**Crafting Metacognitive Teaching Strategies through Lesson Study:**

**A Study in Teacher Education**

Abstract

Purpose

This paper reports a study using Lesson Study to nurture pre-service teachers metacognitive teaching knowledge and skills to address the implementation of Learning to Learn 2.0+ curriculum in Hong Kong. Lesson study was adopted to craft metacognitive teaching strategies in an action research course of a pre-service teacher education programme of an Education University in Hong Kong.

Design/methodology/approach

An experimental design with a control group and an experimental group was adopted as the research method. Lesson Study that aims to develop metacognitive teaching strategies were adopted as an intervention to the experimental group. Flavell (1979) and Brown (1987) metacognition models which conceptualize metacognition as knowledge of cognition, regulation of cognition and motivational learning experiences were adopted as the guiding principles for instructional design. Pre-post questionnaire survey on metacognitive teaching was applied to collected data from both control group and experimental group. Exploratory factor analysis (EFA) and reliability test was applied to test the constructed validity and reliability of the instrument respectively. T-test was applied to gauge the significant of the incremental scores of the pre-post survey.

Findings

Modelling thinking process, thought-provoking reflections, reviewing thinking process, enabling self-regulation and motivational feedback for metacognition teaching were empirically constructed by CFA. The results of the t-tests show that significant differences between pre-post survey were found in modelling thinking process, thought-provoking reflections and reviewing thinking process in the experimental group. Lesson Study can be adopted as a collaborative platform for pre-service teachers to brainstorm teaching strategies mutually, thus enabling them to regulate their cognitions for developing their metacognitive teaching competencies.

Practical implications

Lesson Study could be an effective approach to develop metacognitive teaching strategies to address the challenge of implementing the Learning to Learn 2.0+ curriculum.

Originality/value

This study sheds light on crafting metacognitive teaching strategies through Lesson Study in teacher education so as to address the Learning to Learn curriculums. It also brings in a new research dimension of teacher’s regulation of cognition for learning instructional design into the Lesson Study communities.

Keywords: Lesson Study, Metacognitive Teaching, Metacognition, School Partnership Model, Learning to Learn 2.0+ Curriculum

**Introduction**

This paper discusses the application of Lesson Study approach in teacher education programme to enhance pre-service teachers’ metacognitive teaching knowledge and skills with a view to tackling the impacts and challenges created by and underlying the Learning to Learn 2.0+ curriculum in Hong Kong (Curriculum Development Council, 2015). Since the introduction of the Learning to Learn curriculum around the world, metacognitive teaching has come to the forefront as an innovative research agenda in teacher education (Iksan, Nor, & Nor, 2014; Martin, & Clerc-Georgy, 2015; Zhou, Xu & Martinovic 2017; Moghaddam et.al 2020). The key concept underpinning Learning to Learn 2.0+ is that of teachers developing students’ generic skills including decision making, planning, and problem solving. All these skills can be conceptualized as metacognitive skills. The curriculum consists of a wide range of elements including science, technology, engineering and mathematics (STEM) education, information literacy, language across the curriculum, values education, and e-learning (Curriculum Development Council, 2015, p.6). It is suggested that schools implement these curriculums with a view to enhancing the metacognitive capabilities of students for achieving life-long learning. However, the recently implemented Learning to Learn 2.0+ curriculum in Hong Kong has caused positive challenges and impacts on the curriculum implementation and instructional design in Hong Kong schools. (Curriculum Development Council, 2015, 2017). Developing and maintaining the professional competency of teachers has been shown to be a critical factor for successful curriculum reform (Cheng, 2017; Connolly & Chris, 1998). Lesson Study can be an appropriate approach to support teachers to acquire such knowledge and skills – if they successfully implement the Learning to Learn 2.0+ curriculum (Cheng & Lee, 2019).

Metacognition is a monitoring mechanism of cognition. Cognition deals with mental processes like memory, learning, problem-solving, attention and decision making, such processes help learners to generate new knowledge and to use the knowledge they have already internationalized. Metacognition gives a learner active control over his cognition and is a process of cognition, and therefore it is thinking about thinking. With an effective control of metacognition, learners’ academic achievement and their adaptability can be enhanced. Metacognition is the abilities of learners to monitor and control their cognitive process (Young & Fry, 2008) for improving academic achievements (van der Stel & Veenman, 2014; Tanner, 2012), fostering reading and comprehension skills (Reeve & Brown, 1984), advancing students’ critical thinking skills (Ku & Ho, 2010) and enhancing problem solving and mathematical skills (Schraw, 1998; Kramarski, Mevarech, & Arami, 2002). Metacognition outweighed intelligence as a predictor of mathematics learning performance (Schneider & Artelt, 2010) and is positively related to self-regulated learning, independent learning, and self-management (Backer, Keer & Valcke, 2015).

