GPE KIX SYNTHESIS REPORT

The Global Partnership for Education Knowledge and Innovation Exchange

TEACHER PROFESSIONAL DEVELOPMENT A RESEARCH SYNTHESIS

GPE KIX
KNOWLEDGE INNOVATION EXCHANGE

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About GPE

The Global Partnership for Education (GPE) is the largest global fund solely dedicated to transforming education in lower-income countries, and a unique, multi-stakeholder partnership. Find out more at globalpartnership.org.

About GPE KIX

The Global Partnership for Education Knowledge and Innovation Exchange (GPE KIX) is a joint endeavour between GPE and IDRC that aims to ensure partner countries have and use the evidence and innovation they need to accelerate access, learning outcomes and gender equality through equitable, inclusive and resilient education systems fit for the 21st century.

About this report

This synthesis report is one of five commissioned by GPE KIX to consolidate evidence and lessons learned from applied research projects funded during the program's first phase, from 2019 to 2024. These multi-stakeholder projects focused on key challenges facing education systems across the Global South and generated evidence, strengthened capacities and mobilized knowledge into policy and practice. The reports in this series address five priority themes identified by national education stakeholders: data systems and data use; early learning; gender equality, equity and inclusion; out-of-school children and youth; and teacher professional development.

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For more information: www.gpekix.org

ACRONYMS AND ABBREVIATIONS

CL4STEM	Connected Learning for Teacher Capacity Building in STEM
CLIx	Connected Learning Initiative
DL4D	Digital Learning for Development
GEI	Gender equality, equity and inclusion
GPE	Global Partnership for Education
ICT	Information and communication technologies
IDRC	International Development Research Centre
KIX	Knowledge and Innovation Exchange
LMS	Learning management systems
MATPD	A Multi-modal Approach to Teacher Professional Development in Low Resource Settings
OER	Open educational resources
PARI	Improving Community Teacher Development in the Digital Era
SITMS	Strengthening School-Based In-Service Teacher Mentorship and Support
SITT	School-Based In-Service Teacher Training
STEM	Science, technology, engineering and mathematics
STEPS	Science, Technology, Engineering and Mathematics (STEM) Teacher and Student Education for Primary Schools
Strengthening Capacity for Scaling Education Innovation in the Caribbean	Strengthening Teachers and School Principals' Capacity for Scaling Innovation from the Bottom Up in the Education System in the Caribbean
Teaching at the Right Level	Teaching at the Right Level: Learning How to Improve Teacher Support Through Mentoring and Monitoring
TEPA	Adapting and Scaling Peer Tutoring for Teachers and School Leaders for Equitable Rural Education
TPD	Teacher professional development
TPD@Scale	Adapting and Scaling Teacher Professional Development Approaches in Ghana, Honduras and Uzbekistan

CONTENTS

EXECUTIVE SUMMARY

Extensive evidence suggests that teacher professional development (TPD) programs must go beyond traditional, top-down approaches, focusing instead on innovative, context-specific interventions that encourage active learning, provide continuous expert support and promote peer collaboration. Effective TPD programs are grounded in several core principles: relevance to the needs of teachers, alignment with local policies and educational priorities, and person engagement over time. Technology is increasingly important in scaling these programs, enabling broader access to quality resources and peer networks. However, challenges remain in ensuring equitable access, especially in remote or underserved areas.

This report aims to inform and influence regional and global education debates by increasing the visibility of southern perspectives, evidence and experience. It summarizes emerging lessons from applied research on models that are supporting effective TPD practice in low- and middle-income countries. This report provides a synthesis of findings from eleven TPD-focused applied research projects supported by the Global Partnership for Education Knowledge and Innovation Exchange (GPE KIX) and the International Development Research Centre (IDRC). Implemented across 41 countries in Africa, Asia, Latin America and the Middle East, these projects include:

- Adapting and Scaling Teacher Professional Development Approaches (TPD@Scale) in Ghana, Honduras and Uzbekistan
- Teaching at the Right Level: Learning How to Improve Teacher Support Through Mentoring and Monitoring (Teaching at the Right Level) in Côte Ivoire, Nigeria and Zambia
- Connected Learning for Teacher Capacity Building in STEM (CL4STEM) in Bhutan, Nigeria and Tanzania
- Adapting and Scaling Peer Tutoring for Teachers and School Leaders for Equitable Rural Education (TEPA) in Honduras and Nicaragua
- Strengthening Teachers' and School Principals' Capacity for Scaling Innovation from the Bottom Up in the Education System in the Caribbean (Strengthening Capacity for Scaling Education Innovation in the Caribbean) in Haiti and Saint Lucia
- Science, Technology, Engineering and Mathematics (STEM) Teacher and Student Education for Primary Schools (STEPS) in Benin, Cameroon and Democratic Republic of the Congo

- Improving Community Teacher Development in the Digital Era (PARI) in Cameroon, Chad and Central African Republic
- A Multi-modal Approach to Teacher Professional Development in Low-Resource Settings (MATPD) in Afghanistan, Maldives and Nepal
- Strengthening School-Based In-Service Teacher Mentorship and Support (SITMS) in Kenya, Tanzania and Zambia
- Digital Learning for Development (DL4D) in Cambodia, China, Indonesia, Jordan, Mongolia, Nepal, Pakistan and the Philippines
- Supporting Teacher Professional Development at Scale (TPD@Scale IDRC) in Bangladesh, Brazil, Chile, China, Colombia, Costa Rica, Ecuador, Ghana, India, Indonesia, Kenya, Mexico, Nigeria, Pakistan, the Philippines, Rwanda, Senegal, South Africa, Sudan, Tanzania, Togo, Uganda and Zambia

Each of these 11 projects aimed to bring effective TPD innovations to new contexts and with different scaling perspectives. Each generated new knowledge to effectively expand the impact of teacher professional development, thereby contributing to improving education systems in GPE partner countries.

These projects fell into four categories: (1) those that adapted and scaled existing TPD innovations; (2) those that combined innovations into new interventions; (3) those that designed innovations and adaptations from the bottom up, using collaborative methods to identify and address priority learning problems and teachers' needs; and (4) those that researched the variables influencing effective implementation of large-scale, technology-enabled TPD innovations. Despite their differences, these projects shared common objectives of improving teacher practices, fostering professional collaboration and scaling successful models in resource-constrained environments. Most also incorporated elements of digital learning to varying degrees, with some relying heavily on ICT tools to reach more significant numbers of teachers in remote settings.

By consolidating findings across these 11 projects, this synthesis situates the specific contributions of grounded research within broader bodies of knowledge. This report informs regional and global education debates by highlighting key features of effective TPD programs across the projects analyzed, and lessons learned that can help future efforts to scale options for strengthening teacher training and ongoing professional development.

The TPD challenge

Increasing both the supply and quality of teaching professionals is critical to achieving United Nations Sustainable Development Goals for inclusive and equitable quality education. A wide body of research has demonstrated that improving learning outcomes for students demands a shift from traditional top-down models of pedagogy toward student-centred learning. This entails supporting the development of teachers to strengthen their mastery of core curriculum content, such as mathematics and reading, and innovative teaching skills to meet the needs of diverse learners.

Innovative TPD programs that focus on contemporary educational needs, incorporate technology and promote active, collaborative and contextualized learning are increasingly recognized as a potential solution to this challenge. Across the Global South, there is broad consensus on the need to refocus TPD to address gaps that impede quality education for all.

Synthesis of the 11 IDRC and GPE KIX projects revealed three features as key to sustaining and scaling effective TPD innovations: i) strengthening stakeholder engagement and alignment; ii) harnessing the potential of technologies adapted to the local teaching and learning environment; and iii) effectively mobilizing new knowledge on innovative teaching practices so that they can be taken up in policies and programs at scale.

Fostering stakeholder alignment and engagement

Key findings from these projects highlight the critical importance of aligning TPD programs with stakeholder interests, particularly those of teachers, school leaders and governments. Teachers are the primary stakeholders in TPD initiatives, and their active participation is essential for the successful adoption and adaptation of new teaching practices. Several projects demonstrated the value of involving teachers in the design and implementation process, fostering a sense of ownership that contributes to the long-term success of the interventions. Likewise, the involvement of school leaders — principals, headteachers and coordinators — is crucial, as they are critical drivers of pedagogical transformation within schools. However, their participation in TPD programs has often been limited, underscoring the need for targeted professional development opportunities for these leaders.

Government engagement emerged as another critical factor in ensuring the sustainability and scalability of TPD programs. Projects that secured early buy-in from national and local governments were more likely to succeed in integrating their innovations into existing educational systems. In some cases, governments adopted and scaled the innovations, or key components, incorporating them into national TPD strategies. Nonetheless, political changes and turnover among key government actors remain significant challenges to maintaining these programs over time.

Harnessing context-informed technologies

The role of technology in TPD is both promising and complex. While digital platforms, online learning management systems and mobile technologies can significantly enhance the reach and flexibility of TPD programs, equity issues related to access remain a significant barrier. In low-resource settings, many teachers lack access to the necessary devices and internet connectivity, limiting their ability to participate in digital learning. To overcome these challenges, some projects adopted low-tech solutions, such as text messaging, offline content delivery and phone-based mentoring, ensuring more inclusive participation. Hybrid models that combine face-to-face and online components also proved effective in balancing the scalability of digital learning with the depth of in-person interactions.

Mobilizing new knowledge on TPD to sustain and scale innovation

These projects mobilized knowledge on TPD by documenting, systematizing and sharing their processes and how challenges were addressed at each stage. From the design stage, all projects included tailored knowledge mobilization strategies to share the new knowledge generated with key stakeholders. Recommendations on mobilizing knowledge to support innovations include customizing knowledge mobilization strategies for different audiences; incorporating teachers' own insights into products and strategies; promoting interaction and communities of practice to allow teachers and other stakeholders to exchange experiences and discuss research evidence; and involving stakeholders throughout the research process.

Conclusions and areas for further research

The insights from these TPD projects provide valuable guidance for designing and implementing scalable, context-specific professional development initiatives. The success of these programs relies on strong stakeholder alignment, strategic integration of technology, capacity building and ongoing engagement with teachers and school leaders. There is also a continued need to explore hybrid approaches and low-tech solutions to ensure that all teachers have access to quality professional development opportunities, regardless of location or resources. These lessons are essential for addressing the pressing challenges in education systems across the Global South and improving student learning outcomes.

This synthesis of lessons and findings on TPD also surfaced some knowledge gaps that point to potential avenues for future research. These include: how to best tailor TPD and training for school leaders to meet their learning needs and styles; how to balance the costs and benefits of technology use in TPD; how to maximize the effectiveness of TPD in promoting learning outcomes; and how to deepen teachers' engagement in TPD programs and opportunities.

1. INTRODUCTION

Studies conducted before the global COVID-19 pandemic refer to a widespread "learning crisis" in the Global South. In 2017, the UNESCO Institute for Statistics warned about the high proportion of children and adolescents who, despite school gains in enrolment over the previous two decades, were still failing to meet basic proficiency levels in reading and mathematics. This gap in learning has far-reaching consequences, leaving millions of students unable to acquire the foundational skills necessary for meaningful participation in society and the workforce.

1.1 The teacher professional development challenge

The United Nations Sustainable Development Goals include specific targets related to education and teachers under Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities. Key targets under this goal include increasing the supply of qualified teachers to achieve broader education goals, such as ensuring that all children of all ages complete a free and quality primary and secondary education, eliminating gender disparities in education, and ensuring that all students acquire the knowledge and skills needed to promote sustainable development.

Achieving these goals worldwide largely relies on teachers' availability, training and professional development. Research repeatedly demonstrates that the most effective interventions to improve student outcomes depend on the ability of teachers to implement strategies that foster learning. This shift calls for a transformation of traditional pedagogical practices toward student-centred classroom dynamics, highlighting the need for teachers to develop new skills that address the challenges posed by increasingly diverse classrooms.

Ensuring an adequate supply of qualified teachers in the long term depends on the quality of initial teacher training and the effectiveness of incentives designed to attract and retain a skilled teacher workforce. However, implementing these essential changes requires complex and systemic reforms that are unlikely to generate immediate results, especially on the urgent task of addressing learning poverty in the Global South. As highlighted in educational development studies, this demands timely and effective interventions (World Bank, 2021).

Innovative teacher professional development (TPD) programs are increasingly recognized as a potential solution to education's challenges, particularly in improving teaching quality and student outcomes. These programs go beyond traditional TPD methods by focusing on contemporary educational needs, incorporating technology and promoting active, collaborative and context-specific learning approaches.

The need to refocus TPD is widely acknowledged across the Global South, with broad consensus on the critical issues that must be addressed. Encouragingly, a growing focus on student-centred learning reflects the concerns of teachers and experts striving to meet the needs of children and youth. Key strategies include adopting active pedagogical practices, implementing formative assessments and preventing school failure, primarily through strategies that incorporate a gender perspective and support students with learning difficulties or special needs (D'Angelo et al., 2023).

