

Teacher professional development in sub-Saharan Africa: Equity and scale

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1. Education in sub-Saharan Africa

The educational issues in sub-Saharan Africa (SSA) have been known for decades:

“poorly-resourced schools; large classes; a curriculum hardly relevant to the daily lives of students; a lack of qualified teachers; and inadequate teacher education programs” (↑Ottevanger et al., 2007, p. v).

While the issue of large classes has been addressed, at least in some contexts, this has often been through drawing on unqualified teachers; the student number per qualified teacher remains high (↑World Bank, 2016). The United Nations (UN) post-2015-pre-2030 development agenda focuses on raising the quality of teaching and learning in schools (↑United Nations, n.d.) and, in particular, on supporting teacher learning (e.g. ↑Westbrook et al., 2013; ↑Orr et al., 2013; ↑Moon & Dladla, 2013). There is an increasing consensus that African teacher education needs to focus on more effective and culturally appropriate pedagogical practices, both in the classroom and at the school level.

2. Insights into teacher professional development and learning in SSA

The teacher professional development and learning (TPDL) insights presented in this report originate mainly from three reviews, chosen because they draw on international literature highlighting what works in both high-income and low- and middle-income countries (LMICs). Synthesising findings from various regions of the world is critical to determining contextualised best practices, or what works, and how, in different countries. For clarity in a single chapter, we will use the term TPDL to refer to both initial and continuous professional development.

The three reviews are:

- ↑Haßler et al. (2018). Grounded insights for teacher professional development. Referred to as [Grounded Insights](#), this review provides an evidence base for nine characteristics of TPDL.
- ↑Cordingley et al (2015). Developing great teaching. Referred to as [Developing Great Teaching](#).
- ↑Bethell (2016). Mathematics education in sub-Saharan Africa. Referred to as [Mathematics Education](#).

To distinguish these three references from the text flow, we have used the Ethiopic word separator ‘፡’ (Unicode U+1393) for decoration. The first review ([Grounded Insights](#)) summarises the evidence base in SSA. As this is not well developed, the insights from [Grounded Insights](#) are of a narrative nature and are more tentative than the second review ([Developing Great Teaching](#)), which builds on the more prolific and rigorous evidence-based literature in higher-income countries. As it was commissioned for the UK, [Developing Great Teaching](#) uses ‘international’ to mean ‘outside the UK’. The third review, [Mathematics Education](#), focuses particularly on Cameroon, Democratic Republic of the Congo, Ethiopia, Nigeria, Rwanda and Uganda; it is used here because it offers valuable insights on TPDL. Given the different foci of these reviews, reliance on their

findings has to be considered carefully. As [Grounded Insights](#) notes, much of the evidence in LMICs is small-scale. The discourse around rigorous and systematic teacher-development research is more extensive in developed countries ([Hill et al., 2013](#), [King, 2014](#)) and [Developing Great Teaching](#) outcomes are more secure; however, they pertain to higher-income countries and may not always translate to low-income settings (Table 2.1).

While this chapter does not offer a direct synthesis of the primary evidence, the TPDL features discussed here draw on the broad sets of literature used in the three reviews. This evidence includes:

- **Limited evidence from TPDL research in LMICs**, i.e., [Grounded Insights](#) and other studies, e.g., [Lange, 2014](#); [Moon, 2007](#); [Nag et al., 2014, p. 29](#); [Orr et al., 2013, pp. 75–76](#); [Westbrook et al., 2013, pp. 60–61](#);
- **Wider TPDL literature in developed countries**, i.e., [Developing Great Teaching](#) and other studies, e.g., [Timperley et al., 2007](#); [Borko et al., 2010, Table 2](#); and the [Education Endowment Foundation \(2014\)](#). [Hattie's \(2009\)](#) meta-analysis of over 800 factors influencing attainment, indicating an overall large effect size (0.62) for professional development, is important;
- **Additional insights**, e.g., from regarding school improvement (Ethiopia: [Mitchell, 2015](#)) and Leadership for Learning ([Frost, 2014](#)).

Given the existing evidence, it seems unlikely that an entirely different set of insights would somehow apply to TPDL in SSA. The existing literature constitutes a sensible first approach to TPDL in SSA. In our view, this evidence needs to be taken very seriously, particularly in the absence of reliable evidence to the contrary. We define effective TPDL in terms of its impact on student attainment. However, such an impact relies on the TPDL being well designed. Hence, both publications ([Developing Great Teaching](#) and [Grounded Insights](#)) seek to draw out the characteristics of effective TPDL.

3. Validity of [Developing Great Teaching](#) for LMICs

As highlighted above, the evidence base for TPDL in LMICs is less secure than in higher-income countries. So, we need to consider some of the key differences between high-income and low-income settings. The messages of the [Developing Great Teaching](#) (UK, high-income countries) need to be considered in relation to the original setting in which the messages were generated and the new setting where they are applied. Table 2.1 outlines several of the differences that must be examined when considering the evidence base of high-income countries in relation to low-income countries.

Table 2.1. Differences between high-income contexts and LMICs

	High-income countries	Low- and middle-income countries
School environments	The school environment is usually functional, offering a relatively safe environment for teachers and children. There may well be strong — and perhaps distributed — school leadership. Schools may have liberal traditions regarding political and gender identity, and may be sensitive to special educational needs and disability. Nevertheless, there may be exceptions to this, for example for students with low socio-economic status.	School environments may be dysfunctional. In many settings, schools do not offer adequate sanitation. Certain learners may be marginalised because of gender, special needs or other characteristics. In some settings, female students are at risk of violence, both in and outside of school.
Resourcing constraints¹	Usually insignificant.	Usually severe in rural areas. Moderate even in urban areas.
Formal qualifications of teachers	While requirements for formal qualifications vary between school types, higher-achieving schools will have well-qualified staff, who have undertaken reasonably effective initial or continuing programmes. However, due to staff shortages schools increasingly draw on lower-qualified staff.	Often, initial teacher programmes are of poor quality, with a theoretical focus that does not equip teachers to teach effectively. While the teacher–student ratio has improved, the number of qualified teachers remains low in many contexts. Where teacher standards have been formalised, they may not be implemented.
Teacher motivation to teach	Teachers are often demotivated, and there are issues with teachers leaving the profession. However, while under contract, teachers will be active in schools.	Teachers are often demotivated, e.g., due to the prevalent infrastructure constraints, delayed payment, etc. In some countries, there are significant problems around teacher absenteeism.
Teacher appreciation of TPD	Teachers recognise the importance of TPD, for example, as a prerequisite for career progression. It is fair to say that there is a ‘culture of TPD’. However, TPD can be side-lined due to teacher workload.	There is often no culture of TPD. An initial qualification (obtained at the start of the career) is seen as sufficient. As promotion is often not based on qualifications, teachers may not be motivated to undertake TPD.

