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Examining the relationships between professional learning community, teacher self-efficacy and experiential learning in Japan

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Abstract

This study investigated the relationships between professional learning communities (PLCs), teacher self-efficacy, and experiential learning. A conceptual model that connects PLC components, including shared vision, interactive reflection, and collegiality, to teacher self-efficacy was proposed, as mediated by experiential learning. The data comprised 3604 teachers from 204 primary schools and 787 teachers from 90 lower secondary schools in Japan. First, a multi-group confirmatory factor analysis confirmed that the same constructs of PLC, teacher self-efficacy and experiential learning were measured at different school levels. Second, a multi-group structural equation modelling revealed that some PLC components were related to teacher self-efficacy at different school levels. Moreover, experiential learning mediated the relationship between some PLC components and teacher self-efficacy at different school levels. The theoretical and practical implications are discussed based on the results of the study.

Keywords**:** professional learning community, teacher self-efficacy, experiential learning

Introduction

A growing body of research has recognised the importance of professional learning communities (PLCs), given that schools are surrounded by complex environments wherein teachers need to learn the knowledge and skills required for collective endeavours (Harris & Muijs, 2005; Louis et al., 2010; Stoll & Louis, 2007; Vangrieken et al., 2017; Zheng et al., 2019). According to Stoll et al. (2006, p. 223), PLCs refer to "a group of people sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way". Since PLCs are school-wide learning endeavours that encourage teachers' professional development, much attention has been paid to how PLCs as collective phenomena relate to teachers' personal development (Zhang et al., 2020). In Japan, the importance of school-wide learning endeavours has been recently emphasised (Tsuyuguchi, 2013). Japanese teachers historically have developed their knowledge and skills for instruction and classroom management through peer-learning activities, for example, lesson study (LS), comprising the foundation of PLCs (Chichibu & Kihara, 2013; Schipper, et al., 2018; Tsuyuguchi, 2013). However, peer-learning activities do not necessarily include the idea of school-wide endeavours, which PLCs emphasise (Chichibu & Kihara, 2013). To integrate each peer-learning activity into a school-wide learning endeavour, the government recently encouraged schools to come up with new ways to approach teachers' learning by introducing an idea, "School as a team", in 2015 (Ministry of Education, Culture, Sports, Science and Technology [MEXT], 2016a).

Researchers previously have demonstrated that teachers' participation in PLCs contributes to personal development of teachers (Louis et al., 1996; Vanblaere & Devos, 2016), thereby leading to enhanced learning among students (Lomos et al., 2011). The present study focusses on teacher self-efficacy as an outcome of PLCs because it has been examined as a crucial indicator of school effectiveness and improvement (Klassen & Tze, 2014; Tschannen-Moran et al., 1998; Zheng et al.,

2019). Previous studies have demonstrated that teachers' participation in PLCs is likely to improve their professional practice, thereby enhancing their self-efficacy (Ross & Bruce, 2007; Zheng et al., 2019).

PLCs are collective phenomena that play a key role in changing teachers' individual learning experiences (Kakoi, 2017; Vanblaere & Devos, 2016). Experiential learning represents an individual learning process in which information is generated by transforming experience (Kolb, 1984); it also occurs in PLCs. Teachers reflect on their experiences in PLCs and internalise them as learning opportunities, thereby enhancing their self-efficacy (Chong & Kong, 2012; Schipper, et al., 2018). Experiential learning appears to bridge a gap between PLCs as collective phenomena and individual learning. Researchers have explained the potential relationship between experiential learning and self-efficacy, stating that teachers' appraisals of their past experiences create new information that develops their self-efficacy (Morris et al., 2017). Thus, experiential learning could mediate the relationship between PLCs and teacher self-efficacy.

Three issues in the extant research stream should be spotlighted. First, the idea that PLCs contribute to teachers' development originated in the West and relies highly on data collected from Western countries (Zheng et al., 2019). The situation is different in non-Western contexts (Markus & Kitayama, 1991), particularly in Japan's local context, wherein teachers currently are encouraged to be involved actively in PLCs. Although PLCs arguably encourage teachers' experiential learning, existing studies have not elucidated how PLCs, as collective endeavours, relate to teachers' personal learning to create a quality experience. Moreover, PLCs have been investigated separately in relation to teachers' learning at different school levels (Voelkel & Chrispeels, 2017; Zheng et al., 2019; Zonoubi et al., 2017). Teachers' learning in PLCs may vary among school levels because of differences in teachers' expertise. For example, Japanese primary school teachers are mainly classroom teachers who are in charge of almost all subjects, while those in lower secondary school are mainly subject teachers who teach one

subject. Thus, how PLCs relate to teachers' experiential learning should be examined at different school levels in local contexts (Lomos et al., 2011; Vanblaere & Devos, 2016).

Second, although many researchers agree that mastery experience is the strongest source of teacher self-efficacy (Bandura, 1997; Klassen et al., 2011; Morris et al., 2017), previous studies tend to focus on the amount of teaching experience needed to gain mastery experience (Morris et al., 2017). Experiential learning – which includes learning from past experience, reflecting on it and creating new classroom practice – is suggested to induce higher teacher self-efficacy (Girvan et al., 2016; Lee et al., 2013). Thus, the relationship between experiential learning and teacher self-efficacy should be examined. Third, what is less clear is the relationships between PLCs as collective phenomena and experiential learning and teacher self-efficacy as individual phenomena. Considering that teachers' personal learning experiences vary within PLCs (Stoll et al., 2006), experiential learning that encourages personal reflection and the practical application of past experience should be more explored in relation to PLCs as collective phenomena and the development of teacher self-efficacy. Although previous studies have demonstrated the relationships between PLCs and teacher self-efficacy (Zhang et al., 2020; Zheng et al., 2019), no detailed investigation of experiential learning as a mediator between PLCs and teacher self-efficacy has been conducted. Thus, the relationships between PLCs and teacher self-efficacy, as mediated by experiential learning, should be investigated.

