

## How Lesson Study Develops Pre-service Teacher' Instructional Design Competency?

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### Abstract

*This paper aims to examine how Lesson Study of an initial teacher education course develops the instructional design competency of pre-service teachers in Hong Kong. Lesson Study is a collaborative action research approach for developing teacher professional competency. This study assesses the effectiveness of the Lesson Study course conducted in a teacher education institute that based on a quasi-experimental design. There were 341 pre-service teachers participated to a questionnaire survey. Confirmatory factor analysis and reliability test were used to confirm the constructed validity and reliability of the survey instrument. Canonical correlation was applied to explore the relationship between the approaches of their learning process and their learning outcomes. Results show that action research tutorials and collaborative practice are predictors of their instructional design skills and teaching competency. This paper discusses the critical success factors and the potential for using Lesson Study as a model to help pre-service teachers develop their teaching competency.*

**Keywords:** Lesson Study, Instructional design, Pre-service Teacher Education

### Introduction

Developing pre-service teachers' teaching competency has always been regarded as a critical element of initial teacher education programmes. Darling-Hammond (2006) mentions that the core dilemma in initial teacher education is the gap between theory and practice. How to bridge the gap between theory and practice has been an eternal problem in teacher education and the subject of investigation by numerous scholars in the field (Stigler & Hiebert, 1999; Brouwer & Korthagen, 2005; McIntyre, 2005; Christianakis, 2010). Unsurprisingly therefore, existing empirical studies focus on using different approaches to bridge that gap. For example, using action research in an undergraduate teacher education programme (Smith & Sela, 2005; Zambo & Zambo, 2006); applying a lesson study approach in an elementary science methods course for pre-service teachers (Marble, 2006) These models were applied with the aim of bridging the gap and enhancing the teaching competency of pre-service teachers.

Recent literature reveals a growing interest in exploring the potential of lesson study, an action research-based approach of teacher development in which teachers work together collaboratively to plan and reflect on their teaching through lesson cycles, and which can be used as a pedagogical approach to bridging the gap in initial teaching education programmes (Marble, 2006; Fernandez & Robinson, 2006; Davies & Dunnill, 2008). Educators attempted to find out if this approach could better support the learning of pre-service teachers in terms of connecting theory and practice, and establish an inquiry lens for examining teaching. In Hong Kong, the practice of Lesson Study was applied into a Bachelor of

Education programme of a teacher education institution. The Lesson Study course aims to enhance pre-service teachers' teaching competency by developing their instructional design skills. It provides a collaborative learning experience for pre-service teachers by a spiral learning activities including tutorials and try-out lessons. Pre-service teachers are expected to acquire the skills needed to implement Lesson Study as an action research method for improving teaching and learning by developing an understanding of how pupils learn and at the same time developing their own instructional design skills. With the purpose of providing teacher educators' insight into practical methods of promoting initial teacher education, this study explores the predictive effective of the action research tutorials and its collaborative practice on participants' instructional design skills and teaching competency by a quasi-experimental design from the participants' perspective. It is expected the course learning outcomes could be empirically identified and could also be predicted from the action research tutorials and collaborative practice.

### Literature Review

Teacher development should be viewed as an ongoing lifelong learning process as teachers strive to learn how to teach (Cochran-Smith & Lytle, 1999). Darling-Hammond (2006) has identified some distinctive features of initial teacher education programmes which enable pre-service teachers to confront the problems and challenges involved in teaching practice. These features include providing extended reflective and clinical experiences which are carefully developed to support the ideas and practices presented in simultaneous, closely interwoven coursework; using case study methods, teacher research, performance assessments and portfolio evaluation to apply learning to real problems of practices; and engaging in inquiries or research concerning teaching in the programme. Most of these features are related to the idea of action research or the lesson study approach to teaching. The use of action research or lesson study in teacher preparation could create strategies for equipping teachers with an inquiry lens and enhancing their professional competency.

Action research is a form of self-reflective enquiry undertaken by participants in educational situations in order to improve the rationality and justice of their own educational practices, their understanding of these practices and the situations in which the practices are carried out (Kemmis, 1988). The study of involving teachers in collaborative action research into their own practices can be traced back to John Elliott's (1976) research work. As part of the action research process, teachers are expected to learn cooperatively and become reflective practitioners (Schon, 1983) by practising theories postulated from others. Research shows that incorporating action research approaches into initial teacher education programmes could encourage critical reflection on their beliefs and conceptions about the role of teachers, teaching and learning, therefore educates reflective teachers to deal with the complexity of practice (Gore & Zeichner, 1991; Price, 2001; Cochran-Smith, 2004; Mills, 2007).