Metacognitive knowledge and skills can be taught (Flavell, 1979; Reeve & Brown, 1984). Literature shows that metacognitive abilities can be developed through learning experiences (Pintrich, 2002; Veenman et al., 2006) with interactions from peers, teachers and parents. Metacognitive teaching strategies are pedagogies for developing students’ metacognition. Teachers’ awareness and regulation to their teaching strategies to address the learner’s need and responses is critical in metacognitive teaching (Wall & Hall, 2016; Soodla, Jõgi, & Kikas, 2017). The arguments for adopting Lesson Study to nurture preservice teachers metacognitive teaching skills is that Lesson Study provide a platform to enable the teachers to aware the effectiveness of their teaching strategies through collaborative lesson planning, observing and reflecting on lessons with specific attention being paid to a selected group of pupils and their learning (Dudley, 2014, 2015). Such process helps pre-service teachers to develop a critical perspective on the teaching thinking skills to regulate their strategies in an authentic learning environment, which is driven by them and is characterized by the reciprocal sharing of teaching ideas and strategies for instructional design.

The study aims to examine the extent to which Lesson Study can enhances the metacognitive teaching skills of pre-service student teachers through a classroom research course. The course was streamlined with a school partnership model that consists of course instructors, teachers from partnership schools and pre-service teachers, which were utilized to provide an authentic learning environment to enhance the metacognitive teaching competence of the pre-service students in an Education University in Hong Kong. A series of metacognitive teaching strategies were introduced in the course, self-regulated strategies through working on problem-solving activities, modeling and think-aloud metacognitive and learning strategies explicit, and encouraging students to reflect upon and talk about their learning (Whitebread et al., 2017). School principals and teachers were invited as guest lecturers of the course to bring in teaching experiences in curriculum implementation to the pre-service teachers. These experienced practitioners opened some of the classes in their schools to the preservice teachers to carry out lesson implementations. Course instructors, teachers of the partnership schools and pre-service teachers were conducted Lesson Study to identify the successful metacognitive teaching strategies and skills to implement the Learning to Learn 2.0 + curriculum. A pre-post survey on metacognitive teaching behaviours were conducted to measure the perceptions of the pre-service teachers on their learning. Exploratory factor analysis (EFA) and reliability test were conducted to validating the constructed validity and the reliability of the instrument. Modelling thinking process, thought-provoking reflections, reviewing thinking process, enabling self-regulation and providing motivational feedback were empirically extracted by the EFA. Results of this study show that Lesson Study enhances their teaching knowledge and skills in modelling thinking process, thought-provoking reflections, review thinking process significantly.

**Literature review**

Lesson Study provide a collaborative platform for teachers to create pedagogical knowledge to bridge the curriculum implementation gaps (Cheng, 2018). Research show that Lesson Study enables teachers to create pedagogical content knowledge (Mostofo, 2014; Leavy & Hourigan, 2016; Da Ponte, 2017; Saran, 2018; Zhou, Xu & Martinovic, 2017), pedagogical and technological content knowledge (Meng & Sam 2013) Lesson Study supports teachers to construct pedagogical content knowledge on orientation toward teaching, instructional strategies, and students understanding of specific topics (Coenders & Verhoef, 2019). In term of process, Lesson Study involves collaborative lesson planning, peer lesson observations and post lesson conferences in one or more cycles. It enable teachers to work collaboratively in teaching and learning, and bring in and share their experiences on finding out how students learn, how they respond in classes, and how to make students' thinking visible during planning, observing, and reflecting phases. Such process promotes peer learning among the participated teachers (Lamb, 2015; Iksan, Zakaria, & Daud, 2014) and help them to focus on students’ learning for effective instructional design (Hourigan & Leavy, 2019). With the lesson's goal in mind, teachers can design ways to make students thinking visible, such as giving them exercises which allow them to discuss, compare, comment and reflect on ideas. (Cerbin, William & Kopp, 2006). The Plan-Do-Check-Act cycle of Lesson Study enhances the critical thinking, communication and collaborative skills, metacognition, literacy of pre-service teachers, acquiring these skills enable them to teach their pupils with 21st century skills (Susilo, Sudrajat, & Indriwati, 2018). Beyond doubt, the development of Lesson Study around the world prove itself to be a powerful tool for creating pedagogical knowledge for teaching.