Simultaneously, there is an urgent demand for teachers to enhance both their mastery of curricular content and their teaching methods in alignment with the concept of pedagogical content knowledge. While strengthening pedagogical practices is essential, it must be complemented by ensuring teachers are thoroughly equipped to manage subject content effectively. The World Bank (2021) highlights significant challenges in large regions of the Global South, where a high percentage of teachers exhibit major deficiencies in mathematics, reading and pedagogical knowledge. Closing these gaps is crucial for improving education quality and student outcomes.

1.2 About this report

This report is one of five synthesis reports commissioned by the Global Partnership for Education Knowledge and Innovation Exchange (GPE KIX) to consolidate evidence and lessons learned across supported research projects related to priority themes identified by national education stakeholders: data systems and data use; early learning; gender equality, equity and inclusion; out-of-school children and youth; and teacher professional development. GPE KIX supports the synthesis of findings across funded projects to identify knowledge and capacity gaps that need to be addressed in the Global South. This facilitates the exchange of best practices and evidence-based responses that contribute to capacity development and the strengthening of education policies and systems.

GPE KIX is a joint endeavour between GPE and Canada's International Development Research Centre (IDRC) to ensure partner countries can have and use the evidence and innovation they need to accelerate access, learning outcomes and gender equality through equitable, inclusive and resilient education systems fit for the twenty-first century. During its first phase, from 2019 to 2024, GPE KIX funded 41 applied research projects focused on key challenges facing education systems across the Global South. These projects generated evidence, strengthened capacities and mobilized knowledge into policy and practice.

This report aims to inform and influence regional and global education debates by increasing the visibility of southern perspectives on evidence for education. It summarizes emerging lessons from applied research on models that are supporting effective TPD practice in low- and middle-income countries. The report synthesizes findings from research in a total of 41 countries, carried out by nine GPE KIX projects and two earlier projects funded by IDRC. Each of these 11 projects aimed to bring effective TPD innovations to new contexts and with different scaling perspectives. Each generated new knowledge to effectively expand the impact of teacher professional development, thereby contributing to improving education systems in GPE partner countries. The data and detailed evidence from individual projects can be found in the primary research outputs referenced in the bibliography.

Taken as a whole, the reviewed projects provide a comprehensive view of the challenges and opportunities that arise when successful innovations are adapted and scaled in new contexts. The lessons identified as a result of this analysis lay new foundations for consolidating and scaling up solutions to critical problems of educational quality in the Global South, particularly regarding teacher professional development.

This report consists of five sections. Following this introduction, section 2 briefly describes the methodology used to carry out this synthesis and presents key findings on the attributes of effective TPD programs from the literature review. Section 3 presents and categorizes the projects under analysis and describes how they facilitated active learning and integrated a focus on gender equality, equity and inclusion. In section 4, key findings in relation to stakeholder engagement and alignment, and the role of technologies and knowledge mobilization are explored in terms of how they contribute to the sustainability and scaling up of TPD innovations. Specific recommendations are included on each of these areas of findings. Finally, section 5 presents summary conclusions and recommendations for future research, highlighting what these 11 projects reveal about the conditions needed for the adoption and scaling of TPD innovations, and challenges that remain.

2. METHODOLOGY AND LITERATURE REVIEW

This synthesis is based on thematic analysis, a method of qualitative research in the social sciences. It entailed data collection and systematization to identify key elements of the TPD strategies that projects adopted and interventions that were judged effective — either in achieving replicability and scalability results, or for their use of specific frameworks and tools.

2.1 Information sources

The information used for the synthesis process started with a literature review, to situate the projects' findings within the wider trends and approaches to TPD. Other activities that informed the synthesis included:

- analysis of the projects' technical proposals and mid-term and final reports
- interviews with over 20 project representatives and IDRC officials
- an online survey of implementers, to which 16 people responded
- review of project publications on the GPE KIX portal and individual project web pages

Appendix 1 summarizes the 11 projects based on documentation available at the time of writing and information gathered through interviews and the survey.

2.2 Findings from the literature

Traditional TPD interventions are typically top-down didactic models — whereby facilitators dictate strategies or provide materials without allowing teachers to actively develop skills or reflect on how these methods affect student learning. Such interventions have been shown to have limited effectiveness and a limited impact on both teachers' willingness to change their practices and student outcomes (Popova, Evans, Breeding & Arancibia, 2021).

Research conducted over the past two decades has consolidated a significant body of evidence on the characteristics of TPD programs that have had a positive impact on student learning (Chung Wei, Darling-Hammond & Stelios, 2009; Popova, Evans, Breeding & Arancibia, 2021). The effects of TPD interventions on teaching practices, which influence student achievement, can be observed in the short term and serve as a reliable quality indicator. Well-designed and implemented TPD programs can positively transform teaching practices and student progress, as demonstrated by a growing number of observational studies and others based on teacher self-assessments (Darling-Hammond, Hyler & Gardner, 2017).

The above-mentioned studies indicate that, to be effective, TPD should:

- focus on subject matter contents and specific pedagogies
- build on active adult learning strategies for teachers
- favour peer collaboration and peer-to-peer learning
- provide support, such as tutoring or mentoring, by experts and experienced facilitators
- ensure sustained duration over time to allow the adoption of new practices

The use of technologies has great potential to support these main attributes of effective TPD when scaling TPD programs. They enable more teachers to benefit by facilitating access to quality educational resources and fostering peer-to-peer exchanges. Moreover, technology helps reduce costs over time, making professional development programs more scalable and sustainable.

However, evidence suggests that no single practice is particularly effective on its own. The impact is more significant when there is a deeper understanding of how teachers learn and what motivates them. For TPD to be effective, learning opportunities must provide structured activities that allow teachers to understand, practise and reflect on the implications of new approaches (Boeskens, Nusche & Yurita, 2020). Most importantly, program objectives must be clear and relevant to participants. Professional development activities should be aligned with these objectives, and frequent opportunities should be given to assess both teacher progress and the program's impact on student learning outcomes (Cordingley et al., 2015).

3. OVERVIEW OF PROJECTS

This synthesis analyzes nine GPE KIX research projects that focused on TPD programs in 20 countries between 2020 and 2024. In all, research was conducted in 11 countries in Africa, five in Asia, and four in the Americas. Two earlier TPD projects — funded by IDRC and implemented by the Foundation for Information Technology Education and Development — are also considered in this synthesis, as their outcomes generated valuable knowledge on TPD in the Global South. These two research projects were conducted in 21 countries. More detail on the project aims and strategies can be found in Appendix 1.

Table 1. Research projects included in this synthesis

Research projects and countries	Implementing partners	Objectives and innovations
Funded through GPE KIX		
Adapting and Scaling Teacher Professional Development Approaches in Ghana, Honduras and Uzbekistan (TPD@Scale)	Foundation for Information Technology Education and Development UNESCO Tashkent SUMMA Worldreader	• Determine how information and communication technologies (ICT) can be used at scale to strengthen equity, quality, and effectiveness of TPD systems. • Study how diverse groups of teachers and other actors in public education systems respond to new and adapted models of ICT-mediated professional development at scale.
Teaching at the Right Level: Learning How to Improve Teacher Support Through Mentoring and Monitoring (Teaching at the Right Level) Côte Ivoire, Nigeria and Zambia	Abdul Latif Jameel Poverty Action Lab — Massachusetts Institute of Technology	• Evaluate innovative approaches within Teaching at the Right Level methodology, mentoring and monitoring systems to gain insights on how government systems can more effectively support teachers at scale, even in resource-constrained settings.

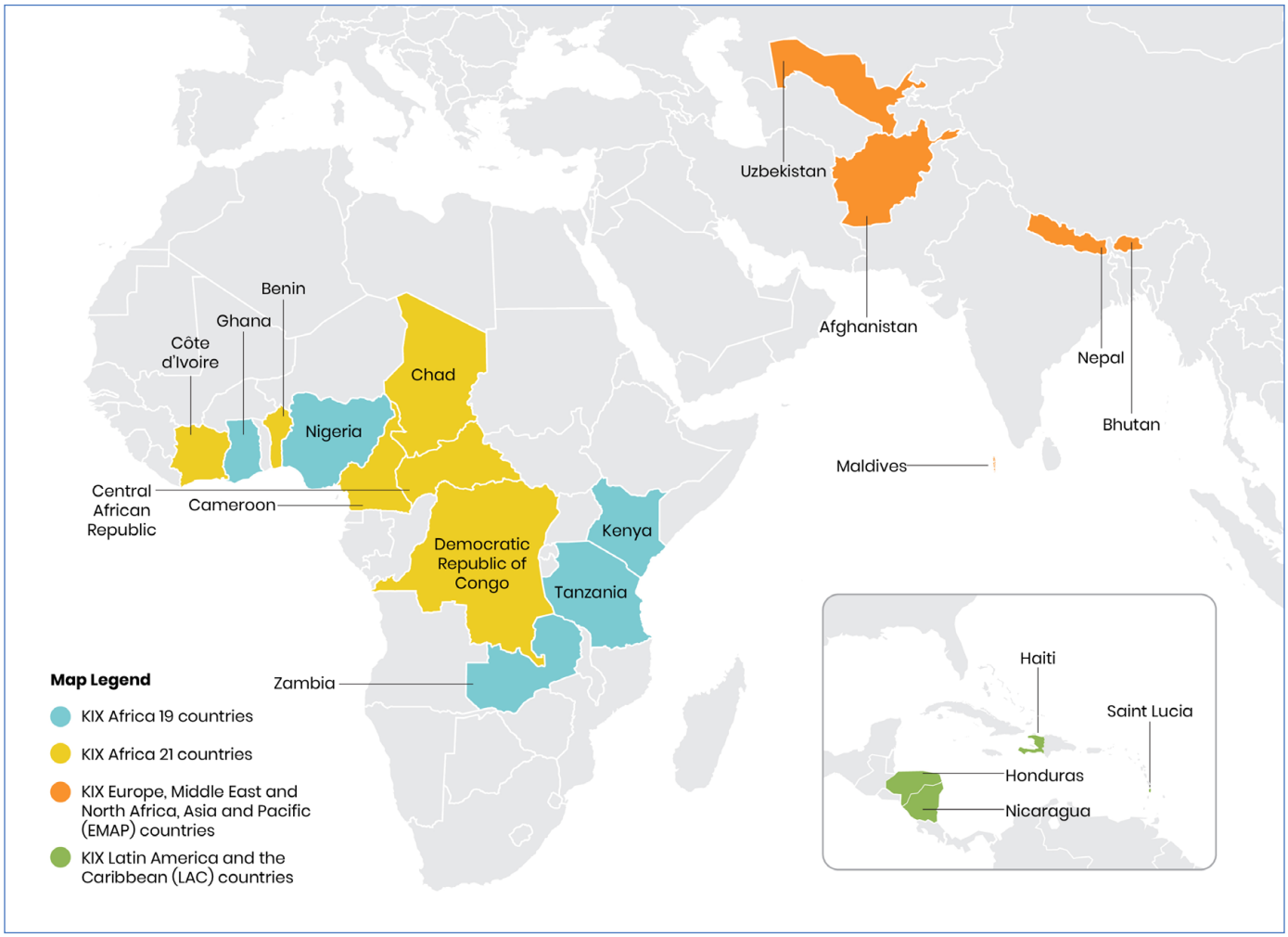
Research projects and countries	Implementing partners	Objectives and innovations
Connected Learning for Teacher Capacity Building in STEM (CL4STEM) Bhutan, Nigeria and Tanzania	Ibrahim Badamasi Babangida University Samtse College of Education The Open University of Tanzania Tata Institute of Social Sciences	• Pilot the Connected Learning Initiative (CLIx) — an open-source online TPD program originally designed in India for middle- and high-school math and science teachers, which builds higher order thinking skills with inclusion and quality in the classroom. • Evaluate the effectiveness of the innovation and its potential for scaling.
Adapting and Scaling Peer Tutoring for Teachers and School Leaders for Equitable Rural Education (TEPA) Honduras and Nicaragua	Fundación Educación 2020 Fundación Fe y Alegría	• Identify key actors and factors for the adaptation and scaling of peer tutoring. • Implement and evaluate a pilot of the peer tutoring model, focusing on the improvement of teacher professional training processes, leadership competencies and student learning outcomes. • Mobilize evidence among crucial actors in the educational system of both countries.

Research projects and countries	Implementing partners	Objectives and innovations
Strengthening Teachers' and School Principals' Capacity for Scaling Innovation from the Bottom Up in the Education System in the Caribbean (Strengthening Capacity for Scaling Education Innovation in the Caribbean) Haiti and Saint Lucia	Université d'État d'Haïti, Campus Henri Christophe de Limonade Wilfrid Laurier University Raise Your Voice Saint Lucia	• Strengthen the capacity of teachers, principals and education administrators to identify challenges, create and test solutions and share findings. • Foster a bottom-up innovation culture in the education systems, addressing social needs, enhancing stakeholder capacities, and optimizing resource use. • Adapt proven methodologies for the Caribbean context, combining qualitative and quantitative approaches with participatory components.
Science, Technology, Engineering and Mathematics (STEM) Teacher and Student Education for Primary Schools (STEPS) Benin, Cameroon and Democratic Republic of the Congo	Cameroon Baptist Convention Ulrich and Ruth Frank Foundation for International Health Emmanuel Community HEAR Congo Trois Soeurs Education Fund	• Study the feasibility of scalable, effective and equity-focused low- and high-tech solutions to improve teaching and learning of math and science in primary education by designing and testing instructional materials that improve student learning outcomes and strengthen teachers' capabilities.