Action research helps pre-service teachers to improve their professional growth and teaching efficacy (Zambo & Zambo, 2006), and to develop skills of careful observation and reasoned analysis (Zeichner & Liston, 1987), but that adequate resources and supports need to be provided for the programme implementation. Some researchers felt that prospective teachers should be given appropriate support to undertake the research needed to acquire better learning skills to help them to develop an inquiry-oriented perspective on teaching (Clift, Veal, Johnson, & Holland, 1990; Cochran-Smith, 1991). Providing appropriate clinical support to pre-service teachers undertaking action research is an essential part of helping them to develop a perspective on teaching. Although action research has been shown to be effective as a means of enhancing teachers' professional development, its focus on improving educational practices (Kemmis, 1988) has been criticised as vague. The emerging lesson study approach was influenced by the book *The Teaching Gap* written by James Stigler and James Hiebert (1999). Lesson Study has adopted the mechanism of action research, but has shifted the focus to student learning (Wiburg & Brown, 2007).

Lesson Study can be defined as action research conducted by teachers, in which they work collaboratively to reflect on their lessons and improve their teaching. Lesson Study has a long history in Japan (Yoshida, 1999; Watanabe, 2002) and spread rapidly throughout the United States following the publication of *The Teaching Gap* (Stigler & Hiebert, 1999). Stigler and Hiebert (1999) examined in great detail a large number of eighth-grade mathematics lessons in the U.S., Japan, and Germany. They found that in most Japanese lessons, teachers were better equipped to cater for students' individual needs and to teach conceptual rather than procedural knowledge, compared to their U.S. counterparts. Their explanation for this difference was that while U.S. teachers work in isolation, all Japanese teachers have to engage in Lesson Study and meet regularly over a long period of time to work on one or more 'research lessons'. Their findings sparked interest in Lesson Study among U.S. teachers, researchers and educational policymakers. The lesson study model in Japan essentially consists of four steps: Plan-Do-Check-Action (PDCA) (Sarkar & Matoba, 2005), whereas in the United States it developed as a design-based action research cycle which works on repeated 'cycles of design, enactment, analysis, and redesign' of lesson study (Lewis et al, 2006). Recent years have seen a steady growth in lesson studies outside the United States in places such as Hong Kong, Singapore, Sweden, and Iran (Lewis, 2002; Fernandez, 2002; Lo, et al., 2005). More recently, some researchers have been interested in assessing the feasibility and effectiveness of introducing the lesson study approach in initial teacher education. Marble (2006) applies the lesson study approach to develop a critical lens through which pre-service teachers can view their practice. He reports that lesson study encourages practitioners to take a reflective and engaged approach to teaching, focus on student success in their classrooms and create knowledge for teaching.

## Research Questions

Lesson Study course appears to conceptualise an effective way of enhancing pre-service teachers' instructional design and teaching competency by helping them to gain clinical experience through a process that requires them to inquire, diagnose, observe and evaluate learning and teaching. How effective are the learning activities in achieving the learning outcomes? The effectiveness of the course can be evaluated by considering the following research question: What are the participants' perceptions of the theory based tutorial and collaborative practices on their instructional design and teaching competency in the Lesson Study course?

## Method

### Lesson Study Course

A teacher education institute in Hong Kong has offered the Lesson Study course to all Year 2 study of the BEd programmes. During the Lesson Study course, pre-service teachers were taught the theories and practice of Lesson Study in tutorials, and then worked collaboratively together in small subject groups to implement the Lesson Study project. The tutors plan the lesson with the participants throughout the process and give them guidance. Clinical supports were provided for the participants in the tutorial to select learning objective, formulate pre-test and post-test papers, analyse data from test papers, formulate lesson plans, conduct micro-teaching and evaluate lesson effectiveness.

### Learning Process

They have to take part in the Lesson Study groups, contributing to the planning and evaluation of the research lesson, as needed to implement the two research lessons. Each group works on the design of a lesson period and the teaching practicum takes the form of two cycles of teaching in schools conducted by two students chosen from their own groups. There are two rounds of teaching in each group. The lessons are observed by the group members, video-taped by their peer and taken back to the tutors for detailed analysis. They then continue with their study and complete the next cycle. They have chance to discuss issues relating to the design of their lesson plan and the effectiveness of their research lesson implementation. Obviously, action research approached tutorial and collaborative practices are the main feature of their learning process in the Lesson Study Course. Collaborative practices are deliberately embedded in to the PIE tutorials. Through this collaborative practice the pre-service teacher are provided an opportunity to share their knowledge, to learn from the others and product collective lesson planning and practices that enhance students learning.

