Chapter 1
Mathematics Teacher Professional Development: An Asian Perspective

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Abstract This introductory chapter sets the context for the book. It also provides an overview of the chapters in the two parts of the book. The first part comprises eight chapters on policies, structures, frameworks, and contexts. The chapters provide us with some ideas about the professional development (PD) of mathematics teachers in eight Asian countries, namely China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, and Taiwan. It is evident from these eight chapters that the countries are at different phases of development of teacher professionalism. In some countries there are mandatory acts and regulations governing the continuous teacher PD while in others the situation is lax, and in such cases PD would greatly depend on a teacher's own motivation and also the availability of resources. The second part comprises eight chapters that showcase innovative approaches to mathematics teacher PD in Asian countries, namely India, Japan, Korea, Pakistan, Singapore, and Taiwan. It is apparent that all of these PD programs have similar characteristics and exemplify a critical development in teacher PD in Asia. This development reflects a gradual shift in the center of gravity away from the university-based, supply-side, off-line forms of knowledge production conducted by university researchers for teachers toward emergent school-based, demand-side, on-line, in situ forms of knowledge production by teachers with support from university scholars.

Keywords Teacher professional development · Teachers in Asia

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1.1 Introduction

"The quality of an education system cannot exceed the quality of its teachers" was one of the three key findings in the McKinsey's report on how the world's best performing school systems come out on top (Barber and Mourshed 2007, p. 16). The report also states that "the main driver of the variation in student learning at school is the quality of teachers" (p. 12). The quality of teachers depends on several factors and one of them is certainly their continuous professional development (PD) (Barber and Mourshed 2007; Mullis et al. 2012).

There has been an interest over the last decades in teacher PD and its impact on both students and teacher learning (Avalos 2011; Yoon et al. 2007). For example, in a most recent study using fourth- and eighth-grade mathematics data from the 2003, 2007, and 2011 TIMSS assessments, Liang et al. (2015) conducted a cross-national empirical study to examine teacher participation in PD and its impact on student achievement. They conclude that professional learning for teachers of fourth- and eighth-grade mathematics is associated with increased student achievement. Based on the positive association between student mathematics achievement and teacher PD, researchers conducted a series of multiple regression models. The regressions indicated that, after controlling for GDP and educational expenditure, there was a statistically significant association in 2007 in five of the six PD areas for fourth-grade students (math content, pedagogy, curriculum, integrating technology, and improving critical thinking and problem-solving skills) and in 2011 in one area. For eighth-grade students, a percentage point increase in access to teachers with PD in mathematics content, pedagogy, curriculum, and integration of technology increased the national mean mathematics achievement score by an average of 1.04, 1.24, 0.93, and 1.07 points, respectively.

Similarly, Unal et al. (2011) analyzed the TIMSS 2007 data of participants from Turkey and found that mathematics teacher PD made a big difference and affected students' performance positively. Kwon and Ju (2012) also claimed that a part of the high performance of Korean students in TIMSS and PISA may be attributed to the higher level of teacher preparation and PD. These findings, when coupled with other studies (for example, Desimone 2009), emphasize the importance of linking the content of professional learning to specific outcomes for students, ensuring depth of teacher content knowledge and content-specific pedagogy, depth of knowledge of curriculum, assessment practices, and technology integration into the content. These studies support the implementation of policies, advocacy, and practices for PD as a vehicle for improving student achievement and supporting educational reform.

The premise of this book is that teachers are the key to students' opportunities to learn mathematics. What mathematics teachers know, care about, and do is a product of their experiences and socialization both prior to and after entering teaching, coupled with the impact of their ongoing professional education. The significance of this impact varies among different education systems: the effects of professional education appear in some systems to be weak or even negligible,

whereas other systems are structured to support effective ongoing professional education and instructional improvement. Documenting and focusing on the mathematics teacher PD are important in the context of teachers' central role in students' learning of mathematics. Also important is the fact that efforts to improve students' opportunities to learn mathematics cannot succeed without parallel attention to their teachers' opportunities for learning. Thus, teacher PD is a crucial element in the effort to build an effective system of mathematics education.