Research projects and countries	Implementing partners	Objectives and innovations
Improving Community Teacher Development in the Digital Era (PARI) Cameroon, Chad and Central African Republic	Université de Yaoundé 1 École Normale Supérieure N'djamena École Normale Supérieure de l'Université Bangui	• Design, implement and reinforce innovative content and governance to generate contrasted knowledge on training trainers (contract and community teachers) from an inclusive and differentiated perspective.
A Multi-modal Approach to Teacher Professional Development in Low-Resource Settings (MATPD) Afghanistan, Maldives and Nepal	Villa College Swedish Committee for Afghanistan Tata Institute of Social Sciences	• Influence policy, practice and future research on distance strategies for TPD through action research, mentoring and communities of practice. • Generate knowledge on factors that can facilitate the implementation of integrated TPD models in resource-limited contexts.
Strengthening School-Based In-Service Teacher Mentorship and Support (SITMS) Kenya, Tanzania and Zambia	Dar es Salaam University College of Education University of Zambia Kibabii University HELVETAS Swiss Intercooperation	• Strengthen continuing professional development for secondary school teachers by generating knowledge around the use of effective mentoring and support models. • Build the capacity of mentors and teachers to improve teaching and learning. • Adapt and extend an inclusive mentoring and support model for primary-level teachers — school-based in-service teacher training (SITT) — to improve math and science teaching in secondary schools.

Research projects and countries	Implementing partners	Objectives and innovations
Funded through IDRC		
Digital Learning for Development (DL4D) Cambodia, China, Indonesia, Jordan, Mongolia, Nepal, Pakistan and the Philippines	Foundation for Information Technology Education and Development	• Improve education systems in developing countries by conducting collaborative research to test and scale digital learning-based innovations and generate new knowledge in this area.
Supporting Teacher Professional Development at Scale (TPD@Scale IDRC) Bangladesh, Brazil, Chile, China, Colombia, Costa Rica, Ecuador, Ghana, India, Indonesia, Kenya, Mexico, Nigeria, Pakistan, the Philippines, Rwanda, Senegal, South Africa, Sudan, Tanzania, Togo, Uganda and Zambia	Foundation for Information Technology Education and Development	• Identify strategies to enhance government-backed teacher professional development programs. • Create knowledge on the use of ICT in scaling TPD programs in the Global South.

Figure 1: Countries in which the nine GPE KIX research projects were conducted



3.1 Categories and results of the TPD models studied

The projects and their reported results can be organized into four categories to offer a comprehensive overview of the sample under analysis. These categories are not mutually exclusive, as the purposes and modalities of the projects often overlap.

Scaling previously tested TPD models

The first group of projects focused on scaling up structured TPD models that had been successfully tested in other contexts. Both Connected Learning for Teacher Capacity Building in STEM (CL4STEM) and Strengthening School-Based In-Service Teacher Mentorship and Support (SITMS) advanced online professional development innovations for secondary school teachers in mathematics and science. CL4STEM adapted and implemented the Connected Learning Initiative (CLIx) — an open-source online TPD program — for secondary and middle school teachers in mathematics and science. SITMS generated knowledge about the contextualized school-based in-service teacher training (SITT) model to improve mathematics instruction at the

secondary level. Both projects reported positive impacts on teachers' knowledge, attitudes and practices, particularly in adopting student-centred teaching strategies. In CL4STEM, substantial gains were observed in teachers' instructional strategies and in their response to inclusion and equity in their classrooms. The research also showed that teachers were positively inclined to adopt the CL4STEM TPD model. In SITMS, changes were observed at multiple levels, including in students' stronger interest in mathematics; in the school environment, thanks to the adoption of a collaborative learning culture; and in teachers' ability to integrate interactive teaching strategies, which led to a student-centred approach that empowered learners to contribute meaningfully to the learning process.

Through the project Teaching at the Right Level: Learning How to Improve Teacher Support Through Mentoring and Monitoring (Teaching at the Right Level), the well-established and widespread Teaching at the Right Level model — which helps teachers improve students' reading and mathematics skills by grouping them according to their learning level rather than age or grade — was scaled up through a combination of in-person and remote mentoring, using phone calls and text messages. For the approach to be sustainable at scale in Africa, this research project paved the way for different cost-effective strategies to support the professional development of teachers. The governments of Côte d'Ivoire, Nigeria and Zambia have begun mainstreaming the approach based on the results of the research.

Combining innovations for new interventions

The second group of projects focused on designing interventions that combined innovative elements, not based on a single model. Science, Technology, Engineering and Mathematics (STEM) Teacher and Student Education for Primary Schools (STEPS) provided primary school teachers with STEM materials adapted to each country's context, curricula and content on pedagogy, instructional design and data management. While the mathematics materials were locally designed, the science materials are based on open educational resources (OER) that could be adapted to country realities and local curricula. Improving Community Teacher Development in the Digital Era (PARI) conducted research to develop tools, models and inclusive training practices tailored to the diverse needs of teachers and students affected by crises and those in bilingual and multilingual contexts, using digital learning environments. The resulting tools are highly contextual, focusing on the unique linguistic and educational challenges in Cameroon, Chad and the Central African Republic. PARI has contributed to capacity building in the three countries, impacting 892 teachers, 62 school principals, and 83 district inspectors in skills development, community supervision and governance of in-service training through digital learning environments. In both projects, teachers' pedagogical skills and digital literacy were strengthened, promoting the virtualization of professional learning. These efforts contributed to some governments and teachers' colleges adopting these innovations.

For example, the Université de Yaoundé 1 teacher training college has integrated the digital learning environments into its continuing education, and the government of Cameroon has incorporated this technology into the training of trainers.

Designing innovations from the bottom up through local-level collaboration

A third group of projects used participatory methodologies to identify teachers' needs and priority learning problems, and to collaboratively adapt or design innovative solutions in specific curricular areas. A Multi-modal Approach to Teacher Professional Development in Low-Resource Settings (MATPD) incorporated action research, whereby research fellows worked alongside teachers to identify students' difficulties and scale up tested innovations. Strengthening Teachers' and School Principals' Capacity for Scaling Innovation from the Bottom Up in the Education System in the Caribbean (Strengthening Capacity for Scaling Education Innovation in the Caribbean) employed a bottom-up approach to enhance the capacities of teachers, school leaders and ministry of education professionals to co-develop innovative proposals and solutions based on the principles of Universal Design for Learning (a framework for designing flexible learning spaces to accommodate individuals' diverse needs), co-creation and learning-by-doing. Adapting and Scaling Peer Tutoring for Teachers and School Leaders for Equitable Rural Education (TEPA) adopted the peer tutoring methodology to transform traditional power dynamics in the classroom into interactions between equals, fostering learning skills and enjoyment of learning in a tutoring relationship. This active learning experience focuses on a topic of interest that touches on several curricular content areas, emphasizing intrinsic motivation and healthy social-emotional connections, with particular attention to overcoming gender bias. This TPD program involved familiarizing teachers with action research methodology by problematizing situations and exploring solutions.

The projects in this third group helped teachers develop skills to better understand their students' needs, change how they interact with them, and develop and test innovative solutions to transform their practices; these changes enabled students to grasp concepts from various curricular areas more comprehensively. Other significant impacts included improved collaborative working skills, the development of metacognitive abilities, and increased self-esteem, self-efficacy and autonomy in both teachers and students. There was also greater awareness of gender roles, and the need to promote women's empowerment, break stereotypes and advance equity. In Haiti, for example, women teachers felt empowered and perceived an increased sense of agency, thanks to their inclusion in teacher innovation teams through the project Strengthening Capacity for Scaling Education Innovation in the Caribbean. Meanwhile, principals supported teacher-led innovation activities and networking opportunities to discuss and share findings from innovation activities in their schools.

Exploring the impacts of ICT-enabled scaling

A fourth group of projects, including Adapting and Scaling Teacher Professional Development Approaches in Ghana, Honduras and Uzbekistan (TPD@Scale), Digital Learning for Development (DL4D), and Supporting Teacher Professional Development at Scale (TPD@Scale IDRC), focused on the variables of large-scale implementation that affect the quality, equity and efficiency of professional development innovations. TPD@Scale piloted ICT-mediated professional development models previously tested in low- and middle-income countries, contextualized and adapted for larger samples of teachers from different groups and in diverse settings, including remote rural areas. DL4D conducted collaborative research to test and scale innovations based on digital learning and generate new knowledge in this field. Finally, TPD@Scale IDRC focused on producing a broad knowledge base on ICT-based professional development in the Global South to make it efficient, equitable and high-quality.

The projects in this fourth group allowed for rigorous evaluation of large-scale teacher support innovations and generated an analytical framework of the factors to consider when implementing cost-effective, ICT-mediated TPD programs at scale within national or local education systems with different structures and types of governance. They also contributed knowledge on how ICT can support professional development in low- and middle-income countries and help reduce inequalities in access to such opportunities.

3.2 Projects' focus on teachers' active learning

Teacher professional development is often used to distinguish more active and contextually relevant forms of teacher learning from passive interventions associated with some teacher education modalities. Active learning recognizes teachers (both individually and collectively) as reflective professionals. It emphasizes the importance of teachers' autonomy in defining and achieving learning goals for students, schools, communities, educational systems and the profession. It involves teachers in systematic examination of the effectiveness of their practices. It is a long-term process embedded in regular school life that includes systematically planned opportunities to promote professional growth and leads to changes in teachers' knowledge bases, beliefs, practices or capacity to practise (Boeskens, Nusche & Yurita, 2020).

The GPE KIX and IDRC projects included in this synthesis introduced innovations aimed at addressing specific learning challenges, such as improving student competencies in areas like math and reading. The projects recognize teachers as adult learners whose needs are shaped by the challenges they encounter in their daily work. Acknowledging that one-size-fits-all solutions are inadequate, these initiatives focused on building teachers' capacity to address specific classroom contexts.

Through these research projects, teachers were supported by experts and accessed innovative resources such as learning units, modules and OER. They also actively contributed to the design or adaptation of materials. Teachers applied their learning through practice, received guidance from mentors or tutors, and reflected both individually and in groups on the process, outcomes and ways to improve. These activities were frequently enhanced by technologies that broadened the scope of information and resources available. More importantly, projects enabled collaboration with peers beyond the school setting and fostered connections with professional networks, allowing teachers to learn from experts and colleagues alike. In this way, the projects contributed to understanding how teachers learn, a topic that requires greater attention in adult learning research, as Kennedy (2016) points out.

Active learning facilitators

The effectiveness of TPD programs depends on the role of facilitators, mentors or tutors who possess a deep understanding of professional learning strategies and classroom dynamics (Hassler, Henessy & Hoffman, 2018). These experts, usually experienced educators, are instrumental in designing learning experiences, developing materials, supporting participants and fostering collaboration within professional communities. Practice-based training is crucial for teachers to understand and effectively implement new teaching methods. Effective facilitators can guide teachers with proper training and sufficient knowledge of classroom practice. This hands-on experience is essential for changing paradigms and ensuring long-term acceptance and sustainability.

Tutors and mentors in the projects analyzed came from diverse backgrounds and received tailored training and support from the project teams, varying in methodology, content and duration. Specific initiatives — such as the in-service mentoring and tutoring provided through SITMS — were conducted by trained university professors who also developed materials, visited schools to present the research, analyzed the applicability of the innovations and monitored implementation. TEPA focused on developing teacher training processes to create effective peer tutoring in the classroom, based on direct teaching experiences with students. In Honduras, TPD@Scale officials worked to build capacity and legitimize innovations, while MATPD used trained fellows to support teachers in action research and collaborative sessions. Teaching at the Right Level instructors were supported by mentors with teaching experience, who observed and provided feedback on teaching practices.

Active learning pedagogical resources

Quality learning resources are a key component of effective TPD interventions, especially in ICT-mediated settings. The process of designing and adapting educational materials provides material developers with a valuable opportunity to

deepen their understanding of effective teaching elements. When integrated into online modules, session protocols, individual tutoring and classroom materials, these elements have the potential to help teachers explore innovative teaching methods, improve their adaptability to diverse classroom needs and contribute to improved student outcomes by fostering a more engaging and dynamic learning environment.

This process was particularly evident in CL4STEM. The Tata Institute of Social Sciences, one of the implementing partners, facilitated both online and in-person workshops for university professors from Bhutan, Nigeria and Tanzania. These workshops aimed to enhance their skills in designing, developing, and customizing educational materials initially created for CLIx. This collaboration led to the development of thirteen online mathematics, physics, chemistry and biology modules, which were then provided to the teachers participating in the project.

