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The role of a professional development program in improving primary teachers' formative assessment literacy

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ABSTRACT

Successful implementation of formative assessment in classrooms relies on teachers' formative assessment literacy, which is typically supported by professional development programs. This study reports on the impact of a professional development program on a group of in-service primary teachers in Hong Kong. The authors investigated the effectiveness of the program in developing teachers' formative assessment literacy and how far the program assisted them in addressing the challenges they faced when implementing formative assessment in classrooms. With a mixed-method design, quantitative data were collected with a pre- and post-program survey ($N = 27$); qualitative data were collected with open-ended survey questions and a focus group with six participating teachers. The results provide evidence of the program's success in developing teachers' formative assessment literacy and equipping them with the necessary skills to address the challenges in implementation. The features of professional learning communities embedded in the program contributed to the positive impact of the program.

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Formative assessment; assessment literacy; professional development; professional learning community

Introduction

Formative assessment has gained recognition as a powerful tool to enhance learning effectiveness owing to its role in informing instruction and scaffolding student learning (Black and Wiliam 1998; Wylie 2020). Through formative assessment, teachers can better understand students' learning needs and adjust their instructions accordingly (Andrade, Bennett, and Cizek 2019). However, many studies have reported that effective implementation of formative assessment is seldom observed in actual classroom practice in both the Western (e.g. De Simone et al. 2002; Wylie and Lyon 2015) and Eastern contexts (Yan 2021; Yan and Cheng 2015). As 'education and training' is one of the most crucial factors influencing teachers' intentions and practices regarding formative assessment (see Yan et al. 2021 for a review), it is likely that teachers' inadequate understanding and skills hinder the implementation of formative assessment (Tang et al. 2010; Tierney 2006). Hence, developing teacher formative assessment literacy is one possible way to address this worldwide challenge (Yan and Pastore 2022). Formal professional development

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interventions are known to play a key role in assisting teachers in acquiring new knowledge, skills, and awareness in many contexts (Andersson and Palm 2017; Borko 2004; Darling-Hammond and McLaughlin 1995). However, the empirical evidence of the effectiveness of professional development in enhancing teachers' formative assessment literacy is still limited.

This study aimed to examine the effectiveness of a professional development program designed to enhance teachers' formative assessment literacy in Hong Kong. The education system in Hong Kong is famous for its exam-oriented culture, where summative assessment plays a dominant role. However, formative assessment has gradually become more recognized for supporting students' learning (Guo and Yan 2019; Yan and Cheng 2015). The Hong Kong government has been promoting formative assessment in schools for the last two decades, intending to maximize the pedagogical merits of formative assessment during the learning process (Curriculum Development Council 2001). Nevertheless, the actual implementation of formative assessment still appears to need support (Lam 2019; Yan 2021).

In this study, the effectiveness of the program refers to: 1) whether the program can enhance conceptual, practical, and socio-emotional dimensions of teachers' formative assessment literacy according to Pastore and Andrade's (2019) three-dimension model of assessment literacy; and 2) to what extent the program assists teachers in addressing the challenges they face in implementing formative assessment in their classrooms. We also aimed to identify the program's features that prove helpful in helping teachers develop formative assessment literacy.

Assessment literacy

Teachers are the key agents in assessment activities as they play an important role in the whole process of assessment design, implementation, and evaluation of assessment results (Lukin et al. 2004; Stiggins 1991). Teachers' assessment literacy is one of the important indicators of teaching effectiveness, as suggested by studies to promote teachers' professional learning about assessment (DeLuca, LaPointe-McEwan, and Luhanga 2016; Plake 1993). Capacities for assessment literacy entail teachers having the ability to design appropriate assessment tasks, implement assessment activities, and interpret the results to inform future instructional decision-making (Pastore and Andrade 2019; Plake 1993; Stiggins 1991). Teachers' assessment literacy also enables them to create learning experiences that help students learn from assessment and self-regulate their learning (Ashraf and Zolfaghari 2018; Lam 2019).

Although many studies have discussed the definition and the measurement of teacher assessment literacy, there is some disagreement about both specific components and standards (DeLuca, LaPointe-McEwan, and Luhanga 2016; Plake 1993; Soh and Zhang 2017). This study has adopted Pastore and Andrade's (2019) three-dimension model of assessment literacy as the theoretical framework. Pastore and Andrade (2019) conceptualized three dimensions of assessment literacy: conceptual, practical, and socio-emotional. Their model covered the key aspects of assessment literacy with consideration of the cultural and social contexts. Based on the three-dimension model, this study operationally defined formative assessment literacy as an interrelated set of knowledge, skills, and dispositions for designing and implementing effective formative assessment experiences.