To fill the aforementioned research gap, this study aims to examine the relationships between PLCs, teacher self-efficacy and experiential learning as factual collective and individual phenomena at different school levels to help measure and understand PLCs' outcomes and how they are linked to one another in local contexts.

PLCs and their components in Japan

The process of defining the concept of PLCs has proven to be complex (Lomos et al., 2011), as no

consensus on a definition exists yet. According to Zhang et al. (2020), studies on PLCs are derived from two theoretical strains. One is Senge's (1990) theory on learning organisation, which views PLCs as school-wide phenomena and includes leadership aspects as basic PLC components. The other is rooted in Wenger's (1998) contention that PLCs are communities of practice. The latter idea emphasises social engagement and interaction, in which teachers exchange knowledge, views and advice, as well as help each other learn and improve. Given the notion's overall fuzziness (Vanblaere & Devos, 2016), this study takes the latter approach, applying a more constrained strategy to optimise concept clarity.

The educational context impacts practice and development of PLCs (Stoll et al., 2006). Tsuyuguchi (2013) contends that three aspects of PLCs fit the Japanese context and have been used commonly in previous international studies: shared vision; interactive reflection; and collegiality. First, having a shared vision and a sense of purpose is crucial for PLCs (Stoll et al., 2006; Vangrieken et al., 2017). School staff commit to the school's mission and the principles underlying everyday practice in PLCs (Louis et al., 1996). A shared vision in Japanese schools is based on each school's education goal statements, which represent the school's educational value and characterise the school. Researchers have pointed out that while PLCs in other countries tend to focus on student learning, education goal statements in Japanese PLCs emphasise students' holistic development, including their cognitive, emotional and physical development (Fukuhata et al., 2017). In particular, the emphasis on holistic development is stronger in primary schools (Mimizuka, 2003).

Second, PLCs are characterised by interactive reflection that comprises reflective dialogues and deprivatisation through formal practices, for example, team teaching, mutual classroom observation and collaborative planning (Bryk et al., 1999; Vanblaere & Devos, 2016). While discussing education issues, for example, curriculum development and instructional design for students' development, teachers openly share and reflect on their practices and develop them (Louis et al., 1996). In Japan, interactive reflection occurs during in-house peer-learning trainings, for example, LS, mentoring and team teaching.

Most primary and lower-secondary schools in Japan have a school-wide research theme and formally conduct in-house peer-learning trainings (*konaikensyuu*) (Chichibu & Kihara, 2013). The most typical activity from in-house peer-learning trainings is LS. Japanese schools historically have conducted LSs wherein teachers open up about their practices and provide feedback to one another (Chichibu & Kihara, 2013). LSs usually are implemented across subject areas in primary schools and within subject areas in lower secondary schools (Kitada, 2019). Compared with other school levels, LSs are conducted more actively in primary schools (Chichibu & Kihara, 2013). However, researchers have warned that these in-house trainings have been reduced to a mere formality when they are forced to implement them (Shintani, 2014; Takatani & Yamauchi, 2019). Moreover, teachers in Japan might feel like they are being judged during in-house trainings, leading to them hesitating to provide critical comments if they do not know what to answer fully (Ahn, 2016; Maeda & Asada, 2020). Thus, teachers' active participation in PLCs would be more effective than simply implementing in-house trainings (Shintani, 2014).

Third, collegiality represents teachers' interdependence because better teaching practices are realised through informal relationships (Stoll et al., 2006). Teachers sharing information and their mutual support foster and change their teaching practices and competencies through reciprocal learning processes (Stoll et al., 2006; Vanblaere & Devos, 2016). A much-debated question is whether Japanese teachers' collegiality helps cultivate their development (Kurebayashi, 2007). Some researchers have criticised Japanese collegiality for overemphasising a harmonious orientation that deprives teachers of opportunities to develop their individual expertise (Kurebayashi, 2007). However, collegiality based on informal and open relationships is crucial for teachers' learning because it can create a psychologically safe environment in which teachers can develop without fearing failure (Tanaka, 2020). Thus, Japanese teachers collectively engage in peer learning within a culture of collaborative development without being forced to implement it (Chichibu & Kihara, 2013).

Teacher self-efficacy

In social cognitive theory (Bandura, 1997), teachers are viewed as active agents who affect and are affected by the context. Bandura (1997, p. 5) described this process as "triadic reciprocal causation", comprising dynamic interactions between internal personal factors (e.g., self-efficacy), behaviours (e.g., teaching practices) and the external environment (e.g., school context). Triadic reciprocal causation stresses that human agency is fundamentally psychosocial and context-dependent (Bandura, 2001). Self-efficacy, an internal personal factor in reciprocal causation, plays an important role because it affects adaptation and induces structural changes through its effect on other factors (Bandura, 2001).

The term *self-efficacy* has been used in the literature to refer to "beliefs in one's capabilities to organise and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). Tschannen-Moran et al. (1998) argued that teachers generally hold certain beliefs about what they can accomplish. In particular, their beliefs in their capabilities to facilitate students' educational outcomes collectively are called "teacher self-efficacy" (Skaalvik & Skaalvik, 2007; Tschannen-Moran & Hoy, 2001), which is imperative for teachers' behaviours (e.g., the use of new instructional approaches and efforts to achieve higher targets), affects (e.g., stress, burnout and turnover) and student activity, self-efficacy and academic outcomes (Klassen & Tze, 2014; Ross & Bruce, 2007; Skaalvik & Skaalvik, 2007).

Given that several studies have indicated the importance of teacher self-efficacy in the teaching profession, researchers have been demonstrating increased interest in developing teacher self-efficacy (Klassen et al., 2011). For example, Bandura (1997) indicated that four sources might strengthen or weaken self-efficacy beliefs: a) mastery experience; b) vicarious experience; c) verbal and social persuasion; and d) psychological and affective states. Mastery experience refers to a person's perception of successful or unsuccessful performance and is identified as the strongest among the four sources of self-efficacy (Tschannen-Moran & Hoy, 2007; Usher & Pajares, 2008).