The pivotal role of the teacher—and hence teacher education—is attested by a discernible surge in reports on PD in the mathematics education literature over the last decade. Apart from an increase in the number of journal articles and book chapters in this sub-field, there had been special issues of mathematics education journals (e.g., ZDM Special Issue on Evidence-based Continual Professional Development, 2015), scholarly books (e.g., The 15th ICMI Study Group report on the professional education and development of teachers of mathematics, 2009), and even volumes of a handbook (Volumes 1–4 of The International Handbook of Mathematics Teacher Education, 2008) that are focused on this area of PD for mathematics teachers. The collection of chapters in this book further contributes to this trend. In particular, we seek to moderate an underrepresentation in the global corpus on this subject: an Asian perspective.

The outcomes of TIMSS (Mullis et al. 2008, 2012) and PISA (OECD 2010, 2013) show us that students in some Asian countries, such as Korea, Taiwan, Japan, and Singapore, achieve much more than their counterparts in other Asian countries, such as Indonesia and Malaysia. This may be a consequence of varying teacher recruitment standards, teacher preparation and ongoing development programs, and other factors, such as political, social, and cultural factors. As teacher PD does have an impact on student outcomes, this book attempts to provide a resource for scholars to hypothesize relationships between the myriad attributes of mathematics teacher PD and student outcomes. In addition, cross-cultural exchange of knowledge and information about the professional education of teachers of mathematics would be beneficial. Learning about practices and programs in Asian countries can provide important resources for research, theory, practice, and policy in teacher education, both locally and globally.

In the rest of this chapter, we provide a broad overview of the two main parts of the book before concluding with some observations about current trends and likely directions of mathematics teacher PD in Asia.

1.2 Policies, Structures, Frameworks, and Contexts

Part I comprises eight chapters on policies, structures, frameworks, and contexts. These chapters provide us with some ideas about mathematics teacher PD in eight Asian countries: China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, and Taiwan. It is apparent from these chapters that there are similarities and also

differences in the approaches to mathematics teacher PD in these countries. Table 1.1 shows the various acts and national initiatives that have had an impact on teacher PD, including mathematics teachers, in the respective countries.

Table 1.1 Acts and national initiatives related to teacher PD

Country	Act/Initiative	Year	Mandatory teacher accreditation/PD requirements
China	The Teachers Act	1994	In-service teachers must do a minimum of 240 h of PD over a five year period
Indonesia	Undang-Undang Guru dan Dosen (UUGD) Number 14	2005	The law mandates standard qualifications for teachers to teach in schools and universities
	UUGD Number 14 (Chapter IV Unit 18) Law	2005	All teachers in Indonesia must have a national teaching certificate as a license to practice
			Teachers are free to engage in activities that develop them professionally
Japan	Lesson Study	Early 1900s	A cultural and traditional form of PD that is inherent in the Japanese school system
	Renewal System of Teachers' Certificate	2009	30 h of "certificate renewal courses" approved by Minister of Education, Culture, Sports, Science, and Technology
Korea	The Teachers Act (New Educational Reform Plan)	1995	In-service teachers must receive training at regular intervals. However, the plan did not specify the mandatory hours and intervals
	Reform Act	2010	Development of teaching competence was enacted into law. Teacher evaluation system by students and parents was adopted. Teachers whose student evaluation is 2.5 points or less out of a total of 5 points must undertake 30 h of training
	On-the-job Training	2011	Teachers must complete over 60 h of on-the-job training per year, which is a feature of their performance-based pay
Malaysia	Directive from MOE	2005	Teachers to undergo 7 days of in-service training per year directed by the school leaders
	Malaysia Education Blueprint 2013–2015	2013	All practicing teachers must undergo continuing PD at various stages of their teaching career
Philippines	Department of Education (DepEd) annual in-service (INSET) program	2001	An INSET program ranging 3–5 days per year according to the school calendar issued by the DepEd
Singapore	Thinking Schools Learning Nation (TSLN) vision	1997	As of 1998 teachers are entitled to 100 h of PD per year that is funded by the Ministry of Education
	Teach Less Learn More (TLLM) initiative	2005	Planned time for teachers during curriculum hours to meet, plan, and deliberate on their instructional practices was made mandatory
Taiwan	Education Act	1996	In-service teachers must do 90 h of PD over a period of 5 years
	The Education Act was repealed in 2003	2003	With the dissolution of the act, teachers now participate in PD to improve themselves without any mandatory requirements

From Table 1.1 it is evident that each of the eight countries is at a different phase in its development of teacher professionalism. In some countries there are mandatory acts and regulations governing the continuous teacher PD while in others the situation is lax and in such cases a lot would depend on the teachers' own motivation for development and also the availability of resources.

