Initial teacher training to promote sustainable education system improvement: A review of the evidence on pre-service teacher education for primary grade literacy and numeracy in low- and middle-income countries

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Abstract

Pre-service teacher education (PSTE) has largely been excluded from investments in foundational literacy and numeracy in low- and middle-income countries (LMICs). This approach has consequences for sustainability due to the central role of PSTE in supporting lasting educational change. In this literature review, we examine key challenges facing PSTE in LMICs and draw on the evidence to suggest areas for teacher educators and stakeholders to focus attention—including curriculum revisions to make PSTE more applied and relevant, enhanced focus on the practicum, and high-quality professional development for teacher educators—to promote alignment of content and pedagogy with evidence-based practices.

Keywords

pre-service teacher education, literacy, numeracy, primary school, developing countries

Introduction

Over the last two decades, actors in international education development have noted that there is a global crisis in education in low- and middle-income countries (LMIC). Though school attendance has risen, more than 617 million children and youth are not achieving the basic competencies in literacy and numeracy needed for secondary and tertiary education (United Nations Educational, Scientific, and Cultural Organization [UNESCO], Institute for Statistics, 2020; World Bank, 2018). Accordingly, substantial investments have been made by bilateral donors such as the United States Agency for International Development (USAID), the German Agency for International Cooperation (GIZ), the United Kingdom's Foreign Commonwealth and Development Office (FCDO) and multilateral donors (United Nations agencies, World Bank) to improve basic

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learning outcomes for children in low- and middle-income countries (LMICs).[1]

One of the causes of this crisis is insufficiently prepared teachers in these countries who have little current, evidence-based pedagogical and pedagogical content knowledge and therefore lack the skills to teach effectively (Bold et al., 2017; Popova et al., 2022). Given the urgency of the situation in many LMICs, donors and governments alike have generally concentrated their efforts on training in-service teachers, as current teachers can have immediate impact at scale. Pre-service teacher education (PSTE) systems have largely been excluded from these investments in education for foundational literacy and numeracy (FLN). From a sustainability perspective, this approach is problematic due to the central role of PSTE in promoting and supporting lasting change in education systems. We posit that since quality teachers lead to the achievement of learning outcomes, PSTE programs in LMICs must be ameliorated to produce a pipeline of well-prepared teachers who are skilled in evidence-based practices, ready to teach children in these contexts. Improvement of these programs can lead to the development of a sustainable teaching workforce. If PSTE is not reformed in parallel with classroom practices introduced to in-service teachers, new teachers will be released into education systems looking, in the words of one Zambian teacher educator, "rusty." This requires ongoing rounds of intensive professional development for new teachers who are entering schools that look very different from the ones for which they trained.

Research from LMICs has shown that new teachers use their PSTE as a foundation for their practice in the classroom, and they refer back to it as they build their skills (Akyeampong et al., 2013). Both content knowledge and pedagogical skills learned in PSTE are therefore embedded in teachers' pedagogy for the length of their career. Accordingly, enhancing the focus on PSTE offers an opportunity to improve the sustainability of the FLN investments that have been made by international aid donor agencies, governments, and nongovernmental organizations. This requires the above entities to conceptualize and develop PSTE as an integral part of a continuum of teacher professional development leading to sustained teacher development and quality teachers (Feiman-Nemser, 2001; Roberts-Hull, Jensen, & Cooper, 2015). PSTE programs that embrace evidence-based FLN approaches are more likely to align well with programs being implemented in schools.

In this study, we draw on the literature on PSTE in LMICs to examine key challenges facing PSTE in LMICs and use this evidence to highlight the barriers to providing high-quality pre-service teacher education. We suggest areas for teacher educators and stakeholders to focus attention—including curriculum revisions to make PSTE more applied and relevant, enhanced focus on the practicum, and high-quality professional development for teacher educators—to promote alignment of content and pedagogy with evidence-based practices.

In Section 1, we outline the barriers that have been identified in the PSTE literature from LMICs, focusing on the program curriculum, the practicum component of teacher education, and

[1] As classified by the World Bank in the 2023 fiscal year, low-income countries are those with a GNI of $1,085 per capita or less and middle-income countries are those with a GNI per capita between 1,086 and $4,255 in 2021. Examples of low-income countries include Afghanistan, South Sudan and Yemen, and lower-middle income countries include Bangladesh, Samoa and Bolivia (World Bank, 2023).

the capacity of teacher educators. In Section 2, we draw on literature from both high-income countries and LMICs to provide evidence-based recommendations for improving PSTE. We provide a summary of action points and direction for future research in Section 3.

Challenges in providing high-quality pre-service teacher education in LMICs

Our review of the literature identified three key categories of barriers in LMICs: curriculum-related issues, practicum-related issues, and the capacity of teacher educators. In this section, we address each of these three areas.

Curricular issues

Teachers need three types of knowledge in order to teach effectively: content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK) (Shulman, 1986). CK comprises subject matter knowledge such as theories and concepts specific to the subjects the teacher teaches—mathematics, reading, science, etc. PK includes the general ability to plan, organize, and implement lessons in the classroom across topic areas. PCK is teachers' ability to use pedagogy that is specific to and appropriate for a given subject. PSTE programs must provide their students with the information and practice opportunities needed to develop all three types of knowledge to produce effective teachers ready for the challenges of the classroom.