Although other sources might exist apart from Bandura's (1997), extant studies on their impacts remain limited regarding Japanese and Finnish teachers' self-efficacy and its sources (Yada et al., 2019). These studies found that the four sources explained only 15% of Japanese teachers' self-efficacy variance and 54% of Finnish teachers' self-efficacy. These results indicate that other sources are associated with teachers' self-efficacy, particularly in the Japanese context. Although Bandura (1997) suggested that one's behaviour, external environment and internal personal factors are influential reciprocally, studies on other sources related to teacher self-efficacy are surprisingly scant.

Relationship between PLCs and teacher self-efficacy

Although extant studies have indicated that teachers' participation in PLCs may improve their classroom teaching, only a few have examined the relationship between PLCs and teacher self-efficacy thoroughly (Kennedy & Smith, 2013; Zhang et al., 2020; Zheng et al., 2019). For example, an intervention study found that language teachers' self-efficacy improved when they were involved in PLC practices (Zonoubi et al., 2017). Moreover, teacher self-efficacy in science teaching has been found to increase after a three-year professional development programme that was designed as PLCs (Lakshmanan et al., 2011). Thus, teachers can increase their self-efficacy through PLCs because they can share their experiences with colleagues, ask questions about effective teaching and receive reflective feedback from them (Zonoubi et al., 2017).

In considering the four sources of self-efficacy that Bandura suggested (1997), teachers' participation in PLCs may help develop teacher self-efficacy. When teachers need to improve their teaching knowledge and strategies, collaborative reflections through mutual observations and team teaching provide opportunities for vicarious experience and social persuasion (Zonoubi et al., 2017). Based on these experiences, teachers can deepen their own understanding of their teaching contexts and adapt others' teaching strategies to their practices, thereby gaining mastery experience (Zonoubi et al.,

2017). Concerning psychological and affective states, facing new teaching knowledge and strategies may arouse teachers' interest and curiosity. Related to this, PLCs provide opportunities for teachers to try out new endeavours with encouragement and assistance from their colleagues, thereby reducing their fear of trying these new activities (Tschannen-Moran & McMaster, 2009).

Although researchers agree that PLCs are related positively to teachers' practices and learning (Vanblaere & Devos, 2016), findings on PLCs' effects on teacher self-efficacy remain inconsistent. For example, Kennedy and Smith (2013) found that teachers' collective reflective practice predicts teacher self-efficacy. However, Zheng et al. (2019) found that some PLC elements – including collaborative activities, a collective focus on student learning, deprivatisation of practices and reflective dialogues – significantly affected teachers' self-efficacy, whereas a shared sense of purpose did not. Therefore, the present study seeks to examine the respective relationships between several PLC elements and teacher self-efficacy.

Experiential learning as a mediator between PLCs and teacher self-efficacy

Teachers' professional development to improve students' learning is a continuous and systematic process – one not achieved overnight (Stoll & Louis, 2007). Thus, PLCs promote teachers' personal reflections and provide them with feedback from their colleagues regarding their educational endeavours. However, some researchers have warned that PLCs may turn into add-on teams that do not enhance actual teaching and learning quality if great emphasis is placed on ideological and legislative aspects, and if teachers' learning becomes mandated (Hargreaves, 2007). Therefore, more research is needed to investigate how PLCs as a school-wide developmental endeavour relate to teachers' personal professional development (Zhang et al., 2020).

As mentioned above, mastery experience is the most fundamental and strongest source of self-efficacy; thus, many researchers have studied this topic. In previous studies, mere exposure to or the

amount of teaching experience was used to measure mastery experience (Morris et al., 2017). However, Morris et al. (2017) argued that research should focus instead on how teachers personally experience particular events, rather than mere quantity. Thus, this study utilises experiential learning that creates a kind of quality experience as an antecedent of teacher self-efficacy. *Experiential learning* refers to "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). Kolb (1984) argued that the process of experiential learning differs from traditional learning theories, which assert that learning is a behavioural or cognitive outcome. Experiential learning emphasises a holistic learning process that includes feeling, observing, thinking and interacting with others and the environment. Given that learners challenge old ideas and perspectives, relate to and integrate them, and create new knowledge in the process, learning occurs through concrete experiences and critical reflections on these experiences (Zuber-Skerritt, 2002). Kolb (1984) described experiential learning further as a continuous cycle of four learning modes: concrete experience; reflective observation; abstract conceptualisation; and active experimentation. Furthermore, he opined that concrete experience entails learners engaging actively in a task. Considering that learners grasp new experiences or interpret previous ones in new ways through concrete experience, it becomes a foundation for observation and personal reflection, which are assimilated as abstract concepts that generate new implications and hypotheses, thereby leading to new efforts. In this sense, personal reflection as an individual action is different from collective reflection occurring as a school's endeavour in PLCs. Experiential learning also provides immediate problem-solving opportunities that allow teachers to enhance their personal understanding of what they have learnt in the community, rather than mere experiences (Girvan et al., 2016).

Teachers' appraisals of their experiences are crucial to improving their self-efficacy (Morris et al., 2017). However, the relationship between experiential learning and teacher self-efficacy remains underexamined. For example, in teacher development contexts, researchers have noticed that the actual

experience of teaching, personal reflection and testing a new practice are critical to enhancing teachers' beliefs in their capabilities (Girvan et al., 2016; Lee et al., 2013). Furthermore, in a multilevel study in Japan, Tsuyuguchi (2013) found that PLCs were not related to teachers' lesson ability at the school level, while the perception of PLCs at the individual level was related to their ability. Thus, we propose that teachers who actively participate in PLCs develop experiential learning, thereby leading to greater teacher self-efficacy.