¹ E.g., electricity, transport, writing materials, internet access.

4. Principles for designing effective TPD

It is becoming increasingly clear that narrowly focused ‘solutions-driven’ approaches or ‘quick fixes’ do not result in improved learning outcomes for children. Instead, systemic approaches are becoming favoured, which take a wider view, focusing on specific obstacles as they arise (↑Haßler et al., 2019). Table 2.2 presents the factors that need to be considered in developing comprehensive and effective TPD.

Table 2.2. Factors involved in a systemic approach to TPD together with the relevant Principles

Students (at all levels)	Student-level factors arise from students’ backgrounds, such as the languages spoken at home.	Principle 1
Classroom practices	Including teacher–student and student–student interactions.	Principle 2
Teachers	Factors to do purely with teachers (outside the classroom), such as TPD, motivation, working conditions.	Principle 3
School/ community/ clusters	School-level factors and factors that concern the community as well as clusters of schools (e.g., working together on TPD).	Principle 4
National level	National factors, including policy and policy implementation, teacher income, status of the teaching profession.	Principles 5–8

Principle 1: TPD should focus on student learning outcomes – what the student does

TPD must explicitly and directly promote – and focus on – student learning outcomes. TPD must, therefore, focus on teaching and learning practices that promote student learning outcomes. Student learning outcomes encompasses a broad range of outcomes, including basic skills, life skills, socio-emotional and mental-health skills.

In the light of [Developing Great Teaching](#) and [Grounded Insights](#), Principle 1 should be considered reasonably secure. Both reviews are clear that TPD must promote, and focus on, student learning ([Grounded Insights](#), Characteristic #1). Indeed, the rationale and the evidence base for the first and second characteristic is particularly strong.

TPD that promotes student learning outcomes needs to focus on teaching practices that promote such outcomes. In other words, teachers need to draw on effective teaching

practices in the classroom. This is the focus of the second characteristic. As [Developing Great Teaching](#) notes, there is a need to distinguish between types of professional learning aimed at:

Type 1: operational and procedural knowledge;

Type 2: building on teachers' skills to significantly enhance pupil learning outcomes.

Type 1 TPLD includes, for example, workshops for instructing teachers on how to use fire extinguishers or how to comply with legislation or monitoring and evaluation systems. Such topics may only require simple briefings and group discussion. Type 1 goals lend themselves to a cascade model; the transmitted messages are simple and can be easily learnt through repetition. However, [Developing Great Teaching](#) notes that professional learning, which does not have a strong focus on aspirations for students and assessing the impact of changed teacher practices on pupil learning, is not effective. For Type 2 TPLD, the usual simplistic cascade/ multiplier models are ineffective ([Grounded Insights](#)). Attempts to apply these models of any objective beyond the transmission of basic procedure-oriented messages will not be successful. However, where interventions are successful, they become self-reinforcing:

“interventions are most effective when they bring significant, positive changes to the daily experience of learners” ([Mathematics Education](#), p. 69, with reference to ↑[Evans & Popova, 2015](#)).

Regarding equity, 'equitable access to learning' must mean the opportunity to actually improve one's learning outcomes, rather than simply to access a 'learning institution' (a school).

Principle 2: TPDL should focus on effective teaching practices – what the teacher does

Effective classroom teaching practices to support student learning outcomes include: giving good feedback; promoting metacognition and self-regulation; utilising mastery learning; collaborative learning (group work and peer tutoring); and oral language interventions (whole-class dialogue, questioning, code-switching). Effective teaching combines such approaches in lesson sequences in safe, inclusive environments that are sensitive to pupils' backgrounds and achievements (including language).

Given that TPDL should focus on student learning outcomes, a reasonable second principle is that TPDL should also focus on teaching practices that bring about improved student learning outcomes. ↑[Westbrook et al. \(2013\)](#) noted the following factors as having an impact on pupils' learning outcomes:

1. Feedback, sustained attention and inclusion;
2. Safe environments;
3. Drawing on pupils' backgrounds.

Furthermore, they identified the following as practices that are characteristic of effective teachers:

- Whole-class dialogue;
- Group work;
- Questioning;
- Pedagogical content knowledge;
- Code-switching;
- Lesson sequences.

Another important source for this principle is the toolkit for teachers provided by the Education Endowment Foundation (2014), which reviews effective classroom practices for UK students aged 5 to 16 years, in relation to cost and evidence. Certain teaching practices are highly effective at a reasonable cost, including feedback, reading comprehension strategies, metacognition, oral language interventions, collaborative learning and the use of technology in education. While the toolkit was developed in the UK context, its findings are broadly corroborated by our two key sources. Bearing in mind the key differences indicated in Table 2.1, many of the main strategies of the toolkit appear to be equally applicable to low-income countries.

Finally, as with the first principle, we note that effective classroom pedagogy, i.e., classroom pedagogy that improves learning outcomes and responds to local needs, is a necessary condition for sustaining and scaling TPD. If the programme is ineffective, and teachers do not see an impact on pupils, it will not be sustained ([Grounded Insights](#)). Similarly, 'equitable learning' requires all pupils to be taught by teachers who are effective.

Principle 3: TPDL should promote teacher learning and recognise teachers as professionals

TPDL must promote teacher learning in appropriate ways. Teachers must be recognised as professionals, capable of learning and progressing. If students are to become skilled problem-solvers and critical thinkers, teachers must be skilled (pedagogical) problem-solvers and critical thinkers too. TPDL should model interactive pedagogy and active, collaborative learning in TPDL sessions. In order to solve shared problems, TPDL should include collective inquiry, reinforced through shared lesson planning, structured peer observation and peer support (in and out of the classroom).

As well as promoting student learning (Principle 1) and effective classroom practices (Principle 2), TPDL must also promote teacher learning ([Grounded Insights](#), Characteristic #2). Additionally, this teacher learning must not focus on general knowledge, but specifically on promoting student learning. In other words, TPDL needs to empower teachers to support students to learn effectively within effective, inclusive classroom environments.

