experimental group and the other as the control group.

Teachers in both groups took part in a 5-week personalized learning program based on the problems reflected in their initial lesson plans. The difference between the two groups was that the experimental group used the peer

coaching-based personalized learning approach, while the control group used the expert guidance-based personalized learning approach.

When the control group teachers entered the learning platform and submitted their initial lesson plan, the training experts diagnosed the problems existing in the plans according to the Instructional Design Diagnosis Framework, and then recommended a personalized learning contents and activities list for each trainee. The participants could check the course list and learn independently and adaptively. When the trainees met questions or problems, they could post their questions in the discussion forum, and the training experts would give them feedback. The experts also gave some learning suggestions, additional learning materials, or raised some questions according to each teacher's individual needs. For example, if a trainee did not raise any questions or ask for any information, the experts would communicate with her and give some suggestions or try to provide some support for her.

When the experimental group teachers first entered the learning platform, they introduced themselves and got to know each other. Then, they checked their peers' lesson plans and performed diagnosis on them according to the Instructional Design Diagnosis Framework, proposed personalized course lists for each trainee, and recommended the lists to them. Trainees in the experimental group studied individually referring to the lists, but during the process, they could communicate with their peers about any questions or problems that they met or found.

After 5 weeks of learning, a post-test was carried out to check and evaluate the differences in the teachers' learning participation, learning design skills, and in-practice teaching abilities. These results were mainly derived from the analysis of the online learning process, the quality of the post-lesson plans, and videos of the participants teaching in the classroom after the learning process.

Instruments

To evaluate the effectiveness of the proposed approach, an evaluation framework for lesson plans, a coding scheme for learning participation analysis, and an evaluation framework for the teaching videos were employed for the pre- and post-test in the experiment.

Table 1. The instructional design diagnosis framework

Dimensions	Assessment items	Scores
Front-end analysis	Analyse the learners	3
	Identify and describe the learning goals	3
	Identify and describe the learning content, especially the important and difficult learning points	3
	Describe the core pedagogy or teaching ideas	4
Learning process design	Design an appropriate learning context and lead into the learning fluently	4
	Set or post appropriate tasks/questions/problems	12
	Design rich, interesting, and effective learning activities that can promote the students' learning attitude and deep learning	6
	Select or develop effective strategies for guiding the students' reading, such as role play, teacher modelling, etc.	9
	Select or develop strategies to help the students grasp the method of literacy learning, especially for writing	9
	Select or develop rich materials for extensive reading that focused on the learning goals	8
	Set effective and proper writing items, provide relevant scaffolding for writing	8
Pedagogies and teaching ideas	The 211 teaching approach (20 minutes for studying the textbook, 10 minutes for extensive reading, and 10 minutes for composition writing)	6
	Appropriate integration of literacy, reading and writing	5
	The role of the teacher and the students (students as the principal part of the learning, teachers as the assistant and supporter of the students)	5
	Development of the students' creative thinking in language learning	7
	Development of the students' critical thinking in language learning	8

For the diagnosis and assessment of the teachers' pre- and post-lesson plans, the Instructional Design Diagnosis Framework was modified from the measurement developed by Li and Ma (2014). The framework was developed

by three experienced experts who had more than 10 years' experience of Mandarin teaching. It consists of three dimensions and 16 assessment items, as shown in Table 1. Using the Analytic Hierarchy Process (AHP) approach, the researchers checked the consistency of the weighted scores given by the three experts to derive the scores for each item.

Before and after the experiment, three experts evaluated the pre- and post-lesson plans of the in-service teachers according to the framework. Kendall's coefficient of concordance was used to test the consistency of the results for the three aspects, with Kendall's W of 0.83 (p = .000) and 0.72 (p = .002), respectively. Therefore, the pre- and post-test scores given by the three experts showed significant consistency, and the scores were valid.