## Learning Outcomes

Pre-service teachers of the Lesson Study course are expected to gain knowledge of instructional design experience. This study adopts ADDIE instructional design model to conceptualize instructional design as a multiple competencies that involves analysis, design, development, implementation, and evaluation of a lesson (Molenda, 2003; Strickland, 2006). The acronym ADDIE stands for the 5 phases contained in the model. These five phases are compatible with the delivery of the tutorials and the PIE of the Lesson Study course. Pre-service teachers' learning on instructional design is conceptualized by the knowledge and experiences they come across in the 5 phases of ADDIE model including analysis, design, development, implementation and evaluation. The learning outcomes include know how to analyse learner characteristics and task to be learned and identify learner entry skills; to design learning objectives and choose an instructional approach; to develop instructional or training materials; implement the lesson and deliver the instructional materials; and to evaluate the lesson plan and recommend the materials achieved the desired goals. The teaching experience that they had gained include determining the current state and needs of the learner, defining the end goal of instruction, and creating some instructional and learning strategies to facilitate teaching and learning. The learning outcomes in the Lesson Study are conceptualized lesson planning and teaching experience for instructional design of a research lesson.

## Research Design

The study explores the relationship between the learning processes and the learning outcomes of the Lesson Study course. A quasi-experimental research design was used in this study to evaluate the effectiveness of the Lesson Study course and to determine the relationship between their learning process and learning outcomes. The theoretical framework of the study is shown in Figure 1. The independent variables were the PIE tutorial and collaborative practice. The dependent variables were instructional design skills and teaching competency. A self-response quantitative questionnaire survey was prepared in order to obtain feedback from the all the students on the Lesson Study course. There were 341 pre-service teachers responded to the survey. Data was collected directly from them by means of the questionnaire.

## The Instrument

The questionnaire was based on four scales that were constructed to measure the variables. In order to develop valid items for these scales, the researcher conducted a content analysis of the Lesson Study course outlines. The learning process and the learning outcomes of the course 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 16 questions which were used to measure the independent and dependent variables (see Table 1). Participants were asked to answer questions on the effectiveness of the learning process and their learning outcomes from the Lesson Study course. 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).

## Data Analysis

Exploratory factor analysis was done separately for the two sets of variables by principal factor axis analysis to confirm the constructed validity of the instruments (see table 1). The study is interested 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 (PAF) analysis, which aims to reveal the underlying factors which produce the correlation or correlation among a set of indicators 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 for the factor solutions.

Canonical correlation analysis was applied to explore the correlation among a two sets of variables in the experimental context and analyse the latent variables that represent the two sets of variables. This study is interested in exploring how the planning-implementation-evaluation (PIE) tutorials and collaborative practice related to the instructional design skills and teaching competency. Canonical correlation coefficient that measures the strength of association between learning process and learning outcomes and the canonical variants that weight the sum of the variables in the analysis will be identified.

## Findings

The results of exploratory factor analysis, presented in Table 1, clearly suggest two two-factor structures for both independent and dependent variables that are both empirically feasible and theoretically acceptable. An eigenvalue greater than one was used to determine the appropriate number of factors for the factor analysis solution. Items were extracted with factor loadings greater than 0.624 across and within factors. The numbers of factor solutions extracted from a Promax rotation afforded the most meaningful interpretation theoretically. The process employed to identify and to label the factors that emerged was based on examining the derivation of the highest loading items on each of the factors. The reliability coefficients of the scales ranged from 0.850-0.922, which was

judged adequate for this study. The result of the factor analysis and reliability shows that the theoretical concepts of instructional design, teaching competency, PIE tutorial and collaborative practice are empirically constructed with constructed validity and reliability. The results of descriptive statistic show that the scale means of all the variables are higher than 4.7 within the 6 point-scale, this reflects that the participants tend to agree with all the items. The results of the canonical correlation analysis are presented in Table 2 and Figure 1. Two pairs of canonical variates were constructed. 49.547% variance was extracted from the set of learning process variables and 81.970% variance was extracted from its set of learning outcome variables (see table 2). The canonical correlation ( $\rho$ ) between the learning process and outcome is 0.801. These results reflect that both the learning process PIE tutorials and collaborative practices contribute significantly to the learning outcomes that include instructional design and teaching competency.

