Literature Review on Pre-service Teacher Education for Primary-Grade Literacy and Numeracy

1. Introduction

Despite the central role of pre-service teacher education (PSTE) in promoting quality education, it has largely been left out of the significant investments made to improve foundational literacy and numeracy (FLN) in low- and middle-income countries (LMICs) over the past two decades.[1] These bilateral- and multilateral-funded interventions have instead tended to focus on in-service teacher training as a means of producing faster results at scale. While investments in PSTE may take longer to influence student-level outcomes, they are key to the sustainability of pedagogical changes in schools. If the PSTE sector is not involved, systems will be forced to engage in intensive, continuous rounds of professional development to realign the knowledge and skills of new teachers to school practices.

PSTE provides a foundation upon which new teachers will build over their teaching careers.[2] **Content knowledge and pedagogical practices learned in pre-service teacher education are likely to be embedded in teachers' practices throughout their career**. A greater focus on PSTE—namely by embedding evidence-based FLN approaches into initial teacher education—is therefore an opportunity to improve the sustainability of investments in FLN that have been made by governments, international aid actors, and nonprofit organizations alike.

The potential positive impact of PSTE on student outcomes is related to teacher selection and deployment policies. In this review of the literature, the term "selection" refers to actions taken to attract candidates to PSTE programs, while "deployment policies" refers to the procedures used to assign teachers—both new and experienced—to specific schools throughout a country. PSTE's impact will be diluted if these essential policies do not ensure the equitable distribution of high-quality, well-trained teachers within countries, particularly in rural and other disadvantaged areas. Alignment between PSTE and deployment policies is critical to ensure that the education system produces the types and numbers of teachers required and that those teachers are placed in the schools where they are most needed.

This literature review, which draws on more than 200 sources, including peer-reviewed journal articles, project evaluations, and policy documents, is a companion to the how-to guide on primary-grade PSTE programs. It provides an overview of the key issues required to develop and maintain effective primary-grade PSTE programs, with a particular emphasis on FLN. Section 2 discusses challenges that have been identified in the literature on PSTE in LMICs, with special attention to curricula, practica, teacher educator capacity, and the deployment of new teachers after program completion. Section 3 provides evidence-based recommendations on these topics and considers the characteristics of education systems that are required to maximize the benefits of changes to countries' PSTE structures. Section 4 concludes with a summary of key action areas and suggestions for future research.
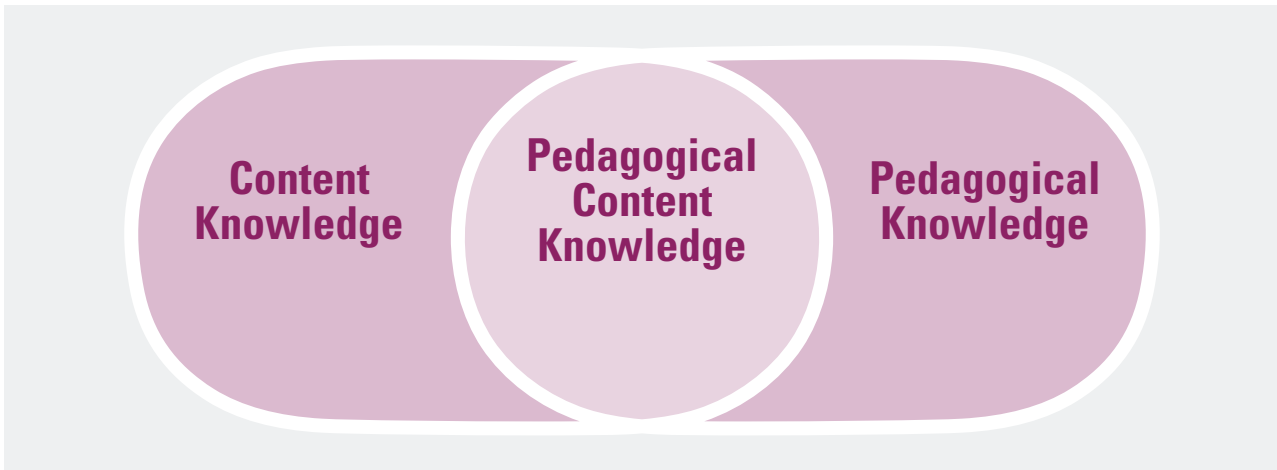
2. Challenges in Pre-service Teacher Education in LMICs

2.1. CURRICULAR ISSUES

To teach effectively, teachers need three types of knowledge: content knowledge, pedagogical knowledge, and pedagogical content knowledge (Figure 1).[3] The first of these, content knowledge, includes subject-matter knowledge (such as theories, concepts, and materials) relevant to the subjects a teacher teaches—for example, reading, mathematics, science, etc. The second, pedagogical knowledge, refers to the general ability to plan, organize, and carry out lessons, regardless of the specific topic. Lastly, pedagogical content knowledge is the ability

to use pedagogy that is specific to and appropriate for a given subject, including an understanding of how children learn. Pre-service teachers need to develop their skills and knowledge of these three areas during their pre-service education. Courses on universal design for learning (UDL) should be woven into the core courses that constitute and facilitate pedagogical knowledge, with technological resources to ensure that pre-service teachers know how to address the needs of the diverse learners in their future classrooms.