Teachers often begin participation in TPD after years of experience. It is important that this experience is not ignored or undermined. Teachers' practical and professional knowledge should be recognised and valued as a means of not only motivating them to engage and participate in TPD but of leveraging their knowledge through collaborative dialogue and active learning:

"Rather than trying to 'plug gaps' in teacher knowledge, programmes ideally empower teachers to become reflective practitioners, able to identify gaps in their own knowledge and skill, and to acquire these as needed" (↑Hardman et al., 2011; [Grounded Insights](#), p. 62-63).

Empowering teachers as reflective professionals is done by addressing teachers' needs, modelling interactive pedagogy, and providing opportunities for critical inquiry, active learning, and teacher collaboration. As in the case with student learning, this too should be backed up by data on teacher competencies or standards (↑McMahon, 2019). ↑Bainton et al. (2016), working in SSA, recommended that schools and educational institutions "*fund diagnostic research to identify research gaps in teachers' knowledge*" (p. 18).

Moreover, school leaders can play an integral role in meeting these needs. A study of 40 primary schools across New Zealand (↑Education Review Office, 2018) found that school leaders played a key role in identifying the strengths and needs of their teachers, setting out clear objectives based on the context of their schools and staff, and either providing internal TPD or outsourcing it selectively to expert providers (↑ERO, 2018). These leaders established specific targets, identifying the year levels, groups of students and operational domains they should focus on; thus, providing clear direction and reducing the tendency to focus on aspects of the curriculum where the children were already succeeding (↑ERO, 2018).

Modelling interactive pedagogy and active, collaborative learning in TPD sessions

↑Schweisfurth (2011) noted that, in LMICs, interactive pedagogy is not only the message, but also the medium. Teachers should be trained in interactive, learner-centred pedagogy by trainers and facilitators who model these instructional strategies. The literature unanimously agrees that modelling effective teaching practices is an essential component of productive TPD (e.g., [Grounded Insights](#), Characteristic #2A). ERO, 2018, p. 19 expands upon this, recognising how external TPD facilitators may model new teaching strategies and support improved leadership practices.

Modelling may happen at the classroom level as well. By inviting more confident colleagues into their classrooms, teachers can see their students being taught using new pedagogical strategies that may be unfamiliar to them. For example, the ERO (↑2018, p. 30) explains how successful programmes invited mathematics specialist teachers to work with small groups of children within classrooms, so that teachers could observe their practice first-hand.

However, workshops also need to model in other ways. Lesson planning is one example. [Developing Great Teaching](#) argues that TPD leaders should

"model explicitly the quality and depth of planning for schemes of work that leaders are expecting teachers to create for their pupils and make these connections explicit" ([Developing Great Teaching](#), p. 13).

In addition, contextualisation – for specific subjects, individual pupils, or groups of pupils, including advanced students or those with special needs – must be addressed in TPDL modelling.

Teacher learning, like student learning, needs to be as active and learner-centred as possible. Workshops and training sessions should focus on modelling the type of learner-centred activities and exercises that teachers are expected to implement in their own classrooms. In other words, teachers need to be given meaningful opportunities to apply what they learn in TPDL, such as whole-class brainstorming, small-group work or partner projects, as well as focused and critical collaborative dialogue. Overall, teacher trainers and facilitators should not simply lecture, or

“give [teachers] materials without giving them opportunities to develop skills and inquire into their impact on pupil learning” (Developing Great Teaching, p. 8).

Enquiry encourages teachers to think critically about their approach to teaching and how to improve it, and to examine their pedagogical strategies and the impact those strategies have on student learning. In order to guide this enquiry, therefore, it is important that teachers refer to hard evidence of student achievement (or lack thereof) as a way of examining where their practice may be improved. This auto-examination, a critical reflection on one’s own practice, helps develop metacognitive skills:

“Fostering a meta-cognitive approach among teachers was also consistently recognised as valuable for both bringing about change and sustaining learning” (Developing Great Teaching, p. 7).

[Grounded Insights](#) (Characteristic #2A) notes the importance of TPDL supporting collaboration with peers. Similarly, [Developing Great Teaching](#) notes that *“The only common finding across all reviews was that peer support was a common feature in effective CPDL”* ([Developing Great Teaching, p. 7](#)). However, in general, it is unclear what exact form peer support should take, and how it is different to in-depth specialist support. This is an area that requires further research.

Existing TPDL models take different approaches to peer support:

- **Shared lesson planning.** The models described in [Grounded Insights](#) do have clearly structured school-based collaboration among teachers.
- **Structured peer observation and peer support (inside and outside the classroom).** Similarly, making arrangements for structured peer observation (e.g., using specific forms) has been helpful; otherwise, the reflection at the end of lessons stays at the surface. Within the peer-support structure, less confident teachers could be partnered with more confident teachers, as in the case of the school-based TPDL programmes in New Zealand ([ERO, 2018](#)). Similarly, structures for mentorship could be put in place ([Bainton et al., 2016](#)).
- **Collective enquiry.** This can be a catalyst of positive change. Teachers looked closely at *“what they believed and whether their actions were consistent with their beliefs. If they noticed misalignments, they investigated how they could change their practice”* ([ERO, 2018, p. 12](#)). In the case of mathematics TPDL specifically, ([Education Review Office, 2018](#)) identified several approaches to collective teacher enquiry, including:

- identifying students' strengths and weaknesses in mathematics and brainstorming possible reasons for the weaknesses;
- having instructional leaders ask 'sensitive questions' that provoke teachers' deep reflection on their approach to mathematics teaching;
- focusing on a school-wide TPD structure that incorporates developing both teachers' mathematical content knowledge and pedagogical content knowledge.

For these aspects to be feasibly undertaken by teachers, space in the school routines need to be created. We return to this in Principle 4.

Seeing, experiencing, reflecting

The cycle of seeing, experiencing and reflecting is a powerful process to enhance teachers' understanding of pedagogical practices and thus their effectiveness in the classroom.

[Grounded Insights](#) (Characteristic #2B) suggests that enabling teaching to be seen and experienced first-hand, through video clips of microteaching episodes or by observing live classroom practice, is the first step in improving teaching. Seeing is most helpful, however, when teachers focus on increasing their understanding of pedagogical practice. Carefully designed activities using video clips as a stimulus for discussion can be highly effective; rather than looking at live classroom practice, video clips allow teachers to practice their observation skills, with the benefit of being able to pause and rewind. This, of course, assumes that there are facilities for playing video clips in LMIC settings.