Research questions

In this study, we posited that participating in PLC learning opportunities helps teachers improve their self-efficacy. Furthermore, experiential learning likely is enhanced from participating in PLCs that allow for actively learning through reflection and mutual feedback. In this way, teachers' self-efficacy is enhanced as they interpret, understand and define their experiences well. Figure 1 presents the conceptual model. Moreover, researchers have demonstrated differences between primary and lower secondary schools in Japanese PLC practices (Chichibu & Kihara, 2013). Thus, PLCs' effect on teachers' self-efficacy and experiential learning may be different between primary and lower secondary schools. Based on these notions, the following research questions were formulated in this study:

Research Question 1: How are PLCs related to teachers' experiential learning in primary and lower secondary schools?

Research Question 2: How is experiential learning related to teacher self-efficacy among teachers in primary and lower secondary schools?

Research Question 3: Does experiential learning mediate the relationship between PLCs and teacher self-efficacy in primary and lower secondary schools?

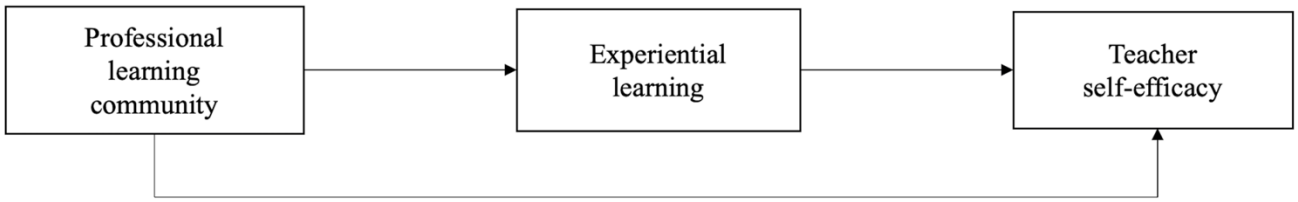

Figure 1. Conceptual model

Method

Procedures and participants

The survey was conducted on primary and lower secondary school teachers in Tokyo, Japan, in November 2017 using a convenience sampling method. In 2017, 32,410 primary school teachers and 15,110 lower secondary school teachers were working in Tokyo (Tokyo Metropolitan Government, 2019). First, the research team invited all public primary and lower secondary schools in Tokyo to participate in the survey, and the questionnaires were distributed to schools that agreed to participate. A faculty member at each participating school was asked to coordinate distribution of the questionnaires. Each teacher filled out the questionnaire with a pencil, placed it in an envelope to avoid others reading it and handed it to the coordinator, who then mailed the envelopes to the research team. Following the ethical code for Japanese research institutions (Science Council of Japan, 2013), we explained the survey's intention, the analytical process, voluntary participation in the survey and ethical considerations, including guaranteed anonymisation, at the beginning of the survey.

Altogether, data were collected from 3,165 teachers at 204 primary schools and 685 teachers in 90 lower secondary schools. The average experience of these teachers was 12.32 (SD = 10.15) years in primary schools and 15.32 (SD = 12.27) years in lower secondary schools. These numbers are broadly indicative of Japan's teacher population (MEXT, 2016b).

Instruments

The professional learning community was measured using 11 items (α = .88), which were developed originally by Tsuyuguchi's (2013) scale that consists of 19 items based on previous studies (Bryk et al., 1999; Louis et al., 1996). The scale comprises three sub-scales: shared vision (α = .87); interactive reflection (α = .85); and collegiality (α = .74). To keep the questionnaire as brief and as direct as possible, we selected 11 items based on the high factor loading items in the study (Items 1, 2, 4, 5, 6, 10, 11, 12, 14, 16 and 17) (Tsuyuguchi, 2013). The participants answered on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated that participants perceived they participated more often in PLCs.

Experiential learning was measured using four items (α = .84) adapted from Kimura et al. (2011) with a 16-item scale based on Kolb's (1984) theory about four dimensions of experiential learning: concrete experience; reflective observation; abstract conceptualisation; and active experimentation. In this study, we selected the highest-loading items from each dimension (Items 1, 6, 12 and 15) in the study of Kimura et al. (2011) to measure experiential learning to keep the questionnaire as brief and as pertinent as possible. Then, the participants answered on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated that participants perceived that they engaged in experiential learning more often.

Teacher self-efficacy was measured using 12 items (α = .92) adapted from the teachers' sense of efficacy scale (TSES), developed by Tschannen-Moran and Hoy (2001). The scale comprises three sub-scales: instruction (α = .84); classroom management (α = .88); and student engagement (α = .83). Considering that the original was a nine-point Likert scale in English, a Japanese version translated by Yada et al. (2019) was used. The participants answered on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) to be consistent with the other scales. Higher scores represented higher teacher self-efficacy among the participants.

The item descriptions of the scales and the items' means and standard deviations are presented in Table 1.

Table 1.