FIGURE 1. Shulman's model of content knowledge, pedagogical knowledge, and pedagogical content knowledge

The curricular focus of pre-service teacher education programs in LMICs is largely on content knowledge rather than pedagogical knowledge or pedagogical content knowledge, and on theory rather than practice.[4] In his study of PSTE programs in six African countries, Akyeampong concludes that pre-service teachers learning to teach primary-grade reading and mathematics spend more time on content knowledge (e.g., teachers' knowledge of mathematics) than on how to teach this content to children.[5] In a study in Zambia, a mentor teacher reported the pedagogical weaknesses she saw in pre-service teachers, 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."[6] High-quality primary-grade PSTE programs focus on the methods of teaching, particularly in the skills of FLN. Several studies also note the challenges pre-service teachers and PSTE programs have with implementing UDL or any form of inclusive education. More of these studies are needed, particularly those that focus on innovative and effective approaches to preparing pre-service teachers for inclusive classrooms.[7]

Despite the heavy curricular focus on content knowledge, however, many pre-service teachers still have **weak content knowledge** of the subjects that they intend to teach. A study of pre-service science teachers in four colleges of teacher education in Ethiopia found that their content knowledge attainment did not meet the standards laid out in the curriculum.[8] These teachers ended their programs with TIMSS mean scores only at the international mean for eighth graders. In a small study in South Africa, third-year pre-service science teachers scored similarly to grade 11 students on a test of basic science concepts.[9] Another study in South Africa found that the mathematics content knowledge of pre-service teachers in three programs improved little over the course of their four-year program.[10] In Zambia, pre-service mathematics teachers took advanced mathematics coursework but struggled to explain lower-level mathematics functions.[11] Lastly, a study of pre-service teachers and PSTE program teacher educators in Bauchi and Sokoto states in Nigeria found that the knowledge of literacy development was so low that, as one teacher educator said, "Teaching reading is confused with teaching English."[12]

One reason for this pattern—poor content knowledge among pre-service teachers despite a focus on content knowledge in pre-service programs—is that in LMICs, **these programs are generally seen as low-prestige options for students who do not have other post-secondary education opportunities.**[13] Students enter with insufficient academic background in key subject areas, which means that the pre-service programs are forced to spend valuable curricular space filling holes in pre-service teachers' content knowledge. Additionally, the view of teaching as a "fallback" career may have negative implications for pre-service teachers' motivation in their academic programs, as well as their satisfaction with teaching as a career.[14]

The overemphasis on theory results in **PSTE that is often disconnected from the teaching context** (see box below). Pre-service teachers do not learn about the actual curriculum that will be used in the schools where they will

teach; about the materials used in those schools (including materials from large-scale FLN programs conducting in-service trainings); about the local languages spoken and used for instruction in different regions; or about the social, economic, and cultural contexts of schools in various regions.[15] PSTE program curricula often present teaching as a standardized process, without consideration of the contextual factors that may vary widely across regions and across rural-urban divides.[16]

Research on PSTE in LMICs provides numerous examples of disconnects between PSTE curricula and primary-school contexts. For example, Buckler describes an assignment in which pre-service teachers in Ghana were asked to prepare a lesson for 35 students; 35 students is the target class size according to government policy, but far smaller than the actual class size of most Ghanaian primary classrooms.[17] To get high marks on the assignment, the lesson plan had to be for precisely 35 students. As one of the participants stated, "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."[18] A study in Bhutan found that while multigrade classrooms are common, many teachers received no training on multigrade teaching in their pre-service programs;[19] this problem has also been documented in Indonesia.[20] Studies in South Africa have found that PSTE programs do not prepare pre-service teachers well to teach in rural schools.[21]

Additionally, instruction in PSTE programs, as in many other institutions of higher education in LMICs, tends to **use traditional lecture-based teaching approaches instead of more active, engaging approaches**.[23] Teacher educators are seen by pre-service teachers as distant authority figures and the source of all correct information.[24] Pre-service teachers have little opportunity to see their instructors utilizing active pedagogical methods in the PSTE classroom and will likely teach their future students as they themselves were taught in their "apprenticeship of observation."[25] This sets these newly trained teachers up for conflict with the more active learning approaches used in many large-scale FLN programs and in primary-grade curricula in LMICs.

2.2. PRACTICUM ISSUES

The teaching practicum is a critical component of teacher preparation; during this period, pre-service teachers are assigned to a school where they teach under the direction of an experienced mentor teacher. Practicum experiences vary widely across countries and in their structure, length, and responsibilities.[26] However, two types of misalignment are common. First, there is frequently a disconnect between course content in the PSTE program and the content of the practicum.[27] Second, the practicum is often unconnected to the core instructional practices utilized in FLN programs. These issues suggest that the practicum receives too little attention from PSTE curriculum designers in LMICs.

The most frequent problems identified with the practicum are the **quantity and quality of mentoring and support** that pre-service teachers get during this period. Pre-service teachers should have a mentor teacher as well as supervision by a teacher educator from their PSTE program. Their experiences are often highly dependent on the teacher to whom they are assigned. In a study of pre-service teachers' experiences during practicum in Mpumalanga Province, South Africa, Nkambule and Mukeredzi describe very different practicum experiences.[28] Some mentor teachers were unwilling to be observed by their pre-service teachers and reluctant to offer any kind of assistance, while others were supportive and scaffolded pre-service teacher growth. Observations of pre-service teachers in classrooms by faculty are generally very limited; and in some cases, they are sometimes just one-off visits.[29] In Cameroon, a study found that schools often scheduled in-service training for the regular classroom teachers during practicum times, leaving the pre-service teachers to teach alone without observation or feedback.[30] Similarly, a study in Zimbabwe found that many pre-service mathematics teachers were left largely on their own during their eight-month teaching practicum.[31]

The quality of feedback and support provided in the practicum is also a common issue. In a study of university-school partnerships in PSTE programs

The Multi-Site Teacher Education Research Project (MUSTER), which explored pre-service teacher education in Malawi, Ghana, Lesotho, South Africa, and Trinidad and Tobago, found that "sometimes the colleges appear to be training students for schools as tutors think they ought to be, rather than for schools as they are."[22]