[Grounded Insights](#) (Characteristic #2B) notes the importance of foregrounding concrete and detailed (planning for) classroom-based activities, combined with reflection on those activities. [Developing Great Teaching](#) also emphasises the importance of transitioning from TPD activities to classroom-based activities. TPD should not only provide teachers with new skills and knowledge, but with opportunities to apply these new skills and knowledge to practical classroom-based activities. Once these concrete classroom-based activities are designed and critically considered, they must be trialled; finally, this trialling should be followed by enquiry and reflection. This allows for a cyclical approach to professional development (plan–teach–reflect), and for an iterative process through which teachers can continue to fine-tune their practice and improve the effectiveness of their teaching for the specific context of their classroom and students.

The first three principles considered student learning outcomes (Principle 1), teaching practices that lead to such outcomes (Principle 2) and the teacher learning needed to undertake such teaching practices (Principle 3). We now move beyond students and teacher factors to consider school- and cluster-level factors relating to the organisational principles of TPD; as the ERO report describes it, "*a set of expectations and practices to be consistently applied school-wide*" (↑[ERO, 2018, p. 33](#)). Principle 4A is derived from insights that are supported by evidence from very high-income countries (VHICs) but, nevertheless, applicable to low-income countries. Principle 4B is based on insights primarily supported by evidence from low-income contexts; necessarily, the scarcity of research means that these insights are somewhat less secure than those for Principle 4A. The remaining sections draw on insights from both high-income and low-income contexts and address the

roles of various stakeholders, including school leaders and parents, families and communities.

Principle 4A: TPDL sequencing and duration in VHICs

TPDL needs to be carefully sequenced, long-term and regular. In many contexts, this means that TPDL should be school-based. One-off events (e.g., 'residential workshops') do not work.

TPDL models that tend to focus on one-off 'top-down' teacher-development 'interventions' are now recognised as being ineffective (↑[Moon & Dladla, 2013](#); ↑[Bett, 2016](#)). Scheduling ongoing, long-term and continuous TPDL is therefore of critical importance for programme effectiveness and for ensuring that TPDL is not sidelined. Structured arrangements are necessary to

"follow up learning from [TPDL] programmes through sustained and iterative experimenting with and refining new approaches in the light of learning with and through pupils' responses" ([Developing Great Teaching](#), p. 12).

Given that this is a concern even in VHIC contexts, where teachers are generally reasonably well supported (Table 2.1), such structured arrangements are very likely to be crucial in LMICs too. TPDL needs to be undertaken through regularly scheduled and timetabled meetings within the school.

Once a formal schedule for TPDL is set up, it then becomes possible to sequence activities to create 'logical threads'. While it is necessary

"to have a variety of activities to reinforce messages and test things through different lenses, no single particular form of activity was shown to be universally effective ... what mattered was a combination of a logical thread between the various components of [TPDL], and the provision of opportunities for teacher learning which are consistent with the principles of student learning being promoted. ... aligning goals, activities, experiments in classrooms, engagement with evidence and underpinning rationale does matter alongside multiple perspectives and angles" ([Developing Great Teaching](#), p. 8).

For example, within OER4Schools (<https://www.oer4schools.org>), activities within and between sessions are carefully sequenced to form such logical threads, enabling the exploration of ideas coherently and systematically. The programme offers structured learning activities, together with follow-up activities such as scheduled opportunities for classroom experiments, allowing teachers to trial new instructional practices and ideas in real classroom settings ([Grounded Insights](#)).

TPDL should be a series of cyclical processes that allow teachers to learn new content through observation and collaborative dialogue, trial new pedagogical practices through lesson planning and implementation and, finally, reflect on this implementation in order to modify it and continue to iteratively adapt and improve instruction. Scheduled meetings involving sequenced activities can be seen as a rhythm to TPD: multiple instances of ongoing support/ follow-up activities can form

“creative ways of disaggregating INSET days to create a rhythm for TPDL ... fortnightly” (Developing Great Teaching, p. 12).

Grounded Insights (Characteristic #4) notes that TPDL needs to be long-term. In many LMICs, it is hard to see how long-term TPDL could be organised unless it is scheduled as regular teacher group meetings. There are clear recommendations for operating within a structured timetable:

- TPDL should last at least one year unless a tighter, more intensive schedule is possible (e.g., if there are strong motivations, such as a national government mandate with progression and salary incentives).
- If there are no wider pressures to undertake TPDL, a programme less demanding for teachers should be implemented, typically run over two years.

Similarly, **Developing Great Teaching** emphasises the importance of TPDL being sustained typically for at least one year (in UK contexts).

Principle 4B: Considerations for TPDL in LMICs

TPDL should:

1. Comprise school-based professional development with a focus on active teacher learning and modelling interactive pedagogy (**Grounded Insights**, Characteristic #2a);
2. Draw on school-based peer facilitation, rather than rely on ‘external experts’ (**Grounded Insights**, Characteristic #3);
3. Support TPDL leaders in organisation and facilitation through induction and ongoing professional development (**Grounded Insights**, Characteristic 5);
4. Favour whole-school approaches, making learning available to all teachers and building a community of practice.

TPDL needs to be tailored and adapted to the local context. There are certain ‘meso’ factors normally considered important for such adaptation (country, region, school level, subject, national languages). However, there is some evidence that there are other ‘micro’ factors, pertaining to the individual circumstances of the school, that may be equally significant. These include the:

- Degree of (external) expert input needed vs. self-sufficiency of the school;
- Cost of logistics (such as teachers travelling to a workshop venue or external experts/coaches travelling to schools);
- Benefits of working as a whole school (all teachers) vs. in segmented grade- or subject-specific groups.

Principle 4B1. School-based professional development

Experience often suggests that ‘process’ may well be as important as ‘curriculum’. By ‘curriculum’ we mean the curriculum intended by the TPDL provider, written down in

terms of competencies, learning outcomes, tasks and activities. By 'process' we mean how these activities are put into practice: who conducts which activities together? Where and at what times? How regularly? What support is available? This appears reasonable, as we know that curriculum 'design' is not the same as curriculum 'implementation'; the best curriculum in the world does not contribute to student learning if it is never implemented.

This can be seen in the different models for a TPD process for one learning objective (e.g., TPD topic: 'understand positive discipline') via four one-hour activities on classroom management. These four activities could be conducted:

- Either in the course of one day, as part of a cluster meeting or workshop led by an expert. Teachers are asked to implement the new strategies when they are back at school (Model 1).
- Or as part of a school-based programme, distributed over four weeks. In this case, the presence of an external expert is unlikely because they cannot travel to the school on a weekly basis. However, teachers have time to implement in their classrooms and reflect collaboratively between the activities (Model 2).