For the assessment of the online learning participation, the learning behaviours and the interaction information of the teachers recorded by the personalized learning system were analyzed. In this research, all the participants learned online. The experimental group participants interacted with their peers, while the control group interacted with the expert. Seven dimensions were selected from the online knowledge-building rubric proposed by Li and Ma (2011) as the learning participation instrument to code and count the participants' learning behaviours and interaction data. It consisted of seven dimensions, namely raising questions, discovery and explanation, conflict, support, reflection, sharing, and affective communication, with a total of 19 items, as shown in Table 2. The learning behaviours and the interaction data of the participants were coded by the instrument, and the numbers of each dimension were counted. The scores of each dimension were the count numbers. Then, an independent t-test was conducted on the average numbers of the seven dimensions for the two groups.

Table 2. The seven dimensions of the online knowledge building rubric

Dimensions	Assessment items	Code
Raising questions	Asking for information	1a
	Raising a well-structured question	1b
	Raising an ill-structured question	1c
Discovery and explanation	Briefly statement about the concepts, definitions and facts.	2a
	Building relationship between the facts, ideas and principles	2b
	Identify or analyzing a question	2c
	Clarifying a question through analogizing	2d
	Clarifying a question through comparing	2e
	Distinguish the reason and outcome, advantage and disadvantage	2f
	Proving a point	2g
Conflict	Strongly opposed to a view	3a
	Raising a disagreement to a view	3b
Support	Agreement to a view	4
Reflection	Summarizing the learning outcomes	5a
	Self-reflection	5b
Sharing	Sharing a view, solution, information, web site, material, etc.	6
Affect communication	Greeting to others	7a
	Expression of friendship, encouragement, support, understanding, funny, agreement, etc.	7b
	Expression of rejection, depression, worry, etc.	7c

In order to assess the teachers' in-practice teaching abilities, each participant submitted a 40-minute teaching video showing how they applied the knowledge, skills, and the lesson plan in the classroom after the learning process. The last two dimensions of the "Instructional Design Diagnosis Framework" were used as the assessment tool, which were the dimensions of learning process design and pedagogies and teaching ideas. Although the names of the dimensions and the relevant items of these two assessment tools are the same, the concerns are different. The lesson plan shows the ideas and plans of the teacher, while the teaching video shows the actual teaching abilities reflected in the teacher's behaviours and activities. A teacher who can write a good lesson plan is not necessarily a teacher who can teach well in an actual classroom. Three experts evaluated the teaching videos of the in-service teachers according to the frameworks. Kendall's coefficient of concordance was used to test the consistency of the results for the three aspects, with Kendall's W of 0.78 (p = .001). Therefore, the evaluated scores of the teaching videos given by the three experts showed significant consistency, and the scores were valid.

Research results

Learning participation

To understand if there was a difference in the learning participation of the experimental group and control group teachers, content analysis was conducted firstly on the participation information in the online communities of the two groups. Then, an independent *t*-test was conducted on the seven dimensions of the teachers' learning participation. As shown in Table 3, there was a significant difference between the two groups in all seven dimensions. The experimental group showed a significantly higher occurrence of raising questions ($t = 2.11$, $p < .05$, Cohen's $d = 1.05$), discovery and explanation ($t = 5.02$, $p < .01$, Cohen's $d = 2.25$), conflict ($t = 4.16$, $p < .01$, Cohen's $d = 1.86$), support ($t = 3.04$, $p < .05$, Cohen's $d = 1.36$), reflection ($t = 9.00$, $p < .001$, Cohen's $d = 3.98$), sharing ($t = 9.51$, $p < .001$, Cohen's $d = 4.24$) and affective communication ($t = 2.67$, $p < .05$, Cohen's $d = 1.19$) than the control group. Furthermore, Cohen (1988) indicated that a Cohen's *d* value greater than 0.50 represents a medium effect size, while a Cohen's *d* value greater than 0.80 represents a large effect size; this result, therefore indicated a rather good effect size.