Lesson Study enables both in-service and preservice teachers to master teaching skills (Galini & Kostas, 2014; Munthe, Bjuland & Helgevold, 2016; Angelini & Álvarez, 2018), develop their instructional design competency (Cheng, 2011b) promote their reflective abilities (Lamb & Aldous, 2016). There is a growing trend to adapting Lesson Study in teacher education programme of universities for enhancing pre-service teachers’ teaching skills and competences through micro-teaching in their campus courses (Iksan, Nor, & Nor, 2013; Zhou, Xu & Martinovic, 2017; Moghaddam et. al. 2020) or through practicum in partnership schools (Cheng, 2014) Lofthouse and Cowie (2018) adapted Lesson Study to develop a repertoire for teaching thinking skills for pre-service teacher in a PGCE module. Integrating the concept of metacognition and teachers' guidance in Lesson Study training for pre-service teachers show improvement in both students' learning and pupils learning (Martin & Clerc-Georgy, 2014). However, there is still lacking relevant studies reported in literature to explore application of Lesson Study to craft metacognitive teaching strategies to address competencies-based curriculum. It is worth to explore how can Lesson Study craft pedagogical knowledge for developing student competencies. This study applied Lesson Study in a course of an Education University in Hong Kong support with a school partnership for crafting metacognitive teaching strategies to bridge this research gap.

Metacognition is a process of higher order thinking (Livingston, 2003) which involves “critical analysis of thought” (Serra & Metcalfe, 2009), “knowledge and cognition about a cognitive phenomenon” (Flavell, 1979) through monitoring, regulating and orchestrating of cognitive processes and products (Flavell, 1976, 1979). Metacognition is an individual ability to understand and manipulate their own cognitive processes (Reeve & Brown, 1984) and it is about individuals' having information about their cognitive structure and being able to organize it (Akturk et al., 2011). Flavell (1979) conceptualize metacognitive activities as an interactive process of four critical elements metacognitive knowledge, metacognitive experiences, goals and cognitive strategies to operate the metacognitive process for learning. The interactions of these four elements fully operate the monitoring, regulating and orchestrating of cognitive processes for effective learning. Brown (1987) propose knowledge about cognition, regulation of cognition and motivation to explain the metacognitive learning process. Brown’s concept of knowledge about cognition is similar to Flavell’s concept of metacognitive knowledge, both concepts refer to what learners know about their own cognition or about cognition. Brown’s concept of regulation of cognition refers to a set of monitoring, regulating and orchestrating of cognitive activities that help students control their learning, which ethos to the interaction of the four elements of Flavell’s model.

The concepts of Flavell’s and Brown’s metacognition models were tested and operationalized in many classroom researches (Schraw, 1998; Pintrich, 2002; and Veenman et al., 2006). Some metacognitive teaching strategies were proposed, for examples, teachers model their thinking process to enable learners to know about their cognitions, engage students in thought-provoking reflections through problem solving activities and facilitate them to review their problem solving process are critical strategies to develop student metacognition (Schraw, 1998; Veenman et al., 2006); and facilitating students with an iteration process of plan-implementation-evaluation cycle for problem solving enable them to regulate their cognitions for effective learning. The researcher adopted Schraw (1998), Pintrich (2002) and Veenman et al. (2006)’s ideas of metacognitive teaching and summaries and operationalized into five guiding principles for designing metacognitive teaching and learning activities. They are modelling thinking process, thought-provoking reflections, reviewing thinking process, enabling self-regulation and motivational feedback.