It is evident from Chap. 2 by Huang, Ye, and Prince that mathematics teacher PD in China has had a long tradition and is structured with very clear development pathways. The Teacher Act of 1994 (Ministry of Education China 1994) has led to the development of an accreditation system which sets guidelines for teachers to obtain their license to practice. There is a ranking and promotion system and teachers have to undertake a minimum of 240 h of PD over a five-year period. The local education authorities stipulate the requirements for teacher continuing education programs according to the ranks of the teachers. The major PD practices are one-to-one mentoring; practice-based research activities comprised of three clusters, namely, routine activity, competitions, and new developments; and both training and education degree programs for teachers to upgrade themselves, implement new curriculum contents and initiatives, and most importantly raise the quality of mathematics instruction in the country. Through PD there is a dedicated attempt to develop expert teachers with deep knowledge in both content and pedagogy.

In Indonesia, as noted in Chap. 3 by Kusumah and Nurhasanah, national certification of teachers was only mandated in 2005. This is probably the first step toward setting standards for teachers to be professionals. The UUGD, Number 14, Chapter IV, Unit 18, states that, "Teachers must have academic qualifications, competencies (pedagogical, social, and professional), national certification for teaching, good physical and spiritual health, and the desired ability to achieve the national education goal" (Depdiknas 2005, p. 6). Although there appear to be no guidelines as to teacher PD, it is evident from this chapter that mathematics teachers do engage in PD mainly through two types of programs. The first are programs that teachers attend outside of their schools that are often courses of study at institutions of higher learning, training workshops and conferences. The two main institutes that provide PD programs for mathematics teachers are the Educational Institute of Quality Assurance and the Institute for Mathematics Teacher Training. The second type allows teachers to engage in learning while carrying on with their duties in school. The authors note that lesson study is a good form of activity for the second type of program. The Japan International Cooperation Agency has been instrumental is initiating lesson study in Bandung, Yogyakarta, and Malang in Indonesia.

Takahashi in Chap. 4 describes lesson study as the fundamental driver for mathematics teacher development in Japan. He outlines the three levels of expertise of mathematics teachers and how lesson study develops teachers at Level 3, which is beyond the scope of any teacher preparation programs in Japan. School-based in-service training is a tradition and culture in Japanese schools, particularly lesson study, during which teachers work collaboratively to develop their pedagogy (Centre for Research on International Cooperation in Educational Development University of Tsukuba [CRICED], n.d.). Although it is not mentioned in this chapter, a recent development that has also fueled the development of teachers is the mandatory

Renewal System of Teachers' Certificate introduced in 2009 (Ministry of Education, Culture, Sports, Science, and Technology Japan [MEXT], n.d.). Every 10 years teachers have to renew their practicing certificates and two years prior to the expiration of the certificate they have to complete 30 h or more of "certificate renewal courses" approved by the Minister of Education, Culture, Sports, Science, and Technology (MEXT, n.d.). The 30 h are comprised of 12 h on core topics of reflection on teachership and understanding how children change; trends in educational policies and coordination and cooperation in and out of school; and 18 h on elective topics related to teaching subjects, guidance to students, and other topics to enrich education (CRICED, n.d.).

From Chap. 5, Kwon, Park, Park, and Park state that teachers in Korea are constantly developing themselves and that the excellent achievement of their students in international benchmark studies such as TIMSS and PISA is a result of teacher development. They must complete at least 90 h of PD activities to upgrade their initial teaching certificate (usually within 3–4 years of their preservice training). Subsequently they are required to participate in PD activities every year (Sami 2013). In 1995, the New Educational Reform Plan was announced that requires that in-service teachers must receive training at regular intervals. However, the plan did not provide any mandatory details about the number of hours and regularity of the intervals, such as every year or three years (Education Reform Commission 1996). In recent years, the government has fully supported a minimum of 20 h of annual PD for each teacher. However, most teachers attend 40–60 h of PD activities to keep abreast of new developments in their fields of expertise.