The MUSTER project in Malawi, Ghana, Lesotho, South Africa, and Trinidad and Tobago found that lecturers' visits "tended to be badly timed, rushed, irregular, and mostly orientated to assessment. Sustained formative feedback geared to the student's own development does not generally occur."[32]

in South Africa, teacher educators reported that there was little training given to mentor teachers on how to support pre-service teachers during their practicum and that teacher educators' observation of pre-service teachers was minimal.[33] Kenya utilizes a structured feedback system 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 found that this did not generally happen due to the large number of pre-service teachers who had to be observed and the distances that PSTE faculty had to travel to reach the schools.[34] It was rare for teacher educators to discuss pre-service teachers' performance with the mentor teacher. Pre-service teachers reported feeling fearful about the evaluations and noted that there was little opportunity for collaborative reflection on their pedagogical practice with their supervising teacher educator. In sum, there are few incentives for PSTE faculty and mentor teachers to give high-quality, intensive support to pre-service teachers, and pressures on their time make it nearly impossible within the current structure. These findings suggest that the practicum component of pre-service training requires enhanced funding, to improve the quality and quantity of oversight and support.

Even if the mentor teacher is skilled and supportive, **the teaching practicum is often too short** to allow pre-service teachers to fully benefit. In Cameroon, participants in a nine-month PSTE program reported teaching practice placements as short as two weeks.[35] Pre-service teachers at the University of Zambia reported that their teaching practice—both peer teaching and practicum—was too short for them to develop the needed skills.[36] Some of the participants in a study of 61 final-year pre-service teachers and 26 PSTE faculty members in South Africa felt similarly.[37] As one teacher educator in that study said, "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."[38]

In sum, the lack of connection with coursework taken before the practicum, lack of high-quality supervision and mentoring, lack of connection to new instructional approaches used in the schools, and insufficient practicum length can result in pre-service teachers finding their PSTE experience not very useful in developing their skills and confidence as teachers.[39] Perceived hierarchies between teacher educators and mentor teachers can also limit the potential positive impact of the practicum on pre-service teachers, as well as the content of PSTE programs.[40] Successful FLN programs should encourage governments to tackle these issues in their practica system. In the following section, we address the capacities at the institutional and teacher educator levels that are necessary to support enhanced practica, as well as the curricular revisions discussed above.

2.3. INSTITUTIONAL CAPACITIES

In addition to the structural issues of PSTE curricula mentioned above, limitations in the capacity of PSTE faculty to adequately teach the curriculum and prepare pre-service teachers are well documented in LMICs. **Teacher educators often have limited or outdated training**, as they receive little professional development and have few opportunities to keep up with evidence-based practices in the fields they teach.[41] A mixed-methods study of faculty at four colleges of education in Nigeria found that teacher educators generally lack the early-grade reading-related content knowledge and pedagogy required to teach pre-service teachers.[42]

Additionally, **teacher educators in PSTE programs commonly have little classroom teaching experience**, especially in the early grades.[43] Since these positions generally (and increasingly) require university degrees,[44] some teacher educators are hired directly from their university programs, while others are former secondary school teachers holding university degrees. The mismatch between this requirement and the available stock of potential faculty with primary teaching experience means that many countries' teacher educators lack experience in teaching primary education, let alone the particular FLN skills. Thus, teacher educators, even those in primary teacher training programs, may have little knowledge of how to teach children to read or understand mathematics concepts, which helps explain their resulting focus on complex theoretical concepts rather than practical pedagogical contexts.

Discussing the MUSTER project, Lewin states, "The qualitative data MUSTER collected suggests that often tutors have surprisingly little detailed knowledge of the characteristics of the cohorts of students they train, and also of the school environments that newly trained teachers enter."[45]

The lack of classroom experience means that teacher educators are also often unable to prepare pre-service teachers for the contexts in which they will teach (see box). This is compounded when PSTE faculty receive their

own teacher training in other countries. A study in Samoa found that most of the teacher educators in that study were educated at universities in New Zealand and Australia[46] and used textbooks and other materials from abroad in their courses, resulting in limited connections to and appreciation of Samoan knowledge and content. If teacher educators cannot prepare pre-service teachers for the specific conditions they will face in the classroom, pre-service teachers are less likely to be successful in challenging conditions.

While teacher educators often have weaknesses in their capacity to train pre-service teachers, it is important to acknowledge that these individuals are working in institutions that are often not supportive of their professional growth. Teacher educators in LMICs generally lack autonomy in their decisions about what to teach and how to teach it because curricular content is often determined at the national level. For example, Buckler describes a teacher educator in Ghana who was required to teach a session on science laboratory safety, though he had never seen a primary school with a science lab.[47] The teacher educator performance was judged based on his coverage of the official curriculum, including the sections that were irrelevant to the local context.