Modelling thinking process is a teaching strategy to visualize differential value of alternative strategies in teacher mind for enhancing performance to develop students’ metacognitive knowledge. The knowledge about cognition in teacher’s mind can be visualized by teachers think-aloud to students. Modelling is a teachers’ demonstration or imitation of a concept for students, so that the students learn by implicit learning (Haston, 2007). Metacognitive knowledge and regulation are tacit in nature, neither knowledge nor skills are necessarily made explicit (Schraw and Moshman, 1995), therefore, teachers should embed metacognitive instruction in the content matter and include metacognition as a goal in teaching plans. They may delivery the content through think-aloud to visualize their minds. Think-aloud is an effective way to reveal and visualize the thinking processes of the teachers, such that students see teachers thinking processes by thinking aloud and describing their own reasons for selecting portfolio pieces (Laski, 2013).

Provoking reflections is a teaching strategy to facilitate students to regulate their cognition through questioning and engaging students in problem solving activities. Such regulation process can also be triggered by think-pair-share activities, in which teachers group students to discuss solutions for problem solving, encourage them to share their thinking process and encourage students to ask questions. Organizing the discussion activities of metacognitive knowledge in part of the everyday discourse can helps students to foster a language in which they can talk about their learning and cognition (Pintrich, 2002, p.223). Questioning and problem-based learning are keys to facilitate students’ thinking and directs them to the learning goals. The design of or construct the questions could be around the six cognitive levels in Bloom’s taxonomy (Larson & Keiper, 2013).

Reviewing thinking process is a teaching strategy that provides opportunities to students to review and present their thinking process for problem solving can facilitate them to regulate their cognitions. Such activities may include, teacher arranges presentation to students for report explicitly their think process, after that teacher may assess students’ prior knowledge and listen carefully to students’ descriptions of their cognitive process and learning. Student thinking aloud their ideas in the presentation, error detection activities can help students to regulate their cognition for effective learning.

Facilitating self-regulation is a teaching strategy to enable learners to monitor, regulate and orchestrate their own cognitive activities which is the core mission of metacognitive teaching. Such mission can be realized by conducting self-regulated teaching and learning activities to develop learners’ abilities of planning, monitoring, and evaluating their learning progress. Self-regulated teaching and learning activities develop students’ abilities of planning, monitoring and evaluating their learning progress (Pintrich, 2002; Cheng, 2011a). Such activities include help student to set learning goals, formulate learning strategies, to carry out self-questioning for understanding, and to detect their own errors. Teachers could conduct activities and use regulation checklists, strategy evaluation matrices to help students to check if their goals are achieved to develop student’s regulated abilities.

Providing motivational feedback to learners is a strategy to enable learner to have positive a learning experience to sustain their metacognitive learning. Favell and Brown both emphasis on the important of motivation for metacognitive learning. Flavell’s concept of metacognitive experiences is about a motivational aspect of students’ learning. A high-metacognitive classroom as described by Kohen and Kramarski (2018, p.280) “encourages student-centered learning, in which knowledge typically develops out of students’ needs and interests.”. Therefore teachers’ positive feedback for promoting students’ self-efficacy and motivation is an essential principle for metacognitive teaching. Such pedagogies include positively evaluate students’ efforts, emphasizing the learning process rather than grades and helping students concretize their goals and foster a metacognitive learning environment, promoting the use of metacognitive language and strategies, and reward the efforts made in learning.

The above five metacognitive teaching principles for metacognitive teaching were derived as the interventions of the classroom research-based course. Research show that application of metacognitive strategies framework in lesson planning has positive effect on developing pre-service teachers’ skills in lesson planning. (Liyanage, & Bartlett, 2010). This study evaluates if these five principles of metacognitive teaching could be learned and internalized by of preservice teacher through the Lesson Study approach in a classroom research course. The research question of this study is “to what extent does Lesson Study approach nurture pre-service teachers metacognitive teaching skills?”

**Methodology**

The subject of this study is 100 pre-service teachers of an Education University in Hong Kong. An experimental design with a control group (N=50) and experimental group (N=60) was adopted as the research method. The course for the experimental group comprised a series of theory-based tutorials, supportive consultation meetings, and a research lesson practicum, while the course for the control group involved campus-based lectures and tutorials for delivering teaching methods. During the course for the experimental group, the pre-service teachers were taught the theories and practice of metacognitive teaching in tutorials, and then work together in small subject groups with support and guidance from the instructors to implement the Lesson Study project in the partnership schools. All students have to take part in the Lesson Study groups, contributing to the planning and evaluation of the research lesson as needed to implement one lesson observation and one research lessons. The 60 students were be divided into 8 groups mainly according to their subject areas, each group containing around 7-8 students to work on one Lesson Study case.