The differences between these two approaches are clear: Model 1 has more expert engagement, but implementation at the school is left unstructured. In Model 2, there is little, if any, time with the expert, but the implementation at school is more structured, therefore offering a clearer sequence.

Certain school-level micro-factors may make Model 1 or Model 2 more appropriate. However, it is often simply taken for granted that the external expert input is critical and that, therefore, Model 1 is the only viable option. This has ramifications for the supply of experts, and the adoption of a cascade model. Typically, a cascade model means that, in practice, the expert may only be a 'relative' expert, who is only a few days of training ahead of other teachers. Will such an expert really be expert enough to be helpful? Moreover, could such a marginal advantage be obtained through other means such as scaffolding peer facilitators through materials? If this is possible – as suggested by [Grounded Insights](#) – then Model 2 may well be more favourable, offering at least comparable, but potentially much better, learning outcomes for teachers at a lower cost compared to Model 1. In other words, the TPDL proposed in Model 2 may well significantly outperform the cascade model.

A basic premise of the cascade model appears to be the assumption that 'good teaching is a function of teacher knowledge only'. If that were the case, transmission models would work. For example, for transmission of basic facts (e.g., operational and procedural knowledge, such as basic facts about HIV transmission), cascade models do work. However, teachers do not become effective through knowledge alone. Indeed, the research literature is clear that that knowledge, while important, is by no means the only consideration. The analogy of crafts or music illuminates how teaching must comprise both knowledge (subject/ pedagogy) and subject-pedagogical skills. It would clearly be impossible for master craftspeople or musicians to teach all novices to achieve mastery through a cascade approach. Yet for teaching (an equally complex profession!), we assume that a simple cascade will suffice, or at least make a significant impact.

For over 10 years there has been an awareness that cascade models can be very problematic. ↑[Ottevanger et al. \(2007\)](#) found that several countries

“acknowledge the vulnerability of the cascade model and the importance of the facilitators in the cascade model” (p. 57).

More recently, ↑[Bainton et al. \(2016\)](#) stated that:

“Generally, cascade models of delivering CPD involving the training of trainers are found to be less effective” (p. 12).

Principle 4B2. Draw on school-based peer facilitation, rather than relying on ‘external experts’

If we accept Model 2 as potentially more effective, we must ask to what extent contributions from ‘external experts’/ specialists are needed; or whether it is possible to operate the model led by internal facilitators. This is an unknown factor even in high-income contexts, and [Developing Great Teaching](#) notes the following implications for further research:

“There would be real benefit in identifying specifically what it is that external specialists can contribute to effective CPD and TPD and the implications of that for the growing numbers of internal TPD facilitators” ([Developing Great Teaching](#), p. 13).

We argue that the role of external experts is not fixed, and may vary in importance depending on the nature of the TPD delivered and the specific local contexts of the teachers and the school. In particular, this may mean that within a national TPD programme it would seem disadvantageous to prescribe the same amount of ‘external expert time’ for each and every school.

Identifying an optimal location for TPD is an important logistical matter. There are several factors to consider, including convenience, commute, costs, and the resources and infrastructure available. This is especially important in LMICs, where teachers may have to travel long hours to get to schools, or where internet access, clean water and sanitary facilities may not be readily available. TPD that is conducted at the school means that teachers do not need to travel to a workshop venue; similarly, external experts do not need to travel to the school. This implies low logistical costs. Expert-led workshops are more expensive and should only be used where they can make effective contributions, and then only as a last resort, rather than as standard practice.

However, if TPD is to be led by peer facilitators, and given that this role is then pivotal, then those facilitators need to be supported. They must not only be experts at teaching but also at modelling effective teaching and ensuring that teachers are able to transform these practices into meaningful professional learning opportunities. We believe that there is a role for cascading here, whereby school-based facilitators are inducted to the processes of TPD (supported through TPD materials). In the context of the T-TEL programme in Ghana (2015–2016), a cascade, inducting peer facilitators by role-playing TPD sessions, appeared to be effective. The goal of this cascade was more limited than usual. Rather than attempting to transmit good teaching practice, the cascade focused on the mechanics of the sessions: the number required, how to timetable them to maximise

attendance, how to run through the printed workshop plans. Additionally, each workshop plan had interspersed facilitator notes that offered additional materials (available at <https://opendeved.net/t-tel/>).

Principle 4B3. Favour whole-school approaches, making learning available to all teachers and building a community of practice

An important question is whether to undertake TPDL for groups of teachers, such as lower vs. upper primary or one subject-group (potentially across school), compared to undertaking TPDL for all teachers at the school (i.e., whole-school TPD). It is well established that 'one size fits all' TPDL does not work. However, this is typically taken to mean differentiation by grade or subject or according to national characteristics (e.g., TPDL for primary teachers, secondary teachers, secondary mathematics teachers, etc.). However, this rarely includes differentiation by school: how much outside expert input a particular school needs. If there is limited outside expertise, which schools should receive it? Who are the most appropriate experts for which schools? What individual support does a particular teacher need? When we speak of differentiation for pupils, we mean, of course, depending on their learning needs. By comparison, for teachers and schools, differentiation is not well developed.

Whole-school TPDL does not mean that this TPDL is about general pedagogy, as theoretical workshops on the generalities of pedagogy do not work. So whole-school TPDL is still about subject pedagogy. However, it does mean that the mathematics teachers interact with English teachers during TPDL activities, and they see how each other applies subject pedagogy. In order to ensure learning from the most capable and inspiring teacher at the school, let's assume there are 40 teachers in total. This might mean only 3–5 teachers per subject. There may not be many inspiring teachers at any one school. It is therefore unlikely that the school's most capable and inspiring teacher is in that group of 3–5 mathematics teachers. Whole-school TPDL can utilise the most capable and inspiring teacher at the school.

We argue that this constitutes a major difference to TPDL in VHICs, where teachers have a much better starting point for their careers (such as a reasonable first degree and at least one year of teacher education). Hence, running professional development aimed at specialist mathematics topics makes sense, and this requires bringing mathematics teachers together. However, where the initial education of teachers is poor, teachers across subject groups can learn from subject pedagogy in any subject. Moreover, as teachers are frequently required to teach other subjects, this offers an additional reason for organising professional development as a whole school.

We also note that 'sending a mathematics teacher to mathematics TPDL' assumes that the mathematics teacher is at 'fault' ('teacher deficit'). In LMICs it is much more likely that the core issues are to do with the school environment. Such schools face a systems deficit rather than a teacher deficit, and it is often wider factors, such as attitudes of inspectors, parental engagement, school environment and/or the school cultures (absenteeism, lack of peer support) that cause poor school performance (Table 2.1).