Active peer-learning

In each reviewed project, the teachers' learning experience involved engaging with other teachers in discussions on issues relevant to teaching and learning. Teachers shared ideas, strategies, experiences and challenges through these interactions and worked together to find solutions and improve their practices. These collegial conversations created a safe and supportive environment where educators could learn from each other, reflect on their work and develop new pedagogical skills and approaches. Some evidence suggests that collaboration is the only variable in high-quality TPD programs that is consistently associated with teachers' adoption of new practices (Barrera-Pedemonte, 2016).

Many projects emphasized the value of school-based collegial professional development and establishing professional networks (or communities of practice) as fundamental to ensuring sustainability. Projects generally incorporated strategies that fostered the creation of communities designed to enhance exchange and collaboration among participating teachers. This approach facilitated peer-to-peer learning, mentoring by mentors or tutors and exchanging information and materials to reinforce or complement their training.

The size of these learning communities varied significantly, ranging from as few as ten members in Honduras to more than fifty in Uzbekistan under TPD@Scale. In Ghana, the project established communities at both school and district levels to leverage the proximity of schools for offline support. In CL4STEM, communities of practice included teacher trainers responsible for developing content and educational resources and facilitating collaborative work in the mathematics and science modules. Along with its support for action research and social learning, MATPD created online professional learning communities to provide real-time support to teachers and connect them with existing communities of practice to foster motivation and enhance their professional development.

Study groups and peer-to-peer interactions supported training within these communities, as seen with TPD@Scale in Uzbekistan and TEPA in Honduras. The support included regular meetings, both face-to-face and virtual, with tutors or mentors providing feedback and answering questions, as exemplified by CL4STEM. The communities encouraged sharing of classroom resources, such as lesson plans and other materials. They also promoted problem-solving and reflective practices related to teaching. In Zambia, Teaching at the Right Level utilized these community spaces to challenge teachers to assess their knowledge and the application of their methodologies.

3.3 Projects' focus on gender equality, equity and inclusion

Gender, equality, equity and inclusion (GEI) received particular attention in the projects' research proposals, and some made considerable progress in this area. The most notable case is that of TEPA, which explicitly incorporated both gender equity and social inclusion into its problem statement, justification and methodology and applied a gender-responsive approach transversally — in all components and stages of research. Based on a conceptual framework and methodological tools developed by one of the consortium members, the project was aimed at both teachers and students.

Gender equality in teacher training seeks to create equitable opportunities and resources for all individuals, regardless of gender, to access professional development and learning opportunities. This involves addressing structural inequalities and fostering inclusive representation in work teams, the target population and educational content. The project actions focused on gender representation in research teams and teachers and on creating materials with a gender perspective.

Different initiatives tried to promote gender equity by including women in the work teams and in their target populations. This approach was evident in efforts by Strengthening Capacity for Scaling Education Innovation in the Caribbean, MATDP and STEPS, which attempted to achieve a gender balance among their participants. In STEM-focused projects, the inclusion of women was particularly emphasized (or encouraged) to challenge stereotypes portraying women as less skilled than men in mathematics and science. In Strengthening Capacity for Scaling Education Innovation in the Caribbean, for example, a gender-based disparity in the perception of performance in mathematics had been identified. This led to a decision to hire female tutors. However, achieving gender equality goals proved challenging sometimes due to a lack of available candidates. In Afghanistan**,** maintaining gender balance was difficult for MATPD because of a lack of female teachers. This shortage affected project implementation in other ways, as female teachers and mentors were needed to intervene in girls' schools.

The projects also focused on creating content to promote gender equality among students by incorporating inclusive language and positive representation of female roles, while adapting teaching materials to mitigate gender stereotypes and foster an inclusive educational environment. SITMS implemented modules and content that sought to promote gender equity based on baseline studies that identified the lack of female roles in areas such as mathematics. It addressed gender barriers by including female tutors and adapting teaching materials. STEPS used materials with gender-affirmative language and content that encouraged positive female roles. It selected open-source curricular materials with a gender approach to address barriers for female students and make visible the unconscious biases and stereotypes that perpetuate the gender gap in education.

Inclusion refers to improving participation options for the entire population, especially for those vulnerable due to geographic location, economic status, disability, ethnicity or other factors that affect capacity. The projects identified barriers such as location in remote areas and lack of internet access, and tried to offer flexible and accessible delivery models. Thanks to these actions, it was possible to include rural teachers and other populations traditionally excluded. In this sense, the availability of different formats was fundamental to adapting contents to teachers' and students' varying conditions and resources. In Honduras, for example, TPD@Scale offered offline access to content in different formats, allowing it to reach a larger number of mathematics teachers. These conditions enhanced the participation of rural teachers who did not have permanent Internet access or who traveled on weekends. MATPD included fellows from diverse areas, including remote locations where teachers traditionally don't get access to quality TPD opportunities.

Various projects also developed tailored modules and materials to address the needs of populations with specific vulnerabilities, such as students with disabilities. These resources were designed to promote inclusivity, ensuring that all students could benefit from equitable education. STEPS, for instance, focused on urban and rural schools, including one for students with hearing disabilities and other schools in Cameroon that had students with diverse abilities. The project provided differentiated guides to cater to these students' needs. Similarly, SITMS introduced a module to identify students who required additional support. In Afghanistan, MATDP concentrated on integrating students with diverse abilities into classroom activities, ensuring equal learning opportunities through appropriate pedagogical strategies and classroom management.

PARI also made notable adaptations to its platform to remove language and cultural barriers. These modifications involved delivering content in the languages of the countries where the project was implemented and incorporating cultural elements relevant to each context, thereby personalizing the user experience and enhancing its relevance.

4. FINDINGS AND RECOMMENDATIONS FOR SUSTAINING AND SCALING TPD PROGRAMS

This synthesis reveals important lessons learned from the projects on contextualizing and implementing effective TPD programs and doing TPD research. These insights are organized below around essential strategies for sustaining and scaling these innovations: aligning and engaging key education stakeholders; empowering teachers and education systems to harness technologies suited to their local context; and mobilizing knowledge through channels and approaches that effectively reach and involve the intended users. Recommendations relevant to these three features are provided for education policymakers, researchers, and project designers and implementers interested in incorporating successful elements identified in the projects studied.

4.1 Fostering stakeholder alignment and engagement

Successfully implementing teacher professional development programs depends on a broad and diverse set of individuals and institutions. Responding to the needs and interests of stakeholders and securing their support for the initiatives being tested is essential for a project's successful implementation and contributes to its sustainability, especially in challenging contexts. From the outset, it is also of great relevance to identify voices that may be critical of the interventions, as well as potential mediators between diverse viewpoints, as they can also have some degree of influence on decision-making (Olsen, Rodriguez & Elliott, 2022).

Participating teachers and the schools where they teach were key stakeholders in the projects. So too were school leaders (principals, headteachers or coordinators, depending on the titles used in each country) and communities, although their participation in the projects was quite uneven. Important external stakeholders included government actors at the national, subnational or local level, non-governmental allies, universities and teacher colleges. To a lesser extent, teachers' unions, the media, private companies and, in some cases, technology companies were involved.

All projects conducted a mapping of the most relevant stakeholders as part of their initial contextualization exercises. The goal was to ensure that the innovations addressed the priorities and needs of governments, schools and teachers, and would receive adequate support during implementation of their various stages or components. Aligning objectives with stakeholders and fostering high-quality relationships with them during the contextualization and implementation phases was crucial, as they determine an innovation's potential for long-term sustainability and scalability to other schools, regions and countries.

The following sections analyze the roles played by the most relevant actors: teachers, school leaders and government representatives, followed by an examination of how other stakeholders — international organizations, NGOs, universities and teacher colleges, research centres, teacher unions, the private sector and media and technology companies — contributed.

Engaging teachers as primary stakeholders in TPD innovations

In the context of TPD innovations, teachers are not only beneficiaries but also primary stakeholders whose active participation is crucial for the effectiveness and sustainability of interventions. Their role extends beyond simply adopting new methodologies: teachers are key agents in adapting and refining these innovations to fit the specific needs of their students and classrooms. Prior knowledge of the characteristics and expectations of the participants is essential in adapting an educational innovation, as it helps to understand existing roles and support systems, establish relevance and criteria for making the necessary adaptations, and define metrics for evaluating its effectiveness. It was therefore important for projects to have effective strategies to understand and engage teachers as active participants in the assessment process.

The projects employed various approaches to gain insights into teachers' interests and needs and the learning methods and resources they use. For example, CL4STEM and MATDP conducted classroom observations followed by feedback discussions. SITMS used surveys to explore teachers' interests, motivations, and attitudes toward mathematics, while TEPA developed interviews to assess teachers' openness to adopting new pedagogies and tutoring methods, as well as to understand students' perceptions of self-efficacy and gender roles. These practices not only provide valuable information but also foster interaction with teachers.

Through CL4STEM and SITMS, substantial improvements in teachers' knowledge, attitudes and practices were observed, particularly in the use of student-centred instructional strategies and inclusive teaching practices. By regularly engaging in the cycle of applying new techniques, receiving feedback and reflecting on their teaching practices, teachers directly influenced the success of the programs. Their involvement provided critical insights for refining TPD models, ensuring that knowledge, attitude and practice improvements were integrated into both the design and implementation phases, enhancing the overall impact on classroom learning and equity.

Similarly, the implementation of TPD@Scale in Honduras demonstrated that identifying the distinct needs of generalist versus mathematics teachers created a demand for differentiated materials. Teaching at the Right Level conducted studies in Côte d'Ivoire, Nigeria and Zambia to understand what drives behavioural changes in teachers and to identify existing tools that could leverage transformations in their pedagogical practices. In Strengthening Capacity for Scaling Education Innovation

in the Caribbean, surveys and semi-structured interviews were conducted at the beginning and end of the program, and the innovation projects developed by teachers were documented.

Participation was voluntary in most of the projects analyzed, but the methods for inviting teachers to join the program varied. In some cases, open calls were made, some targeting teachers across all grades in public and private schools, and some targeting specific groups such as all mathematics teachers, as seen in TPD@Scale in Honduras. For the project Strengthening Capacity for Scaling Education Innovation in the Caribbean, government authorities in Saint Lucia and Haiti identified and invited potential participants from among teachers, school leaders and Ministry of Education professionals. While voluntary participation might seem preferable at first glance, it is essential to consider the relevance of bringing these innovations to teachers of students with critical learning needs, who may not see them as a priority.

Regardless of how interesting the topics or methodologies were, the projects faced challenges in sustaining the motivation and consistent involvement of participating teachers. As pointed out by Tan and Dimmock (2021), maintaining engagement was particularly difficult due to competing demands such as heavy workloads, family obligations, and domestic responsibilities, especially for women. Some also experienced difficulties in accessing devices and connectivity and overcoming weaknesses in their digital skills. Various incentives were provided to recognize teachers' efforts and encourage them to participate in and complete the training process: CL4STEM covered transportation costs and mobile data or Internet plans, Teaching at the Right Level allocated budgets for toll-free lines and text messaging for mentoring, and MATPD offered financial incentives. CL4STEM, TPD@Scale and MATPD also provided certificates of participation, which some interviewees believed could be a significant incentive. The impact of these incentives has yet to be determined, and questions remain about their long-term sustainability. In Honduras, TPD@Scale found greater involvement of teachers with temporary contracts, even though there was no explicit incentive to ensure that their participation would have some concrete benefit, such as a more stable future contract.

There are some instances of early uptake of some of these teacher engagement innovations within national systems. In TPD@Scale in Ghana, existing regulatory mechanisms related to compliance with the National Teachers' Standards were used to officially recognize teachers' time participating in the program and in professional learning communities. Points were also awarded for promotion or remuneration purposes based on the percentage of course deliverables teachers successfully completed. Moreover, this innovation was incorporated into the regular TPD program offerings of the National Teaching Council strategy. In Uzbekistan, the Presidential Agency for Educational Institutions adopted the TPD@Scale model for a program aimed at teachers of creative children as part of its training offerings.

RECOMMENDATIONS TO STRENGTHEN TEACHER ENGAGEMENT IN TPD

Based on the input from GPE KIX research implementing partners and stakeholders interviewed, the following practices should be considered by those designing or implementing TPD innovations to engage teachers.

- Conduct preliminary measures to understand the characteristics, knowledge, interests and expectations of potential participants in TPD programs and the contextual conditions in which these programs will be implemented.
- Involve practicing teachers in adapting and implementing the processes of innovation. Their classroom experience and familiarity with their working environment can enhance the relevance and impact of the programs while also expanding the possibilities for sustainability and scaling up.
- Conduct pre- and post-assessments of teachers' knowledge, attitudes and practices to identify and measure changes. This may entail conducting classroom observations during and at the end of an intervention to evaluate changes in teachers' practices.
- Encourage teachers to experiment with new pedagogical strategies in their classrooms and document their experiences to generate new knowledge. Provide opportunities for them to share their findings with different audiences and through various types of media, including reports, videos, audios and social networks.