In 2005, the OECD (2005) reported that teachers in Korea had a low rate of participation in training programs. In response to the announcement of this finding, the government made training programs mandatory. The Ministry of Education and Science Technology (2010) enacted the development of teaching competence into a law. A teacher evaluation system by students and parents was adopted. Teachers whose student evaluation is 2.5 points or less out of a total of 5 points must undertake 30 h of training. In addition, as of 2011, teachers have to complete over 60 h of on-the-job training per year, which is a feature of their performance-based pay.

Chiew and Lim in Chap. 6 state that mathematics teacher PD in Malaysia mainly involves two types of activities. The first type is carried out by education agencies of the Ministry of Education (MOE), which conducts in-service courses and workshops for teachers to accomplish the requirements and changes in the mathematics curriculum. This is meant to ensure that teachers are competent to teach and deliver what is prescribed in the curriculum. The second type is more autonomous and allows teachers to take charge of their own development through research-based projects such as action research and lesson study.

The MOE has begun to try to regulate teacher PD. The directive from the MOE in 2005 mandating seven days of PD per year for teachers was not necessarily subject pedagogy specific as the school leadership was empowered to decide on the focus of the PD and often used it to address the general needs of their schools. Recent developments arising from Malaysia's participation in international benchmark studies such as PISA and TIMSS has led the MOE to examine

mathematics instruction in schools. The findings show that there is a lack of an acceptable standard of teaching in schools and thus the MOE (2012) is initiating a reform to transform the landscape of Malaysian education system. This reform, the Malaysian Education Blueprint 2013–2015, is mandating that teachers undergo compulsory continuing PD. As the implementation of the blueprint is still in its infancy, it may be too premature to say how mathematics teacher PD may change.

In the Philippines, as noted by Verzosa, Tulao-Fernando, and Vistro-Yu in Chap. 7, the Department of Education mandates three to five days of PD every year for all teachers. For some teachers this may be the only PD they undertake in the year but may not support in them in their own subjects. Therefore, mathematics teacher PD is often implemented outside of annual school INSET. There appear to be many contexts and opportunities for mathematics teachers to engage in PD but often they lacked long-term coherence.

Kaur and Wong in Chap. 8 recount how two national initiatives of the Ministry of Education in Singapore, the Thinking Schools Learning Nation vision (Goh 1997) and the Teach Less Learn More initiative (Ministry of Education 2005), have fueled teacher PD, including mathematics teacher PD. They outline how the systemic infrastructure put in place by the Ministry of Education has facilitated mathematics teacher PD. Mathematics teachers work and learn collaboratively in the classroom while addressing issues related to the teaching and learning of mathematics and being part of research projects and lesson study groups. They also engage in PD activities to suit their individual needs. They attend higher degree courses at universities in Singapore and elsewhere. They also participate in PD activities conducted regularly by the Association of Mathematics Educators, the Singapore Mathematical Society, and the Academy of Singapore Teachers.

In Taiwan, according to Lin and Chang in Chap. 9, the Education Act of 1996 stipulated that teachers must attend at least 18 h of PD per year or accumulate 90 h over five-years. However, it did not specify any particular PD that teachers must undertake. The act was repealed in 2003 and at present teacher PD is guided by three policy directions: upgrading the academic qualifications of teachers through master degrees, engaging teachers in lifelong learning through workshops and sustained school-based projects addressing the needs of teachers so that they keep abreast of educational issues and reforms and using technology to provide a one-stop resource to support teachers in their professional learning. Since 2003 the decreasing emphasis on the number of hours of PD per year or over a period of five years signals a positive development in teacher PD in Taiwan. Teachers are empowered to take charge of their lifelong learning in the spirit of professionalism.

1.3 Innovative PD Programs in Asia

Part II consists of seven chapters that showcase innovative approaches to mathematics teacher PD in five Asian countries: India, Korea, Pakistan, Singapore, and Taiwan. Table 1.2 shows some of the common characteristics of their approaches.

