Preface

Professional development (PD) is a growing area within the field of STEM. There is increasing need for STEM teachers’ professional development activities in higher education across the world. Effective PD that serves for effective teacher learning in the long term requires cognitive, knowledge and practical development simultaneously. To this end, constructive, socio-constructive, and interactive approaches to PD are documented in this book in a way to show how teachers develop and are likely to change for better instruction and student learning. In this sense, the professional development strategies that teachers are involved in should reflect cognitive, constructive, interactive, thought-provoking and argumentative aspects of development. The major mission of this book is to bring together implementations of effective professional development strategies including those that are trainee-based and process-oriented, which extends the amounts of cognitive engagement and lead to concurrent cognitive and behavioral changes in teachers from the field of STEM education. However, the impact of various types of PD activities across the world needs more extensively documentation. The chapters in this book focus on the description, implementation and impact of PD strategies on the participating teachers and highlight several characteristics of trainees who are intrinsically motivated to develop and change personally and professionally.

Teachers’ Professional Development and Learners

PD has been one of the critical areas in education sector in relation to teacher learning and development particularly at higher education level. The importance attached to PD increases as students’ profile is changing towards one that encompasses more in-depth capabilities enabled through multifaceted educational tools particularly thanks to the developing digital facilities connected through information exchange and sharing technology. This incremental and exponential change in student profiles necessitates developmental pedagogical growth in teachers who can address these shifted and increased students’ learning potential. This book showcases these efforts for teachers’ professional development across the world from a wide range of specific contexts.

In line with these development on the part of student profiles, the nature of PD is also changing from top down approach, which is externally governed to bottom up approach, which is internally initiated or individually managed over a course of period. The latter is introduced as a more contemporary approach in that it leads to more self-control over PD and more relevance to personal needs for own learning and development. These two basic approaches serve for different purposes. The former addresses short term
Preface

needs for discrete skill learning based on preset learning outcomes, while the latter addresses long term needs based on development personally identified which required cognitive processing of what is learnt. Knowledge generated in this way might lead to more permanent learning and developing ownership of self-constructed knowledge. Learners are the primary beneficiaries as opposed to actors and learning is the ultimate process that needs promoting through the impact of PD participation.

Professional Development Methods and Strategies

Several different methods and strategies are employed to promote teachers’ knowledge, beliefs and skills which could play a key role in enhancing students’ learning and promoting school development, which in turn contribute to socio-intellectual progress. In general there are two general paradigms to the concept of professional development. One is the top-down models which are planned, designed and delivered by those parties who are not going to benefit directly from the intervention namely decision makers such as administrators or coordinators. The other is bottom up models which prioritize those who will benefit from the interventions, namely the teachers. In the latter teachers are given the control of their own professional development with little or minimized interference from others such as trainers, supervisors or mentors. Teachers’ own needs and ideas are centralized in these models, thus helping them sustain their professional development with an intrinsic motivation which includes a purpose to fulfil or a benefit to make at the end. On the other hand, the former may not be addressing and covering teachers own needs and understanding, thus leading to little or no positive impact at the end of the engagement in the activities.

Most PD models require principles of bottom-up paradigm, which is supported by top-down resources. This clarifies the role of each party. Teachers’ role has shifted from the recipient of knowledge to constructor of it, which has also changed PD providers’ role from source of knowledge to supporters of personal and social knowledge construction. However, it should be noted that top down models are not completely ignored but are changing in nature. When top down decisions are taken in relation to the needs of the teachers, and the guidance and control of the training process is shared democratically, where teachers also play key roles in learning new knowledge and skills, then top down models are not to be harshly criticized. Similarly, bottom up models may also bring about failure in creating efficient impact and results if the participants are totally given the control of the training process. First, it could be because trainees or teachers may not possess the skills and knowledge to decide properly on exact PD procedures to be followed. Second, general organization of PD can be evaluated and developed on the basis of the expert input and perspective without any relevance to the actually needs of the trainees. It is then clear that two models should go hand in hand to ensure quality of PD and clear and observable influence of the participants.

Scope of Professional Development

In the light of the discussion hitherto, it is necessary to consider a set of nine standards that all professional development should follow which were highlighted by The National Staff Development Council (2007): content knowledge and quality teaching, research-basis, collaboration, diverse learning needs, student learning environments, family involvement, evaluation, data-driven design, and teacher learning. This
set of standards shows that professional development is a social activity that involves full participation and consideration of a wide range of parties from researchers to families of students. It is this integrity that could lead to greater learning on the part of the person who is doing professional development.