School leaders as learners

A considerable number of studies highlight the role of principals and other school leaders as key drivers of pedagogical transformation within the framework of effective school research (Fullan, 2001; Day, 2016; Leithwood, 2018; Parlar & Turkoglu, 2021; Tan & Gao, 2022). Findings from these studies about the fundamental role of leadership training and professional development for school leaders were confirmed by the projects' experience. Such training equips them with the necessary skills to motivate and inspire their teams of teachers, fostering a school culture that values collaboration, communication, continuous learning and alignment around common goals. Additionally, professional development equips school leaders to better monitor and evaluate the extent to which expected results are being achieved.

While most projects did not include school leaders among their priority groups for professional development, some projects illustrated best practices in involving school leaders. Strengthening Capacity for Scaling Education Innovation in the Caribbean and TEPA were two projects that explicitly focused on building the skills of principals and other school leaders. But other projects that primarily targeted teachers found it essential to secure the support of school leaders in order to effectively implement and sustain TPD innovations. Many project leaders felt that adopting and sustaining new pedagogical practices can be hindered without clear school leadership and fluid communication between teachers and managers and between teachers and educational authorities. Factors such as demotivation and resistance to change, or a lack of commitment, guidance, follow-up, timely feedback and a unified vision of the potential benefits of new practices can all negatively impact their successful implementation. For TPD@Scale in Uzbekistan, it was especially important for school leaders to understand the scope of the innovations and identify the changes needed to implement them in schools. Joint training sessions involving teachers and school leaders were carried out in several projects. During the monitoring of Teaching at the Right Level in Côte d'Ivoire, classroom observations revealed that implementation of the teaching innovation in schools varied according to the level of involvement of principals and pedagogical advisors in mentoring and coordination.

RECOMMENDATIONS ON ENGAGING SCHOOL LEADERS

Based on the input from GPE KIX research implementing partners and stakeholders interviewed, the following practices should be considered by those designing or implementing professional development innovations to engage school leaders.

- Focus on the acquisition or strengthening of pedagogical leadership and mentoring skills.
- Promote the formation of peer groups for discussion and learning among school leaders so they can exchange with peers from other schools in their area or region. This aims to create a culture of support for managing changes in teachers' practices.
- Involve school leaders in teacher training and communities of practice to facilitate the adoption of new concepts and methodologies into school pedagogy and classroom practices, and their uptake by other teachers in the school.

Governments: key enablers in sustainability and scaling up

Securing acceptance, alignment with the policies and commitment from national, subnational and local governments is crucial for gaining their support and fostering a sense of ownership that enhances the visibility, advocacy and sustainability of TPD programs. Building solid and continuous interactions with government representatives, based on careful planning and clear, consistent communication is essential. These interactions should focus on presenting a program's characteristics, progress, results and benefits while also soliciting timely feedback for continuous improvement. Effective communication is vital for ensuring the longevity of project innovations, identifying opportunities for scaling up and engaging new allies.

Teaching at the Right Level, TPD@Scale, CL4STEM and SITMS secured government support from their early stages. Building on previous research, these initiatives had already gathered evidence of success and developed robust processes, enabling them to demonstrate their impact clearly. Their proven track record was essential in earning the trust and backing of key stakeholders in government.

Teaching at the Right Level worked closely with ministries of education in Côte d'Ivoire, Nigeria and Zambia to ensure that project interventions were aligned with national policies and to facilitate their scaling up. In Côte d'Ivoire, local government pedagogical advisors also mentored teachers, facilitating articulation with other educational strategies.

In TPD@Scale, the involvement of ministries and local education authorities from the outset was crucial to the project's success. This was particularly noticeable in Uzbekistan, where the government adopted one of the implemented TPD models. In the case of CL4STEM, educational authorities in Bhutan expressed interest in adopting and scaling up the project's approach because it aligns with the country's principles and guidelines on teacher professional development and supports its political agenda regarding planned reforms to integrate STEM learning in education. In Nigeria, several government agencies have expressed interest in adopting this innovation as well.

Also noteworthy is the involvement of government agencies in charge of teacher training in the Maldives (National Institute of Education) and in Nepal (Center for Education and Human Resource Development) in MATPD. This involvement has contributed to the sustainability of project outcomes through the government's appropriation of knowledge on mentoring, so that it can be integrated into other TPD programs.

Contextualizing research and making needed adaptations contributed to projects' alignment with national or sub-national public policies and TPD systems. The education policies provide a crucial framework for justifying the relevance of using a particular innovation to address a given problem (such as strengthening teachers' knowledge and practices to improve student learning at a given grade or school

level or on a given subject). This ensures the innovation's legitimacy and cultural appropriateness, encourages the involvement of all stakeholders and helps secure the resources needed for its effective implementation.

The contextual analyses conducted by the projects had different areas of emphasis. The most frequent were educational policies and TPD programs, curricula, professional requirements for teaching and administrative rules regarding the length of teachers' working day, workloads, compensation and incentives to participate in professional development. For example, in Bhutan, teachers must complete 80 hours of professional development per year; this provided the opening to propose that participation in CL4STEM be validated to fulfill this requirement.

TPD@Scale reviewed existing TPD policies and systems in Ghana, Honduras and Uzbekistan, and assessed teachers' level of preparedness to participate in ICT-mediated activities. Information on demographic variables, access to technologies, geographic location and language was also collected to understand their experiences and professional practices with digital technologies. At the same time, meetings, interviews and enlistment surveys were conducted with national stakeholders, including teachers' associations, to validate the context analysis and confirm the priorities for improving the TPD system. The research questions at this stage focused on identifying formal teacher support systems, their costs, how the different stakeholders understood TPD and the degree to which ICTs were used in their practices.

In the case of CL4STEM, the partners used situational analysis based on the data collected to establish relationships with national, provincial and local stakeholders, including ministries of education and district education administrators. A stakeholder map was also developed, which identified key actors and their potential levels of involvement and support for the project.

In TEPA and SITMS, the contextualization also highlighted the most relevant characteristics of the environment and the target population, which allowed for a clearer understanding of their needs and demands. In STEPS, the science and mathematics curricula of the three countries in the study (Benin, Cameroon and the Democratic Republic of the Congo) had been previously reviewed, which made it possible to find differences in the school grades at which specific contents were addressed in each country and to establish mechanisms to harmonize interventions through the design of curricular gateways to offer the same materials.

Government involvement was key in adapting innovations for new contexts in the analyzed projects. This involvement helped secure endorsements and approvals for various implementation aspects and supported capacity building. For example, in the STEPS and PARI projects, education inspectors reviewed and validated the content and materials, enhancing legitimacy among local stakeholders and ensuring alignment with government policies and guidelines. Additionally, regular meetings

were held with the teams responsible for adaptations in the STEPS project, ensuring effective coordination. In the case of Teaching at the Right Level, government officials participated in the design and training teams.

As noted, clear and continuous communication with government representatives to monitor the implementation of innovations contributes to their sustainability and increases the likelihood of scaling up. But a significant challenge highlighted by project leaders was gaining the attention of the educational authorities, as ministries must simultaneously manage many competing priorities. The projects analyzed in this synthesis used various strategies to involve government representatives from the outset.

The most frequently used strategy was holding periodic meetings with the leaders of ministries of education and other national, provincial and local government entities to present innovations, monitor progress, identify difficulties and potential solutions, and to share results and outputs. In Teaching at the Right Level, TPD@Scale, CL4STEM and Strengthening Capacity for Scaling Education Innovation in the Caribbean, government representatives were also directly involved in some activities, the most common being school visits, academic events and training sessions, where they were able to interact with teachers. As mentioned earlier, in Côte d'Ivoire, local government pedagogical advisors provided mentoring to participating Teaching at the Right Level teachers.

Governments signal their interest in TPD programs in many ways. Analysis of the projects identified several key indicators that suggest governments have taken ownership of these initiatives and are interested in scaling them up. Recognizing these signals can help new projects consider them in their design and implementation.

- Direct participation of government representatives in the project's contextualization, adaptation, implementation and follow-up
- Mention of the project by government representatives in meetings outside the project context, such as with other public or private, national or international stakeholders
- Adoption of the project or some components within new or ongoing initiatives
- Interest by government partners in new opportunities to continue working collaboratively with project teams, as in developing new TPD courses or programs using previously implemented methodologies
- Participation of government representatives in events related to project development and results (such as conferences, seminars or round tables), either as hosts or speakers
- Support for project implementation in the field by government representatives
- Interactions between government representatives and participating teachers at project events or training or mentoring sessions where the latter are sharing their experiences
- Integration of professionals who implemented the project into government roles
- Allocation of financial resources from government, even if they are minimal amounts

While these signals are relevant, projects also found that even when governments express interest in collaborating or adopting project innovations, ministries in some countries are so understaffed and overburdened with activities that requesting a higher level of commitment and responsibility can be a challenge.

It is also important to monitor political changes, as they may interrupt established relationships between governments and project teams, affecting chances of continuity and scaling. This can damage project momentum and hinder the acquisition of critical allies. This is particularly challenging in countries or states or provinces where appointments to government positions are politically based as this can lead to the replacement of champions who had supported the project. However, it is possible to mitigate this risk if there is strong buy-in and support from other stakeholders, such as teachers, school leaders, communities, international agencies, NGOs and local governments, whose officials are more likely to remain in their positions for longer periods.

Through their successful engagement with governments at different levels, some of the analyzed projects succeeded in having their innovations adopted, in whole or in part. TPD@Scale was adopted by the government of Ghana to strengthen TPD programs and integrate them into the strategies of the National Teaching Council. This was also the case in Uzbekistan, where project results were used as inputs for the reform of regulations governing the official in-service training offer, which, until then, had been structured around 178-hour distance courses and follow-up exams that teachers had to take once every five years.

With some variations, the CLIx model has been adopted in all three countries where CL4STEM piloted it. In Bhutan, the government decided to implement this innovation with all secondary school mathematics and science teachers through a cascade model. In Nigeria, Niger State committed to training 1,000 mathematics and science teachers, and one of the implementing partners — Ibrahim Badamasi Babangida University of Lapai — was invited to train secondary school teachers in Oyo State. In Tanzania, the government will implement CLIx in most secondary schools in Iringa State.

In the MATPD project, government agencies responsible for teacher training — such as the National Institute of Education and Villa College in the Maldives and the Center for Education and Human Resource in Nepal — incorporated project knowledge related to mentoring, implementing inclusive education models and using OER with students. This knowledge will be used to update other TPD programs.

Governments in several countries have also begun mainstreaming the Teaching at the Right Level approach. In Côte d'Ivoire, the Ministry of Education has identified Teaching at the Right Level as the preferred remedial approach in their foundational learning strategy; its integration into pre-service education (including hybrid training) is underway. In Zambia, the Ministry of Education is developing an overarching plan to roll out the approach at national scale, while in Nigeria, state governments are building the costs of deploying Teaching at the Right Level into their budgets.

RECOMMENDATIONS ON ALIGNING AND ENGAGING WITH GOVERNMENTS

Based on the input from GPE KIX implementing partners and stakeholders interviewed, the following practices should be considered by those designing or implementing TPD innovations to engage policymakers.

- Align TPD programs with educational policies, particularly those related to professional development and curriculum, to ensure that innovations are integrated into broader strategies to achieve sustainability.

- Involve government representatives in projects from early stages through to implementation, as this will contribute to their sense of ownership and increase the likelihood that they will allocate budgets that ensure the sustainability and scaling of innovations. Hold periodic meetings with relevant local, provincial or national education authorities during all project stages to review progress and results and make pertinent decisions.

- Make clear and specific requests to ministry staff members, explaining the purpose of the project, its expected achievements and the benefits of improving teacher practices and the cost-effectiveness of training.

- Foster a broad and sustained relationship with local governments, which are usually less susceptible to political changes, to obtain their support for the projects.

- Hold events such as seminars, conferences or round tables for government officials and other stakeholders to learn about and analyze the results and impact of the projects. Having teachers and mentors participate in these events can allow them to directly share their experiences and the changes they have made with decision-makers. This can also strengthen teachers' confidence and motivate them to continue improving their practices.

- Present concrete project results to government representatives and other stakeholders, including data on their impact on teaching practices and cost-effectiveness.

- Maintain links with education authorities after project completion. Even though funding for adoption may not be available at that time, the efforts of other stakeholders may sustain government motivation for adoption.

Other stakeholders' roles in building capacity and sustaining TPD innovations

Partnerships with many other stakeholders — including NGOs, international organizations, universities, teacher colleges, research centres, teachers' unions, the private sector, media and technology companies — play a vital role in sustaining and scaling up TPD programs. These groups can contribute complementary technical and financial resources, networks, visibility and expertise, especially in contexts where government capacity is limited. Maintaining communication with these actors also helps them understand the importance and impact of these projects and motivates them to get involved.