Pre-post questionnaire survey on metacognitive teaching was applied to collected data from both control group and experimental group. All the pre-service teachers of the course were invited to fill in a self-developed questionnaire for the pre-post survey. The questionnaire was based on five scales that were constructed to measure the variables of metacognitive teaching principles. In order to develop valid items for these scales, the researcher conducted a content analysis of the Flavell’s (1979) and Brown’s model (1987) of metacognition and the studies from Schraw (1998), Pintrich (2002) and Veenman (2006). The principles were then converted into statements for use in the questionnaire. The data was collected directly from the participants by means of the questionnaire. The questionnaire contained 24 questions. Likert six-point scales were used in both sections to measure the variables. Likert scales are commonly used in attitudinal research. The Likert scale assumes that the difference between answering agree strongly and agree is the same as between answering agree and neither agree nor disagree (Likert, 1932).

Exploratory factor analysis (EFA) and reliability test was applied to test the constructed validity and reliability of the instrument. EFA was done for the variables by principal axis factor analysis to confirm the constructed validity the instruments (see table 1). The study is interest in a theoretical solution uncontaminated by unique and error variability and it is designed with a framework on the basis of underlying constructs that are expected to produce sources on the observed variables. Principal axis factor analysis, which aims to reveal the underlying factors which produce the correlation or correlation among a set of indictors with the assumption of an implicit underlying factor model, was applied to the items from the learning processes and learning outcomes separately. Promax rotation, a method of oblique rotation which assumes the resulting factors are correlated with one other, was applied to extract the factors. An eigenvalue greater than one was used to determine the appropriate number of factors. T-test was applied to examine the differences between the pre-post tests on. T-test was applied to test the significant of the incremental scores of both control group and experimental group for the five teaching principles.

**Findings**

The results of Exploratory factor analysis (EFA), presented in Table 1, clearly suggest five factor structures for the variables that are both empirically feasible and theoretically acceptable. Results of the factor analysis show that 16 items were extracted with factor loadings higher than 0.5. The construct validity of the instrument is confirmed by EFA. The result shows that five factors are extracted. They are modelling thinking process, thought-provoking reflections, reviewing thinking process, enabling self-regulation and motivational feedback respectively. The reliability coefficients of 0.7 or higher are judged adequate for research purposes (Caplan, Naidu, & Tripathi, 1984). The reliability coefficients of the scales ranged from 0.714 to 0.848, which were judged adequate for this study.

**Table 1. Results of the Factor Analysis and Reliability Test for Each Scale**

|  |  |  |
| --- | --- | --- |
|  | **Teaching Principles and Items** | Factorloadings |
| **Scale 1: Enabling self-regulation (eigen-value = 7.751, reliability α = 0.848)** |
| Q20 | I teach students how to set learning goals. | 0.987 |
| Q21 | I teach students how to employ methods and strategies to achieve their learning goals. | 0.878 |
| Q19 | I teach students the method of self-questioning so that they can monitor their own understanding. | 0.645 |
| Q18 | I teach students to check mistakes from time to time so that they can monitor their learning processes. | 0.583 |
| **Scale 2: Thought-provoking reflections (eigen-value =1.493, reliability α = 0.756)** |
| Q10 | I provide the opportunities for students to discuss how to solve problems. | 0.763 |
| Q9 | I encourage students to share their thinking processes. | 0.752 |
| Q12 | I encourage students to ask questions about the learning content.  | 0.600 |
| Q13 | I arrange problem solving activities for students. | 0.503 |
| **Scale 3: Model thinking Process (eigen-value = 1.303, reliability α = 0.738)** |
| Q3 | I ask students inferential questions and check if their answers are correct. | 0.779 |
| Q4 | I demonstrate the thinking process in answering inferential questions to students. | 0.767 |
| Q11 | I demonstrate the thinking process of problem solving to students. | 0.460 |
| Q2 | I teach students how to complete their assignments with the strategies they have learned. | 0.421 |
| **Scale 4: Motivational Feedback (eigen-value = 1.226, reliability α = 0.814)** |
| Q23 | I motivate students’ learning by teaching them how to recognize their self-worth. | 0.794 |
| Q24 | I motivate students’ learning by teaching them the idea of self-reward. | 0.714 |
| Q22 | I motivate students’ learning by complimenting their abilities. | 0.707 |
| **Scale 5: Review thinking process (eigen-value = 1.026, reliability α = 0.714)** |
| Q6 | I review with students the thinking processes which benefit their learning after class. | 0.720 |
| Q7 | I assess whether students can report their learning processes. | 0.665 |
| Q8 | I assign class time for students to report how they solve problems. | 0.560 |