PD is no more an exception but a necessity. However, it should be well-resourced and supported in terms of money, time, incentive, and support. It is the institution that could provide all these conditions by offering finance and guidance. Therefore, the context where PD is carried out plays a major role in the continuation of professional learning opportunities. PD could empower and influence teachers, learners, and the schools positively when teachers’ efforts are appreciated and considered in future decisions of curriculum, syllabus and appointment, which could lead to more motivation to do professional learning on the part of teachers.

Overview of Chapters

The future of PD seems brighter than it is today particularly because so many research studies are being carried out and disseminated which richly delineate and critically evaluate and insightfully synthesize the professional development activities in a wide range of disciplines. The chapters in this book are also adding to that increasing number of publication. This book is a collection of studies carried out in diverse contexts and contents including science, math, education, engineering, technology. It also encompasses theoretical research studies from pre-service and in-service levels, which helps see the status of professional development from different layers of education for professional community. Professional development of STEM teachers are also discussed and presented with special emphasis on theoretical perspectives underlying these PD initiatives.

In the first chapter, Smith, Fulton, Irons, and Sanders elaborate on the major role that practice-base doctorates, a new approach to promoting practice through project work, play in developing experienced practitioners’ professional practice in STEM subjects. In the second chapter, Farland-Smith details how to mentor girls in science drawing on eight case studies which involve content specialists and middle school girls in order to provide implications for diverse roles of teachers and scientists in learning and teaching science. In the third chapter, Martin, Polly, Wang, Lambert, and Pugalee describe and discuss a mathematics professional development in order to report the potential impact of primary grades teachers’ online reflections over the internet-based formative assessment system on their fidelity of implementation. In the next chapter, Günel, Özer-Keskin and Keskin-Samanci delineate a paradigm shift in the structure of in-service science and technology teachers’ professional development in Turkey by explicitly focusing on how PD has been moving from instruction to learning through process-based approaches with a view to affecting teacher learning. In the fifth chapter, Rogers, Winship, and Sun draw on social constructivist and interactive approaches and describe an authentic and sustainable four-pillar professional development model which provides systematic support for STEM pre-service teachers to promote K-12 students’ authentic STEM learning experience. In the following chapter, Dickenson and Montgomery describes the critical role of teacher professional development in mathematics in developing relevant instructional practices and teachers’ leadership skills. In chapter 7, Ateş Özdemin and Dikilitaş describe a pedagogical technology-oriented professional development programme conducted with a group of in-service teachers from different subjects and report short and long term impact that the programme had on the participating teachers’ integration of technology into their classrooms and institutions.
Preface

In the next chapter, Van Ryneveld describes a professional development programme that involves training educators to develop skills by which to use educational technologies especially for suggesting how technology can be integrated effectively in higher education. Chapter 9 by Polly, Martin, Wang, Lambert and Pugalee describes two learner-centered PD projects which aim to facilitate mathematics teaching practices of elementary school teachers with an emphasis on the implications for PD program designing, which is based on learner-centered PD in mathematics. Chapter 10 by Topkaya and Nişancı involves an ESP context and identifies the target needs of non-native science and mathematics teachers for the use of English in their professional/school settings. The data triangulated through interviews with stakeholders in the programme revealed a critical need for developing training aiming for productive skills. In the next chapter, Kırkgöz describes and discusses potential impact of a collaborative action research professional development programme on the change in the pre-service teachers’ beliefs and teaching practices with special emphasis on implications for school-based professional development. In chapter 12, Rakıcıoğlu-Söylemez and Akay investigate prospective EFL teachers’ perceptions of using CALL in the classroom to identify perceived benefits and challenges which facilitate and inhibit future teaching practices with reference to the implications for professional development and EFL teacher education programs. Chapter 13 written by Mede-Saban and Keşli-Dollar describes the possible effects of reflection-based teacher development activities such as diary keeping on pre-service teachers’ perceived instructional practices, self-awareness and strategy implementation. In chapter 14 Rakıcıoğlu-Söylemez, Söylemez, and Yeşilbursa analyze pre-service EFL teachers’ metaphors to explore their beliefs about teachers and teaching and the potential sources of impact in the prospective teachers’ beliefs and practices in order to draw implications for identifying areas of improvement for professional development.

Overall, this edited volume brings together detailed descriptions and experiences of constructive, socio-constructive and interactive approaches to PD and offers a diverse collection of chapters from different STEM subjects including education and provides potential impact areas on trainees and implications drawn for trainees and trainers. It is my hope that academicians, researchers, advanced-level students (MA and Ph.D), and technology developers will find this book beneficial and contributing to their PD engagement in relevant topics in STEM subjects and education.

Kenan Dikilitaş
Hasan Kalyoncu University, Turkey