More broadly, PSTE faculty often work in **poorly resourced institutions**. A high-quality FLN-focused teacher training program requires a wealth of learning materials, including resource libraries, primary-grade curricula and texts, leveled readers, and manipulatives. But PSTE programs, particularly those at the primary-grade level and those not affiliated with universities, often lack sufficient materials as well as the materials used by actual teachers in schools.[48]

2.4. SELECTION AND DEPLOYMENT ISSUES

PSTE is connected to classroom teaching via selection and deployment policies, which involve attracting PST, and hiring as well as assigning both new and existing teachers to specific schools. As Anjum and Durrani state, "the recruitment and deployment of teachers is not simply a matter of teacher quality; it is also a concern of social justice in education provision."[49] **Selection and deployment policies affect the quality of teachers, the equitable distribution of those teachers across geographic regions, and the attractiveness of teaching as a career, especially to women and other disadvantaged groups; they also have enormous budgetary implications.**[50]

These policies are under pressure from a variety of stakeholders. In many LMICs, the need for rapid increases in the number of trained teachers conflicts with pressures to improve the quality of teacher training and to increase standards for entry into the field.[51] Teachers may be assigned to positions that do not align with their training—for example, a new teacher with a secondary school science background might be assigned to teach primary school to fill an urgent gap. However, deployment challenges can persist even when the overall supply of teachers is not an issue, as in Indonesia.[52] Political influence and corruption in teacher hiring and deployment are well documented in LMICs;[53] teachers' unions may also have great influence on how teachers are assigned.[54] Further, many LMICs have experienced violent conflict, and the resulting displacement adds another layer of complexity to teacher deployment policies, as shown by a recent qualitative study in the Democratic Republic of Congo.[55]

Tensions between costs, the quantity of teachers, and the quality of teachers have implications for teacher selection policies. For example, some countries have hired contract teachers to quickly fill teaching positions at a lower cost.[56] However, the lower teacher salaries, reductions in the numbers of new permanent positions, and decreased professional prestige that result may dissuade potential teachers from joining the profession.[57]

A major issue in teacher deployment in LMICs is related to **teacher placements in rural and disadvantaged schools**.[58] Teachers often resist rural placements,[59] refusing to accept them or transferring to preferred locations as soon as possible. In a case study of 61 pre-service teachers in a teacher training college in Zimbabwe, pre-service teachers' priorities were to be placed in schools that had easy access to water, that were near reliable transport and good roads, and that had strong mobile phone networks, electricity, and good teacher accommodation.[60] The authors found that it was not being in a rural area per se that made those schools undesirable, but rather specific quality-of-life factors that were of importance. Female teachers may be more likely than their male counterparts to resist rural school placements, reducing the number of educated female role models in those locations. In a survey of pre-service and in-service teachers in Sindh, Pakistan, more male teachers than female teachers declared a willingness to teach in a rural area.[61] For female respondents, major concerns about rural placements were transportation costs, a lack of basic facilities, and a lack of family members with whom they could live. Issues such as these lead to system-level inequities because they contribute to urban-rural disparities in educational outcomes.[62] These gaps remain significant in many LMICs today, more than 30 years after the launch of the Education for All movement.[63]

A second major issue, which is of particular importance when considering early-grade reading instruction, is **mismatches between teachers' languages and schools' language of instruction**.[64] For example, a Zambian teacher who speaks Bemba, Nyanja, and English may be assigned to a school in a province where Tonga is the official language of instruction for grades 1 through 3. Evidence-based approaches for literacy instruction include the explicit instruction of foundational skills of literacy, including phonological awareness, and mapping sounds to symbols. It is difficult for teachers to do this if they are not fluent in the language in which they are supposed to be teaching. In Kenya, an evaluation of the impact of a mother-tongue arm of PRIMR, a USAID- and FCDO-supported literacy and mathematics intervention, found that some teachers who were not native speakers of Kikamba, a Kenyan language, could not correctly make that language's diacritic vowel sounds.[65] These mismatches, which are the result of deployment policies, are one reason why teachers often resist teaching in local languages, even when required by national policies. The interaction between language of instruction, on the one hand, and selection and deployment policies, on the other, can therefore result in poorer education quality and reduce the success of local-language mother-tongue programs.[66]

In summary, selection and deployment policies can interact with PSTE in ways that promote children's equitable access to high-quality teachers, or in ways that compound disadvantages. Equity—for students and teachers alike—must be directly addressed in these policies.

3. Evidence-Based Essentials and Promising Practices for LMICs

The goal of this section is to discuss recommendations for PSTE and teacher selection and deployment that are based on rigorous evidence. However, even in high-income countries such as the United States, **evidence on the impact or effectiveness of pre-service teacher education programs remains limited** (see text box below). With this in mind, the discussion below draws on the best evidence available—from LMICs when possible, and high-income countries when not—to make recommendations for improving PSTE programs in LMICs.

In a 2020 report on the K–12 teacher workforce, the National Academies of Sciences, Engineering, and Medicine states the following:

The field lacks empirical evidence about what [PSTE programs] programs are effective, why, and for whom. Most state data systems fail to link preservice teacher candidates to inservice outcomes. Part of the problem has to do with the disagreement about what constitutes effectiveness (i.e., should indicators of effectiveness be student test scores, teacher retention rates, or closing achievement gaps among groups of students, or some other measure?). The NRC report Preparing Teachers (2010) called for research on the development of links between teacher preparation and outcomes for students, but that call has yet to be fulfilled. The problem also has to do with the difficulty in examining the causal effectiveness of teacher preparation programs, given all the confounding variables—including individual teacher traits—that might explain teacher success.[67]

The report goes on to critique the practice of selecting programs as models for PSTE without the necessary rigorous evidence to underpin their selection:

High-profile reports on teacher education … have singled out specific programs as exemplars of excellence. Whereas these programs vary greatly in terms of program design, it is important to recognize that judgments about what constitutes 'excellence' are often based on subjective assessments of what teacher preparation ought to look like rather than empirical, causal evidence on the effectiveness of teacher education.[68]

3.1. RECOMMENDATIONS FOR PRE-SERVICE TEACHER EDUCATION

Despite frequently being left out of major basic education initiatives, PSTE programs are a significant entry point for sustainably improving the quality of education in LMICs. In their study of PSTE in Ghana, Kenya, Mali, Senegal, Tanzania, and Uganda, Akyeampong and colleagues found that **"initial teacher education remains the most powerful influence on the practice of teachers in the early part of their career."**[69] The authors explain 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."[70] In their review of education research in LMICs, Evans and Popova note that teacher education programs in LIMICs play an important role in improving student learning outcomes.[71] While in-service teacher education can update knowledge and give teachers new skills, their PSTE is the foundation upon which they build.