There are differences in TPD according to subjects, so is there a benefit in sharing subject pedagogy across subject boundaries? Even in the UK, this has implications for further research:

“The similarities and differences between effective [TPDL] in relation to mathematics, English and science as highlighted at headline level by this review are intriguing and potentially very important to practice, especially given the strong finding that pedagogic CPD alone is not effective. It is important to unpack these similarities and differences as revealed by the best studies encompassed by the most rigorous reviews” (Developing Great Teaching, p. 13).

However, we would argue that these differences only become important if basic subject pedagogy is conquered. Until then, a struggling mathematics teacher benefits from seeing an inspiring English teacher from the same school. When mathematics teachers need specific inputs (e.g., on avoiding common misconceptions in specific mathematics topics), more specialised TPD is mandated. However, in many settings teaching standards are not at that level, and the focus needs to be on the school.

Situating TPD at the school is also a significant factor in ensuring equity. Rather than a teacher leaving to attend an external workshop, then reporting when back at the school, all teachers have access to materials and the opportunity for personal and professional development.

Principle 4B not only points to educationally effective whole-school TPD, but also shows how this can ease logistics and widen participation. Often, we do not have detailed insights into school accessibility and, while we know that there are differences, these are not easily quantified. One available example that illustrates the need for school-based programming is the distribution of primary schools by remoteness in Sierra Leone (↑[Nमित & Thi Mai, 2019](#)). This elegant mapping study demonstrates how equity depends on micro-geography; the ‘not accessible by road’ schools are widely dispersed and thus much less likely to receive attention for TPD programmes that depend on travel. However, such schools can participate in distributed TPD models where travel matters much less.

Principle 4C: The role of head teachers and school leadership

Overall, school leadership is a crucial component of ensuring that TPD design and implementation are effective. Headteachers must be empowered, through access to professional development themselves, to become involved as pedagogical leaders, and not leave the learning just to their teachers.

Communities, families and parents are important stakeholders who can contribute to improving education systems.

Effective TPD should be implemented at the school level and involve all teachers and personnel. Thus, the role of school leaders is critical in ensuring successful TPD design and implementation. As discussed previously, school leaders should ensure that TPD focuses on both student learning and teachers’ needs. In addition, school leaders play a

paramount role in ensuring TPDL is coherent across grade levels ([↑ERO, 2018](#)). Overall, head teachers should define clear objectives at the school level and hold all teachers to high standards. School leaders must have the vision to look beyond the subject needs of students to ensure that the overall school culture fosters a positive and safe learning environment.

Finally, it is important that school leaders do not feel alone in their efforts to lead school-wide TPDL. So, another effective strategy is to train leaders at different levels within the school system, i.e., not only the headteacher but also subject leaders or grade coordinators and other support staff ([↑Bainton et al., 2016](#)). Furthermore, TPDL for headteachers does not need to stop at the school level: they can draw on other school leaders' effective practices within their district or neighbouring communities. In one New Zealand example of this, the deputy principal at a school

“visited other schools and examined research to learn more about programmes for gifted and talented students” ([↑ERO, 2018, p. 24](#)).

Parents, families and communities

“Transformation will not happen without the deep engagement of all stakeholders – particularly those whose voices are often less strongly heard – teachers and communities” ([↑Bainton et al., 2016, p. 20](#)).

Involving parents, families and other community members contributes to improving overall teaching and learning processes. One way of doing this is to *“create new ways for community and schools to talk to each other”* ([↑Bainton et al., 2016, p. 19](#)). Parental involvement and the home environment are inextricably linked to student learning ([↑ERO, 2018](#)). For mathematics learning, getting parents and family members to support students' development outside school hours is an effective strategy for support; this includes supporting struggling students to catch up, as well as encouraging advanced students to further their mathematical skills development. The ERO (2018) report noted several opportunities to involve parents and community members, such as providing students with personalised activity books to be done at home to keep students practising during their time off. Events for parents allowed parents to recognize how the mathematics programmes were similar to or different from what they encountered when they were students.

Ultimately,

“by working with parents and situating mathematics learning in engaging and authentic contexts, teachers found they could accelerate the children's progress” ([↑ERO, 2018, p. 47](#)).

It is important to note, however, that parental involvement is often a challenge within LMICs, and thus these types of interventions must be adapted for the context of SSA, where according to the [Mathematics Education](#) report:

“The achievement of a society's learners appears to be linked to the attitudes towards the learning of mathematics generally held by that society's non-specialists (rather than mathematics educators)” ([Mathematics Education, p. 73](#)).

Therefore, it is necessary to change not only the attitudes of students themselves, but also of the members of the homes and communities they come from. Within LMICs, and especially SSA, it is imperative to sensitise communities to gender-based inequalities and their impact on education. [Mathematics Education](#) cites data from PISA 2009 to determine that

“in societies where there is greater gender equality, girls perform better reducing their disadvantage in mathematics and simultaneously increasing their advantage reading literacy” ([Mathematics Education](#), p. 78).

Holding meetings and events to inform the public of both the short- and long-term impact of deep-seated cultural gender biases is critical for making impactful change to teaching and learning.

Having considered student and teacher factors (Principles 1–3) and school/ cluster factors (Principle 4A–4C), we now turn to factors at the national level.

5. National level

Teaching and learning processes within classrooms and schools are inevitably impacted by policies and structures enforced at the national level:

“A focus on strengthening quality teaching needs to be mindful of the professional environment that enables this to happen: professional systems enable quality teaching, and achieving high impact demands careful consideration of the capacity of the system to support innovation. Strengthening high-level planning through Education Sector Plans was offered as a model that is able to identify gaps, and create greater coherence between actors and stakeholders” ([Bainton et al., 2016](#), p. 20).

Education sector plans involve conducting *“detailed mapping to understand priorities, opportunities, and gaps”* ([Bainton et al., 2016](#), p. 21). This allows for system-level improvement. However, within the context of SSA,

“Limited systematic mechanisms are in place to monitor the quality of classroom assessment practices” ([Mathematics Education](#), p. 107).

We will now look closer at issues at the national level, including teacher motivation, lack of resources, infrastructure and technology, as well as the policy environment.

Principle 5: Teacher status and motivation

TPDL should appropriately motivate teachers (working in challenging settings) to engage, including attention to teacher career progression and salary structure ([Grounded Insights](#) Characteristic #6). Many education systems suffer from the low societal status of teachers. The status of teachers must be raised to attract and retain the brightest and most motivated individuals into the teaching profession.