One of the strongest themes that emerged from our review of published research on PSTE programs in LMICs was that the focus of the curriculum was generally on CK, at the expense of PK or CPK, and on theory more than practice broadly (Barnes et al., 2019; Korthagen, 2010; Masaiti & Manchishi, 2011). Examining PSTE programs in six African countries, Akyeampong (2013) found that pre-service teachers training to teach primary grade reading and mathematics spend more time learning CK than how to teach the content and skills to students (Akyeampong et al., 2013). These choices have consequences for pre-service teachers, which are evident from their first experiences in the classroom. A practicum mentor teacher in Zambia discussed pre-service teachers' weaknesses in pedagogy, explaining, "Yes, some have the subject content, but they do not know how to put across the messages. That is why we say they leave the university while very raw in teaching methods" (Simuyaba et al., 2015, p. 92). High-quality primary PSTE programs should have a balanced focus on CK, PK, and PCK, particularly in the skills of FLN.

Despite spending the majority of course time on CK, many pre-service teachers in LMICs still have poor CK in the subjects they will teach (Altinok, Antoninis, & Nguyen-Van, 2017; De et al., 2016; Tefera, Atnafu, & Michael, 2021). In a study of pre-service teachers in four colleges of teacher education in Ethiopia, Alemu et al. (2021) found that the pre-service teachers did not meet the level of content attainment required by the curriculum. In that study, primary-level science pre-service teachers scored at the international mean for eighth-grade students on the Trends in International Mathematics and Science Study. A study in South Africa found that the mathematics CK of pre-service teachers in three PSTE programs did not improve much during their four-year program (Bowie, Venkat, & Askew 2019). In Zambia, pre-service mathematics teachers were required to take advanced mathematics classes but had difficulty explaining basic mathematics functions (Malambo et al., 2019). In a study of pre-service teachers and PSTE program lecturers in Bauchi and Sokoto States in Nigeria, the knowledge of literacy development concepts

was so low that, as one teacher educator explained, "Teaching reading is confused with teaching English" (Barnes et al., 2019, p. 157). Evidence from research studies demonstrates that lack of teacher CK has an impact on student learning outcomes (Akyeampong, 2022; Filmer, Molina, & Stacy, 2015; Glewwe & Muralidharan, 2016; Ganimian & Murnane, 2016), so it is imperative that PSTE programs ensure that pre-service teachers graduate with enough CK to teach FLN.

The insufficient academic background of preservice teachers and the duration of some PSTE programs contribute to the theme of weak CK among pre-service teachers despite a strong focus on CK in PSTE programs. In LMICs, PSTE programs are often perceived as low-prestige tertiary education options pursued by students who did not perform well enough in secondary school to have access to other options (Barnes et al., 2018; Beteille & Evans, 2019; Ngao, 2022). Criteria for entry-level admission to PSTE programs for pre-service teachers in LMICs can be quite low. In Ethiopia, teachers with a grade 10 education can be admitted into PSTE programs if their scores on the national examination were not high enough to enter upper secondary school (Mekonnen, Fesmire & Barnes, 2018). Many LMICs offer short certificate and diploma PSTE programs. For example, Nepal offers a 10-month upper secondary training course, Liberia offers a one-year C certificate (Republic of Liberia, Education Sector Analysis, 2022) and Sri Lanka a yearlong diploma (Ramchand, 2020). Given the duration of these programs and the academic background of pre-service teachers, programs spend significant curricular time filling gaps in pre-service teachers' CK.

The resulting focus on CK and theory results in PSTE programs that are disconnected from the teaching context. In many LMICs, pre-service teachers do not learn about the curriculum in use in local schools; the instructional materials used in those schools, including books and other materials from large-scale FLN programs that have trained in-service teachers; languages of instruction and related policies; or the social, economic, and cultural contexts of schools in their countries (Akyeampong et al., 2013; Masaiti & Manchishi, 2011; Mulenga & Luangala, 2015; Pryor et al., 2012; Wawire, 2021). Instead, the curriculum at PSTE programs often presents teaching as a standardized process, ignoring contextual factors new teachers will face in the classroom that may vary widely within countries (Akyeampong et al., 2013).

The disconnects between PSTE and primary schools are well documented in the PSTE literature. Buckler (2020) describes an assignment in which Ghanaian pre-service teachers were asked to plan a lesson for 35 students. While the government's target class size is 35 students, it is well below typical class sizes.[2] To receive a high score, the lesson plan had to be for exactly 35 students. As one of the participants reported, "We can't veer off script! It's like everything at college—it's not real, it's a game we play to pass our exams" (p. 856). In Bhutan, where multigrade classrooms are common, many PSTE programs provided no training on how to teach in these settings (Kivunja & Kuyini, 2015); research in Indonesia has documented similar issues (Luschei & Zubaidah, 2012). Studies in South Africa have found that PSTE programs do not prepare pre-service teachers well to teach in rural schools

[2] Ghanaian EMIS data from 2014/2015 show regional average class sizes ranging as high as 91 students in kindergarten in the Northern region and 52 students in the primary grades in the Upper East region (Ananga & Tamanja, 2017).

(Heeralal, 2014; Mukeredzi, 2016). PSTE programs are therefore failing to adequately prepare their students for the real-world demands and conditions they will face in the classroom.