The conceptual dimension covers the knowledge and rudiments a teacher needs to know about formative assessment in terms of its purposes, methods, and its relationship with learning and teaching. The practical dimension refers to the formative assessment practices a teacher employs to monitor, judge, and manage the assessment process, and assure its soundness and quality, with the aim of promoting learning. The socio-emotional dimension is related to a teacher's consciousness of the social and emotional aspects of formative assessment that can affect the effectiveness of learning and teaching. With the three-dimension model as a framework, the current study can depict a detailed picture of the effectiveness of the professional development program in enhancing different aspects of teachers' formative assessment literacy.

Teacher professional development and professional learning communities

A considerable body of literature regards formal professional development activities and interventions as an appropriate means of knowledge acquisition, which, in turn, enables teachers to continuously adjust and improve their teaching practices (Andersson and Palm 2017; Valiandes and Neophytou 2018). In a recent review, Yan et al. (2021) pointed out that teacher professional development was one of the most critical factors influencing teachers' intentions and implementations regarding formative assessment. Researchers have identified the impact of teacher professional development programs on raising the quality of instruction and influencing students' learning (Andersson and Palm 2017; Borko 2004; Teemant, Wink, and Tyra 2011). Acknowledging that teachers' professional practice is one of the main influencing factors on students' performance and achievements, many studies have confirmed the importance of mandatory professional development for teachers during their professional service in the form of in-service teacher training (Borko 2004; De Simone et al. 2002). This type of professional development can improve teachers' practical skills and deepen their educational knowledge, including assessment literacy (Koh 2011; Pastore and Andrade 2019; Plake 1993; Stiggins 1991; Yan 2021).

However, the effectiveness of professional development depends on what and how it is delivered (Avalos 2011). High-quality professional development programs are creative and interactive since the traditional lecture approach seems no longer sufficient to facilitate participants' development (Valiandes and Neophytou 2018). Professional development programs that are supportive, focused, and collaborative are more likely to result in enhanced teaching practice (Hunzicker 2011). Some discussed that a high-quality professional development program is usually characterized by active exchange of ideas, collective engagement, relevance to actual teaching context, and available support (Birenbaum et al. 2009; Desimone 2011).

Many researchers argue that the professional learning community (PLC) is one of the most effective ways of promoting teacher professional development because of its collaborative character and timely responses to student learning needs (DuFour 2007; DuFour, Eaker, and Eaker 2009; Hord and Hirsh 2008). A PLC involves 'a group of people sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way, operating as a collective enterprise' (Stoll et al. 2006, 223). The three main features of productive PLCs include collegial interaction, productive collaboration, and focus on teaching and student learning (van Es 2012). Group members of PLCs share

responsibilities and develop sustained relationships for advancing each other's growth (*collegial interaction*). Participants constructively exchange their ideas, practices, and reasoning about teaching as they engage in productive conversations (*productive collaboration*). PLCs' activities are centered on sustained inquiry around teachers' practice that can promote students' learning (*focus on teaching and student learning*). Although PLCs are often regarded as informal learning organizations that develop naturally, such as a school or a school department (DuFour 2007; Hargreaves 2007; Wenger 1998), it is possible to use some PLC features in formal teacher development programs. For instance, with shared professional goals and learning needs, teachers can work together in a PLC where they share their practices and ideas, renew their concepts, and enhance their skills and knowledge accordingly. They can have reciprocal support and feedback from other participants in this social context (Hord 1997, 2009). Many scholars (DuFour 2004; Skerrett 2010; Valiandes and Neophytou 2018) stated that people build their knowledge and create sustainable changes through communication and exchanging ideas. Hargreaves et al. (2013) investigated the effect of two Teacher Learning Communities projects (a variation of PLCs), one in Hong Kong and one in London, on developing teachers' assessment-for-learning practice. They found that teachers' initiative, independence, and critical reflection in the communities would bring more productive assessment-for-learning practice. Therefore, the current study aimed to integrate some features of PLCs into the design of the teacher development program to promote teachers' formative assessment literacy.

The present study

Objectives and research questions

Given that insufficient formative assessment literacy is an important reason for the unsatisfactory implementation of formative assessment in Hong Kong (Lam 2019; Yan 2021), there is an urgent need to enhance teachers' formative assessment literacy. However, there is limited empirical evidence about whether formal professional development programs can enhance teachers' formative assessment literacy and how to provide tailor-made programs to in-service teachers to serve this purpose. This study aimed to evaluate the effectiveness of a professional development program in developing in-service teachers' formative assessment literacy. In particular, the research questions that guided this study included:

(1) Has the professional development program impacted teachers' formative assessment literacy?
(2) Are there challenges for teachers in implementing formative assessment? If yes, what are they? And how far do teachers think that the program assists them in addressing those challenges?
(3) Are the PLC features embedded in the program helpful for teachers' professional development?

The program

The program was managed by a teacher education institute in Hong Kong and developed and taught by the second author with the aim of enhancing primary school teachers' formative assessment literacy. It was a five-day program across two weeks. The first four days were within the first week (Wednesday to Saturday), and the last day was Saturday of the next week. This arrangement only occupied three working days, so the intrusion to their teaching schedule was minimal. The participating teachers were off work on training days but carried out their regular teaching duties between the fourth and fifth days.