Item Descriptions, Mean, and Standard Deviation of the Items

ID	Items	*M*	*SD*
Professional Learning Communities (PLC)			
PLC1	Faculty members understand the need for instructional improvement	3.94	.83
PLC2	Faculty members share a common mission to be accomplished in their schools	3.78	.81
PLC3	Faculty members set high standards for themselves	3.56	.83
PLC4	Faculty members have a vision that they strive to achieve	3.29	.89
PLC5	Faculty members understand how to improve student achievement	3.50	.80
PLC6	Faculty members customarily observe other teachers' classes and exchange opinions	3.12	1.05
PLC7	Faculty members have the habit of opening their own classes with other teachers	3.01	1.08
PLC8	Faculty members get effective feedback from other teachers on their own classes	3.10	1.06
PLC9	Faculty members discuss classes and teaching practices with colleagues	3.56	1.03
PLC10	Faculty members have conversations with colleagues about classroom management issues	4.03	.84
PLC11	Faculty members discuss with colleagues how to support students with special needs	4.30	.76
Experiential learning (EL)			
EL1	Try new things without fear of failure or difficulty	3.79	.84
EL2	Recapture experiences from multiple perspectives	3.88	.75
EL3	Find common rules from the experiences to create your own way of working	3.86	.73
EL4	Verify whether your way of doing things is the right way or not in the actual implementation, and apply it flexibly	3.91	.72
Teacher self-efficacy (TSE)			
TSE1	I can use a variety of assessment methods in the classroom	3.54	.83
TSE2	I can provide alternative explanations and examples when my students are confused	4.01	.70
TSE3	I can craft good questions for my students	3.82	.75
TSE4	I can prepare and implement multiple teaching methods in my class	3.51	.85
TSE5	I can control disturbances and other problems in the classroom	3.60	.83
TSE6	I can make sure that students follow the rules of the classroom	3.88	.76
TSE7	I can calm down disruptive or noisy students in the classroom	3.62	.81
TSE8	I can establish classroom and subject management for all types of classroom groups	3.23	.93
TSE9	I can get students to have a positive attitude that they can do it	3.78	.74
TSE10	I can help students value learning	3.58	.74
TSE11	I can motivate students who show low interest in learning	3.44	.78

TSE12	I can provide appropriate support for home learning.	3.27	.84

Note: The items are translated into English from the ones in Japanese that was used for this study. The English version was not validated.

Data analysis

All the data were analysed using SPSS software (Version 27) and Mplus (Version 7.0) (Muthén & Muthén, 2012). The maximum likelihood parameter estimates with standard errors and a chi-square test statistic (MLR function in Mplus) were utilised.

Before the main analyses, we calculated the intra-class correlation coefficient (ICC) value of the variables because participants were nested within schools. Using ICCs, the proportion of variance in a school unit was calculated, and the results indicated the following ICC values: PLCs, .09; experiential learning, .01; and teacher self-efficacy, .02. According to James (1982), ICC ranges from .00 to .50, with a median of .12. Considering that all the ICC values were lower than the median or recommended ICC values in the literature (e.g., Liao & Chuang, 2004), we concluded that the variables did not indicate an adequate degree of agreement across participants, which justified treating the data at the individual level.

The number of missing values was 1.04% for primary schools and 1.83% for lower secondary schools. Missing at random (MAR) assumption was applied, which enabled us to use full information without imputing alternative numbers for the missing data. A likelihood ratio test is probably sensitive to a large sample size (MacCallum et al., 2006); therefore, the model fit was assessed using a two-index strategy (Hu & Bentler, 1999), in which where the root mean square error of approximation (RMSEA) close to .06, and the standardised root mean squared residual (SRMR) close to .08 indicate a good model fit. Moreover, a cut-off value of .95 for the comparative fit index (CFI) also was checked for reference.

The data analysis comprised two main stages. First, measurement invariance between primary and lower secondary school teacher data for the three scales was tested using multi-group confirmatory factor analysis (MGCFA). Testing measurement invariance across groups enables researchers to assess whether the same constructs are measured in different groups (Dimitrov, 2010), which is a prerequisite

for meaningful comparison. First, to test for configural invariance, a theoretically driven, freely estimated model was examined for both groups (Model 1 in Table 2). Second, factor loadings were set to equal across groups (Model 2), and the model was compared with a less-constrained model (Model 1) to test metric invariance. Third, factor loadings and intercepts were set to equal across groups (Model 3), and the model was compared with Model 2 to test scalar invariance. The existence of a high-order factor was assumed when the first-order factors were highly correlated (Chen et al., 2005). The second-order factor model for the teacher self-efficacy measure seemed suitable because the aforementioned condition was met in our sample. Thus, configural invariance and metric invariance for the second-order factor models were tested between the groups (Models 4 and 5). To evaluate for invariance between the constrained and less-constrained models, changes in RMSEA (ΔRMSEA) were checked. It is assumed that if a change in RMSEA is less than .015, model invariance is confirmed (Chen, 2007).

During the second stage, a predictive model that examined the relationship between the five factors was conducted for each group. PLCs comprise three factors: shared vision; interactive reflection; and collegiality. The other two factors were experiential learning and teacher self-efficacy. Predictive paths were added to the second-order factor model to determine whether a relationship existed between each factor. Furthermore, mediation analysis (Sobel, 1982) was performed to test the indirect effects of the three PLC factors on teacher self-efficacy via experiential learning. The mediation analysis enabled us to examine whether the three factors of PLCs were related to changes in experiential learning, which are associated with teacher self-efficacy.

Results

Testing Measurement Invariance

First, the theoretically driven CFA was conducted for each group separately, in which all the factor

loadings with first-order factors were found to be statistically significant. Next, MGCFA was conducted to test measurement invariance between the teachers from the primary and lower secondary levels. The configural invariance model (Model 1 in Table 2), with no constraints, was examined first. The model had a sufficient fit (RMSEA = .052, SRMR = .042, CFI =.943); thus, configural invariance was supported. The metric invariance model (Model 2), in which factor loadings were set to be equal across the groups, was tested next, and the model had an adequate fit (RMSEA = .051, SRMR = .043, CFI = .943). The changes in RMSEA were .001, indicating that this additional constraint did not cause a significant difference between the two models; therefore, metric invariance was supported. Model 3 also had an adequate fit (RMSEA = .053, SRMR = .047, CFI = .938) when factor loadings and intercepts were set equally across the groups to test scalar invariance. No significant difference was found between Models 2 and 3 (ΔRMSEA = .002), providing support for scalar invariance. Moreover, the second-factor model for teacher self-efficacy was tested. Both the configural invariance model (Model 4) and metric invariance model (Model 5) for the second-order factor structure had acceptable fits (RMSEA = .052, SRMR = .047, CFI = .938; RMSEA = .052, SRMR = .047, CFI = .938, respectively). Considering that the changes in RMSEA for both models were not significant, metric invariance for the second-order factor model was supported.