The results of the post survey of the experimental group show that the scale means of all the teaching principals are higher than 5.0 within the 6 point-scale (see table 2); this indicates that the pre-service teachers agree they know how to practice these five metacognitive teaching strategies. They can visualize teacher’s thinking process to students through modelling and think aloud; engage students in thought-provoking reflections through problem solving activities; facilitate them to review their problem solving process; provide motivational feedback to student and develop pupils’ self-regulation learning behaviors.

Positive incremental scores for all the five teaching principles between pre-post survey in both the control group and experimental group were identified. However, the results of the t-tests show that significant differences between pre-post survey were found in modelling thinking process(p=0.007), thought-provoking reflections (p=0.000), and review thinking process (p=0.044) in the experimental group. For the control group, only the incremental scores of the review thinking process (0.015) was identified to be significant differences between pre-post survey.

Table 2 T-Tests on the five teaching principles

|  |  |  |
| --- | --- | --- |
|  | Control group  | Experiment group |
|  | Pretest Mean | Posttest mean | P-values | Pre-testMean | Posttest mean | P-values |
| Modeling thinking  | 4.99 | 5.00 | 0.92 | 5.05 | 5.34 | 0.007 |
| Thought-Provoking reflections | 5.05 | 5.01 | 0.739 | 5.11 | 5.48 | 0.000 |
| Reviewing thinking process | 4.55 | 4.93 | 0.015 | 4.19 | 5.05 | 0.044 |
| Enable self-regulation | 4.92 | 4.95 | 0.809 | 5.08 | 5.27 | 0.139 |
| Motivational feedback | 4.99 | 5.09 | 0.489 | 5.06 | 5.30 | 0.072 |

**Discussion**

The five principles for metacognitive teaching - modelling thinking process, thought-provoking reflections, reviewing thinking process, enabling self-regulation and motivational feedback are empirically constructed by the CFA with construct validity. This reflects that the guiding principles for metacognitive teaching proposed by Schraw (1998), Pintrich (2002) and Veenman (2006) are conceptually applicable which can be operationalize to questionnaire items with content validity for measuring the behaviors of metacognitive teaching. Since these five guiding principles are derived from the elements of Flavell’s (1979) and Brown’s (1987) models - knowledge of cognition, regulation of cognition and motivation for learning, in turn, this results verify the power of Flavell’s (1979) and Brown’s (1987) models to explain metacognitive behaviours.

In answering the research question - the extent to which Lesson Study nurtures pre-service teacher metacognitive teaching skills, the incremental scores between pre-post survey in the experimental group are identified for all the five teaching principles. Moreover, a significant different are identified in modelling thinking process, thought-provoking reflections, reviewing thinking process. These reflect that the collaborative lesson planning, peer lesson observation and post lesson discussion of Lesson Study help preservice teachers to visualize their thinking process explicitly for problem solving, provide problem solving activities to provoke pupils reflection and guide pupils to review their thinking process to improve pupils’ problem solving abilities.

The significant incremental scores provide evidences to support the fact that Lesson Study enable the pre-service teachers to grasp the core metacognitive teaching principles, they can craft metacognitive knowledge for designing activities and implement in their research lesson. This finding is similar to Liyanage and Bartlett’s (2010) assertions that metacognitive strategies framework in lesson planning has positive effect on developing pre-service teachers’ skills in lesson planning. This finding also echo to Dudley’s (2014, 2015) assertions that that Lesson Study enables the teachers to aware the effectiveness of their teaching strategies through collaborative lesson planning, observing and reflecting on lessons with specific attention being paid to a selected group of pupils and their learning.