The content of the program

A needs analysis was conducted before the commencement of the program to identify the particular knowledge and skills pertinent to formative assessment literacy that participating teachers might require. The data for the needs analysis were gathered from two sources. First, the program team posed an open-ended question, 'What topic(s) do you want to learn if you were enrolled in a professional development program related to formative assessment?' to primary teachers who participated in other programs/seminars ($N = 82$). Teachers' responses provided opinions from the target audience and reflected their needs. Second, the program team sought viewpoints from Education Bureau officers who had ample first-hand knowledge of local schools and were in charge of teacher professional development. The training contents were then designed and divided into three main areas to cater to Hong Kong teachers' needs, as explained in detail below:

(A) Overview of formative assessment literacy theory
(B) Analysis and use of assessment data
(C) Students' roles in formative assessment

Area A introduced the theory of assessment literacy and the major principles of formative assessment (including assessment for learning and assessment as learning) in Hong Kong classrooms. It aimed to enhance teachers' overall understanding of formative assessment literacy and awareness of the relatedness between the theory and daily assessment practice. Areas B and C were the two most significant weaknesses in formative assessment practice in Hong Kong classrooms which had been identified in the formerly conducted needs analysis.

There were two group assignments. The first assignment was a group oral presentation completed on the fifth training day. Each group selected a topic pertinent to formative assessment challenges and proposed solutions based on their classroom contexts and in line with formative assessment principles. The second assignment was a school-based group project that required data analysis and interpretation of an achievement test and effective use of the assessment results to inform subsequent teaching and learning.

The pedagogy of the program

The pedagogy in this program applied PLC principles that emphasize social interactions and discourse among participants to foster the collective construction of knowledge

(McLaughlin and Talbert 2006). It responded to the criticism that a traditional lecture approach appears insufficient for facilitating participants' development (Valiandes and Neophytou 2018). The interactive approach in this program was characterized by frequent dialogue between tutor and participants, or participants and participants, such as group discussions and projects and plenty of opportunities for exchanging ideas. To facilitate the interaction, this program intentionally invited group enrollment. Most of the participating schools contributed two to four teachers; only one school sent one single teacher. In particular, the three main features of PLCs (van Es 2012) – collegial interaction, productive collaboration, and focus on teaching and student learning – were intentionally encouraged in this program. For example, teachers from the same school formed learning groups, and assignments were group projects that required continuous collaborative interaction. The teaching and learning process was driven by frequent discussions and sharing of ideas (an example appears in Appendix A) within and across learning groups. All learning activities emphasized linking course content with teachers' formative assessment practices in their own classrooms. Although developing a PLC is a complex process (Aubusson et al. 2007), we envisaged that the program would inspire and facilitate PLC development by purposefully encouraging active idea exchange, collaboration, and critical reflection among teachers.

Method

A mixed-method approach was utilized. Quantitative data were collected with a pre- and post-program survey; qualitative data were collected with open-ended questions in the surveys and a focus group with participating teachers. The collection of these two kinds of data led to a deeper understanding of the effectiveness of the program.

Participants

A convenience sample was used. Participants were 29 serving primary school teachers from 12 primary schools who enrolled in the program. Among them, there were three male and 26 female teachers. Their average teaching experience was 17 years. Only four of them had fewer than 10 years of experience, and 10 had more than 20 years of experience. All 29 participants completed the pre-program survey, but only 27 of them completed the post-program survey. Hence, only the 27 cases with both pre- and post-program data were used for the analysis. After completing the program, the researcher randomly selected six participants and invited them to focus groups. All of them accepted the invitation. As participants had sufficient knowledge and experience to discuss the topics under investigation, we conducted 'mini-focus groups' (Onwuegbuzie et al. 2009). Two mini-focus groups were conducted according to participants' time availability (with two and four participants, respectively).

Procedure

Ethical approval was obtained from the authors' university. All participants provided written consent before the start of the study, and their participation was voluntary. They completed a survey immediately before and immediately after the training course.

The time gap between the pre- and post-survey was 11 days. Two mini-focus groups, each lasting for around 45 minutes, were conducted immediately after the program to gather an in-depth understanding of participants' views regarding the effectiveness of the program and their experience of an interactive approach to learning. The focus groups were moderated by the second author and assisted by a research assistant. The moderator presented the questions, prompted participants to speak, and facilitated the discussion. The research assistant was responsible for audio-recording and taking notes. Field notes were subsequently summarized to support the data analysis. Interview questions were prepared, and a rehearsal was conducted before the interview sessions.