3.1.1. Key Components of the PSTE program Curriculum

USAID's EQUIP1 report, titled *Designing Effective Pre-service Teacher Education Programs*, states as one of its eight principles that "effective pre-service teacher education should be aligned with professional standards for teachers."[72] While several international organizations have made recommendations, there are no agreed-upon global professional standards for teachers generally nor for pre-service teacher preparation in reading and mathematics for the early grades specifically. These standards are generally set at the national level and vary widely across countries. In Ghana, for example, Transforming Teacher Education and Learning, a government program supported by FCDO and implemented by Cambridge Education, assisted in the development of Ghana's National Teachers' Standards. The three domains of the new standards are professional values and attitudes, professional knowledge, and professional practice.[73]

The **content of the PSTE program curriculum must be defined by what teachers in a particular context need to be able to do, and it should focus on high-leverage pedagogical practices**[74]—the core elements of high-quality instruction.[75] Some curricular content issues will vary across LMIC contexts. However, there are certain core components of FLN that should be included in primary-grade PSTE programs. Pre-service teachers need to learn the key building blocks of literacy and numeracy development, as supported by current evidence, and must understand how to teach those skills to students. To use Shulman's terminology, pre-service teachers need content knowledge, pedagogical knowledge, and pedagogical content knowledge for the subjects they will teach.[76]

In the early primary grades, literacy development is a core focus of the school curriculum in most countries. Therefore, all pre-service primary teachers should have formal training in this area. At a minimum, this should include 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. Special education and inclusive approaches should be infused throughout the curriculum rather than taught as separate modules.[77]

As with literacy, pre-service teachers' content knowledge in numeracy should be closely linked to the national or local curriculum; teachers must be competent in the numeracy skills they will teach.[78] Several groups have identified core content for PSTE programs to cover in mathematics.[79] **The Conference Board of the Mathematical Science recommends that pre-service primary teachers study numbers and operations, algebra, geometry, and measurement and data, through an approach that combines content knowledge and pedagogical content knowledge.**[80]

The curriculum for pre-service teachers should also include **methods courses that connect theory to practice.**[81] Ways to do this include modeling by teacher educators and the use of active pedagogies in the PSTE program that require pre-service teachers to engage with actual instruction, such as critiquing peer micro-teaching. Several studies have examined the use of videos in courses as a means of bridging theory and practice.[82] Pre-service teachers could also be required to complete field experiences in schools as part of their coursework—for example, working with early-grade students in partner schools who need additional support in reading.[83] This type of engagement allows pre-service teachers to begin applying their theoretical knowledge of instruction gained from their coursework immediately, rather than waiting for the teaching practicum, which is usually at the end of the program.

Exposure to practice during PSTE can also help **develop professional dispositions**[84]—defined by the US-based National Council for Accreditation of Teacher Education as "professional attitudes, values, and beliefs demonstrated through both verbal and non-verbal behaviors as educators interact with students, families, colleagues, and communities."[85] However, the specific areas that are included in "professional dispositions" should be determined in

each particular context.[86] The inclusion of these areas in the curriculum, especially in connection with opportunities to observe practicing teachers or to engage in short-term, pre-practicum field experiences, will better prepare pre-service teachers for their future roles.

The curriculum must be taught to pre-service teachers using **pedagogies that reflect the ways that these teachers are supposed to teach children**. If learner-centered pedagogies (which use active learning approaches and shift the focus away from teachers as the sole sources of knowledge) are embedded in the primary school curriculum, as is increasingly the case in primary-grade interventions, then those pedagogies must be modeled for and practiced by pre-service teachers.[87] Conflicts between pre-service program instruction and primary school practices can lead to contradictory approaches and beliefs among new teachers.[88] Implementing this recommendation will require training and support for the PSTE faculty, as discussed in Section 3.1.3.

Three facets of **curricular alignment** should be considered when planning PSTE programs. First, as discussed above, PSTE program content must be aligned with national standards for teachers. Second, there must be a clear mission for the program and alignment across courses within the program.[89] If pre-service teachers are taught in their literacy courses that literacy activities should be incorporated into all subjects, but the subject-area pedagogy course for mathematics, for example, does not include or model this integration, there is a curricular disconnect. Third, the curricular content for PSTE programs must be linked to the content of ongoing in-service trainings.[90] Program designers—in high-resource and low-resource settings alike—should simplify the transition from pre-service teacher to new teacher by reducing the conflicts between the PSTE curriculum school practices, in-service professional development, and teacher career progression standards.[91]

Finally, the curriculum must be accessible to and supportive of all pre-service students, including women and those with disabilities.[92] Inclusion for all qualified PSTE candidates may help address the selection and deployment issues discussed in Section 2.4 above.