Effective coordination between donors, NGOs and government entities ensures that resources are allocated efficiently and project objectives are aligned with education policies. In countries where donor activity is high, lack of alignment can lead to fragmentation of efforts, negatively affecting results and impact. In the case of TEPA, effective collaboration with the international federation Fe y Alegría in Honduras and Nicaragua, and with the Honduran Ministry of Education, were crucial for project implementation and scaling. This, in turn, strengthened relations with Fe y Alegría, which operates in 22 countries in Latin America, Africa and Europe, expanding the potential to apply the peer tutoring methodology in other contexts.

Similarly, STEPS collaborated with several organizations. The non-profit Ukuqonda Institute of South Africa, which promotes excellence in mathematics and science, facilitated the use of various mathematics materials and connected two of its members to the team responsible for developing the mathematics curriculum. Scientific Animations Without Borders — a university-based program that extends knowledge through animations in diverse languages — developed content in English, French and Fon.

Donors and international organizations can play a pivotal role in facilitating government involvement, as they often have established relationships with key government representatives. In Côte d'Ivoire, for instance, partnerships with UNICEF and the Belgium-based education for development organization VVOB were instrumental in securing government support and integrating Teaching at the Right Level activities into national programs. These collaborations helped the project connect with policymakers, ensuring greater alignment and sustainability. A research centre also made relevant contributions to its innovations. In Côte d'Ivoire, the global research and policy nonprofit Innovations for Poverty Action helped to broaden the project's impact by validating and proposing adjustments to its methodology.

SITMS, CL4STEM, and MATPD involved representatives of teacher colleges and universities, especially faculties of education or pedagogy, in adapting innovations. This collaboration enriched the adaptation process while increasing the likelihood that

these innovations — which provide classroom strategies that are more active and motivating for students — are integrated in the curricula for training new teachers. This also created opportunities for higher education institutions to design and offer short courses for ongoing professional development of in-service educators.

Universities, teacher colleges and NGOs also contributed professionals for mentoring and coaching. In the case of Teaching at the Right Level and MATPD, they supported the establishment and consolidation of learning communities among participating teachers. Their involvement fostered collaboration and support for changes in classroom practices, continuous professional development and the integration of innovations. In MATPD, several fellows from Nepal published their research, testifying to the high quality of their work and their empowerment to make such contributions.

While the leaders of the projects analyzed in this synthesis recognized the strategic importance of involving teacher colleges in adapting and implementing TPD programs, they also identified some important caveats to consider. First, to implement inclusive and active learning environments that meet the needs of diverse student populations, these institutions need direct knowledge of the conditions and challenges teachers face daily in their classrooms. Second, some educators in these institutions hold outdated views on education and classroom practice and can be resistant to adopting innovative and relevant pedagogical strategies.

Teachers' unions are powerful actors in many education systems and can have significant weight in accepting and implementing new initiatives. During the contextualization phase of TPD@Scale, meetings were held with important stakeholders, including union representatives, to validate the context analysis and confirm priorities for improving professional development systems. In Ghana, four teachers' unions participated. In Honduras, interaction with the national association of principals and teachers' unions was key in the initial stages of the process, as their support generated trust and facilitated smoother project implementation.

SITMS also included teachers' associations and unions in their stakeholder meetings to discuss issues related to the expansion of the SITT innovation. As a result, the innovation was piloted through an ongoing collaboration between the Tanzania Teachers Union and the Swiss development organization Helvetas. Some of the fellows who participated in MATPD belonged to science teachers' unions and helped to disseminate the project among their members.

The private sector can provide resources and innovation to complement efforts. In Saint Lucia, the banking sector helped finance an innovation centre, inspired by the actions of the Strengthening Capacity for Scaling Education Innovation in the Caribbean project, which focused on empowering local teachers and building their community capacity. Public-private partnerships with companies in

telecommunications and other sectors can support the development of technology-based initiatives. In Teaching at the Right Level, one such partnership enabled toll-free phone calls and text services for remote mentoring.

Finally, the media plays a crucial role in amplifying project visibility, which can inspire governments and other stakeholders to offer both technical and financial support for successful programs. In Côte d'Ivoire, the media frequently highlighted the achievements of the Teaching at the Right Level project in enhancing student learning, showcasing its impact and encouraging broader support.

RECOMMENDATIONS FOR ENGAGING OTHER STAKEHOLDERS

Based on the input from GPE KIX implementing partners interviewed, the following practices should be considered by those designing or implementing TPD innovations to engage other stakeholders.

- Support cross-sector collaboration and alignment, including donors and other stakeholders from the beginning of projects so that activities are well-articulated, the expected results are achieved and sustainability is ensured.
- Build and maintain strong relationships with local influencers, such as district leaders, NGOs, universities, the private sector and the media, among others, who can contribute to the sustainability of projects if high-level champions are replaced. Clear and continuous communication and exchange of results are key.
- Finance collaborative research among teachers and teacher educators on using pedagogical practices in diverse contexts to strengthen their professional knowledge and skills.
- Encourage university and teacher college facilitators and mentors to write proposals, seek funding and explore new possibilities, such as by creating flexible courses based on lessons learned from implementing TPD programs.
- Encourage partnerships between actors that can support educational innovations, especially those based on technologies.

4.2 The growing role of technologies

The TPD innovations leveraged various technologies to support teacher learning, including phone calls, text messaging and other communication applications. Learning management systems (LMS), such as the open-source learning platform Moodle, were also utilized. The digital content developed or provided was accessible through connected devices, phone networks and offline options. Due to the pandemic and resulting restrictions, many projects had to adapt their delivery methods and activities, shifting to virtual modalities for training and support. This shift demonstrates the flexibility of these innovations and their ability to adjust effectively to changing circumstances.

One of the main attractions of these technological approaches is their potential for scalability, allowing programs to reach a wider audience at a lower cost by reducing associated logistical expenses. However, for these initiatives to work as expected, accessibility and infrastructure are required. Teachers need Internet access, devices compatible with the technology, and the ability to pay for calls, messaging or data, for example.

Despite the enormous potential of technology, its integration into TPD initiatives must be thoughtfully approached. Attention to local contexts, infrastructure constraints and cultural dynamics is important. Project leaders agreed that while technology is a powerful tool, it does not replace face-to-face interaction. By prioritizing hybrid approaches, developing digital competencies and ensuring equitable access, technology can be a powerful enabler of professional development, enhancing program reach and effectiveness.

Equity in access

The effectiveness of technology-based TPD is intricately linked to equity issues in access to devices and connectivity. Teachers in rural and remote areas often face difficulties accessing computers, tablets or smartphones, and cannot rely on Internet connectivity. The cost of essential services such as data plans, software licenses and connectivity can often be prohibitive, limiting their use in low-resource contexts. These barriers restrict teachers' ability to participate and exacerbate existing inequalities.

Addressing these equity issues requires an approach that integrates high-tech solutions with low-tech alternatives to implement the project or initiatives with the available resources. For example, where LMS and digital platforms that offer interactive content are not accessible, text messaging and offline content delivery can be used.

In Honduras, TPD@Scale used technology to reach as many mathematics teachers as possible, making adaptations so that contents could be accessed offline and in different formats that teachers could download to their personal devices. The same approach was applied with PARI, which, through strengthening skills in a digital learning environment, allowed teachers to access resources to update their skills. However, certain minimum conditions are necessary to enjoy the benefits of these digital resources. In Haiti (Strengthening Capacity for Scaling Education Innovation in the Caribbean), Afghanistan (MATPD), and Zambia and Nigeria (Teaching at the Right Level), the use of technology was marginal due to the lack of adequate conditions for accessing online resources. In the case of CL4STEM in Bhutan, the cost of accessing the Internet did not allow teachers to review content and activities at home.

Experience in these countries highlights the need to consider local contexts when designing and implementing projects, and to combine low- and high-tech approaches to make TPD programs more inclusive. Low-tech strategies, such as free phone calls and text-message tutoring, were used to mitigate these constraints. In Nigeria, Teaching at the Right Level introduced toll-free phone lines to facilitate remote tutoring in regions with poor Internet access, while in Côte d'Ivoire, teachers in urban and rural settings were reached by hybrid tutoring that combined phone calls and in-person visits. In Zambia, WhatsApp groups and chatbots were used to maintain participation despite connectivity challenges.

Meeting teachers' needs, abilities and preferences

The effectiveness of integrating technology into TPD programs largely depends on how well these technologies address the specific needs of teachers, within their local context. While digital platforms can enhance the reach and flexibility of TPD initiatives, their success depends on factors such as digital literacy, cultural practices and teachers' ability to interact with technology.

One of the challenges in implementing technological solutions is the varying levels of digital competence among teachers. Some struggle with basic digital tasks, such as uploading documents or navigating online platforms, even when resources are available. This problem is prevalent among older teachers who may be less familiar with digital tools.

Trusting relationships are critical for effective professional development. While virtual platforms can facilitate peer-to-peer collaboration and community building, these interactions will not necessarily have the same depth as those achieved in face-to-face modalities. Similarly, the effectiveness of technological solutions is also mediated by cultural relevance and local acceptance, which requires careful consideration of each context's specific needs and characteristics. In Saint Lucia, due to modifications in program delivery that had to be made during the pandemic, the first sessions conducted with teachers by the project Strengthening Capacity for Scaling Education

Innovation in the Caribbean were hosted through an online platform. The initial results were not as expected because, during these first meetings, teachers were reluctant to actively participate in virtual environments. TEPA encountered a similar situation in carrying out online activities, which negatively affected the formation of bonds of trust, a key aspect of the methodology. This led to a review of delivery modalities, prioritizing face-to-face interactions wherever possible.

In Afghanistan (MATDP) and Zambia (Teaching at the Right Level), challenges related to digital literacy and infrastructure limitations required additional support and adjustments to ensure that all participants could use the technology effectively. In Honduras, TPD@Scale opted to follow a process with specialists to ensure the usability of digital and interactive content. These examples highlight the importance of designing TPD programs that consider teachers' diverse capabilities and preferences, ensuring that technology solutions are effective and inclusive.

Sustainability challenges

The sustainability and scaling of technology-supported TPD programs present unique challenges, particularly in low-resource settings. One of the challenges lies in the rapid pace of technological change, which can render platforms or tools obsolete over time. Programs built around a specific platform may need to adapt quickly if user preferences or technology trends change. This demands flexibility to ensure they can evolve with changing technology landscapes while providing ongoing support to educators. Issues of equity and accessibility must also be addressed to avoid creating a system where only those with access to high-tech solutions can benefit from professional development opportunities. In Côte d'Ivoire, for example, Teaching at the Right Level noted a change in teachers' preferred communication platform, moving from Facebook to WhatsApp. Similarly, in the MATPD project, Telegram was initially used for communities of practice, but it soon became clear that participants favoured Facebook for sharing information.

Another challenge is fostering teacher participation — a critical factor in the success of technology-based TPD. For this reason, it is crucial that teachers understand the purpose and advantages of the technology. Awareness-raising activities that highlight the benefits of remote mentoring and digital learning platforms can help educators understand the value of these tools in improving their professional practices. Mentors also play a key role in guiding teachers through this transition. Strengthening mentors' skills in facilitating peer learning and collaboration in both face-to-face and virtual environments can significantly improve the effectiveness of TPD initiatives by creating a supportive environment where educators are motivated to interact with new methods and technologies.

Prioritizing functionality and user preferences is crucial to the success of these initiatives. In the case of Teaching at the Right Level, awareness and training activities on using the technologies were conducted, which was key for teacher acceptance. This approach can also be applied to other actors, such as government representatives. MATPD, for example, identified a lack of knowledge among government representatives about open educational resources, and they agreed on the need for training on the subject.

Hybrid or blended approaches

Hybrid models combine face-to-face and remote training as a strategy to maximize participation and effectiveness. While face-to-face training and mentoring are often more effective in building trusting relationships and ensuring the fidelity of training content, their high cost and logistical complexity hinder their scalability. On the other hand, remote delivery and digital platforms that offer more cost-effective and accessible solutions have limitations in the quality of interaction, engagement and depth of support provided.

Hybrid approaches seek to balance various elements by leveraging technology to reach a larger number of teachers and provide flexible options while preserving face-to-face engagement where direct interaction is vital for building professional relationships and achieving better learning outcomes. This enables teachers to benefit from the scalability and flexibility of online content while participating in in-person sessions that foster community building and mutual support.

For hybrid approaches to be effective, it is essential to clearly determine when in-person support is necessary and when remote options can adequately meet teachers' needs. Additionally, these approaches require selecting the appropriate type of technology. Virtual tools should be used strategically, combining high- and low-tech options based on teachers' characteristics and context.