Instrument

Guided by Pastore and Andrade's (2019) three-dimension model of assessment literacy, a Formative Assessment Literacy Scale was specifically developed for this study. There are three subscales containing 20 items: 7 items in the conceptual subscale (e.g. I understand the purposes of my assessment practices), 8 items in the practical subscale (e.g. Based on assessment results, I provide timely feedback to students to improve their learning), and 5 items in the socio-emotional subscale (e.g. I attend to the relationship between student motivation and assessment). Participants would evaluate their agreement level with each item by choosing from a response scale ranging from *Strongly Disagree* (1), *Disagree* (2), *Slightly Disagree* (3), *Slightly Agree* (4), *Agree* (5), to *Strongly Agree* (6). Two different open-ended questions were added at the end of the questionnaire for the pre- and post-survey.

The two open-ended questions at the end of the pre-survey included: 1) What is the major challenge you face when practicing formative assessment in Hong Kong classrooms? 2) What do you want to learn from this professional development program?

Open-ended questions for the post-survey were: 1) Do you think what you learned from this program can help you with the challenges you faced when implementing formative assessment? Why? 2) Do you think peer discussion and sharing are helpful to your learning? Why?

The focus group interview questions relevant to this study included: 1) What do you learn from this professional development program? 2) Do you think teacher assessment literacy is important? Why? 3) Which features of the program do you find most helpful to your formative assessment literacy development? Why?

Data analysis

The psychometric properties of the Formative Assessment Literacy Scale were first examined with Rasch analysis (Rasch 1960). The invariance of item difficulties across the pre- and post-surveys was checked using the method suggested by Bond, Yan, and Heene (2020). To study the effect of the professional development program, a paired sample *t*-test was applied to the data collected through the pre- and post-surveys to examine differences in teachers' formative assessment literacy before and after participation in the professional development program.

The focus groups were audio-recorded and word-by-word transcribed. Both the interview transcriptions and teachers' responses to the open-ended questions in the surveys were analyzed following a thematic content analysis approach in three stages (Braun and

Clarke 2006). In Stage 1, one author conducted initial coding, and the other author checked if the interpretation was appropriate. This reflective process helps achieve 'a corroborated and coherent analysis' (Boussebaa and Brown 2017, 14). The main points of all participants' responses were summarized and condensed into categories and subcategories. In Stage 2, the authors discussed the summary table with the codes and selected quotes and referred to the original transcripts and field notes taken during the interviews when resolving disagreements. In Stage 3, the authors synthesized the codes and categories into main themes. The themes were then used to understand the individual participants' experiences and views on the program. The focus groups were conducted and transcribed in Cantonese. To minimize the potential meaning lost owing to translation, we were 'staying in the original language as long and as much as possible', as suggested by van Nes et al. (2010, 315). In other words, we analyzed the data in Cantonese and only translated the quotes that were presented in the paper. To enhance the trustworthiness of the transcription and analyses, we invited the participants for accuracy checking (Creswell 2014). Ten days after the focus group, we sent a copy of the transcript to all participants of the focus groups. All participants responded and confirmed that the transcript reflected their words during the focus groups, with minor language edits. The first and second authors met several times to discuss the data and specifically examined disconfirming evidence to check or amend the conclusions. This discussion enhanced reflexivity and reduced bias (Palaganas et al. 2017).

Results and discussion

The impact of the program on enhancing teachers' formative assessment literacy

The first research question, i.e. the impact of the program on enhancing teachers' formative assessment literacy, was addressed by comparing participants' performance on pre- and post-program surveys.

The psychometric properties of the scale were first examined with multidimensional Rasch analysis (Adams, Wilson, and Wang 1997). Item #1 in the conceptual dimension (I know the characteristics of high-quality assessment) was removed owing to substantial variance of item difficulty across pre- and post-surveys. The remaining 19 items showed a good fit to the Rasch model. The EAP/PV reliabilities for the three dimensions were .98, .96, and .90, respectively.

Two of the participating teachers failed to return the post-program survey. The paired sample *t*-test results on responses from the 27 participating teachers who completed both pre- and post-program surveys showed that teachers had higher performance in the post-survey than in the pre-survey for all three dimensions (see Table 1 and Figure 1). All differences reached statistical significance ($p < .01$), indicating

Table 1. T-test of teacher performance on pre- and post-survey.

	Pre-survey		Post-survey			
Dimension	Mean	*SD*	Mean	*SD*	*t*	*p*
Conceptual dimension	1.89	1.28	5.36	1.74	8.454	.000**
Practical dimension	1.18	1.73	4.51	2.09	6.873	.000**
Socio-emotional dimension	1.23	1.82	4.53	1.84	7.347	.000**

Note. All measures are in logits; ** $p < .01$.