Table 1.2 Characteristics of PD approaches

	Participants	Site	Model of PD		Key attributes of PD program	
Country	In-service teachers	Teachers' classrooms	Cascade	Hybrid—Training[a] + work in classrooms of teachers	Situated learning	Community of practice
India	√	√	×	√	√	√
Korea	√	√	×	√	√	√
Pakistan	√	√	×	√	√	√
Singapore-1	√	√	×	√	√	√
Singapore-2	√	√	×	√	√	√
Taiwan-1 and 2	√	√	×	√	√	√

[a]Training here refers to sharing or co-construction of knowledge by experts with teachers in the PD program
√ denotes applicable; × denotes not applicable

From Table 1.2 it is apparent that all six PD programs detailed in Chaps. 10–16 (note that Chaps. 15 and 16 are different aspects of the same project in Taiwan) have similar characteristics, such as the participation of in-service teachers, the location of the PD in teachers' classrooms, the PD model being a hybrid where experts share or co-construct knowledge with teachers who integrate the knowledge into their classroom practices either simultaneously or after class, and the key attributes of the PD programs being situated learning and community of practice of teachers. None of the PD programs adopted the "cascade model" (Kumar et al. 2015); instead all of them were of the hybrid model type (Kaur 2011), which draws on the "training model of PD" (Matos et al. 2009) and supports teachers in integrating knowledge from experts or that which has been co-constructed into their classroom practice. This exemplifies a critical development in teacher PD in Asia. This development reflects a gradual shift in the center of gravity away from university-based, supply-side, off-line forms of knowledge production conducted by university researchers for teachers toward emergent school-based, demand-side, on-line, in situ forms of knowledge production by teachers with support from university scholars.

A synopsis of the innovative approaches to PD follows. Kumar and Subramaniam in Chap. 10 present a case study of an in-service teacher who participated in a PD program highlighting the constraints and affordances in bringing about shifts in the teacher's practice toward developing reasoning in mathematics. The PD program consisted of a training portion of workshops conducted by the university scholars, followed by collaboration with the teachers in their classrooms, and finally teachers in the PD program developing fellow teachers in their school who were not in the PD program. The nature of the PD program facilitated learning within the community of practice, which was comprised of teachers, teacher-educators, and researchers. This study shows promise in the potential for developing communities of practice to engage in the enterprise of analyzing and developing teaching of mathematics in schools.

Kwon, Park, Park, and Park in Chap. 11 describe a community-based mathematics teacher PD program that brought together teachers and mentors to work on common goals, thereby developing multitier communities of practice. The three-phase program consisted of a preparatory intensive course and teaching practice and collaboration followed by post-program sharing by participants of their experiences. The PD program was coherent with the needs of the teachers as it supported the present initiatives of the mathematics curriculum in Korea, i.e., STEAM classes and storytelling. In Chap. 12, Halai elaborates on an innovative PD program that draws on the classroom as a site for teacher learning in Pakistan that sparked the emergence of a paradigm shift in mathematics teacher education in Pakistan. The PD was an advanced diploma program for mathematics teachers that consisted of both training and practice aspects of development. From this chapter it is evident that in-service education and continuing PD with a strong component of a school-based practicum offers a way forward for teacher education that is absolute for teachers and schools.

Kaur, Bhardwaj, and Wong in Chap. 13 outline in great detail their teaching for metacognition-themed PD program in Singapore. Based on the hybrid model of PD, the program has three phases with teachers (classroom, lead, and master), curriculum specialists, a researcher, and a professor working together in two-tier communities of practice. The three phases of the project are training (acquisition of knowledge), integration of knowledge into classroom practice, and empowerment of teachers to develop fellow teachers. The last phase is critical for teachers to sustain their PD and induct others into practices that lead to worthy student outcomes (Kaur 2015). In Chap. 14, Leong, et al. note that for instructional innovations to take root in mathematics classrooms, curriculum redesign and teacher PD are two necessary and mutually reinforcing processes: A redesigned curriculum needs to be seen as an improvement in order to facilitate teacher buy-in—an ingredient for effective PD; on the other hand, teacher PD content needs to be directed toward actual usable classroom implements through the enterprise of collaborative curriculum redesign. In their chapter, they examine the interaction between researchers and teachers in this collaborative enterprise through the metaphor of boundary crossing. In particular, they study a basic model of how "boundary objects" located within a "replacement unit" strategy interact to advance the goals of PD.