The case of Strengthening Capacity for Scaling Education Innovation in the Caribbean illustrates the advantages and disadvantages of both modalities. Initial training activities were planned to be face-to-face in both countries: in Saint Lucia, they had to be done virtually due to the pandemic, while in Haiti, they remained face-to-face due to fewer restrictions. The two implementation contexts revealed the particularities of each option. In Haiti, face-to-face training favoured the organization of teams according to geographic location and required financial resources for travel and logistics. In Saint Lucia, teams were established around common interests among teachers from different areas, and most resources could be invested in prototyping proposals. However, implementers identified that Saint Lucian teachers were less comfortable in the virtual environment, which affected the dynamics and results of the sessions. Eventually, a hybrid approach was adopted in this country.

In Nigeria, Teaching at the Right Level used hybrid mentoring models that combined remote support with occasional face-to-face visits. This proved more effective in maintaining engagement while addressing infrastructure challenges. Remote mentoring had two modalities: phone calls and text messages. It was found that phone calls were the more cost-effective option, as teachers were more receptive to personalized feedback compared to WhatsApp, which also required an Internet connection.

MATPD also used a blended training approach, combining in-person workshops with online course participation and engagement in communities of practice. The face-to-face meetings offered fellows valuable opportunities to build relationships both within and across countries, forming networks they could access through various platforms to enhance their understanding of TPD in other contexts while sharing insights from their own.

These examples underscore the importance of flexible, context-based approaches to sustaining and scaling professional development programs. These programs can achieve a broader reach and lasting impact by incorporating a combination of low- and high-tech solutions and continually adapting to educators' needs.

RECOMMENDATIONS ON THE USE OF TECHNOLOGIES

Based on the input from implementing partners interviewed, the following practices should be considered by those designing or implementing TPD innovations that involve the use of technologies.

- Integrate low- and high-tech options to suit users' needs and the characteristics of the context.
- Encourage and support strategic partnerships with technology companies as a means to strengthen the financial viability and sustainability of training programs. Such collaborations can facilitate access to resources such as discounted devices, data plans, subsidized calls and technical support.
- Include budget allocations to finance or subsidize the cost of devices and connectivity services for teachers to enable remote training and mentoring.

4.3 Knowledge mobilization

Knowledge mobilization plays a role in sustaining and scaling up successful innovations. It involves transferring the knowledge and insights gained from project adaptation and field implementation to facilitate the use of results, conclusions, recommendations, lessons learned and best practices by diverse stakeholders at national and international levels. This process increases the visibility and accessibility of findings and strengthens the potential for scaling initiatives, ultimately amplifying their medium- and long-term impact.

Throughout the projects, knowledge mobilization strategies were linked to efforts aimed at gaining and sustaining the engagement of various stakeholders, while simultaneously building a knowledge base to enhance the capacity of key actors within the system. These strategies also sought to influence policy-level decision-making and encourage government buy-in.

The strategies primarily focused on developing and disseminating a variety of knowledge products in both written and audiovisual formats, with content tailored to different audiences. These products included research reports and academic articles, policy briefs translated from research findings, press releases and social media content. Interpersonal strategies were also widely used, such as seminars and webinars, to disseminate findings and foster informed conversations among researchers, practitioners and policymakers.

Regarding the effectiveness of these strategies, project representatives see particular promise in video formats featuring teachers demonstrating and discussing best practices. There is broad consensus among project leaders on the importance of placing teachers at the centre of knowledge mobilization efforts. As one leader stated in the interview process, “When teachers present their own experiences and solutions, it mobilizes information effectively… teacher-driven narratives about their impact and innovations are powerful in garnering support and scaling solutions.”

Executive summaries with concise, actionable insights are considered more useful than lengthy reports for most stakeholders. Emphasizing personalized and interactive methods over static written reports can enhance engagement and impact. Discussion meetings and roundtables facilitate dialogue, while events such as conferences, report releases and inaugurations provide platforms for discussing ideas and presenting findings, offering valuable opportunities to engage policymakers and other stakeholders. These events support knowledge dissemination in an interactive and impactful way.

A significant challenge in mobilizing knowledge from research to policy is the mismatch in timing that often exists between the stages of research and validation, and available policy windows. Involving stakeholders in the research process from the beginning can help to address this. This includes co-designing research questions,

jointly reviewing findings and ensuring that analyses align with policy needs. Providing baseline reports and early findings, even if preliminary, can help maintain government engagement and ensure that the research remains relevant and usable.

The impact of knowledge mobilization strategies on both policy and practice will be evident over time and needs to be studied further. In-depth interviews with project leaders revealed some skepticism about the value of knowledge dissemination when not accompanied by direct interaction with partners and teachers. Ideally, this interaction should lead to the emergence and consolidation of communities of practice that can benefit from the use of social media. An example of this can be found in MATDP, where a blog was created for participants to share insights on how evidence gathered through knowledge mobilization strategies can foster the development of communities among teacher educators in South Asia and support policy adoption.

RECOMMENDATIONS ON KNOWLEDGE MOBILIZATION

Based on the input from GPE KIX implementing partners interviewed, the following practices should be considered by those aiming to mobilize knowledge on TPD innovations.

- Customize knowledge mobilization strategies for different audiences. Products such as policy briefs and infographics and formal events such as seminars, webinars and roundtables tend to be more relevant for government representatives, policymakers, NGOs, donors and universities and colleges. Video and audio clips work best for teachers and mentors, as they provide practical examples and peer validation.
- Develop knowledge mobilization products and strategies that incorporate teachers' own insights. When teachers share their experiences in strengthening their practices and resolving challenges in their classrooms, it increases stakeholders' interest and makes the information more convincing.
- Promote interaction among various stakeholders around project findings, providing them an opportunity to ask questions, get feedback and discuss the implications in detail.
- Encourage the creation of communities of practice where evidence is discussed and contextualized based on participants' direct experiences.
- Involve stakeholders from the initial stages of research. Share progress and early findings, and remain open to their insights.

5. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The experience of the 11 projects included in this synthesis reveals the potential for scaling effective TPD innovations toward a new paradigm of professional learning. It also highlights the obstacles that must be overcome to move away from programs based on cascade training with prescriptive content that is disconnected from teachers' classroom realities. These projects showed that, given certain conditions, effective TPD innovations can be scaled up in different contexts of the Global South.

Conditions that favour scaling include relevance, an enabling environment, political support and technical capability. Since teachers are the primary stakeholders of TPD programs, it is essential that any given innovation should address their needs and equip them with the skills, tools and support necessary to effectively transform their classroom practices. A conducive environment requires a shared vision among participating stakeholders, a strong commitment to contribute resources and political backing to ensure the programs' lasting impact. Technical capabilities are sustainable when knowledge remains embedded within institutions, ensuring continuity after projects conclude.

The 11 projects employed various strategies to ensure that innovations aligned with country priorities regarding student learning and teacher skills. Yet alignment with country priorities and policies alone is not enough to guarantee government support and buy-in. Trust-based relationships must be built at all levels, working closely with government officials, involving them in decision-making in all project stages, and developing the skills of those at technical levels and closer to schools. Capacity building is a powerful mechanism to counter the effects of fluctuating support during periods of political instability. In some countries, teachers' unions have shown great potential as advocates of professional learning.

Building a critical mass of experts to support effective TPD strategies is a long-term undertaking. The projects that partnered with teacher education institutions recognize the value of teacher educators' contributions and the potential for ensuring a continuous supply of professionals with the knowledge, skills, technical abilities and interpersonal competencies required to perform various roles in mentoring and supporting teachers. The partnerships established during the implementation of these projects provide a solid foundation for driving changes in these institutions toward training programs focused on teaching excellence. This includes incorporating the development of competencies in mentoring, digital skills and

technology-based pedagogical design, among other areas, into their curricula. The role of these experts in sustaining emerging communities of practice is key to helping them thrive and move toward greater levels of autonomy and self-reliance.

Technology was a crucial ally for projects in reaching teachers in remote areas, connecting teachers across various geographical locations and expanding the number of participants. The challenges that arose regarding the use of ICTs were primarily related to teachers' limited access to the Internet and communication devices. To facilitate access, projects turned to simpler solutions, such as offline content delivery and text messaging, which sometimes needed to be subsidized. The limitations of ICT-mediated learning were acknowledged by the projects, giving way to a consensus on the need to evolve toward hybrid support models that maintain in-person interactions, with particular emphasis on those who need them the most, while continuously evaluating their impact on teachers' practices.

A number of areas emerged from this synthesis of lessons and findings on teacher professional development as potential avenues for future research. These include how to best tailor TPD and training for school leaders to meet their learning needs and styles; how to balance the costs and benefits of technology use in TPD; how to maximize the effectiveness of TPD in promoting learning outcomes; and how to deepen teachers' engagement in TPD programs and opportunities.

Increasing teachers' agency in identifying learning needs and styles requires further study, as it can enhance their sense of ownership and commitment to sustainable pedagogical change. The same applies to school principals, who have been identified as crucial actors in fostering and leading pedagogical change within their schools. As adult learners, teachers bring prior experiences to the learning process and seek knowledge that is immediately applicable to their professional practice. Understanding these characteristics is essential when designing professional development programs to ensure that learning opportunities are meaningful, personalized and relevant to real-world challenges.

Further research is needed on the trade-offs of using technology to expand access while reducing costs. Approaches such as limiting person-to-person mentoring to those who need it most clash with the lack of clear criteria for deciding who most needs it. There is also an absence of real-time, detailed and reliable information about the needs of individual teachers and schools. On the other hand, understanding the tensions that arise from expanding access to quality courses through centralized LMS platforms can help designers and implementers identify alternatives that provide some degree of flexibility and responsiveness to teachers' needs at the local level.

There is significant room for research that delves deeper into the effectiveness of these innovations in changing teaching practices toward active pedagogies that improve learning outcomes. As evidenced throughout this synthesis, there is still little evidence on "what works" in TPD and why what works in one context may not be effective in others. Applied research has great potential to address these gaps by formulating relevant questions and using innovative qualitative research methods and appropriate metrics to establish impact (finding appropriate measures and tools to account for significant changes in teaching practices with the potential to improve student performance).

Finally, there are a range of entry points to examine related to enhancing teachers' engagement so that they can more fully benefit from TPD innovations. These include better understanding the learning styles and preferences of participants in TPD programs, as well as the impact of various training and support modalities (face-to-face, remote or hybrid) on teachers' motivation, learning and adoption of classroom innovations. The effectiveness of collaborative efforts between facilitators, tutors, mentors and teachers is another key element. We also need to better understand the factors that motivate participation in communities of practice and the use and impact of social networks in forming and sustaining learning communities — including how these networks affect the quality of interactions and exchanges among their members.

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APPENDIX 1. SUMMARY OF THE PROJECTS UNDER STUDY

Project	Implementing partners	Description
Adapting and Scaling Teacher Professional Development Approaches in Ghana, Honduras and Uzbekistan (TPD@Scale)	Foundation for Information Technology Education and Development UNESCO Tashkent SUMMA Worldreader	The objective of the project was to pilot previously tested TPD models. These were contextualized and adapted for implementation in Ghana, Honduras and Uzbekistan, whose governments recognized that strengthening the capacities of their teachers was fundamental to their education policies. The project also sought to identify factors that could contribute to the sustainability and scaling of TPD models; similarities and differences in the participation of diverse groups of teachers; and the resulting gains in knowledge, skills and attitudes. Different models were applied in each country: in Ghana, the Moodle platform of the National Teaching Council of the Ministry of Education was used to offer content designed by the government; in Honduras, a self-guided mathematics course designed by teams of professionals from regional centres of the Ministry of Education was used to improve the pedagogical skills of teachers in grades 7 to 9; and in Uzbekistan, two models were implemented: one by the Presidential Agency for Educational Institutions, which was school-based and included the training of school leaders, and the Avloniy Institute's model for training primary and secondary school teachers. The strategies used for training and tutoring or mentoring varied in each country. In Ghana, courses were offered by government-approved service providers. Content could be downloaded for offline work, and there was a combination of face-to-face and remote strategies; teachers received support from their respective district education offices and learning communities were formed at school and district levels. Teachers underwent formative and summative evaluations, and those who met all requirements received certification and a score. In Honduras, the course was delivered by regional centres and began with a unit on technological support. There was a tutor for each group of thirty teachers, and formative evaluations were conducted at the end of each unit to promote reflection on practices. The tutors organized learning communities through an instant messaging application, with seven to ten members in each community. In Uzbekistan, training was entirely online and there was permanent interaction between teachers and mentors.