Table 3. Summary of the *t*-test analysis of the seven dimensions of the teachers' learning participation

		N	Mean	*SD*	*t*	*d*
Raising questions	Experimental group	10	7.10	2.30	2.11*	1.05
	Control group	10	4.20	3.16		
Discovery and explanation	Experimental group	10	5.70	3.59	5.02**	2.25
	Control group	10	0.00	0.00		
Conflict	Experimental group	10	12.60	9.58	4.16**	1.86
	Control group	10	0.00	0.00		
Support	Experimental group	10	4.30	4.47	3.04*	1.36
	Control group	10	0.00	0.00		
Reflection	Experimental group	10	1.90	0.32	9.00***	3.98
	Control group	10	1.00	0.00		
Sharing	Experimental group	10	10.10	1.20	9.51***	4.24
	Control group	10	4.10	1.60		
Affective communication	Experimental group	10	1.50	1.78	2.67*	1.19
	Control group	10	0.00	0.00		

Note. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Learning design skills

The total scores for the learning design skills include three dimensions: front-end analysis, learning process design, and pedagogies and teaching ideas. Before the analysis of the learning design skills based on the lesson plans, an independent *t*-test was used to analyse the pre-test. Table 4 shows that these two groups did not significantly differ in their scores for the four aspects before the experiment.

Table 4. Summary of the *t*-test analysis of the pre-test scores for learning design skills

		N	Mean	*SD*	*t*
Total scores	Experimental group	10	60.94	9.70	-0.22
	Control group	10	61.93	10.46	
Front-end analysis	Experimental group	10	8.30	3.22	0.49
	Control group	10	7.62	2.98	
Learning process design	Experimental group	10	35.54	5.06	-0.64
	Control group	10	37.02	5.34	
Pedagogies and teaching ideas	Experimental group	10	17.10	3.90	-0.12
	Control group	10	17.30	3.61	

One-way ANCOVA was then used to compare the scores of the front-end analysis, learning process design, pedagogies and teaching ideas, and the total scores of the post-test for the two groups. The results were shown in Table 5. It was found that the teachers in the experimental group had significantly higher total scores than those in the control group for their total scores ($F = 22.31$, $p < .001$, $\eta^2 = 0.57$), front-end analysis ($F = 4.79$, $p < .05$, $\eta^2 = 0.22$), learning process design ($F = 24.21$, $p < .001$, $\eta^2 = 0.59$), and pedagogies and teaching ideas ($F = 24.56$, $p < .001$, $\eta^2 = 0.59$). The data analysis above showed that there was a significant difference between the

experimental group and the control group in terms of their learning design skills, and these differences were mainly reflected in the learning process design, pedagogies and teaching ideas, and total scores.

Table 5. The one-way ANCOVA result of the post-lesson plan scores of the two groups

		N	Mean	*SD*	Adjusted mean	Std. error	*F* value	η^2
Total scores	Experimental group	10	78.57	4.26	78.82	1.81	22.31***	0.57
	Control group	10	66.95	9.85	66.70	1.81		
Front-end analysis	Experimental group	10	11.34	0.82	11.22	0.54	4.79*	0.22
	Control group	10	9.45	2.60	9.56	0.54		
Learning process design	Experimental group	10	45.22	2.71	45.57	0.95	24.21***	0.59
	Control group	10	39.28	4.62	38.94	0.95		
Pedagogies and teaching ideas	Experimental group	10	22.02	1.37	22.07	0.56	24.56***	0.59
	Control group	10	18.22	3.25	18.17	0.56		

Note. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Teaching abilities in practice

An independent *t*-test was conducted on the two groups to analyse the teaching videos submitted by the participants. The results given in Table 6 indicated that there were significant differences between the two groups in terms of their total scores ($t = 4.27$, $p < .01$, Cohen's $d = 1.91$), learning process design ($t = 4.09$, $p < .01$, Cohen's $d = 1.83$), and pedagogies and teaching ideas ($t = 4.17$, $p < .01$, Cohen's $d = 1.86$). According to the Cohen's *d* value, this result indicated a rather good effect size.