Table 2.

Test of Measurement Invariance for the Multi-group Measurement Model

Model	Explanation	Overall Fit Indices						Comparative Fit Indices	Model Comparison
		χ^2	df	*P*	RMSEA	SRMR	CFI	|ΔRMSEA|	
1	Freely estimated	3785.484	606	< .001	0.052	0.042	0.943	–	–
2	Factor loadings equal	3810.108	626	< .001	0.051	0.043	0.943	0.001	1 vs. 2
3	Factor loadings and intercepts equal	4118.573	653	< .001	0.053	0.047	0.938	0.002	2 vs. 3
4	Factor loadings and intercepts equal for TSE first-order factors Freely estimated for TSE second-order factor	4149.544	666	< .001	0.052	0.047	0.938	0.001	3 vs. 4
5	Factor loadings and intercepts equal for TSE first-order factors Factor loadings equal for TSE second-order factor	4150.527	668	< .001	0.052	0.047	0.938	0.000	4 vs. 5

Note: TSE = Teacher self-efficacy; RMSEA = Root mean square error of approximation; SRMR = Standardised root mean squared residual; CFI = Comparative fit index.

Testing the predictive model

Next, a predictive model in which three PLC factors and one experiential learning factor explained the second-order factor of teacher self-efficacy was built using multigroup structural equation modelling (MGSEM). The MGSEM model indicated a sufficient fit (RMSEA = .052, SRMR = .047, CFI = .938).

In the primary teacher sample (Figure 2), interactive reflection was found to have a positive, significant relationship with teacher self-efficacy; however, the paths from a shared vision to experiential learning and teacher self-efficacy were not statistically significant. No direct relationship was found between collegiality and teacher self-efficacy. Regarding experiential learning, interactive reflection and collegiality were found to have a positive, significant relationship with experiential learning. Moreover, experiential learning was found to have a positive, significant relationship with teacher self-efficacy.

Following the lower secondary teacher data (Figure 3), the results indicated that interactive reflection was related positively and significantly to teacher self-efficacy. However, shared vision and collegiality were found to have no significant relationship with teacher self-efficacy. Regarding experiential learning, only collegiality was found to have a positive, significant relationship with experiential learning. Like the primary teacher sample, experiential learning and teacher self-efficacy were found to have a positive, significant relationship.

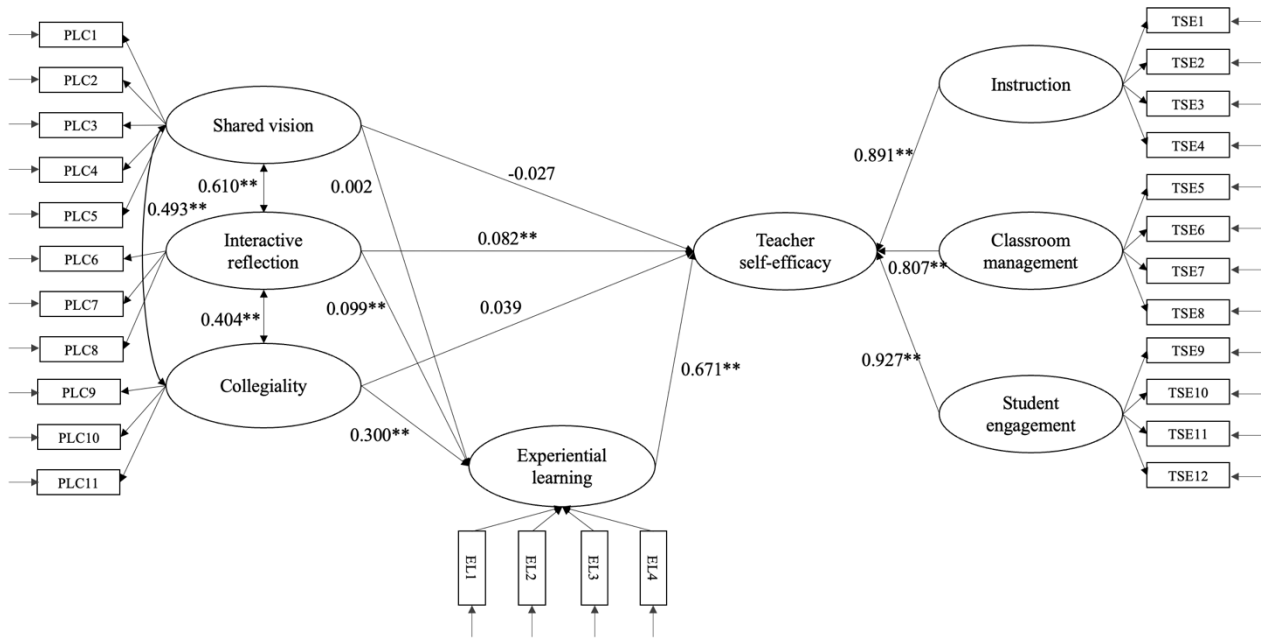

Figure 2. *Final Predictive Model for Primary School Teachers*
Note: Standardised path estimates are reported. * $p < .05$., ** $p < .01$. PLC = Professional learning communities; EL = Experiential learning; TSE = Teacher self-efficacy.