In SSA, low levels of job satisfaction and motivation lead to *“far-reaching adverse impacts on the behaviour and overall performance”* of school teachers and thus learning outcomes

([Mathematics Education](#), p. 89). ↑[Bainton et al. \(2016\)](#) made several recommendations, including:

- Creating financial incentives for teachers;
- Developing clear career pathways, including opportunities for advancement or accredited teacher-training courses, or for teachers to take on leadership roles;
- Recognising good teachers and schools with awards or prizes;
- Running public campaigns to elevate the status of the profession.

An important financial incentive is teachers' salary: this needs to be at an appropriate level and paid regularly. Teachers in many countries are desperately underpaid. When asked to travel long distances, teachers need to be compensated for transportation and catering needs to be provided.

Principle 6: Teaching and learning materials

Teaching and learning materials, for teachers and for students, should be Open Educational Resources ([Grounded Insights](#) Characteristic #8) as well as Open Educational Practices. This increases sustainability, scalability and equity, as well as resilience against unforeseen changes.

The provision of textbooks, teacher guides and other teaching and learning materials is essential to improving teacher effectiveness. Research conducted on the Kenyan Primary Maths and Reading (PRIMR) initiative (↑[Piper et al., 2018](#)) suggests that providing teachers only with professional development plus instructional support, without teaching and learning materials, results in very modest improvements, insufficient to enhance student learning outcomes. Their results highlight the efficacy of students' learning materials when used at a 1:1 (student to textbook) ratio, alongside use of structured teachers' guides for lesson planning. While teaching and learning materials are insufficient on their own, the study clearly indicates the important role that such materials play.

Similarly, the [Mathematics Education](#) report also emphasises the benefits of learning materials on learning outcomes. In LMICs, even when textbooks are available, the ratio of students to textbooks is high. However, the sharing of textbooks could offer opportunities for encouraging student collaboration. *"Textbook sharing does bring benefits – presumably through peer interaction and knowledge sharing"* ([Mathematics Education](#), p. 83).

Of course, textbooks and other materials need to be utilised effectively in teaching and learning. For mathematics, for example, the authors argue that the *"mere availability of mathematics textbooks"* will have little direct impact on learner achievement, *"as measured by test scores"* ([Mathematics Education](#), p. 83). So TPDL facilitators and school leaders need to ensure that the textbooks are aligned with the mathematics curriculum, and that teachers can use them effectively based on their students' needs:

"There is little point in investing in providing more textbooks unless those textbooks have been proven to be effective ... if the mathematics curriculum is not well matched

to the capacities of the majority of learners then simply providing a textbook will not bridge the gap” (Mathematics Education, p. 83).

Ensuring that textbooks are effective, therefore, is not reliant on the content of a textbook alone, but also on the context in which that textbook is used. However, in many LMICs, the ability of teachers to facilitate that enabling context is limited. Teachers are often under time constraints and routinely face challenging classroom conditions, including large class sizes and limited teaching resources. This hampers their ability to prepare adequate instructional materials, such as lesson plans and assessments, that might enhance the effectiveness of textbooks and their teaching overall:

“Teachers are required to prepare their own classroom materials but that it is unrealistic to expect them to produce high-quality assessment instruments for formative purposes especially if they are inexperienced, have few resources to hand and are under pressure of time” (Mathematics Education, p. 108, with reference to ↑Kanjee, 2009).

Given such considerations, [Grounded Insights](#) recommends *“whole programme scaffolding”*, meaning that materials for teachers, facilitators and education managers need to be made available and need to be

“based on a coherent and comprehensive ‘multi-level’ set of resources, tailored to the national and/or local contexts, with activity-based workshop outlines, plus built-in support for facilitators” (Grounded Insights, Characteristic #7, p. 73).

Such materials need to be relevant to educators’ day-to-day experiences and aspirations for pupils. We also emphasise that such materials include not only teaching, assessment, professional-development and management materials for teachers, facilitators and education managers, but materials for pupils as well, such as textbooks. We further suggest that, where possible, materials are in the public-domain, free to use and re-use – i.e., Open Educational Resources (OERs) (↑[Haßler et al., 2014](#)). OERs are scalable and more widely accessible than traditional, commercial teaching materials. Many OER online repositories exist, covering several education subject areas including TPDL. For LMICs, where financial barriers are amongst the greatest inhibitors to education, freely accessible learning materials are particularly important.

While OERs are an important alternative to more traditional educational resources, there are limitations to their relevance and sustainability. Existing OERs cover many general topics but at times are not specific enough to the local context in which a teacher may want them to be used. Unlike commercial educational resources that generate income and can continuously fund updates and the production of more relevant content, OERs cannot always be quickly updated; this creates a sustainability issue.

However, the free availability of OERs does not necessarily mean that it can never be sustainable or relevant to specific local contexts. Many OERs, though not all, are not only free to use and re-use, but also grant permission for their content to be adapted and changed to suit local contexts and new knowledge. Targeted and up-to-date resources therefore need not be created from scratch, since existing OERs provide a well-developed basis on which to build. Through the collaborative work of key stakeholders such as teachers, managers, government, and the extended social and academic community, sustainable and relevant resources can be produced for all, by all. Relevance and

sustainability therefore need not be solely tied to profit. Furthermore, we acknowledge the concept of Open Educational Practices, which adds important dimensions to the OER movement (↑[Haßler & Mays, 2015](#)).

There are a number of key ‘building blocks’ which underpin effective TPD, including TPD learning materials and content. In addition to subject and pedagogic knowledge, clarity around learner progression, starting points and next steps is important ([Developing Great Teaching](#)). TPD content should include a focus on formative assessment so that teachers can see the impact of their teaching on their pupils’ learning. Once teachers collect evidence on their students’ needs, they can adapt their approach to teaching accordingly.

While providing teachers with structured guides including scripted lesson plans is controversial, ↑[Piper et al. \(2018\)](#) found that adding teacher guides to the package of teacher professional development, coaching, and 1:1 student books had a “*dramatic impact on learning outcomes*” and, furthermore, was cost-effective (p. 333). These guides comprised daily lesson plans with a partially scripted approach. and the accompanying training focused on how teachers could effectively utilise these. Moreover, the cost-effectiveness analysis demonstrated that the added ingredient of teacher guides resulted in a remarkable increase in improved student learning. The use of these structured guides may be particularly useful in LMIC contexts where teachers have less academic background and preparation than in Western contexts.