3.1.2. Improving the Practicum Experience

Practicum experiences are acknowledged by a wide variety of stakeholders as one of the core elements of PSTE.[93] USAID's aforementioned EQUIP1 report identifies a "strong practicum" is as one of its eight principles of effective PSTE.[94]

The **practicum experience plays a central role in the preparation of effective teachers**, helping close the theory-practice gap discussed above, as shown in research from higher-income country contexts.[95] Research from the United States has found that practicum improves pre-service teachers' feelings of preparedness and efficacy in the classroom.[96] In China, a study of six pre-service primary teachers found that their understanding of student assessment deepened during student teaching.[97] In New York, a study found an association between the test scores of the students of first-year teachers and whether the new teachers' PSTE program had strong "oversight" of the practicum, a measure indicating a more rigorous practical experience.[98] Research from Singapore suggests that the teaching practicum provides a valuable opportunity for pre-service teachers to learn whether teaching is the right career fit for them, reducing turnover later on.[99]

As discussed above, the length and structure of the practicum varies widely across countries and across PSTE programs.[100] As Jenset and colleagues note, "we do not have many studies comparing variations in how the field placement is organized and its implications for prospective teachers."[101] In the US context, Darling-Hammond recommends that PSTE programs include "extensive and intensely supervised clinical work integrated with course work using pedagogies that link theory and practice."[102] She also states that PSTE programs need to carefully select placement sites and maintain close relationships with those schools.[103] Pre-service teachers should not simply choose any convenient school for their practicum; they should be observing good-quality teaching. The development of school-university partnerships for this purpose is discussed further at the end of this section.

A key factor for consideration is the **length of the practicum**. In a study of more than 3,000 teachers in the United States, the length of practice teaching was positively associated with feelings of being well prepared among new teachers, as well as with retention in the profession.[104] Darling-Hammond notes that strong PSTE programs in the United States often require a full year of student teaching.[105] However, there are clear trade-offs to lengthy practica (and therefore a longer program overall) in terms of training length and costs.[106] For example, student teachers generally have to cover their own living costs during the practicum, so extending this period and overall

program length carries direct costs and opportunity costs in cases where they could otherwise be employed sooner. In low-resource contexts under pressure to produce more certified teachers, it may be difficult to garner policy support for an extended practicum. Even in high-income countries such as Finland, the cost of teaching practice is noted as a consideration in PSTE program design.[107] Regardless of the case, there should be clear minimum national standards for the length of teaching experience to ensure that pre-service teachers have enough time to develop their skills in real classrooms.

During their practicum, pre-service teachers should actually teach and practice what they have learned.

During the practicum, pre-service teachers should be required to engage in activities that **connect their experiences to their coursework and deepen their learning in their placements**. This addresses one of the most frequent practicum-related criticisms, as noted in Section 2.2. A number of studies have shown that pre-service teachers are capable of valuable reflection about their own instructional and classroom management performance.[108] Currently, however, some programs disallow these types of required assignments during the practicum.[109]

Pre-service teachers' practicum experience should afford them the opportunity to have some **autonomy to actually teach and to practice what they have learned**.[110] The practicum should be structured to promote a gradual transfer of responsibility from the mentor teacher to the pre-service teacher.[111] This can be challenging for the mentor teachers, particularly if their perception is that the pre-service teachers are not effective and the material will have to be retaught.[112] However, if a pre-service teacher leaves a practicum having only observed teaching and learning, and not having taught themselves, the experience will be of little benefit.

The **quality of mentorship** received during the practicum is linked to pre-service teacher outcomes. In China, support from practicum mentors was related to pre-service teachers' development of professional identity, which in turn was related to their commitment to teaching.[113] In a study in the United States, there was a positive, statistically significant correlation between pre-service teachers' perceptions of support from their mentor teacher and their sense of teaching efficacy.[114] Mentors can help pre-service teachers learn to acknowledge and address contextual challenges, such as poverty and disadvantage among their students.[115] Positive shifts in mentorship approaches can be supported as a component of donor-funded FLN projects. For example, the Tusome literacy activity in Kenya is working with the Ministry of Education to revise the practicum evaluation criteria to better connect the criteria with high-impact pedagogical practices.

Acknowledging that the quality of mentorship is important leads to the question of how to identify good mentors. The definition of mentoring in the practicum context is often fuzzy, with many "mentor" teachers taking more of a supervisory approach.[116] A recent literature review examined 70 peer-reviewed studies on mentors for pre-service teachers, largely from high-income countries.[117] This rigorous 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 [pre-service teacher]; facilitate the [pre-service teacher's] learning; model effective teaching and make connections between theory and practice; provide direction and support, and; adopt a progressive mindset and support the [pre-service teacher] to nurture a teacher-identity."** [118]

Thus, mentor teachers should be effective teachers themselves and model the type of instruction that the PSTE program wants pre-service teachers to emulate.[119] Effectiveness alone is insufficient, however, as the mentor teacher must also be willing to undertake this extra work in order to develop the necessary skills among pre-service teachers. Not all effective teachers are necessarily good mentors. **PSTEP and school administrators must take into consideration the pressures and challenges of being a mentor teacher, including interpersonal conflicts, frustration, and increased workload (which is generally uncompensated).**[120] It can be difficult to find enough good mentors in some areas, depending on relative pre-service teacher and school population sizes.[121] **PSTE program should take more responsibility in ensuring high-quality placements for their pre-service teachers**, using mentor teachers who are willing and able to take on the extra duties.

In the literature on new teacher development in high-income countries, there has been a movement away from the unidirectional approach of a skilled mentor teacher overseeing a pre-service teacher toward **a model that is more collaborative and reflective.**[122] Several studies from LMICs explore this type of pre-service teacher development during teaching practice. Pre-service teachers at the University of Botswana conduct peer observations during the teaching practicum.[123] In rural KwaZulu-Natal, South Africa, one study described the experiences of pre-

service teachers who participated in peer communities of practice during their practicum.[124] While these pre-service teachers also worked with mentor teachers, the communities of practice offered valuable opportunities for reflection and discussion on issues such as teacher identity, preconceptions about rural students, and gaps in their preparation to teach. However, the communities of practice also reproduced inequalities across race and language; for example, one pre-service teacher who described his English as being weak was unable to participate as much as others. These peer feedback approaches may be useful additions to practicum experiences in LMICs, where costs will likely limit the number of times that a teacher educator can observe each pre-service teacher's lessons. However, they would need to be structured and scaffolded in order for the peer pre-service teachers to provide useful and actionable feedback.