The pedagogical approaches that teacher educators use in the classroom is another area of conflict between PSTE programs and schools that we identified in the literature. The instructional style in PSTE programs, as in many other tertiary education programs in LMICs, is generally based on lecture rather than on more active pedagogies that promote student engagement (Barnes et al., 2019; Borg, Clifford, & Htut, 2018; Buckler, 2020; du Plessis & Muzaffar, 2010; Du et al., 2020; Pryor et al., 2012). In highly hierarchical education systems, lecturers are perceived as authorities and the sole source of correct knowledge and practice (Akyeampong et al., 2013; Du et al., 2020). Pre-service teachers, therefore, are likely to model their pedagogy on their teacher educators' approaches and have few opportunities to be exposed to more active pedagogical styles. This "apprenticeship of observation" (Lortie, 1975) sets these newly trained teachers up for conflict with the more student-centered learning approaches used in many large-scale LMIC FLN programs and in primary grade curricula.

Practicum issues

During the teaching practicum or student teaching experience, pre-service teachers are assigned to a school where they have opportunities to teach under the supervision of an experienced mentor teacher. This is a critical phase in the development of pre-service teachers' skills and perception of their effectiveness. Practicum experiences vary across LMICs in length, program structure, and level of teaching responsibilities (Akyeampong et al., 2013). However, the literature from LMICs documents two common types of misalignments. First, the course content at the PSTE program and the content of the practicum are often disconnected (Sailors & Hoffman, 2019). Second, the practicum often provides no or few opportunities for pre-service teachers to practice the core instructional practices utilized in evidence-based FLN programs. The frequency with which these issues are reported suggests that the practicum period should receive more attention during PSTE programs' curriculum review and development.

In the reviewed literature, the problems most frequently identified are related to the quality and quantity of mentoring pre-service teachers receive during their placements. During the practicum, a student should ideally be supervised by an experienced mentor teacher as well as by a teacher educator from the PSTE program. Individual experiences during the practicum are often highly variable, depending on the skills of their mentor teacher. In a study of pre-service teachers' practicum experiences in Mpumalanga Province, South Africa, Nkambule and Mukeredzi (2017) identified divergent practicum experiences. In some cases, mentor teachers refused to be observed teaching by the pre-service teachers they were supposedly mentoring. In others, mentor teachers were described by their pre-service teachers as excellent. While teacher educators should also play an active role in mentoring during the practicum, observations of pre-service teachers in classrooms by teacher educators are generally limited; in some cases, they are brief, one-time observations (Abie, 2019). In Cameroon, a study found that schools took advantage of the presence of pre-service teachers to schedule in-service training for the regular classroom teachers during practicum periods, leaving the pre-service teachers to teach solo without support or feedback (Wohlfahrt, 2018).

Similarly, a study in Zimbabwe found that many mathematics pre-service teachers were left largely unsupported and unobserved during their eight-month teaching practicum (Makamure & Jita, 2019).

Beyond the quantity of support provided during the practicum, the quality of mentoring was a common issue in the LMIC literature (Lewin, 2004). In a study of university-school partnerships in PSTE programs in South Africa, teacher educators said that there was little training given to mentor teachers on how to support pre-service teachers during their practicum and that their own observation of pre-service teachers was minimal (Mutemeri & Chetty, 2011). The Kenyan education system theoretically uses a structured feedback approach that is supposed to include pre- and post-observation discussions between teacher educators and pre-service teachers, in addition to lesson observation. However, in a qualitative case study, Ong'ondo and Borg (2011) found that this approach was rarely implemented due to the distances that teacher educators would need to travel for observations and the considerable number of pre-service teachers. Additionally, teacher educators rarely discussed pre-service teachers' performance with mentor teachers. Pre-service teachers said they felt anxious about the evaluations and reported that there were no opportunities for collaborative reflection on their teaching with their supervising teacher educator. In summary, we can conclude from the literature that there are generally no incentives for teacher educators and mentor teachers to give high-quality, intensive support to pre-service teachers, and staffing and time constraints would make it impossible to implement such a plan at current resource levels.

Even under good conditions, with a trained, supportive mentor teacher, practica in LMICs are often too short to allow time for pre-service teachers to develop feelings of efficacy and competency. For example, participants in a nine-month PSTE program in Cameroon had teaching practica periods as short as two weeks (Wohlfahrt, 2018). At the University of Zambia, pre-service teachers said that their teaching practice—including both peer teaching and practicum—was too short for them to develop their skills (Masaiti & Manchishi, 2011). Some participants in a study of 61 final-year PSTs and 26 PSTE program lecturers in South Africa had similar feelings (Mutemeri & Chetty, 2011). As one lecturer in that study explained, "we are not doing students any good. Students should be spending a semester or a full year. They need to experience what teaching is—students go out there it's like play teaching" (p. 510).

Taken as a whole, these problems—lack of CK, disconnections from PSTE coursework, lack of sufficient supervision and mentoring, minimal opportunities to practice new instructional approaches used in the schools, and short practicum length—often result in an experience that does not effectively develop pre-service teachers' skills and confidence as teachers (Chomba Manchishi & Sani Mwanza, 2013; Westbrook et al., 2009). Large-scale FLN programs operating in LMICs should engage with governments to advocate for improvements to the practicum phase of PSTE. In the following section, we discuss the institutional and teacher educator level capacities required to support a strengthened practicum system, in addition to curricular revisions.