Table 6. Summary of the *t*-test analysis of the teaching videos of the two groups

		N	Mean	*SD*	*t*	*d*
Total scores	Experimental group	10	63.77	1.53	4.27**	1.91
	Control group	10	54.43	6.74		
Learning process design	Experimental group	10	40.70	0.98	4.09**	1.83
	Control group	10	35.27	4.08		
Pedagogies and teaching ideas	Experimental group	10	23.07	0.91	4.17**	1.86
	Control group	10	19.17	2.82		

Note. $^{**}p < .01$.

Summary and discussion

Recent research has shown that personalized learning for teachers has a positive influence on teachers' professional development (Gynther, 2016; Limongelli, Sciarrone, Temperini, & Vaste, 2011). Studies have also indicated that peer coaching is a powerful approach for teachers' professional improvement, as teachers' perceptions of professionalism are mainly gained from "other teachers" and so peer coaching can help teachers transform their knowledge into practice (Zhang, Liu, & Wang, 2017; Rice, 2012). However, more studies have reported on pre-service teachers than on in-service teachers (Lu, 2010). In this study, we propose a peer coaching-based personalized learning approach for in-service teachers compared to the expert guidance-based personalized learning approach. A 5-week quasi-experiment was conducted to investigate the influences on the teachers' learning participation and the development of the teachers' learning design skills and in-practice teaching abilities.

The peer coaching-based personalized learning approach promotes in-service teachers' learning participation

The experimental results showed that the peer coaching-based personalized learning approach for in-service teachers could improve their learning participation. Peer coaching made the interaction between the trainees and trainers no longer the only important interactive form in the in-service teachers' personalized learning. Peer diagnosis, raising questions and exchanging ideas, and other activities could promote the interaction between the trainees, stimulating the in-service teachers to ask more questions. Because of the similarities in their experience and background, it might be easier for the in-service teachers to express and accept their peers' comments compared with learning with expert guidance. Besides, the in-service teachers could propose solutions to questions based on their own experience, which could give other in-service teachers a better reference.

Peer coaching benefits the development of in-service teachers' learning design skills and in-practice teaching abilities

The research results showed that the peer coaching-based personalized learning approach had a significant influence on the teachers' learning design skills and in-practice teaching abilities. The significant differences in the learning design skills of the experimental and control groups were mainly reflected in two dimensions: the learning process design, and the pedagogies and teaching ideas. These two parts both focus on in-service teachers' knowledge structure based on previous experience, and transformation of theoretical knowledge into practical knowledge. The peer coaching activities in the personalized learning process helped to enrich the in-service teachers' practical knowledge and teaching context. They also benefited the in-service teachers in terms of helping them build relationships between their practical knowledge and the specific teaching context.

Meanwhile, the peer coaching activities allowed the in-service teachers to learn from each other and to reflect on their own work. During the diagnosis and interactive activities, they benefited from others' lesson plans, gave suggestions to each other, and reflected on their own plans. The knowledge structures of the in-service teachers could be promoted during the conflict and negotiation activities (Zhou, 2012). The social cognitive activities during peer coaching helped the in-service teachers go through an implicit-explicit-implicit transformation and iteration process which would benefit their understanding of the knowledge, develop their practical knowledge, and promote their instructional design and in-practice teaching abilities.

Using an empirical research method, this study explored the influence of the peer coaching-based personalized learning approach on in-service teachers' learning participation, learning design skills, and in-practice teaching abilities. The results revealed that the peer coaching-based personalized learning approach had a positive influence on the three dimensions mentioned above, especially promoting the in-service teachers' learning design skills and in-practice teaching abilities.

Although the proposed approach benefited teachers in this application, there are some limitations to this study. The number of participants was not enough, and the data used in analyzing the learning participation was not abundant. However, this study still provides a good reference for those who intend to conduct learning activities and studies related to the use of online peer coaching and personalized learning in in-service teachers' professional development.

In the future, the assessment tools for precise diagnosis, online activities for peer coaching, and supporting tools for interaction and online learning can be improved by analyzing and constructing an accurate learner model and database. The more we know the teachers, the better we can promote the resources, activities, and supports for them. In addition, the proposed method can be adopted with mobile devices, on which in-service teachers can review their performance or give immediate feedback to others.

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