There are broad benefits to involving current teachers in pre-service teacher education programs, including enhancing perceptions of teachers as professionals and better preparing pre-service teachers for classroom realities.[125] Most of the peer-reviewed evidence on this topic is from high-income countries, though these experiences are also relevant to LMICs. In a study of 1,000 teachers in the United States, the majority said they were interested in greater involvement with a university teacher education program, including meetings with pre-service teachers, guest lecturing, and part- or full-time teaching in the pre-service program for a specific time period.[126] In Australia, Canada, and the United States, teachers have been brought in as lecturers in PSTE programs.[127] Participating teacher-lecturers found this to be a positive experience, as it provided opportunities for reflection on their own practice and helped close the gap between the theory and practice of teaching for pre-service teachers.[128]

When building collaborations between PSTE programs and demonstration schools, the roles of all stakeholders must be clear in order to build a positive, ongoing relationship that can better support pre-service teachers during their practicum.[129] **The relationship cannot be extractive—simply demanding more from under-resourced schools and overburdened teachers—but instead must be mutually beneficial.**[130] There are inherent power differentials that can complicate relationships between university-based PSTE program faculty and mentor teachers.[131] If school-PSTE program relationships are to be sustained over the long run, they require the commitment of financial resources,[132] either from PSTE programs or directly from ministries of education. Functional partnerships are a core element of a high-quality PSTE system.

> In Cambodia, a collaborative intervention between VVOB and the Cambodian Ministry of Education, Youth and Sport aimed to improve the content knowledge and pedagogical content knowledge of primary mathematics teacher educators. A pre-post assessment showed that more than 90% of the teacher educators improved their math pedagogical content knowledge through the training and coaching intervention.[133]

3.1.3. Professional Development and Support for Teacher Educators

A focus on the professional development needs of existing PSTE faculty is key to sustainable improvements in PSTE. This is underlined in USAID's EQUIP1 report on the design of PSTE programs, which states, as one of its eight principles, that "effective professional development of teacher educators leads to better program development and implementation."[134] Much of the international development sector's support for higher education capacity development has been in the form of scholarships to study abroad.[135] This type of deep investment in individual faculty, while important, may not provide the base of knowledge that PSTE programs need to support sustainable, ongoing shifts in the quality of their programs. **A combination of deep and broad capacity development can ensure that all teacher educators receive professional development, while defending against brain drain or overreliance on a few key teacher educators**[136] (see box).

There has been relatively little rigorous research on capacity development for PSTE faculty in LMICs. A few recent studies provide some suggestions on approaches. In Ethiopia, a series of workshops for college of education faculty focused on early-grade reading content and pedagogy resulted in statistically significant improvements in knowledge on a written assessment, as well as observed changes in teacher educator behavior in their classrooms.[137] A similar training intervention in Nigeria found positive impacts on teacher educators' knowledge, skills, and attitudes related to early-grade reading.[138] In Ghana, the T-TEL project documented increases in the percentages of teacher educators who used student-centered approaches in their classrooms, as well as gender-sensitive approaches to mentoring pre-service teachers during practicum.[139]

The widespread use of mobile phones, tablets, and other wireless devices may provide opportunities for ongoing professional development for teacher educators. Reduced cost is one advantage of this approach. One example of this type of professional development in an LMIC occurred within the context of the USAID-funded Northern

Education Initiative Plus program, where teacher educators 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 home and community involvement in literacy development. These learning circles were supported by US-based university faculty via WhatsApp. While attempts to leverage technology for teacher educator professional development are relatively recent, they have been accelerated by the COVID-19 pandemic, and greater evidence may be available on their effectiveness in the coming years.

3.2. RECOMMENDATIONS FOR TEACHER SELECTION AND DEPLOYMENT

The changes to PSTE recommended above will have effects on primary student outcomes in FLN only if the newly trained teachers are hired efficiently and placed in schools equitably. Therefore, in this section we consider how these processes can be better managed in LMICs.

Selection policies should begin with a **context-specific analysis of needs across schools and levels of education.** As discussed in Section 2.4, education systems often have difficulty staffing rural schools. While teacher imbalances are well documented, moving existing teachers can be expensive. In Tanzania, if a teacher is "reallocated" to another school, the government must pay a series of allowances, including moving costs, 10% of salary, and a "subsistence" benefit that also covers the teacher's spouse and children.[140] This suggests that there may be financial and quality advantages to hiring potential pre-service teachers who already live in disadvantaged areas.[141] Teachers, like many other professionals, often prefer to live near their hometowns and their families. Selective recruitment could be one way of addressing failures in deployment systems. Rural assignments during teaching practice may also lead new teachers to be more open to a rural teaching position after completing their program, as their experience could help dispel misconceptions about rural schools.[142] However, requiring pre-service teachers to travel to areas where they have no family support would likely require additional funding for living costs. In rural areas with limited or nonexistent rental housing, temporary housing for pre-service practicum teachers may need to be constructed or other arrangements made.

Deployment policies can be placed on a spectrum between two general approaches—highly centralized on one end and completely school based on the other.[143] Approaches in the middle may initially assign groups of teachers to geographic areas, and then allow schools to select teachers from those smaller pools of candidates. Regardless of where a system falls on this spectrum, it should be transparent to avoid perceptions of political pressure, nepotism, and corruption.