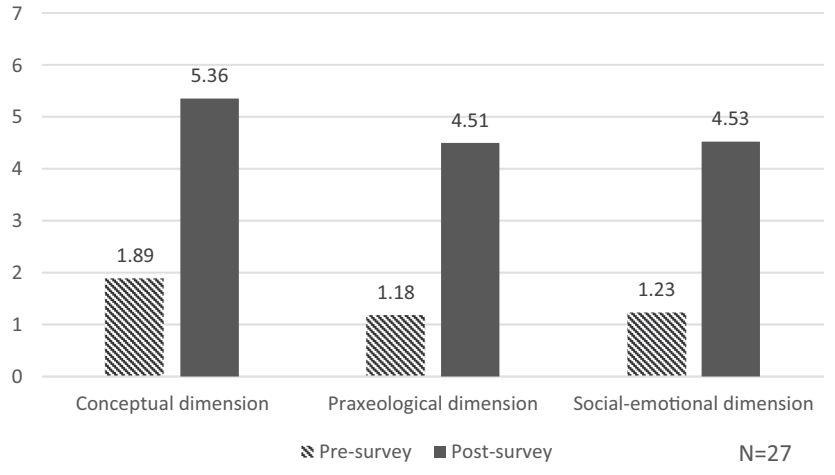

Figure 1. Comparison of teacher performance on pre- and post- survey.

that the program was effective in enhancing teachers' formative assessment literacy in terms of all three (conceptual, practical, and socio-emotional) dimensions. By participating in this professional development program, teachers gained a better understanding in terms of the purposes of assessment, the alignment between assessment and learning objectives, assessment data analysis, the relationship between teaching, learning, and assessment, as well as a variety of assessment methods that can demonstrate students' learning. Teachers also had enhanced consciousness of the social and emotional aspects of formative assessment, such as students' emotional reactions to assessment, the impact of assessment on students' learning motivation, and the student–teacher relationship. More importantly, teachers reported improved formative assessment practices, such as providing feedback and adjusting instruction based on assessment results, using various assessment methods, teaching students to self-assess and reflect, and communicating assessment purposes with other stakeholders. This is an interesting and promising result for two reasons. First, one significant challenge related to formative assessment is its scarce use by teachers in actual classroom practice (Bennett 2011; Wylie and Lyon 2015) because many teachers are reluctant to change their assessment practices (Brown 2004; Remesal 2007), even though teachers acknowledge its pedagogical benefits (Yan and Cheng 2015). This result demonstrates the possibility of changing teachers' assessment practices through appropriate training. Second, there was only an 11-day gap between pre- and post-surveys. One speculative explanation for the behaviour change is that teachers started transferring what they learned from the program into their teaching even before the program ended. This is possible because teachers were still taking teaching duties during the program so that they had opportunities to implement the newly acquired skills into their daily classrooms if they wanted to.

In the focus group interview, all teachers recognized the importance of formative assessment literacy. According to the survey and interview, they have developed a better understanding of formative assessment and gained practical skills after this program.

> Assessment literacy is definitely important. I am much more sure about this point after participating in this program. I also realize that it [assessment literacy] is important not only to teachers, but also to students and parents. (T3IN[1])

Teachers thought they were able to help their peers to improve their assessment literacy. However, they admitted that it takes time to promote formative assessment among their peer fellows. It is necessary to let colleagues realize the effectiveness and importance of formative assessment.

> Teachers in my school have different attitudes or reactions towards formative assessment. Some colleagues are stuck with applying formative assessment methods, and some other teachers don't value formative assessment very much. It depends on teachers' experience and ability. (T2IN)

Past studies have revealed teachers' deficiency in formative assessment literacy in terms of both conceptual aspects, such as insufficient understanding of the value of assessment, a lack of knowledge about the functions of assessment (DeLuca 2012; Schneider and Bodensohn 2017), and practical aspects, such as inability to manage various sources of formative assessment data and or to use assessment data to inform instruction (Will et al. 2019; Yan 2021). The findings on the impact of this program shed light on the role of professional development programs in enhancing teachers' formative assessment literacy and mitigating difficulties in implementing formative assessment practices. This result encourages the provision of further teacher professional development programs on formative assessment literacy to enrich teachers' knowledge and enhance their conceptions about formative assessment. The improvement of teachers' understanding of formative assessment will likely induce more practice in the future.

Challenges teachers perceived in implementing formative assessment

The second research question explores the major challenges teachers face when implementing formative assessment in Hong Kong classrooms and how the professional development program helped them to address those challenges. Participants' responses to the two open-ended questions in the pre-survey (1. What is the major challenge you face when practicing formative assessment in Hong Kong classrooms? 2. What do you want to learn most from this professional development program?) revealed their perceived challenges and what they wanted to learn from the program.

The findings show that the major challenges faced by teachers in implementing formative assessment include time limitations, different expectations of stakeholders, and difficulties in designing high-quality assessments and interpreting the result appropriately. The challenges identified are generally in line with a recent review study (Yan et al. 2021) that summarized factors influencing the implementation of formative assessment, such as time, subjective norms, education and training, and so on. The findings also echo Bennett's (2011) argument that most teachers need substantial time and support to develop formative assessment.