Teacher educator and institutional capacities

A third major theme in the literature on PSTE in LMICs is the capacity of teacher educators to teach a high-quality, evidence-based program. Teacher educators often have

few opportunities to engage in professional development or learn about practices in use at schools, leading over time to the use of instructional practices and content that are dated (Barnes et al., 2019; du Plessis & Muzaffar, 2010; Gemeda & Tynjälä, 2015). In a study of four PSTE programs in Nigeria, Barnes and colleagues (2019) report that teacher educators were insufficiently prepared to teach CK and pedagogy for primary grade reading (Pryor et al., 2012). Given that teacher educator positions typically (and increasingly) require university degrees (Lewin, 2004), some were hired directly out of their degree programs, while others had been secondary school teachers with bachelor's degrees. The mismatch between the minimum degree requirement and the available stock of teacher educator candidates with primary grade teaching experience means that in some LMICs, teacher educators have little to no experience teaching the youngest children, let alone pedagogical expertise related to FLN skills. Therefore, teacher educators, even those in primary-level PSTE, may have little knowledge of how to teach children to read or work with mathematical concepts, and the resulting curricular focus on complex theoretical concepts rather than hands-on pedagogical approaches is a logical response by many lecturers. Borg, Clifford, and Htut (2018), in their study on teacher educators in Myanmar, note that teacher educator participants did not have the experience of teaching in schools and had little pedagogical training.

Minimal classroom experience among teacher educators also means that lecturers are unable to prepare pre-service teachers for the contexts in which they will teach (Lewin, 2004). This is compounded in countries where teacher educators completed their degrees at universities abroad. For example, a study in Samoa reported that most teacher educators in that study were educated at universities in New Zealand and Australia (Tupu Tuia, 2018) and used textbooks and other materials from those countries in their courses, resulting in limited connections to and appreciation of Samoan knowledge and content. Pre-service teachers need to be prepared for the real-world conditions they will face in the classroom, and teacher educators who are disengaged from those settings cannot adequately prepare their students.

Even in cases where teacher educators do have knowledge of local conditions in schools, however, they often lack autonomy in their decisions about what content to teach and how to teach it. The content of the pre-service training curriculum is generally developed at a national level, leaving teacher educators little room to make it relevant for their pre-service teachers' needs. For example, in Ghana, Buckler (2020) describes a teacher educator who was required to teach a class on science laboratory safety, though he personally had never seen a primary school with a science lab. Yet the lecturer's performance was judged based on his coverage of the official curriculum, including components completely irrelevant to the local context.

It is important for program planners and policymakers to note that LMIC teacher educators are working in under-resourced colleges. A PSTE program focused on primary grade FLN requires a range of instructional materials, including reference libraries, national primary grade curricula and texts, leveled readers appropriate for the early grades, and manipulatives to model instruction, to name a few examples. PSTE programs, especially those focused on primary education and those not connected to universities, often lack these materials, in addition to the materials used by in-service teachers in schools (Barnes et al.,

2019; Barnes et al., 2018; Lewin, 2004; Mekonnen et al., 2018; Pryor et al., 2012).

Beyond what is offered in the PSTE institution itself, teacher educators generally have few opportunities to engage in professional development. Although there are professional associations in both high- and low-income countries which support the professional development of teacher educators, faculty in institutions of higher education (IHE) often do not have the financial resources to join these associations (Matiba, 2023). Consequently, teacher educators frequently find it challenging to keep current with evidence-based practices in the profession. Also, many teacher educators are simply unaware of avenues for professional development. To improve teacher educator professional development at scale, the Open University created a massive open online course (MOOC) and open education resources (OER) for teachers and teacher educators in Africa called Teacher Education in sub-Saharan Africa (TESSA). In a study conducted on teacher educator responses to the online course, 83% of the participants stated that their motivation for taking the course was to update their knowledge about teacher education (Stutchbury, Amos & Chamberlain, 2019). In a study on the TESSA MOOC in Uganda, researchers found that in addition to faculty ICT skill levels being low, none of the teacher educators in the study "referenced the internet as a location for formal professional learning" (Buckler, Stutchbury, Kasule, Cullen, Kaije, 2021, p. 21). Mandatory participation in poor quality professional development sessions which did not lead to promotion, the general lack of professional learning for faculty and the lack of recognition of participating in professional learning for promotion, are also barriers to faculty participation in professional development programs (Buckler, Stutchbury, Kasule, Cullen & Kaije, 2021; Matiba, 2023).

Evidence-based essentials and promising practices for LMICs

Though PSTE is frequently omitted from large-scale FLN initiatives, it is a critical entry point for sustainably developing the quality of basic education in LMICs. Akyeampong and colleagues (2013), in their study of PSTE in Ghana, Kenya, Mali, Senegal, Tanzania, and Uganda, conclude that "[i]nitial teacher education remains the most powerful influence on the practice of teachers in the early part of their career" (p. 280). They further argue that PSTE "provides the knowledge and understanding that [teachers] fall back on to justify and generate their classroom practice, even those who have taken further courses" (p. 280). While professional development through in-service teacher training can provide updated skills and knowledge, teachers' PSTE is the foundation upon which they scaffold further development in their profession.

In this section, we present recommendations for PSTE in LMICs that are based on rigorous evidence. We note, however, that empirical evidence on PSTE programs remains limited, even in the United States and other high-income countries. The field has not yet produced substantial evidence linking specific PSTE program design elements or practices and primary student learning outcomes, and the evidence is particularly thin in LMICs. Therefore, in this section we use the best available evidence—from LMICs where possible and high-income countries when not—to make recommendations for improving PSTE in LMICs.