Table 1  
*Results of the Exploratory Factor Analysis and Reliability Test*

No of items	Factor 1	Factor 2
	PIE Tutorials	Collaborative Practice
Q1	0.919	
Q2	0.882	
Q3	0.840	
Q4	0.780	
Q5		0.882
Q6		0.858
Q7		0.832
Q8		0.742
Eigenvalue	5.077	1.308
Variance	63.409	16.344
Cronbach $\alpha$		
Coefficient	0.922	0.906
M	4.765	4.748
SD	0.73	0.73
No of items	Factor 3	Factor 4
	Teaching Competency	Instructional Design
Q13	0.849	
Q14	0.807	
Q15	0.792	
Q16	0.683	
Q9		0.825
Q10		0.803

Cont. Table 1

Q11		0.751
Q12		0.624
Eigenvalue	4.725	1.039
Variance	59.063	12.988
Cronbach $\alpha$	0.884	0.850
Coefficient		
M	4.785	4.725
SD	0.70	0.65

Table 2  
*Result of Canonical Correlation*

		Canonical Variable $\chi$	Canonical Variable $\eta$
Process Variables	PIE Tutorials	0.769	
	Collaborative Practice	0.330	
Outcome Variables	Lesson Planning		0.929
	Teaching Experience		0.881
Variance		49.547%	81.970%
Canonical Correlation	$\rho = 0.801$ ( $\rho^2 = 0.641$ )		

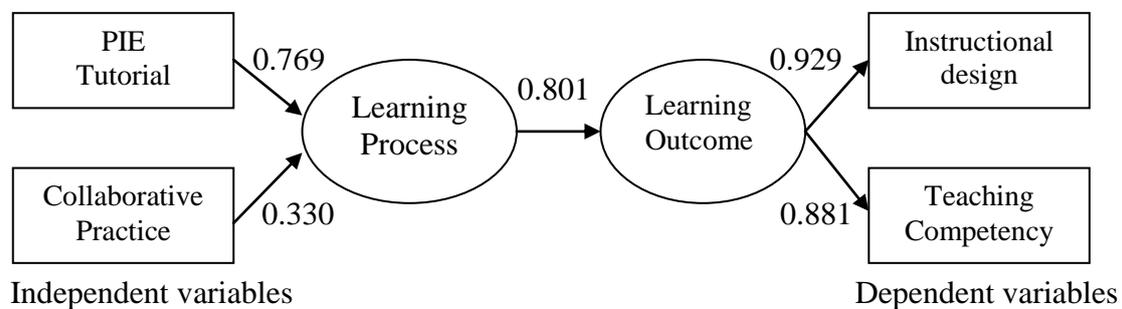


Figure 1. Path Diagram for Canonical Correlation Analysis

### Discussion

In answering the research question “what are the participants’ perceptions of the theory based tutorial and collaborative practices on their instructional design and teaching competency in the Lesson Study course?” The scale means of all the four variables are greater than 4.7, these results reflect that the participants have a positive perception to the learning process and outcomes. They tend to agree that the Lesson Study course has an effect in terms of helping them develop their instructional design and teaching competency effectively through delivery of the PIE tutorials and

try out the lesson collaboratively. This claim is further supported by the canonical correlation analysis, at which the latent variables of learning process and learning outcomes of the Lesson Study course are empirically constructed and there exists a significant relationships (0.801) between the them (see Figure 1). Pre-service teachers' instructional design skills and teaching competency could be enhanced by the PIE tutorials and collaborative practice. These findings are consisted with those of studies on action research conducted by Price, (2001), Cochran-Smith, (2004), Zambo and Zambo, (2006) and Mills, (2007), as well as studies on Lesson Study by Marble (2006), which indicate that action research or a Lesson Study approach can improve the learning of pre-service teachers. It is interesting to explore how PIE tutorials and collaborative practice contributes to their instructional design skills and teaching competency.

### **PIE Tutorials**

The Planning-Implementation-Evaluation tutorials are the main and critical learning activities of the Lesson Study course that help participants master the skills required for instructional design and improve their teaching competency. A systematic process of inquiry which involves planning, implementation and evaluating a research lesson is central to tutorials of the Lesson Study course. The process of ADDIE instructional design model is embedded in the PIE tutorials which provide opportunities for participants not only to learn the concepts of instructional design, but also to gain clinical experience through data analysis and teaching. The PIE tutorials touches on a variety of professional habits and intellectual activities that meet pre-service teachers' learning opportunity for collaboration, reflection, and observation of teaching within the context of specific classroom and student needs, helping to nurture the teaching competency of the participants.