The most frequently mentioned challenge (14 out of 29 respondents) is the lack of time. In Hong Kong, the time for each class session is strictly arranged, so teachers need to plan ahead to teach all mandatory content on time. Therefore, teachers have limited time to spend on doing formative assessment, and the form of assessment conducted in the

classroom is also limited by time. In many circumstances, teachers still use the simple written form of assessment to save class time. Some teachers also stated that they didn't have enough time to follow up on students' progress based on their performance in assessed tasks and provide timely feedback. As stated by one of the teachers:

> Teaching time is very tight in Hong Kong. The data we gained after the assessment may not have enough time to be followed up, and the students' emotional reactions during the assessments are less likely to be assessed. (T4PRE)

Teachers appeared to have insufficient time to interpret and communicate with each individual closely about their performance and progress. Therefore, teachers were not able to use the assessment results as they had expected. Revealed from their responses, teachers wished to learn how to efficiently design and implement formative assessment, and use assessment data to support students' learning with less time-consuming strategies. As one teacher wrote:

> [I hope to learn] an effective, time-saving and focused approach to do analysis and interpretation of assessment data. (T14PRE)

In addition to limited time, teachers mentioned the challenge of practicing formative assessment when teachers, school leaders and colleagues, parents, and students have different expectations, understanding, and beliefs about assessment. Eleven out of 29 respondents mentioned the issue of differing beliefs about assessment. This is an issue relevant to the assessment culture. Hong Kong's examination-oriented education system encourages people to perceive grades as the purpose of teaching and learning. Some teachers mentioned that students are less involved in subjects and contents that are not directly related to examinations and are relatively less concerned about assessments that don't count in final grades. One teacher also argued that it is an issue that:

> Students fail to integrate what they have learned to solve slightly challenging problems. They may even think that the teacher 'hasn't taught the content' and they only deal with the questions in the book. (T11PRE)

It is also challenging when parents do not appreciate the formative assessment and attach less value to the non-score assessment results. Also, some colleagues may think this kind of assessment is too complicated and time-consuming to implement. One respondent said:

> Parents and teachers did not fully accept the diversified assessment. Learning, teaching, and assessment are not closely connected. (T5PRE)

Among teachers' responses to the second open-ended question about what they want to learn, some of them hoped to show the validation of formative assessment and gain support and understanding from other stakeholders. They hope to 'let parents understand and accept the meaning of diversified assessments' (T28PRE) and also 'improve colleagues' assessment literacy' (T3PRE).

The challenges with the limitation of class time and the different expectations of stakeholders are in line with previous studies on formative assessment in Hong Kong (e.g. Yan 2021; Yan and Cheng 2015). For example, Yan and Cheng (2015) explored predictors of teachers' formative assessment practices in Hong Kong classrooms. They

found that teachers' intentions and self-efficacy did not adequately explain formative assessment practices. They argued that contextual factors should be taken into account. As reported in this study, the time limit and pressure associated with the evaluation culture could be counted as important contextual factors influencing teachers' formative assessment practices. Teachers need sufficient time for deliberate planning, implementation, and individualized follow-up in formative assessment practices (Yan 2021). Furthermore, effective formative assessment requires a shared vision and understanding among the different stakeholders (Hargreaves and Shirley 2009; Mak and Lee 2014).

Ten out of 29 respondents also mentioned the challenges of implementing formative assessment, particularly the design of high-quality assessment tasks and using assessment data (both formative and summative assessments) to inform teaching and learning. Teachers had difficulties in defining high-quality formative assessment tasks. They wondered how to design questions with appropriate levels of difficulty according to students' diverse ability levels. One of the teachers said:

> Even when a rubric is provided, people's understanding can still be different. (T16PRE)

Teachers wanted to know how to support student learning with effective assessment and feedback. However, they found it difficult to appropriately interpret assessment data (or students' responses) and provide individualized feedback that can facilitate students' learning. One teacher stated:

> [I have difficulty to] be objective and avoid being subjective. The time is limited, so I can't evaluate each student's status accurately, or I can only do the evaluation based on students' certain moment's work. (T1PRE)

As some teachers reported, 'students are of diverse abilities' (T25PRE), and considerable differences exist in their learning progress and achievements. Teachers wanted to learn varied analysis and feedback methods to help each student. One of the teachers said:

> [I want to learn] how to analyze the assessment data to help my student gain improvement in the future. (T8PRE)

All of these responses imply that the teachers feel they are inadequate concerning knowledge and skills related to formative assessment. This finding confirmed the pre-course need analysis results that Hong Kong teachers need support to develop their formative assessment literacy. This program can contribute to the effective classroom assessment practice because a well-trained cadre of teachers with sufficient professional knowledge, skills, and commitment to formative assessment is a pre-requisite of the successful implementation of formative assessment (Carless 2010; Lee and Coniam 2013).

Besides the three major issues stated above, a few teachers also mentioned other challenges. For example, some reported a challenge to assess with diverse methods because the assessment method is limited to paper-based format owing to practical constraints. Some teachers wanted to keep the assessment data as an example but were concerned about infringing on students' privacy. They were also concerned about the equity and accuracy of the assessment for different students. They doubted if the assessment could evaluate each student's performance precisely based on a one-off exam.