Key components of the PSTE program curriculum

Currently, there are neither universal, international professional standards for teachers generally, nor for primary grade FLN teachers specifically. Such standards are typically determined nationally and differ across countries. In its EQUIP1 report, Designing effective pre-service teacher education programs, USAID advises that "[e]ffective pre-service teacher education should be aligned with professional standards for teachers" (USAID, 2011, p. 6). Increasingly, with support from bilateral and multilateral donors, LMICs are developing, reviewing, and updating teacher professional standards to better ensure the quality preparation of teachers (Otunuku, Finau & Reynolds 2020; Pillay, Muttaqi, Pant & Herath, 2017; UNESCO, 2022).

As standards vary across countries, so should PSTE program content. The curriculum should be driven by what teachers in a specific setting need to be able to accomplish with their students. Having made this disclaimer, the literature suggests that there are certain core components of FLN that should be included in primary grade PSTE program curricula. Pre-service teachers must be taught about the building blocks of FLN skill development, as supported by current evidence, and must learn the relevant pedagogies to teach those skills. Referring to Shulman's (1986) terminology, Pre-service teachers need CK, PK, and CPK development. In the early primary grades, literacy skills are a central focus of the school curriculum in most countries. Therefore, all pre-service teachers should have formal training in this area. This should include, at a minimum, foundations of reading pedagogy, application of research-based instructional practices, basic student assessment, and differentiated instruction for learners with diverse needs, including children with disabilities.

As with literacy, pre-service teachers' CK in mathematics should be intricately linked to the national or local curriculum; teachers must be competent in the mathematics skills they will teach (Anthony & Walshaw, 2009; Young-Loveridge, Bicknell, & Mills, 2012). Several groups have identified core content for PSTE programs to cover in mathematics (Schmidt et al., 2017). For example, according to the Conference Board of the Mathematical Sciences (2012), Pre-service teachers should study numbers and operations, algebra, geometry, and measurement and data, using an approach that combines CK and PCK.

The curriculum for pre-service teachers should also include methods courses that connect theory to practice (Darling-Hammond, 2014; Jenset, Klette, & Hammerness, 2018; Sowa et al., 2016). One approach to this, for example, would be for teacher educators to use active pedagogies in their PSTE classrooms that require pre-service teachers to engage with pedagogy, such as conducting and critiquing peer micro-teaching. Video critiques are another means of closing the theory-practice gap (Allier-Gagneur et al., 2020; McDonald et al., 2014; Plöger, Scholl, & Seifert, 2018; Ulusoy, 2020). Field experiences in schools as part of required coursework can also serve this purpose; for example, pre-service teachers could tutor students in local primary schools who need additional support (DeGraff et al., 2015; McDonald et al., 2014; Sailors & Hoffman, 2019). These activities allow pre-service teachers to begin applying the theoretical knowledge of instruction gained from their coursework immediately, rather than waiting for the student teaching practicum, which is generally at the end of the PSTE program.

Teacher educators should teach using pedagogies that pre-service teachers will use in schools, so pre-service teachers can model their own instruction on their teacher educators' approach (McDonald et al., 2014). In many cases, new learner-centered approaches are being spread across primary schools through bilateral- and multilateral-donor-funded projects, which do not extend training opportunities to teacher educators. This results in potential conflict between PSTE programs—where lecture-based approaches are most common—and primary schools, where the new approaches that invite more active engagement are becoming more widespread. The resulting disconnects between the PSTE content and practices in primary schools can lead to contradictory approaches and beliefs among new teachers (Haser & Star, 2009). Implementing this recommendation, ensuring that pre-service pedagogies match the more active pedagogy being used increasingly in schools, will require training and support for the PSTE program lecturers, as discussed below.

Looking broadly across PSTE curricula, there are three aspects of curricular alignment that should be considered by governments and other actors with oversight roles. First, as discussed above, PSTE content must correspond to existing teacher standards. Second, the PSTE program must have a clear mission and ensure alignment across courses within the program, linked closely to PST field experiences (Darling-Hammond, 2006a). For example, if pre-service teachers are taught in their literacy courses that literacy activities should be incorporated across the subject areas, but the subject-area pedagogy course for science, for example, does not discuss or model how to do this integration in practice, there is a curricular disconnect. Third, the curricular content for PSTE programs should be aligned with that of ongoing in-service trainings (Hardman et al., 2011). These three types of curricular alignment would ease the transition from PST to novice teacher.

Improving the practicum experience

The practicum is widely considered a central and crucial component of PSTE (Council for the Accreditation of Educator Preparation, 2019; Darling-Hammond, 2014; Mattsson, Eilertsen, & Rorrison, 2011; National Council for Accreditation of Teacher Education, 2010). In its EQUIP1 report, *Designing effective pre-service teacher education programs*, USAID names a "strong practicum" as one of its eight principles of effective pre-service education (USAID, 2011). The experience of working in a school, under the supervision of a mentor teacher, can aid in closing the theory-practice gap discussed above (Downton, Muir, & Livy, 2018).