The planning stage includes the process of choosing the topic, defining the learning objectives. The steps involve collecting teachers' and students' conceptual understanding toward the learning objectives. The ideas obtained will help the pre-service teachers identify the learner needs for instructional designing. The planning stage of the Lesson Study course allows participants to select suitable approaches and teaching strategies for lesson planning. It is similar to the function of the analysis, design, development phases of the ADDIE instructional design model.

After the planning stage, the research lesson is then co-taught by two pre-service teachers in same group, and their teaching will be observed by peers in the same group. The lesson is videotaped for detailed analysis later. A post-lesson conference is conducted right after the lesson. They could reflect on the lesson itself and share their views and give suggestions on how to improve the lesson. Then another two pre-service teachers co-teach the revised lesson to another class. Again the lesson will be video-taped and thoroughly discussed and the plan revised. This process is repeated until all the pre-service teachers have taught the lesson to their

respective classes. The lesson implementation for the research lesson is central to the work of Lesson Study; it takes learning beyond talk about practice and into the realm of learning by doing. Engaging in the research lesson of Lesson study and then come together to share their opinion enable the group members to learn from one another's inquiry. This also reflects that teaching practices make a difference. Teaching practices could provoke a higher order reflection of the teachers who implemented the lesson plan.

The evaluation stage, which involves powerful reflective practices of the teachers, occurs simultaneously with the implementation stage. Reflective evaluation on the research lesson is done throughout the process involving data triangulation among the test scores, student interview data and teaching enactment from the video clip. The teaching enactment is the analysis and interpretation obtained from the triangulation of the video records and the data from pre-lesson tests and post-lesson test. Participants are provided with the video record of the research lessons in the different cycles and the test scores that reflected student learning outcomes. By triangulating the way the teachers taught and the performance of the students, the teachers may come up with suggestions as to what can be done to further improve the lesson, revise the lesson design and implement it again. After completing the process of inquiry, the pre-service teachers are required to reflect on what they have learnt through the Lesson Study, and externalize personal knowledge in the presentations by codifying tacit knowledge to explicit knowledge (Nonaka & Takeuchi, 1995). Then, the whole experience is written up and a presentation prepared, including video clips of the research lessons. This PIE tutorial approach could definitely enhance the instructional design and teaching competency of pre-service teacher.

### **Collaborative Practice**

Lesson Study offers the potential for pre-service teachers to intellectually engage what brought them into the learning through collaborative works. Pre-service teachers learn collaboratively with each other and they have equal status in knowledge sharing. They created a team to share a teaching topic, a set of problems on student learning difficulties and a passion about the topic, and deepen their knowledge and expertise in teaching. The collaborative practice did not merely support communications and interactions between teachers; it also transformed knowledge into tangible, sharable, durable and transferable resources. As a collective, participates create knowledge such as learning objectives and learning activities in the lesson plan and teaching aids. If the goal of learning is based on a growth and practice standpoint, assisting pre-service teachers to develop their teaching competence that enables them to improve their practice, then the interaction function of the collaborative practice is essential. Regarding the relationship between collaborative practice and learning, there is a need to link teacher learning with the practice of teaching. Lesson study supports the development of a

collaborative practice because of its connectedness to their social learning. If the collaborative practice is removed from the Lesson Study, their learning will be less effective.

As a collaborative action research, Lesson Study provides pre-service teachers with the opportunity to learn from evaluating what they have planned and done, by reflecting on the discrepancy between the intended and enacted learning objectives, as well as by examining the relationship between enacted learning objectives with what the students have actually learned. They had a successful experience in internalizing the theory via teaching practice. Through the lesson implementation, explicit knowledge is being internalized and become implicit knowledge and reconstructed through reflection and become personal knowledge (Kolb, 1984), in which, they teaching competency are enhanced.

### Conclusion

This study presents findings on the evaluation of implementation of a Lesson Study course in initial teacher education at a teacher education institute in Hong Kong. It describes how PIE tutorials and collaborative practice for initial teacher training operates, and how this approach nurtures their instructional design skills and teaching competency. The Lesson Study course has provided pre-service teachers with the necessary professional development skills. Teacher competency can be enhanced by using Lesson Study to organise initial teacher programmes. This study provides suggestions on the use of collaborative action research approach as a guiding principle for conducting the Lesson Study course. If pre-service teachers are denied the opportunity for involvement in collaborative action research approach for tryout a lesson, the framework for organising their learning will only be of limited relevance. There is an innovative aspect to the study, given the limited use of the collaborative action research approach in initial teacher education, particularly in Hong Kong.

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