The usefulness of the program in assisting teachers in addressing the challenges

As teachers' responses to the pre-survey questions revealed their initial perceptions of challenges when implementing formative assessment, the later post-survey (1. Do you think what you learned from this program can help you with the challenges you faced when implementing formative assessment? Why?), and the first question in the focus group interview (1. What do you learn from this professional development program?) allowed us to know whether the program helped them to address these challenges.

Twenty-three participants pointed out the contents they learned in the program that can help to address the challenges they faced. Eighteen participants stated they learned how to analyze the assessment data using statistical tools. As they know more about using analytical tools efficiently, they can use their time wisely and prepare a suitable assessment for students with varied abilities.

> Yes, the program helps me know how to use the data analysis tool to understand students' learning progress by analyzing data, evaluating the difficult level of the exam and checking whether it is suitable for different students. (T2PST)

They also stated that the analytical tools enabled them to interpret and use assessment results more objectively and precisely. One teacher commented:

> By learning the analytical tools, I know how to obtain evidence of student learning and make more objective and precise decisions. (T4PST)

After participating in this program, 13 teachers become more confident in implementing formative assessment strategies in their classrooms because they have learnt some useful and practical strategies from the program.

> I have learned some concrete strategies (e.g. feedback) that fit my school background. I can use those strategies in my classrooms and inform my students' learning in the classroom. (T6PST)

In particular, teachers had a better awareness of the importance of engaging students in assessment and learnt some strategies to activate students' roles in the assessment process. This is in line with the call for more attention to students' role in assessment (e.g. Curriculum Development Council 2014, 2017; Guo and Yan 2019). One teacher reported:

> They [students] all have to be involved. In fact, the classroom is now more or less permeated [with the formative assessment], and they [students] have to set their own goals, monitor their progress towards the goals, to know what they're learning . . . . . students should be active players in assessment. (T2IN)

Further, some teachers were more willing and confident to share their knowledge with their colleagues and promote formative assessment implementation in their school after the program. In the focus group interview, one teacher stated:

> I appreciate that this program has content about assessment promotion at the administration level. I can apply the solution that the guest speaker shared during the program. I think those solutions are efficient for me. (T2IN)

Teachers also thought group discussion and guest speaker sharing during the program were helpful. They learn from each other's implementation experiences. However, they also shared that it will be a long way to implement formative assessment in schools.

The usefulness of the PLC features embedded in the program for teachers' professional development

Although many scholars acknowledge the significance of teacher professional development, it is still challenging to empirically study what makes professional development effective (Borko 2004, Desimone 2011; Koh 2011). There are many conditions identified by scholars for the professional learning community to be effective (Hord 2009). For example, the professional learning community needs to be well organized and supported in order to promote collective sharing and learning. It needs to facilitate effective interactions among members of the community to promote each member's development. Therefore, the third research question aimed to capture the features of the program, in particular the PLC characteristics, welcomed by the participants. The second open-ended question in the post survey (2. Do you think the peer discussion and sharing are helpful to your learning? Why?) and the third question in the focus group interviews (3. Which features of the program do you find most helpful to your formative assessment literacy development? Why?) collected data for addressing this research question.

It appears that participants appreciated the benefits of the PLCs features embedded in this program in developing their understanding of formative assessment literacy. In particular, all teachers responded that discussions and sharing activities are helpful to their learning. As mentioned earlier, the sharing and discussion were specifically designed to facilitate the development of PLCs. It aimed to maximize teachers' learning by facilitating idea exchange via collaboration and interaction. Teachers from the same school formed learning groups that were required to discuss and collaborate on group projects. Learning groups from different schools were encouraged to exchange ideas throughout the program. Participants' discussions and sharing activities focused on linking the teaching contents and their formative assessment practices in classrooms and schools. During the discussion and sharing, teachers could hear about instances of success and failure. The exchanges between teachers provided them with new ideas and strategies for implementing formative assessment. In this way, teachers could reflect on their work and find ways to improve their practices. One of the teachers wrote:

> Teachers from other schools have many great ideas. For example, their follow-up strategies on students' assignments make me reflect on my own work. Our school has a long way to go to have big-scale reform. (T1PST)

They all agreed that this kind of collaborative and interactive communication was productive and inspiring for their theoretical and practical learning regarding formative assessment. One of the teachers responded:

> Both the course content and peer sharing are helpful. I learn more about formative assessment both theoretically and practically. (T3IN)

In focus group interviews, although the question did not explicitly point to the features of PLCs, such as peer discussion and sharing, teachers reported that the learning group discussion and sharing activities were helpful for their development of formative assessment literacy. As mentioned earlier, teachers from the same school formed a learning group. This arrangement facilitated in-depth discussion

focusing on formative assessment practice which, together with expert support from the tutor, has the potential to foster the application of formative assessment in different subjects and later promotion in schools.