A sizeable body of global research suggests that pre-service teachers' experiences during the practicum can have lasting impacts. A study in the United States found that the teaching practicum can improve pre-service teachers' feelings of preparedness and efficacy in the classroom (Brown, Lee, & Collins, 2015). A study of primary-level pre-service teachers in China found that their comprehension of student assessment developed during student teaching (Xu & He, 2019). In New York, a study found an association between the test scores of the students of novice teachers and whether the new teacher's PSTE program had strong "oversight" of the practicum, a measure indicating a more rigorous practical experience[3]

[3] In that study, "oversight" was defined by "three sub-measures: whether the program requires that cooperating teachers have a minimum number of years of teaching experience, whether the program picks the cooperating teacher as opposed to selection by the K–12 school or the student teacher, and whether a program supervisor observes the participants at least five times during student teaching. Because these measures are highly correlated, we combine

(Boyd et al., 2009). Research from Singapore suggests that the teaching practicum gives pre-service teachers a chance to consider whether teaching is a good career choice, reducing turnover in the early years of the teaching career (Ng et al., 2018).

As noted above, the length and structure of practicum varies widely across countries as well as across programs within countries (Schwille & Dembélé, 2007). Empirical studies in this area are sparse, however, even in high-income countries. Jenset and colleagues (2018) state that "we do not have many studies comparing variations in how the field placement is organized and its implications for prospective teachers" (p. 193). Darling-Hammond (2006a) argues that PSTE programs should include "extensive and intensely supervised clinical work integrated with course work using pedagogies that link theory and practice" (p. 300) and that school placement sites should be selected carefully by the PSTE program (Darling-Hammond, 2006b). The practicum should be an opportunity for pre-service teachers to observe strong teaching, so the practice of choosing a school that is simply convenient but does not offer good learning opportunities for the PST should be discouraged.

PSTE programs and stakeholders should carefully consider the length of the practicum. In a U.S. study of more than 3,000 teachers, the length of practice teaching was positively associated with feelings of preparedness among novice teachers as well as with teacher retention (Ronfeldt, 2014). Darling-Hammond (2006a) writes that strong PSTE programs in the United States often include an academic year of student teaching. There are trade-offs to lengthy practica (and therefore a longer program overall), however (Schwille & Dembélé, 2007). In low-resource contexts striving to produce more certified teachers to fill gaps, an extended practicum may be difficult to achieve. Even in high-income countries such as Finland, the cost of the practicum is noted as a consideration in PSTE program design (Saloviita & Tolvanen, 2017). While the cost and pressures to produce teachers quickly will vary across countries, leading to different answers to this central question, there should be clear minimum national standards for the length of the teaching experience. Without sufficient supervised practice time, new teachers will enter the classroom unprepared.

A high-quality practicum experience includes opportunities for pre-service teachers to connect what they have learned in the classroom with what they need to do in the classroom as teachers. This addresses one of the most frequent practicum-related criticisms, as noted above—the lack of connection between theory presented in the PSTE program and the reality of the practicum classroom. Pre-service teachers' capacity to reflect on their own practices and performance in the classroom and learn from it has been demonstrated in numerous studies (Aslam et al., 2021; Sandholtz, 2011; Spiteri & Sang, 2019; Tigchelaar & Korthagen, 2004). Despite the benefits of these practices, some programs do not allow required assignments during the practicum (Allen, Ambrosetti, & Turner, 2013).

During the practicum, pre-service teachers should have some opportunity to teach independently and with autonomy, practicing what they have learned in their coursework (Chan, 2019). The practicum should be structured in such a way that allows for the

these binary variables into a single sum to measure the program's oversight of student teaching" (Boyd et al., 2009, p. 437).

measured transfer of responsibility for instruction from the mentor teacher to the pre-service teacher (Darling-Hammond, 2006b). Mentor teachers may have difficulty ceding control of the classroom to pre-service teachers, particularly if they believe that the pre-service teachers are not effective and the children will have to re-learn the material later (Simuyaba et al., 2015). However, if a pre-service teacher leaves a practicum having only observed teaching and learning, and not having taught independently, it is a missed learning opportunity.

In the body of research on the practicum, pre-service teacher outcomes are associated with the quality of mentorship. For example, support from mentor teachers was related to Chinese pre-service teachers' development of professional identity, which was also associated with the pre-service teachers' commitment to teaching (Zhao & Zhang, 2017). A study from the United States found a positive, statistically significant correlation between pre-service teacher' perceptions of support from their mentor teacher and their self-reported teaching efficacy (Moulding, Stewart, & Dunmeyer, 2014). Strong mentors can help pre-service teachers learn about contextual issues faced in the classroom, including language complexities, poverty, and other forms of disadvantage (Naidoo & Wagner, 2020).

While the evidence is clear that the quality of mentorship is critical, the definition of a "good" mentor is less defined. In many cases, "mentor" teachers act more like evaluative supervisors (Ambrosetti, Knight, & Dekkers, 2014). A recent study reviewed seventy peer-reviewed studies on mentors for pre-service teachers (Ellis, Alonzo, & Nguyen, 2020). Drawing largely on research from high-income countries, the review concluded that high-quality mentor teachers should:

> collaborate with the university; develop a disposition and professional knowledge in mentoring; establish an effective relationship with the PST; facilitate the PST's learning; model effective teaching and make connections between theory and practice; provide direction and support, and; adopt a progressive mindset and support the PST to nurture a teacher-identity (p. 10).