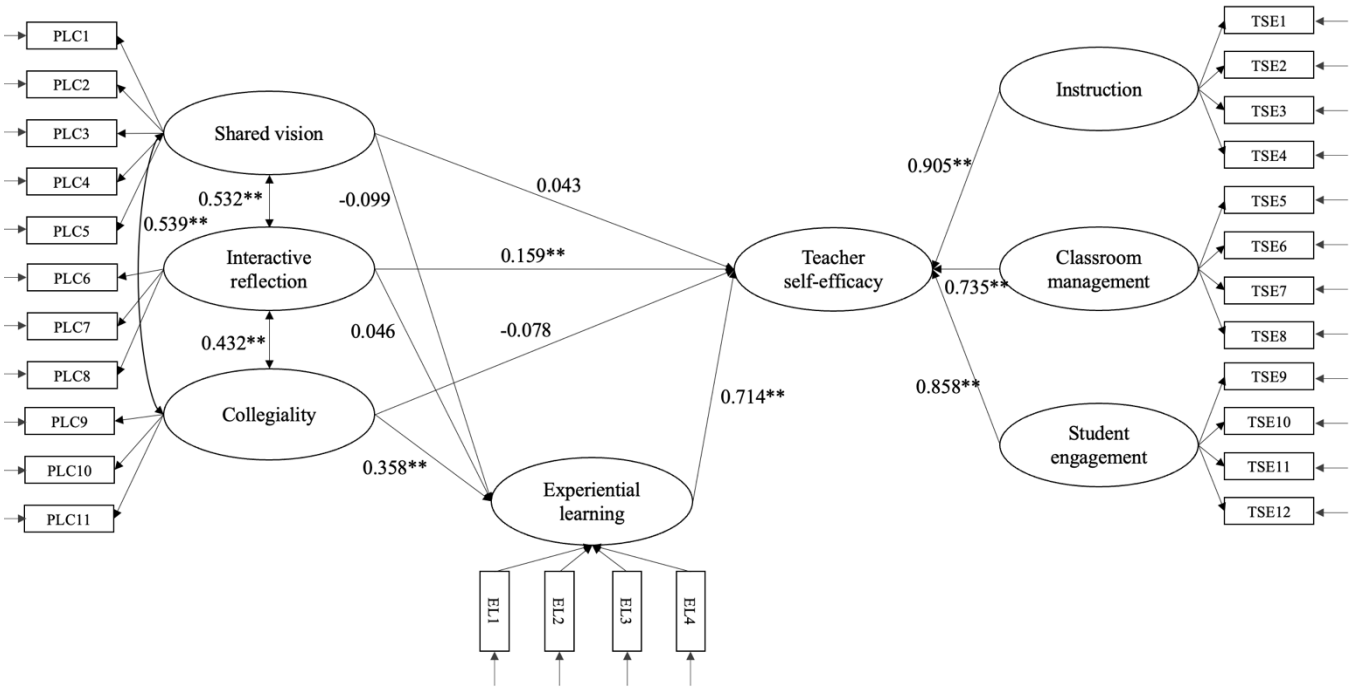

Figure 3. *Final Predictive Model for Lower Secondary School Teachers*
Note: Standardised path estimates are reported. * $p < .05$., ** $p < .01$. PLC = Professional learning communities; EL = Experiential learning; TSE = Teacher self-efficacy.

Testing indirect effects

Finally, a mediated model was specified, using experiential learning as a mediator, with the results presented in Table 3. Some significant indirect effects were found in the mediated model, suggesting that experiential learning could mediate the relationships between PLC factors and teacher self-efficacy. The results indicate a significant positive indirect effect of interactive reflection on teacher self-efficacy through experiential learning in the primary school teacher data; however, this relationship was not found in the lower secondary school teacher data. Furthermore, significant indirect effects on teacher self-efficacy were found via experiential learning in both samples. Considering that collegiality exerted no significant direct effects on teacher self-efficacy, this suggested the existence of a full mediation effect between collegiality and teacher self-efficacy through experiential learning among both primary and lower secondary school teachers.

Table 3.

Direct and Indirect Effects of PLC Factors on Teacher Self-efficacy via Experiential Learning

Dependent Variables	Standardised coefficient		
	Direct	Indirect	Total
Primary school teachers			
Shared vision	−0.027	0.001	−0.026
Interactive reflection	0.082***	0.067***	0.148***
Collegiality	0.039	0.201***	0.241***
Lower secondary school teachers			
Shared vision	0.043	−0.071	-0.028
Interactive reflection	0.159**	0.033	0.192***
Collegiality	−0.078	0.256***	0.178**

Note: *$p < .05$., **$p < .01$., ***$p < .001$. PLC = Professional learning communities

Discussion

The goal of the present study was to clarify factual collective and individual phenomena through examining the relationships between PLCs, experiential learning and teacher self-efficacy. Before

examining the relationships, we investigated the measurement invariance between primary and lower secondary schools, which was supported at the scalar invariance level, that is, teachers in Japanese primary and lower secondary schools similarly understood the research concepts, including PLCs, experiential learning and teacher self-efficacy.

The first research question in this study sought to examine the relationships between PLCs and experiential learning. The results indicate that interactive reflection was related positively to teachers' experiential learning in primary schools, possibly because primary school teachers are accustomed to pursuing school-wide research topics and interactively reflecting them (Chichibu & Kihara, 2013). The results further support Stoll et al.'s (2006) view that PLCs encourage active deconstruction and reconstruction of knowledge through reflection, analysis and action. However, a relationship between interactive reflection and experiential learning was not found in lower secondary schools. Considering that the practice and development of lower secondary school teachers tend to be subject- or grade-based (Chichibu & Kihara, 2013), a formal school-wide exchange of opinions may not lead to practical application to their education. Another possible explanation is that interactive reflection may become a mere shell because different teachers have different interests and concerns, thereby not enriching teachers' experiential learning (Takatani & Yamauchi, 2019). Moreover, collegiality was related positively to teachers' experiential learning in both primary and lower secondary schools. Consistent with the literature, this study confirms that both primary and lower secondary teachers develop their experiential learning through close communication and mutual support with other colleagues (Zonoubi et al., 2017). The results confirm that Japanese school teachers develop their learning experience through daily informal communication with colleagues without fear of being judged (Ahn, 2016; Maeda & Asada, 2020). Furthermore, shared vision was not related to experiential learning in both primary and lower secondary schools, possibly because experiential learning focusses on self-development and work-based learning, whereas shared vision represents the general direction of school development (Zheng et

al., 2019). In particular, school vision tends to emphasise students' holistic development in Japanese primary and lower-secondary schools, which may not be related directly to teachers' immediate learning experience (Fukuhata et al., 2017).