Chapter 15 by Lin, Hsu, and Chen and Chap. 16 by Chen and Lin both are based on the same nation-wide PD program in Taiwan. The Lighten-up School Based Program (LUSBP) adopts a design-based approach and consists of tiers of educators, teachers, and students who collaborate as communities of practice and engage in crafting tasks, enacting them, and reflecting on them using student work as an input and revising them for subsequent work in mathematics classrooms. The findings of the project hold promise for school-based PD, as it facilitates teacher growth and also the development of teacher-educators who experience the integration of their expert knowledge through the teachers in the classrooms and the tensions that may arise during the process. Chen and Lin in Chap. 16 describes how two schools participating in the LUSBP worked with diagnostic conjecturing activities during their PD. From the findings of the study of the two schools it is

apparent that the teachers' learning from the workshops designed to equip them with knowledge about conjecturing activity know-how was integrated into the classroom practices of the teachers. As teachers worked in their respective communities of practice they supported and also challenged each other to develop and refine their student-centered teaching practice.

1.4 Interacting but Diverse Asia

From the broad review in the above sections, it appears that PD practices within some jurisdictions in Asia have reached a rather stable state. The example of teacher PD in Japan is a case in point. In almost all reports about teacher PD in Japan, including the one included in this volume by Takahashi (Chap. 4), there is a unified and relatively unchanging image of how PD among mathematics teachers are conducted: Lesson Study. According to a number of Japanese writers, the origin of Lesson Study is traceable to the year 1872. Against the global norms of educational shifts—and hence the shifting forms of PD practices—the relative stability of Lesson Study across temporal and geographical zones within the country stands as a rather unique model of sustainable teacher PD.

There is evidence that, since about two decades ago, Lesson Study as a form of teacher PD has been 'imported' to other Asian countries (e.g., Isoda et al. 2007). Further evidence can be found in this volume—Chap. 3 by Kusumah and Nurhasanah on mathematics PD Programmes in Indonesia, Chap. 6 by Chiew and Lim on mathematics teacher PD in Malaysia, and Chap. 8 by Kaur and Wong on PD of mathematics teachers in Singapore.

However, other chapters that describe PD strategies at national level did not mention influences from the enterprise of Lesson Study. These include South Korea (Chap. 5), the Philippines (Chap. 7), and Taiwan (Chap. 9). Moreover, there were also no reference to Lesson Study in the chapters that detailed specific PD implementations in India and Pakistan (Chaps. 10 and 13, respectively). Even in the case of Singapore where Lesson Study was ostensibly foregrounded, it was described as one of a number of other platforms (such as Learning Circles and Action Research) for ongoing school-based PD. In addition, other emerging forms of PD in Singapore such as the "Replacement Unit Strategy" were also being developed (Chap. 15).

In other words, while there is interaction across the continent in terms of exchanging ideas on PD strategies, countries within Asia are embarking on their respective journeys with regards to finding their own way in mathematics teacher PD. Given their different historical–political trajectories, it is not surprising to read about diverse practices of teacher PD in different regions of Asia. Thus, while perhaps the conditions in Japan would conduce to uniformity and continuity in PD practices, in most other parts of Asia, there are more experimentation and openness in developing PD strategies that suit the sociocultural contexts of the respective jurisdictions.

Fundamental challenges also vary widely across the continent. In some regions, the effectiveness of PD at scale is threatened by macro-level issues such as national education policy reversals and population-wide low commitment to high-standard education. In other jurisdictions, the attention in PD efforts are directed at more 'local' challenges such as the networking of teachers into learning communities and the tailoring of PD programmes to render them more relevant to the actual instructional practices of the teachers.

1.5 Convergences in Asia

Despite the diversity, the chapters in this volume point to some convergences of mathematics teacher PD in the region. First, almost all the PD programmes reported in this book included components which were school-based—and which were designed to address issues that resonated with teachers' experiences in practice. This aspect of nearness-to-practice is inherent in Lesson Study; thus, the countries that utilised this enterprise as a prominent platform for PD—such as Japan, Indonesia, Malaysia, and Singapore—are included in this class; but it is certainly not limited to Lesson Study. For example, projects in China and Korea involved "practice-based" or "practice-oriented" approaches to teacher PD. In China, PD for teachers—at all levels of expertise—was conducted primarily in a context where teachers observe and discuss about exemplary teaching within classroom instructional situations; the Korean project (as described in Chap. 11) focused on an instructional innovation of "story telling" by examining its use and modification in actual classroom use by teachers.