In term of the collaborative instructional design in Lesson Study, the preservice teachers design problem solving activities to provoke pupils’ thinking, arrange group discussion for problem solving, and encourage pupils to share their thinking process and encourage students to ask questions. Through their lesson implementation in the research lesson, they have developed think aloud skills to model and visualize their thinking process for problem solving, they can guide their pupils know how to complete the assigned learning tasks and ask questions to check the accuracy of pupil answers. Participation in peer lesson observation and post-lesson conference enable them to dialogue with the others. Lesson Study could be a powerful strategy that enable pre-service teachers to work and learn collaboratively and become more metacognitive and self-regulating in instructional design (Cheng, 2011a). This argument is also claimed by Lofthouse and Cowie (2018), they assert that through lesson study, teachers can experience learning situations, activities and content that can best be resolved, understood and applied through opportunities to engage in dialogue with others. So that they become a metacognitive and self-regulated teacher.

Another result of this study shows that there are no significant differences between the pre-post survey of enable self-regulation and motivational feedback. This finding is interesting. To motivate and nurture learners to become self-regulated learners will normally take much longer time than a research lesson. This is because such self-regulation teaching strategies include setting learning goals, no matter short term and long-term goals, helping learners to review which learning strategies enable them to achieve the learning goals, and help them become an self-motivational learners. The preservice teachers of this study only implement two research lessons for a same lesson plan. Therefore, it is not surprising that the incremental scores of these two guiding principles cannot be induced significantly. However, the positive incremental scores of all the teaching principles still have implications to teacher educators and serving teachers of Lesson Study communities for developing students’ abilities of regulation of cognition with metacognitive teaching strategies, if they really want to implement the 21st century curriculum effectively.

The argument for using Lesson Study in teacher education to enhance metacognitive teaching skills is supported by the finding of this study. Lesson Study provides opportunities to teachers to review and regulate their cognition process. As metacognitive teaching is a process to visualize teacher’s thinking process to students through modelling and think aloud to make thinking visible, it requires teachers to aware how they think and reflect on how they regulate their thinking process for improving instructional design. Therefore effective metacognitive teaching depends on the levels of teacher’s metacognition – teachers reflections on how they plan and frame the approach to understand the meaning of the texts and learning materials, how they regulate their cognition to maximize their learning and how they use and formulate strategies for problem solving.

Lesson Study not only enables teachers to focus on students’ learning difficulties and how they think but also allow teachers to know how they themselves constructed these skills within their own repertoire of cognitive skills, and think about how they can teach students about using these skills deliberately. This pedagogical practice paves a path for teachers to craft metacognitive teaching. The teachers in this study arrange presentation for pupils to report their solution for problem solving so as to evaluate if the pupils can report their learning process. They arrange presentations to pupils to help them to review their thinking and learning processes. Lesson Study could be a practical approach to support teachers to create metacognitive teaching pedagogy for implementing the Learning to Learn curriculum.

Conclusions

This study concludes that Lesson Study arouses pre-service teachers’ metacognitive awareness for instructional design and prompts them to think deeply on the applicability of pedagogy to provoke student’s reflection. Lesson Study allows them to integrate evidences from theories learning in campus, practices experience in the lesson implementation at partnership schools and classroom research for authentic reflective learning. The study also contributes an instrument with validity and reliability for measuring metacognitive teaching. The school partnership model enabled the researcher to conduct Lesson Study with the schoolteachers and the pre-service teachers, which craft metacognitive teaching strategies and practical pedagogical knowledge to realize the intended learning objectives of the teacher education programme. While the metacognitive teaching strategies and skills identified from this study contribute to the implementation of the Learning to Learn 2.0+ curriculum and the curriculum for teacher education programmes in Hong Kong. It should be noted that the findings identified in this study from the schools in Hong Kong may not be totally applicable to other contexts due to cultural differences.

There are implications for researchers, educators and teachers of the Lesson Study communities. Students in the 21st Century need to be lifelong learners. In a world that changes with increasing rapidity and unpredictable, there are few things more important to impart to them than the ability to learn to learn. Teachers need to equip themselves with the metacognitive pedagogical knowledge and skills with their peers. They may start by giving explicit instruction to students, embed metacognitive elements in learning content, and most importantly encourage students to keep using metacognitive skills and strategies. The study involved school principals and teachers in the teacher-education programme to support the enactment of the school partnership model, such partnership model is an effective strategy for researching Lesson Study for crafting effective pedagogies for effective curriculum implementation. Further study should be conducted in schools to review how Lesson Study communities can be institutionalized in schools to enable teacher collaborations to craft metacognitive strategies to nurture students’ metacognitive learning behavior and pattern to help them become expert learners, well equipped to enter the world of 21st century.

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