The second research question aimed to determine the relationship between experiential learning and teacher self-efficacy. We found a positive, moderate relationship between experiential learning and teacher self-efficacy, corroborating findings from extensive extant research that found teacher self-efficacy is enhanced by how teachers evaluate their own performance, not by mere experience (Morris et al., 2017; Usher & Pajares, 2008). Through experiential learning, teachers interpret and understand their past experiences and form a solid belief in their capabilities to create new education practices, corresponding with results from previous studies (Girvan et al., 2016; Kolb, 1984).

The third question was to examine the relationship between PLCs and teacher self-efficacy mediated by experiential learning. Along with previous studies (Zhang et al., 2020; Zheng et al., 2019; Zonoubi et al., 2017), this study demonstrated that interactive reflection and collegiality were related to teacher self-efficacy. One interesting result was that experiential learning partially mediated the link between interactive reflection and teacher self-efficacy among primary school teachers, while the link was not mediated among lower secondary school teachers. The results from the primary schools parallel an earlier observation indicating that critical reflection and discussion about pedagogical conceptual change with other colleagues are likely to impact teachers' self-efficacy (Lee et al., 2013; Zonoubi et al., 2017). The inconsistent results between the school levels may be explained by Chichibu and Kihara's (2013) argument that formal in-house trainings, such as LSs, are more active in primary schools in Japan because primary school teachers are mostly classroom teachers who teach the same subjects, while the subject division in lower secondary schools may cause difficulties in reflecting on a common phenomenon in school-wide trainings. Moreover, this study found that the relationship between collegiality and teacher self-efficacy was fully mediated by experiential learning in both primary and

lower secondary schools. This finding emphasises that participating in PLCs leads to the experiential nature of learning through sharing ideas and informally observing practices (Girvan et al., 2016), thereby enriching teachers' experiences as a source of self-efficacy. A possible explanation for this finding might be that daily conversations about improvements in practices among teachers help them apply others' good practices to their own educational activities and enhance informal learning daily.

Future implications

This study theoretically contributes to the growing body of PLC research. First, the results suggest that teacher self-efficacy may change according to how teachers learn from experience in PLCs. If teachers experience the same phenomena in PLCs, they perceive the experience as mere information or learning opportunities, that is, how teachers perceive PLCs is crucial to enhancing their self-efficacy. The results support Tsuyuguchi's (2013) argument that it is important for teachers' development to focus not on whether the school conducts PLCs, but rather on how individual teachers perceive what is happening in PLCs. Thus, future research with longitudinal data analysis is needed to establish PLCs' impact on outcomes, including teacher self-efficacy. Second, although researchers have argued that PLCs develop teacher self-efficacy, this study found that some elements of PLCs were related to teacher self-efficacy, and some were not. Considering that the sample was collected in Japan, contextual factors may have affected the results. For example, our finding of an insignificant relationship between a shared vision in PLCs and teacher self-efficacy corresponded with the results from collectivism and hierarchical culture (Zheng et al., 2019). Thus, a forced collaborative environment may not contribute to teachers' authentic learning (Zheng et al., 2019). A future study with a greater emphasis on the impact of national or each school's cultural context on teacher self-efficacy is recommended.

The results also suggest several courses of action for teacher education practices, demonstrating that teachers improve their self-efficacy by utilising experiences in PLCs as learning opportunities, that

is, teachers must understand how to learn from experiences through the elements of concrete experience, reflective observation, abstract conceptualisation and active experimentation; otherwise, the experiences would not be opportunities to increase self-efficacy. Furthermore, the opportunities to reflect on experience among colleagues should be encouraged, particularly in lower secondary schools, where teachers tend to work individually as subject teachers. Thus, education policymakers and leaders should create resources that generate collaborative and reflective discussions among colleagues that lead to experiential learning. Moreover, teacher education or in-service training should offer experiential learning to enhance teacher learning and strengthen teacher self-efficacy. Finally, we recommend that education leaders create a school environment in which teachers can share their opinions openly without being judged or evaluated. Even during formal trainings in which teachers are from different subject areas, active participation in exchanging opinions may encourage their learning, thereby leading to high self-efficacy.

Limitations and conclusion

Although this study has advanced our understanding of the relationships between teacher self-efficacy, PLCs and experiential learning, the results should be interpreted in the context of the study's various methodological limitations. First, the cross-sectional data did not examine causal relationships between the variables studied, although the larger sample size helped ensure that relationships would be found more easily. Thus, future studies should utilise a cross-lagged longitudinal design to investigate in more detail how PLCs affect teacher self-efficacy via experiential efficacy. Second, the data were collected using self-reporting, which might have caused single-source bias, in which participants generalise their recognition using a cognitive schema (Podsakoff et al., 2012). In future investigations, various data collection methods, for example, having third parties evaluate PLC levels, are recommended. Third, this study was limited by the lack of the validity of combining the four stages of experiential learning cycle

into a single analysis. Teachers are different in the quality of implementing in the four stages. There may be teachers who only perform some of the modes. A further study could assess the validity of the four stages of experiential learning as a hierarchical and circular cycle model. Fourth, since Japanese schools have been conducting LSs as teacher professional development and peer-learning activities have taken roots in the school system, it might be difficult to clearly differentiate some elements of PLCs, such as interactive reflection and collegiality, from peer-learning activities in the Japanese local context. Further work needs to establish the construct validity of PLCs between different cultural contexts.

Finally, education scholars have not examined how teachers develop their self-efficacy in relation to experiential learning in PLCs. This study added a view of how PLCs are related to teacher self-efficacy via experiential learning. To enhance teacher self-efficacy, learning from experience in PLCs, not merely gaining experience, is crucial. Thus, this study provided an important contribution by highlighting PLCs' importance and a more detailed view of experience with teacher self-efficacy.

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