The Lighten-Up School-Based Program (LUSBP) in Taiwan is another example of a project that emphasized school-based approaches in PD. Teachers participated in PD in this programme through the process of planning instructional materials, implementing the materials in their classes, and reflecting upon the implementation for learning and changes for subsequent teaching. In the case of the project located in Pakistan (Chap. 12), the PD for practising teachers included a "Practicum" component. This is novel in that we would usually associate Practicum with pre-service teacher education. Through interactions between what was taught during PD classroom settings and Practicum teaching, teachers in the project reflected on how newly introduced ideas can be incorporated into their classroom practice.

That this movement toward school-based approaches in PD practices within some parts of Asia is a rather recent phenomenon is acknowledged by the authors of a number of chapters in this volume (e.g., Chaps. 12, 13 and 16). This signals a likely significant shift from traditional conceptions of PD being university-based course offerings to one where actual problems of practice become the objects of inquiry in teacher learning.

Closely related to this trend toward nearness-to-school is the "collaboration" between mathematics teacher-educators (usually working in university contexts) and mathematics teachers (in schools) in redesigning mathematics curriculum or

instruction. Collaboration in this sense is conspicuous in a majority of the reports found in this volume. Teacher PD is located in such collaborations as teachers interact with other experts outside of the school system. Quite different from the model of teachers as passive receivers of knowledge—associated with traditional in-service courses given by university professors, this emerging model, as represented by the "collaboration" metaphor, encourages teacher learning by working with these experts—and in the process, they examine new knowledge domains, reflect on existing teaching practices, and clarify novel teaching approaches.

1.6 Distinctively Asia?

It may be argued that the "convergences" mentioned in the above section are not distinctly an Asian phenomenon, but really a global movement. All over the world, PD practices are tending toward nearness-to-school and collaboration with teachers (e.g., Robutti et al. 2016; Weiβenrieder et al. 2015). But when we examine closer the kind of school-based and collaborative work that researchers do—as reported in the chapters here—we find clues for points of departure at various areas. First, the PD programmes were usually conducted within the broader framework of a national or provincial vision of quality pedagogical practices. This means that the researchers entered the school with a prior interpretation of how this vision can be translated into actual instructional practices in the classroom. In other words, the researchers began the engagement with schools with a rather clear portrait of how the schools can realise the educational ideals of policy makers. Second, and closely related to the first, "collaboration" with teachers based on this model of engagement means that the researchers proposed and charted the agenda of instructional design, while the teachers provided inputs for tweaking some aspects of the design. This picture of collaboration is not one of complete equality of roles and voices. It is a model where university mathematics educators were regarded as possessing knowledge—of both mathematics content and pedagogical expertise—at a higher vantage point, teachers usually learnt from these experts and less the other way round, and teachers contributed to the enterprise by highlighting practical constraints, and sharing their learning experiences.

We think a depiction of this rather distinctively Asian way of doing school-based and collaborative PD is "pragmatic". We use this term in two senses: (1) Researchers are less locked-into traditional paradigms of research, neither is research in teacher education oriented toward formulation or development of global theories (as in abstractions for the purpose of universal applicability). Rather, teacher PD work proceeds along the lines of pedagogical fundamentals that tapped on a range of disciplinary traditions. Thus, the use of eclectic frameworks is the norm; (2) the whole enterprise of teacher PD is goal-driven in deference to policy objectives: the main goal is to improve instructional practices in the classroom—toward policy ideals—through teacher PD. What counts as quality instructional practices are centrally crafted and usually resides in the higher reaches of the

policymaking structure. During PD, these parameters are interpreted into instructional designs that are sensitive to teachers' authentic practices.

This pragmatic approach is perhaps most appropriate for societies—such as in most Asian countries—with a history of more centralized administration. Within this model, mathematics teacher educators tap on a rather stable and widely-accepted repertoire of theoretical starting points—as supported by the administration, and focus on teacher PD that integrates these ideals into the realistic framework of teachers' practices. This approach channels less resources on negotiation between researchers and teachers and more resources on making 'it' work in the classroom.

At this stage, it is unclear if this pragmatic approach—arguably the Asian way—would make way for other ideologically based methods of teacher PD. This next step of the Asian journey in teacher PD may contribute to the larger rhetoric of whether 'east' and 'west' would find their respective paths of development or they would ultimately converge.

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