Principle 7: Digital technologies

The use of digital technology in education has to be considered very carefully, as such investments have often not led to improvements in student learning outcomes. In the first instance, technology should be used equitably for essential communication and to support peer facilitation of school-based TPD (face-to-face, offline peer learning in schools: [Grounded Insights](#), Characteristic #9). It is of the utmost importance to learn from the past and heed the established Principles for Digital Development (<https://digitalprinciples.org/>).

Educational stakeholders are moving towards digital technology (DT) and infrastructure. The ↑[WorldBank \(2008\)](#) noted that DT can be

“a powerful tool when trying to shift teaching and learning to more active forms. It will alter teachers’ roles to a facilitator in the teaching and learning process” (p. 66).

However, in LMICs, and especially SSA, schools and classrooms, especially in rural communities, are often disconnected from the internet and have little access to equipment. Where computers are found, several factors still hinder proper utilisation of equipment in teaching and learning. For example, in Cameroon:

“The use of ... technologies in teaching and learning ... has been clearly low due to: low confidence and low competencies of the teachers, formal opposition by teachers to use pedagogical tools that they were not initially trained to utilise in a professional way” (↑[Haji et al., 2017, p. 152](#)).

Moreover, research on the use of technology in classrooms has yielded mixed results:

“There are numerous examples of evaluation reports making spectacular claims for the impact of adopting particular programmes and/or hardware in schools. However, rigorous re-evaluation of reported findings suggests that whilst positive benefits are consistently found, the effect sizes are generally moderate” (Mathematics Education, p. 85).

Therefore, while teachers must have access to TPD on digital literacy and technology integration in classroom instruction, it appears more equitable and impactful to use technology for TPD purposes. For example, in the OER4Schools programme (Haßler et al., 2020), digital technology motivated professional learning, facilitated reflection (audio diaries, video) and enabled facilitator-support (WhatsApp).

Principle 8: Create a coherent policy environment in which to advance educational institutions

Think about TPD from a systems level, creating a coherent policy environment with an appropriate implementation strategy.

As part of its recent education strategy, the World Bank has developed the Systems Approach for Better Education Results (SABER). Within SABER, data and assessment are identified as a key component to improving educational systems both on a national and global scale. The SABER framework outlines

“four major types components: classroom assessment; examinations; national large-scale assessments (NLSA); and international large-scale assessments (ILSA)” (Mathematics Education, p. 87).

At the macro level,

“information from international and national assessments can shape educational policies and, in some cases, spur the implementation of targeted reforms” (Mathematics Education, p. 84).

The national curriculum is a determining factor as it outlines the skills and knowledge students must master in order to progress through the education system. In the case of mathematics, it is important *“to reduce curriculum overload and improve sequencing”* (Mathematics Education, p. 79). Because of the spiral nature of mathematics, sequencing is important to ensure that students develop fluency in basic foundational skills before advancing to higher-order thinking skills.

In addition, many LMICs have been reforming national curricula and shifting to a competency-based approach. In theory, a competency-based curriculum develops students’ skills in order to promote a hands-on approach in the application of curriculum skills and content. It thus encourages teachers to use a more learner-centred pedagogy. However, due to cultural, political and material differences, there is often a gap between policy and practice.

Overall, while curriculum is a key component of the policy environment, there are inconsistent findings regarding the impact that curriculum has on student learning. This

ultimately proves that it is but one of the many factors that needs to be considered in a systematic approach to TPD. For example, [Mathematics Education](#) concludes that

“there was very little evidence that it mattered which curriculum was used. None of them showed any strong evidence of effectiveness in comparison to the others” ([Mathematics Education](#), p. 79).

Finally, in order for TPD to be effective, there must be cohesion across all levels of the system, especially the policy environment. For example, if a new competency-based curriculum is to be implemented effectively, the teacher-training institutions (TTIs) preparing pre-service teachers need to address these child-centred approaches in meaningful practice-based opportunities. Unfortunately, this is simply not the case in many LMICs:

“Research suggests that in many cases the institutions responsible for the pre-service training of teachers in SSA have not adjusted their own curricula and teaching practices to match the demands of the more modern curricula prescribed for schools” ([Mathematics Education](#), p. 79).

Two key needs for TTIs within the context of SSA are:

- *“TTIs need to develop a cadre of tutors with the knowledge, skills and first-hand experience of classroom teaching necessary to deliver a reformed curriculum using active methods”*; and
- *“TTIs need to acquire the resources and personnel necessary to train their trainees in the effective use of the educational technologies both in the classroom and for personal development”* ([Mathematics Education](#), p. 105).

One important aspect is that placing inexperienced trainers in positions of power within TPD frameworks can have grave consequences. Unfortunately, this is often the case in LMICs.

“Tutors in TTIs tend to replicate their own ideas as to what primary school teaching looks like but this, all too often, fails to mirror best practice” ([Mathematics Education](#), p. 103).

6. Conclusion

This chapter explored eight principles for designing effective TPD and, in doing so, discussed a number of issues that prevent adherence to those principles, as well as what might be done to achieve them. We emphasised that TPD must explicitly promote and focus on student learning, as well as what effective teaching and learning practices entail. We further highlighted the need for teachers to be recognised and treated as professionals and for their professional development to be long-term, regular and tailored to the individual contexts of their countries, schools and subject levels. Teacher motivation must also be a key concern in the development of TPD, in order to facilitate career progression and keep teachers engaged and excited about their work. Teaching and learning materials, especially when they are OERs, have the potential to increase student learning outcomes and enhance TPD when used alongside other professional-development efforts. A conducive policy environment is crucial.

Abiding by such principles to achieve effective TPD may not be easy. The limited financial resources available in LMICs are often linked to insufficient infrastructural, technical and social resources being available for the comprehensive development of formal education systems, and relatedly, effective TPD. However, despite those challenges, this chapter argues that some of the ways of achieving equity and scale may be less resource-intensive than current practice. Additionally, there are options for: collaboration and sharing of OERs between relevant partners (families, communities, teachers, schools, governments, NGOs and universities); greater alignment of policy and practice; and the willingness and freedom of the relevant stakeholders to tailor existing TPD to the unique needs of a particular context. Existing starting points include the existing open TPD programmes (including: www.oer4schools.org, www.t-tel.org).

A significant challenge in writing this chapter has been the relatively poor evidence base. In the EdTech Hub (<https://edtechhub.org>), we are revising the evidence base in order to underpin the principles presented here with a more secure footing.

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