Project	Implementing partners	Description
Teaching at the Right Level: Learning How to Improve Teacher Support Through Mentoring and Monitoring (Teaching at the Right Level) Côte Ivoire, Nigeria and Zambia	Abdul Latif Jameel Poverty Action Lab — Massachusetts Institute of Technology	Teaching at the Right Level's purpose was to contribute to elementary school learning in the areas of reading, writing and mathematics. Flexible groups of students were formed according to their skill-mastery levels, which were established through evaluations at the beginning, middle and end of the intervention. Each group performed learning activities adapted to their level, so that effective progress was made. These activities could be carried out during regular class hours or during complementary days, depending on the particularities of each context. Usually, activities developed with the students were led by instructors who were volunteers or public-school teachers; they evaluated the students and grouped them by level. The instructors received prior training that could last, depending on the case, between one or two weeks. There were also mentors, who were preferably professionals with teaching experience, in charge of visiting schools and observing the classes, conducting demonstration activities, identifying areas for improvement and providing feedback to the instructors. Learning communities were organized by tutors and teachers and operated through instant messaging applications, which facilitated communication and the distribution of support materials (written and audio-visual). In Côte d'Ivoire, Nigeria and Zambia, the project explored alternatives for providing school-based support to teachers at reasonable costs. In each country, qualitative studies were conducted to understand the mentoring and monitoring processes within their education systems. The results served as input for Teaching at the Right Level's national partners to jointly design models articulated to the education systems for implementation in a contextualized manner, with materials and other tools to support teaching and learning. In Côte d'Ivoire, the program is called Programme d'Enseignement Ciblé and there is enormous potential for it to be institutionalized and reach a national scale. In Zambia, it is called Catch Up Continuing Professional Development, and it is already integrated into the Zambian education system with funds to expand to almost the entire national territory. In Nigeria, a country with a federalized government structure, the expansion and institutionalization processes are being carried out with the states

Project	Implementing partners	Description
Connected Learning for Teacher Capacity Building in STEM (CL4STEM) Bhutan, Nigeria and Tanzania	Ibrahim Badamasi Babangida University Samtse College of Education The Open University of Tanzania Tata Institute of Social Sciences	The objective of this project was to pilot an online TPD program, based on the use of OER, for high-school and middle-school mathematics and science teachers. It sought to promote the building of higher order thinking skills with inclusion and quality in the classroom. It also aimed to evaluate the effectiveness of the innovation and its potential for scaling. CL4STEM was based on CLIx, which aims to strengthen teachers' knowledge, attitudes and practices in the use of new resources to improve teaching and learning in the two subjects. CLIx was transferred to teacher trainers (who were linked to universities) in the three countries through online and face-to-face workshops and communities of practice focused on the use of ICT in mathematics and science, design thinking and Universal Design for Learning. As a result of the transfer, thirteen online modules for physics, chemistry, biology and mathematics and a general pedagogy module on the teaching of these subjects were collaboratively designed. Subsequently, all these modules were offered through the Moodle platform in the form of online courses that offered certifications to those who completed them. Teachers in initial training also participated in Bhutan. Mentoring of teachers was carried out through a combination of face-to-face and virtual methods, including individualized support from mentors, educational resources and feedback on their practices. Online platforms and other technological tools were also used to facilitate communication and distribution of materials through the communities of practice.

Project	Implementing partners	Description
Adapting and Scaling Peer Tutoring for Teachers and School Leaders for Equitable Rural Education (TEPA) Honduras and Nicaragua	Fundación Educación 2020 Fundación Fe y Alegría	This project aimed to adapt and scale a pedagogical innovation called peer tutoring, initially developed in Mexico, and to generate relevant knowledge to improve equity, inclusion and learning among students in rural schools in Honduras and Nicaragua. The project had an inclusive approach in terms of gender, interculturality and human rights. It aimed to strengthen the professional development of teachers and the educational leadership skills of school administrators. TPD was conceived as a continuous process that contributes to the acquisition of new learning and the transformation of teaching practices for the benefit of students. Tutorials were based on the principles of active learning, constructivism, autonomy and recognition of diverse interests and learning rhythms: they can be used in any subject. Their starting point was the posing of questions on relevant topics, through which challenges and possible solutions could be identified, along with connections between the topics. The application of peer learning also contributed to transforming vertical hierarchical relationships that have characterized traditional classes into ones based on dialogue and interaction among equals. The project incorporated a gender approach in all its actions, particularly in the training on tutoring. Although the tutoring methodology was originally designed to be carried out in person, it was adapted to be implemented remotely due to COVID-19. Primary school teachers from participating schools in both countries were trained and accompanied by monitors to learn the methodology and apply it with their students. This training was initially carried out through online meeting platforms, with sessions recorded to allow access to teachers who had difficulties in participating. Learning communities were also formed between tutors and students for joint work and the distribution of materials. These communities used tools such as instant messaging applications, e-mails, social networks and the project's web page.

Project	Implementing partners	Description
Strengthening Teachers' and School Principals' Capacity for Scaling Innovation from the Bottom Up in the Education System in the Caribbean (Strengthening Capacity for Scaling Education Innovation in the Caribbean) Haiti and Saint Lucia	Université d'État d'Haïti, Campus Henri Christophe de Limonade Wilfrid Laurier University Raise Your Voice Saint Lucia	This project aimed to strengthen the capacities of teachers, school leaders and professionals from the ministries of education in Haiti and Saint Lucia to introduce a culture of innovation in classroom practices, schools and their education systems. The guiding principles were design thinking, innovation, learning-by-doing and peer-to-peer collaboration, through which proposals could be co-created and new solutions prototyped. The project promoted a bottom-up approach, whereby innovations were designed collaboratively at the local level and then scaled up to other levels. Mentoring was carried out by professionals who provided individualized support to participating teachers and school leaders through regular sessions (face-to-face or remote) in which information was shared and advice was given on steps to follow in the innovation process. The aim was to encourage dialogue, reflection and collaborative work, since it was expected that innovations would be designed through joint creation exercises. Likewise, feedback was provided on the innovation proposals put forward by the participants. Materials (written and audio-visual) were produced in English (for Saint Lucia), French and Creole (for Haiti) on the innovation processes to support the development of the mentorships.
Science, Technology, Engineering and Mathematics (STEM) Teacher and Student Education for Primary Schools (STEPS) Benin, Cameroon and Democratic Republic of the Congo	Cameroon Baptist Convention Ulrich and Ruth Frank Foundation for International Health Emmanuel Community HEAR Congo Trois Soeurs Education Fund	The objective of this project was to improve the quality and equity of STEM education in grades 1 to 3. Its conceptual bases were structured around the approaches of Robert Gagné and design-based research. The primary mathematics and science curricula of the three countries were reviewed to identify gateways, especially in science, due to the significant differences found in the curricula of each of the three countries. Teachers were surveyed to characterize their teaching experiences, challenges in teaching mathematics and science, use of materials for teaching science and expectations regarding professional development and on the availability of resources. The contents and materials designed for the project were reviewed and validated by education inspectors. Teachers received training and support on the pedagogical use of resources in their classrooms through online platforms, instant messaging applications and other virtual communication tools, through which materials were also delivered. The tutorials were developed under a participatory and collaborative approach. They sought to promote classroom use of strategies such as experimentation, problem solving and critical thinking in STEM areas to promote student learning. Collaborative communities were also created among partners in each participating country.

Project	Implementing partners	Description
Improving Community Teacher Development in the Digital Era (PARI) Cameroon, Chad and Central African Republic	Université de Yaoundé 1 École Normale Supérieure N'djamena École Normale Supérieure de l'Université Bangui	The objective of this project was to design and implement innovative content in different areas of the curriculum, along with a governance system to train trainers in bilingual or multilingual contexts, using a hybrid format with a focus on inclusion. It sought to understand how primary teachers adopt an innovation based on virtual learning environments, as well as the factors that facilitate such adoption, in order to develop strategies for trainers to take full advantage of the educational possibilities offered by ICT. The project developed a strategy based on: (1) teachers' access to a training offer through virtual learning environments; (2) access to, sharing of and support with digital tools; and (3) support for innovative projects that help to expand the use of virtual learning environments and the digital commons. Online training, webinars and interactive resources were developed, suited to participants' characteristics and needs. Virtual tutorials sought to encourage participation and collaboration to promote reflection and active learning. Online platforms and instant messaging applications facilitated communication and collaboration and the sharing of resources. A platform was also designed to make resources available to participating teachers in their languages: French and English for Cameroon, French and Arabic for Chad and French and Sango for the Central African Republic.

Project	Implementing partners	Description
A Multi-modal Approach to Teacher Professional Development in Low-Resource Settings (MATPD) Afghanistan, Maldives and Nepal	Villa College Swedish Committee for Afghanistan Tata Institute of Social Sciences	This project aimed to influence policy, practice and future research on distance TPD strategies through the contextualized use of various technologies and modalities. It also sought to generate knowledge on factors that can facilitate the implementation of integrated TPD models in resource-limited contexts. The project was based on the principles of constructivism, action research, social learning and the use of various technologies to create professional learning communities to empower teachers as agents of change in their contexts. The methodology followed the following steps: (1) joint identification by teachers and tutors of challenges or areas they wanted to improve (e.g., student learning, teaching strategies or classroom management); (2) formulation of questions to investigate the causes and possible solutions to these challenges; (3) design of interventions to solve these challenges; (4) data collection and analysis; (5) reflection and ongoing dialogue to critically examine teachers' practices and the impact of their interventions; and (6) socialization of research findings and experiences with other teachers, school leaders and other members of the educational community. Face-to-face and virtual workshops, peer tutorials and communities of practice were conducted to foster collaboration, exchange of experiences among participants and continuous learning. The tutorials were personalized and designed to foster the professional growth of participating teachers through individualized and continuous support, so they could reflect with tutors on their pedagogical practices, identify areas for improvement and receive constructive feedback and socio-emotional support. OER were also collaboratively developed or adapted.

Project	Implementing partners	Description
Strengthening School-Based In-Service Teacher Mentorship and Support (SITMS) Kenya, Tanzania and Zambia	Dar es Salaam University College of Education University of Zambia Kibabii University HELVETAS Swiss Intercooperation	This project aimed to: (1) strengthen the continuing professional development of secondary teachers by generating knowledge around the use of effective mentoring and support models; and (2) improve teaching and learning by building the capacity of mentors and teachers. The project design was based on the SITT model of in-service training, which was first implemented in 2003 in some primary schools in Tanzania. It aimed to strengthen teachers' pedagogical skills and critical reflection on teaching and learning processes through contextualized peer tutoring in schools. A baseline study mapped existing mentoring programs in the three countries, involving various stakeholders. Secondary teachers were surveyed on their interests, ideas and attitudes towards mathematics. These results served as inputs to adapt the innovation to include more content on topics considered more difficult by teachers. Educational materials and support resources — such as mentoring guides, sample lesson plans and good practice examples — were designed to facilitate mentoring. Mentoring and support was provided by teachers from teacher colleges selected for their experience and expertise, who received prior training to strengthen their capacity to advise and support teachers. They were also responsible for developing materials to support the training, visiting schools to present the model, analyzing how it could be applied in each school, monitoring implementation and presenting progress reports. Mentoring consisted of providing individualized support, sharing educational resources and offering pedagogical guidance focused on teachers' specific needs. Cooperation between teachers was also encouraged, especially for teaching groups with large numbers of students and for mentoring between neighbouring schools. It also sought to strengthen school leadership to monitor and manage the improvement of teachers' and students' performance.

Project	Implementing partners	Description
Digital Learning for Development (DL4D)* Cambodia, China, Indonesia, Jordan, Mongolia, Nepal, Pakistan and the Philippines	Foundation for Information Technology Education and Development	This project was implemented between December 2015 and August 2018. It aimed to improve education systems in developing countries by conducting collaborative research that focused on testing and scaling digital learning innovations and generating new knowledge in this area. Seminars and workshops were also held to exchange knowledge and experiences. The project produced several outputs, including research reports, case studies, guides and tools for assessing the impact of digital learning interventions. In addition, collaborative networks were created between researchers, education professionals and policymakers. The publications resulting from this project can be found at: https://tpdatscalecoalition.org/publications/.
Supporting Teacher Professional Development at Scale (TPD@Scale IDRC)* Bangladesh, Brazil, Chile, China, Colombia, Costa Rica, Ecuador, Ghana, India, Indonesia, Kenya, Mexico, Nigeria, Pakistan, the Philippines, Rwanda, Senegal, South Africa, Sudan, Tanzania, Togo, Uganda and Zambia	Foundation for Information Technology Education and Development	This project was implemented between October 2018 and December 2021. Its implementation helped create an important knowledge base about the professional development of teachers in the Global South. The project aimed to support high quality, equitable and efficient TPD processes on a wide scale, harnessing ICT as a great ally. It also contributed to the consolidation of the TPD Coalition, which comprises more than 20 members (government entities, international cooperation agencies, NGOs, research centres, think tanks and higher education institutions). One of the guiding principles was to recognize the importance of TPD for national education systems to achieve Sustainable Development Goal 4 targets by 2030, along with the major challenges of quality, inclusion and cost that countries face in delivering TPD programs to benefit all teachers. Lessons learned were compiled and can be found in English, French, Spanish, Russian and Arabic at: https://tpdatscalecoalition.org/publications/ Among these documents is the TPD@Scale framework, which articulates the principles, basic concepts, components, tools and practices associated with effective TPD, which are synthesized into three key approaches: (1) design for scale, localize for inclusion, (2) match the choice of technologies with professional learning needs, and (3) act, evaluate and improve.

* These two projects were executed prior to the nine other GPE KIX projects analyzed in this document.

Source: Prepared by the authors based on project proposals and reports, websites and information obtained through surveys.

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