Therefore, based on this description, mentor teachers should primarily be strong teachers themselves and should model the pedagogy that the PSTE program wants the PST to emulate (Ronfeldt et al., 2020). Strong teaching alone does not necessarily indicate that a specific teacher will be a good mentor, however; they must also be willing to and capable of taking on the role of mentorship. Being a mentor teacher is difficult, adding interpersonal conflicts, frustration, and increased workload—typically uncompensated—on top of the already challenging teaching role (Burns et al., 2018; Sim, 2011; Zeichner, 2010). Some regions may lack sufficient mentor teachers to collaborate with pre-service teachers (Burns et al., 2018). Research on mentor teacher perceptions of their work in both high- and low-income countries, points to the fact that many mentor teachers do not feel prepared enough to take on the task of coaching and mentoring pre-service teachers (Öztürk, 2021; Smit, & du Toit, 2021). Consequently, researchers of PSTE practica in high income countries have called for the introduction of various forms of professional development for mentor teachers, which focus on teaching, coaching and mentoring skills to properly prepare them for working with pre-service teachers (Ambrosetti, 2014; Mackie, 2020; Parker, Zenkov & Glaser, 2021; Wilkinson, 2022). Findings in these studies indicate that

after taking these courses, mentor teachers stated that they felt better prepared to support pre-service teachers' growth during their programs and beginning teachers during their induction (Ambrosetti, 2014; Childre & Van Rie, 2015; Gareis and Grant, 2014; Miller, Hanley & Brobst, 2019; Parker, et al., 2021).

While there is scant literature on mentor teacher professional development in LMICs, there is recognition of the need to better prepare mentor teachers (Jita, & Munje, 2022; Mukeredzi, Mthiyane & Bertram, 2015; Smit & du Toit, 2021) and some movement is being made not only to improve mentor teacher skills but increase their numbers in schools. For example, in the USAID Transforming the Education System for Teachers and Students (TESTS) in Liberia, faculty and mentor teachers are being provided with professional development in current evidence-based methods for teaching, coaching, and mentoring (Smith & Ming, 2023). PSTE programs should take more responsibility in identifying high-quality placements for their pre-service teachers in schools where skilled mentor teachers are available.

In high-income countries, the field has shifted from the unidirectional approach of a mentor teacher supervising a pre-service teacher (PST) toward a model that is more collaborative and reflective (Cavanagh & King, 2020; Daniel, Auhl, & Hastings, 2013; Le Cornu, 2005; Thompson & Schademan, 2019). While it is less common in LMICs, we identified several studies from LMICs that discuss this type of PST development during the practicum. Pre-service teachers at the University of Botswana conduct peer observations during the teaching practicum (Monyatsi & Ngwako, 2019). In rural KwaZulu-Natal, South Africa, one study explored the experiences of pre-service teachers participating in a peer communities of practice (CoP) program during the practicum (Islam, 2012). These CoP groups offered useful opportunities for reflection and discussion on issues such as teacher identity, stereotypes about rural students, and the gaps in pre-service teachers' preparation for the classroom. However, the authors note that the CoP groups also reproduced inequalities across race and language, with pre-service teachers participating at various levels. Peer learning approaches may be useful additions to practicum experiences in LMICs, where costs will limit the number of times that a university lecturer can travel to directly observe each PST's teaching. However, as with any intervention, peer activities must be well planned and scaffolded so that the pre-service teachers can provide useful and actionable feedback.

The potential benefits to the involvement of current teachers in PSTE programs are numerous, including enhancing perceptions of teachers as skilled professionals and preparing pre-service teachers for the realities of classroom teaching (Mason, 2013). In a study of 1,000 teachers in the United States, most said they would welcome engagement with a university teacher education program, including activities such as meetings with pre-service teachers, guest lecturing in PSTE courses, or part- or full-time teaching in the PSTE program for a term (Mason, 2013). In the United States, Australia, and Canada, teachers have served as teacher educators in PSTE programs (Allen, Butler-Mader, & Smith, 2010; Zeichner, 2010; Zeichner, Payne, & Brayko, 2015). Participating teachers found this to be a positive experience, providing them the chance to reflect on their own practices as well as closing the gap between theory and practice for pre-service teachers (Allen Butler-Mader, & Smith, 2010). While evidence in this area is largely from high-income countries, it also

provides illustrative examples that could be feasible in LMICs.

Collaborations between PSTE programs and demonstration schools must have well-defined roles for all partners to build a positive, lasting relationship that can support pre-service teachers during their practicum and at other points during their studies (Allen, Ambrosetti, & Turner 2013). The relationship must be mutually beneficial and not extractive, simply demanding more from under-resourced schools and overworked mentor teachers (DeGraff, Schmidt, & Waddell, 2015; Mutemeri & Chetty, 2011; Sowa et al., 2016). Teacher educators and mentor teachers must be conscious of the inherent power relationships that may be at play and take steps to minimize any negative impacts (Martin, Snow, & Franklin Torrez, 2011). Over the long-term, school-PSTE program relationships require the commitment of financial resources to be sustainable (Allen et al., 2013), either from PSTE programs or directly from ministries of education. Functional partnerships between pre-service institutions and schools are a core element of any high-quality PSTE system.

Professional development and support for teacher educators

Any effort to improve PSTE in a sustainable fashion must include teacher educator capacity development. As USAID argues in its' EQUIP1 report (2011) on the design of PSTE programs, "Effective professional development of teacher educators leads to better program development and implementation" (p. 10). Historically, the international development sector's support to higher education capacity development has centered on scholarships that bring individuals to high-income countries to study (McCowan, 2016). This type of deep investment in a small number of individuals may not develop a broad enough base of knowledge to support sustainable, ongoing programmatic improvements at the institutional level. Combining both deep and broad capacity development can ensure that all teacher educators have professional development opportunities, while reducing the likelihood of larger-scale brain drain or the risk of overreliance on specific individuals for direction (Zuilkowski & Tsiga, 2021).