Schools have needs, but so do individual teachers, and deployment systems must balance those factors. Teacher preferences are important in considering deployment policies.[145] If the system forces teachers to go somewhere they do not want to teach, they will likely leave as soon as possible, causing disruptive turnover.[146] Forced placements also impact the perceived desirability of teaching as a profession and may discourage potential pre-service teachers from entering the field. One means of addressing this imbalance between system needs and individual teacher preferences is to offer incentives.[147] These incentives can include not only salary increases but housing, professional development, scholarships for continuing education, mobile phones and other technology, and faster promotion.[148] **However, in practice, incentive programs can be difficult to manage and target effectively,**[149] as is the case in Malawi (see box).

> Malawi's experience with teacher incentives shows that it can be difficult to accurately determine eligibility for allowances targeting teachers in rural areas.[144] In Malawi, 87% of schools are categorized as rural, meaning that their teachers are eligible for these allowances; as a result, this policy intervention as currently designed does little to encourage teachers to shift to the most disadvantaged schools. The size of the salary differential associated with the incentive has fallen as the number of teachers eligible for it has increased, making it less powerful as an incentive.

There is little evidence available on how teachers in LMICs value financial and non-monetary incentives (such as housing and promotions) against aspects of working conditions;[150] country-specific analyses must be done in order to target and scale incentives efficiently. However, a recent study using a discrete choice experiment methodology

with pre-service teachers in Laos and Cambodia illuminates some of the factors involved in teacher decision-making.[151] One area that was ranked as important by pre-service teachers in that study was the opportunity to continue in higher education. While this is often difficult in rural areas, governments could develop innovative solutions to offer rural teachers access to degree programs online or through blended programs with short-term in-person sessions.[152] In Peru, a recent study found that interventions focused on promoting altruistic and financial motivations for teaching in disadvantaged schools were effective, highlighting the importance of locally relevant research for policy making.[153]

Asim and colleagues' study in Malawi highlights the importance of high-quality administrative data on teachers, which are lacking in many LMICs.[154] Their study suggests that disparities in student-teacher ratios across schools in Malawi could be addressed in two years with targeted new hires and well-calibrated teacher incentives. This type of approach, avoiding forced reassignments, is likely to be far more palatable to teachers, teachers' unions, and other stakeholders. However, it requires investments in data systems and ongoing data maintenance and monitoring. The alignment of changes in PSTE with the development of data management programs could be a powerful opportunity to address disparities in teacher quality and quantity across regions within countries.

4. Conclusions and Future Directions

FLN programs cannot be successful or sustainable over the long term unless PSTE is incorporated into interventions and long-term program planning. This literature review points to several key areas that are key to the development of primary-grade PSTE, including (1) revisions to the curriculum to make it more applicable and relevant to classrooms in context, (2) a greater focus on the practicum as a core component of PSTE, with particular attention to the quality and quantity of mentoring received by pre-service teachers, and (3) increased provision of high-quality, ongoing professional development for teacher educators to ensure alignment of their instruction with evidence-based practices. Underlying these points is the need to ensure that teachers are assigned to schools in equitable ways that balance teachers' preferences with the needs of schools, particularly those in disadvantaged areas.

While the global body of literature clearly identifies problems in PSTE, there is a dearth of rigorous evidence on how to solve these problems.. Research linking aspects of PSTE to primary-grade students' outcomes is challenging because several years often separate potential study baselines and end lines, and some studies would require years of administrative data on students and teachers, including during teachers' PSTE. However, there are several areas where impactful research on aspects of PSTE and teacher deployment could be feasible with smaller, focused investments. These include interventions to increase the quality of applicants to PSTE programs, distance and virtual approaches to PSTE faculty professional development, building connections between primary classrooms and PSTE classrooms through teacher-PSTE faculty partnerships, addressing resource shortages in PSTE institutions, and exposing pre-service teachers to different types of schools, including rural and disadvantaged schools, during practicum and field experiences. In the longer run, investments in education management information systems can also be leveraged to allow for the type of large-scale research on PSTE that has been conducted by Boyd and colleagues,[155] as cited above.

PSTE in LMICs needs greater levels of investment, both for interventions and for research. Governments, international aid donors, and other stakeholders should recognize the key role played by PSTE in improving education outcomes and should incorporate PSTE institutions as full partners into all FLN activities. While PSTE is often seen as a component of higher education rather than basic education, it is an integral component of ensuring a quality foundational education for all children.

Appendix A

ADDITIONAL NOTES ON THE QUALITY OF THE EVIDENCE

As discussed in the introduction to Section 3, the quality of evidence in the field of PSTE lags behind other fields in education, in LMICs and high-income countries alike. To date, the types of randomized control trials, regression discontinuity studies, and other rigorous designs that have been used to examine student-level outcomes have not been used in teacher education. There is some pre- and post-testing and quasi-experimental work, but it is mostly from the United States and other high-income countries. To quote again from the 2020 report by the National Academies of Sciences, Engineering, and Medicine:

> In general, there is a lack of systematic research or evidence beyond anecdotes and case studies about teacher preparation programs' content and effectiveness, and whether these programs have changed over time. Despite a call nearly ten years ago (NRC, 2010) for an independent evaluation of teacher education approval and accreditation, no such evaluation has been initiated.[156]

The evidence cited in this literature review is largely descriptive, and most studies used small, nonrandom samples. Methodologically, most studies used qualitative interviews or surveys to collect data. As a whole, the generalizability of these studies is limited. Additionally, many of the studies published by authors from LMICs are in Tier 3 journals. To remove them from this literature review, however, would be to exclude the voices of LMIC scholars who provide critical contextual information on PSTE in their countries.

As a field, we should advocate for broader, more rigorous research on PSTE in LMICs.

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