> When teachers bring new knowledge and ideas back to their schools, I think it is better to have colleagues that understand and support you. Teachers who take this program together can reflect on their work and collaboratively promote [formative assessment] easier in their school. (T2IN)

Furthermore, participants were from different schools with diverse backgrounds. One of the teachers mentioned that cross-school sharing and discussion could facilitate the exchange of information and encourage teachers to reconsider their own practices and possibly learn from others' practices. They had chances to learn innovative strategies from others when facing similar challenges:

> It is helpful. The assessment model and follow-up work among colleagues in different schools can be used for our reference. After considering our own situation, we can modify and apply it. (T2PST)

Teachers could also share their concerns, and others could provide some possible suggestions. As one of the teachers said:

> Sharing across schools was helpful because I could reflect on my own practices and think about any possible way to improve. As there are many schools, we could discuss and identify the most effective method to help students. (T5IN)

From teachers' responses, the features of PLCs, such as collaborative interaction and sharing, were found to be useful for their professional development. This result corroborates previous studies that indicated the effectiveness of a PLC (e.g. Carless 2010; Hord 2009; Livesay et al. 2005; Skerrett 2010; Stoll et al. 2006). The collaborative interactions facilitated their knowledge building and exchanges, reflected by teachers' responses to the focus group interview and open-ended questions in the questionnaire.

Limitations

While this study has provided original insights into enhancing teachers' formative assessment literacy through a professional development program, the findings are subject to at least three limitations. Firstly, the short period of the program (only five days) might affect its effectiveness. Future studies can either examine whether the findings of this study can be duplicated in other programs with similar periods, or test the effectiveness of shorter versus longer programs. Secondly, the data collected relied on participants' self-reporting; therefore, the results might be vulnerable to potential response bias (e.g. inaccurate memory and social desirability). To evaluate the effectiveness of professional development programs in a more authentic way, future studies could consider collecting direct measures (e.g. observations) of teachers' practices. Thirdly, this study was situated in the Hong Kong context, where the education system has some unique characteristics (e.g. a dominant exam-oriented culture). The generalization of the findings to other contexts with different cultural norms should be made with caution.

Conclusion

As many studies explore the factors that influence teachers' implementation of formative assessment (Schneider and Bodensohn 2017; Yan et al. 2021), this study set out to evaluate the effectiveness of a professional development program in enhancing teachers' formative assessment literacy. The design of the program was tailored to the needs of Hong Kong primary school teachers and integrated some features of PLCs in order to enhance the program's effectiveness. After participating in the program, teachers' formative assessment literacy was significantly improved in terms of all three (conceptual, practical, and socio-emotional) dimensions. Teachers had gained a better understanding and knowledge of formative assessment, practical skills, and strategies in implementing formative assessment, and enhanced consciousness of the social and emotional aspects of formative assessment that can affect this assessment process. The findings show that teachers shared some common challenges in implementing formative assessment, such as time limitations, different expectations of stakeholders, and difficulties in designing high-quality assessments and interpreting the result appropriately. The data also unveiled that teachers were keen to learn how to design suitable assessments for students with varied abilities and use assessment results to better support students' learning. They also wanted to show the effectiveness of formative assessment to other influential stakeholders. More importantly, many teachers agreed that the features of PLCs, such as collaborative learning and sharing within and across groups, were useful in promoting idea exchange and helped them construct their knowledge about formative assessment. The current findings demonstrate the possibility of enhancing teachers' formative assessment literacy through professional development programs. Notwithstanding the short period of the program, its relative success encourages the provision of similar professional development programs and advocates for integrating the characteristics of PLC (e.g. collaborative learning and sharing) into the programs.

Note

1. A coding system was used to label respondents. For example, T4PRE refers to the fourth teacher responding to the pre-program survey; T4PST refers to the fourth teacher responding to the post-program survey; T4IN refers to the fourth teacher responding to the interview.

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Appendix A. An example of discussion and sharing activity

Intended learning outcomes of the activity:
Upon completing the activity, participants will be able to

(1) Reflect and understand the weaknesses of conventional assessment data analysis currently conducted in their own schools; and
(2) Critically analyze the advantages and disadvantages of different assessment data analysis methods.

Procedure:

(1) Group reflection and discussion: each group (all members are from the same school) reflect and summarize the methods for analyzing assessment data; discuss about a) the weaknesses; and b) the information they want but can't be provided by the current data analysis.
(2) Sharing: there are two parts in the sharing including a) each group shares their discussion results to the whole group so that current practices of data analysis from different schools are presented and compared; and b) participants respond to other schools' practices in terms of advantages and disadvantages.
(3) Summary: the tutor summarizes the main points that have arisen from the sharing of experience and comments on major weaknesses of the current practices, and motivate the participants to engage in the next learning topic, i.e. a new method for analyzing assessment data.