The literature on capacity development for teacher educators is thin, with relatively little rigorous research. The extant studies provide some suggestions of areas for action and future research. For example, capacity development activities for college of education lecturers in Ethiopia focused on early grade reading content and pedagogy led to statistically significant improvements in knowledge on an assessment and improved pedagogy in their classrooms (Barnes et al., 2018; Mekonnen et al., 2018). In Nigeria, a similar capacity development activity had positive impacts on teacher educators' knowledge, skills, and attitudes related to early grade reading (Barnes et al., 2019). The TESSA initiative provides free online courses in Arabic, English, French and Swahili. The courses cover topics like inclusive education, teaching reading, active teaching and learning, and using ICT. TESSA courses and resources also provide an avenue for teachers and teacher educators across sub-Saharan Africa to network and collaborate for professional development (TESSA, 2021). In a research study conducted on teacher educator participation in the online courses participants stated that preservice teachers were more engaged in their courses as a result of the online courses they took, and that although internet connectivity had been a challenge, they were proud of learning how to use more ICT in their courses (Stutchbury, Amos & Chamberlain, 2019).

As access to the internet via mobile phones, tablets, and other low-cost devices spreads throughout LMICs, opportunities to reach teacher educators expands as well. Faculty and pre-service use of digital technologies can be challenging due to the cost of data, intermittent electricity, and internet. However, distance training is less costly than in-person training, which could make a large-scale increase of capacity development for lecturers more feasible in low-resource contexts. As with any attempt to use technology in education, however, the intervention can be only as good as the content provided through the electronic platform. One example of this type of ongoing, distance professional development occurred within the USAID-funded Northern Education Initiative Plus activity in Nigeria, where lecturers who had previously completed a graduate-level, face-to-face early grade reading course were supported in creating professional learning circles around specific topics of interest, such as parental involvement in literacy development. These learning circles were supported by US-based university faculty via WhatsApp. Though attempts to leverage technology for teacher educator capacity development are relatively recent, they have been accelerated by the COVID-19 pandemic, and evidence on the effectiveness of these approaches should be available in the coming years.

Conclusions and future directions

No matter how well funded, FLN programs cannot be successful or sustainable over the long term without the incorporation of PSTE into interventions and long-term program planning. Supporting PSTE programs now is imperative. There is a global shortage of teachers and in sub-Saharan Africa alone, fifteen million teachers are needed to reach the Sustainable Development Goals for education by 2030. In south Asia alone, seven million qualified teachers are needed. It is through the development of quality PSTE programs, funded by country governments, bilateral and multilateral donors, that LMICs can be supported to achieve this goal and ensure the transformation and sustainability of education systems and the education workforce in this regard (Naylor, Jones & Boateng, 2019; International Task Force on Teacher Education - 2030; Vargas-Tamez, 2022).

The literature reviewed in this study identifies several areas central to the development of primary grade PSTE, including (1) curriculum revisions to make PSTE more applied and relevant to classrooms in local contexts, (2) enhanced focus on the practicum as a core component of PSTE, including examination of the quality and quantity of mentoring received by pre-service teachers, and (3) consistent, ongoing, high-quality professional development for PSTE lecturers to promote alignment of their course content and pedagogy with evidence-based practices.

Though the reviewed literature clearly identifies a set of problems in PSTE, there is little rigorous empirical research on exactly how to address these issues (Allier-Gagneur et al., 2020). Especially in LMICs, it is difficult to track individual pre-service teachers as they progress in the teaching profession, and several years, at a minimum, elapse between exposure to various aspects of PSTE and being able to measure impact on primary grade students in new teachers' classrooms. While some types of research on PSTE would require large, administrative data sets (as in Boyd et al., 2009), there is a range of topics that could be meaningfully explored on a smaller scale, with focused research investments. A few examples include approaches to enhancing the quality of PSTE program applicants, distance, and virtual platforms for teacher educator professional

development, implementing partnership activities bringing together teachers and teacher educators, mentor teacher training, and providing textbooks and other resources to PSTE programs at the same level as primary schools. Over the longer term, the strengthening of national education management information systems in LMICs should allow for larger-scale studies of the impact of various aspects of PSTE.

Finally, we note that PSTE is underfunded and requires greater investment. Lack of needed resources, from national curricula to textbooks to instructional aids, impacts all facets of PSTE and reduces the preparedness of new teachers. The importance of resources in teacher training is stressed in USAID's EQUIP1 report, which states, "Teacher education institutions require sufficient infrastructure and resources to implement effective PSTE programs" (USAID, 2011). PSTE programs require both broad and deep investment for sustainable capacity development (Zuilkowski & Tsiga, 2021). Governments, bilateral and multilateral donors, nongovernmental organizations, and other stakeholders must acknowledge the role played by PSTE in efforts to improve and sustain education outcomes and include PSTE institutions as full partners in FLN activities.

Some recent evidence suggests that bilateral and multilateral donors are beginning to focus more on PSTE. In January 2023, the European Union (EU) launched a 100 million Euro investment called the Regional Teachers' Initiative in Africa and for Africa, to address the shortage of teachers. This initiative, in partnership with the African Union, UNESCO and the International Task Force on Teachers for Education 2030 aims to support partner countries in Africa in improving teacher education (European Commission, 2023). Though PSTE is often thought of as a component of the higher education sector rather than a part of basic education, it is an integral component of ensuring high-quality and sustainable FLN education for all children globally.

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