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Improving teacher professional development at scale: Lessons from longitudinal evidence from Ethiopia and Rwanda

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Authors

Dawit Tibebu Tiruneh (REAL Centre, University of Cambridge) led the drafting of this paper. Mesele Araya (IGC Ethiopia), Moses Oketch (University College London), Caine Rolleston (University College London), Pauline Rose (REAL Centre, University of Cambridge), Ricardo Sabates (REAL Centre, University of Cambridge), and Tassew Woldehanna (Addis Ababa University) provided comments and suggestions during the revision process. Pauline Rose also provided guidance on the revision and framing of the paper.

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Disclaimer

The findings, interpretations, and conclusions expressed in this policy paper are entirely those of the authors and do not necessarily represent those of the RISE Programme, our funders, or the authors' respective organisations. Any errors in the report are the sole responsibility of the authors.

AI statement

The analysis, interpretation, and substantive content of this paper are entirely the authors' own. AI was used only to help condense selected sections from the authors' original text. All AI-assisted revisions were reviewed and approved by the authors.

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Key messages

- **Connect measures of teaching quality, student learning progress, and teacher professional development (TPD) policy decisions.** Large-scale TPD reforms need evidence systems that link what teachers know and do with how students' learning changes over time, and use this information to design, monitor, and adapt TPD.

- **Measure what teachers know and do, not only whether they participate in TPD.** Teacher qualifications, years of experience, and participation in TPD do not necessarily show whether teachers have the knowledge and classroom practices needed to support learning. Direct measures of teacher content knowledge, pedagogical content knowledge, and classroom practice are essential for understanding how TPD relates to teaching quality.

- **Track learning progress, not only learning levels.** Average student test scores can be misleading in education systems where access is expanding and student composition is changing. Tracking progress over time provides a clearer picture of whether students are learning, how much progress they make, and which groups benefit.

- **Follow the pathway from TPD to student learning.** Improvements in teacher knowledge do not automatically translate into change in classroom practice or gains in student learning. Policymakers should track intermediate implementation processes, including coaching, feedback, and school-level support, to understand whether TPD is creating the conditions for improved learning.

- **Design TPD to connect teachers' content knowledge, pedagogical content knowledge, and classroom practice.** Across the Ethiopia and Rwanda studies, teachers' mathematics content knowledge is consistently associated with student learning progress. This finding should not be read as a reason to give less attention to pedagogical content knowledge, but as a reminder that TPD needs to help teachers translate content and pedagogical knowledge into improved classroom practice through coaching, feedback, and opportunities to apply new approaches.

- **Evaluate TPD with equity in mind.** Monitoring and evaluation should track not only average learning outcomes, but also whether improvements in teaching quality benefit girls, lower-performing students, learners in less advantaged schools, and other groups at risk of being left behind.

Introduction

Improving teaching quality has become a central strategy for enhancing primary and secondary school students' learning outcomes across sub-Saharan Africa. Over the past decade, governments and development partners have invested heavily in school-based teacher professional development (TPD), curriculum reform, and teacher upgrading programmes (Tiruneh et al., 2025). Yet a persistent policy question remains: **to what extent do these investments lead to measurable improvements in teaching quality and, in turn, to improvements in student learning, particularly for those most at risk of being left behind?**

Answering this question requires evidence that can capture both changes in teaching quality and changes in student learning over time. Much of the available evidence provides only a partial view. A recent scoping review focusing on teachers and school leaders in secondary education in Africa finds evidence of improvements in teachers' subject knowledge, pedagogical practices, and engagement with learner-centred approaches following participation in TPD programmes (Tiruneh, forthcoming). However, these findings are often based on self-reported measures rather than direct assessments of teachers' knowledge or classroom practice. Relatively few studies link changes in teaching quality to student learning outcomes, and even fewer use longitudinal designs capable of tracing how teachers, students, and schools change over time.

Understanding the pathway from TPD to learning is important because TPD is intended to change what teachers know and do, and these changes may influence student learning gradually, unevenly, and in interaction with the wider conditions in which teachers work. Evidence based only on whether teachers participated in training, or on student test scores at a single point in time, is unlikely to show how TPD contributes to teaching quality or learning progress. Policymakers therefore need evidence that directly measures teacher knowledge and classroom practice, tracks learning progress over time, and examines how these relationships vary across schools, teachers, and groups of students.

The question is therefore not simply whether TPD 'works' on average, but which aspects of teaching quality improve through TPD, which of these matter most for student learning, for whom, and under what conditions. Experimental and quasi-experimental designs can be useful for testing specific, well-defined interventions and for strengthening causal inference. However, large-scale reforms often raise different kinds of evidence needs. In relation to Ethiopia's General Education Quality Improvement Programme for Equity (GEQIP-E), Hoddinott et al. (2019) argue that such reforms may involve multiple components, phased implementation, variation in take-up, and wider system conditions that shape both

implementation and outcomes. Broeks et al. (2024) similarly note that, while experimental and quasi-experimental approaches can support causal inference, their use in comparative and international education can raise challenges related to implementation, external validity, process understanding, and system context.

For large-scale reforms, longitudinal observational evidence can therefore be particularly valuable. Hoddinott et al. (2019) argue that a longitudinal design was appropriate for evaluating GEQIP-E because the reform was complex, implemented across time and space, and required attention not only to whether learning outcomes changed, but also to why, how, and for whom the reform was working. Longitudinal evidence also helps policymakers understand how wider system conditions and external shocks, including conflict, school closures, or resource constraints, shape reform implementation and influence outcomes over time. This is closely aligned with the purpose of this brief: **to understand how teaching quality and student learning change over time within education systems in practice**.

This point is especially relevant in contexts where more children from diverse backgrounds are entering and progressing through the education system, while inequalities and learning poverty remain widespread. In such settings, improvements in teaching quality may coincide with shifts in student composition, making trends in average learning outcomes difficult to interpret. A flat or declining average test score may conceal important changes in who is entering school, how much progress students make over time, and which groups benefit most from improvements in teaching quality. Understanding these dynamics is therefore critical for both policy and practice.

This policy brief synthesises findings from six studies we conducted over the past six years in Ethiopia and Rwanda (see Appendix 1). The focus on Ethiopia and Rwanda is intentional: both represent major reform contexts in which we have been able to generate longitudinal evidence on teaching quality and student learning. In Ethiopia, our studies were conducted as part of the Research on Improving Systems of Education (RISE) Ethiopia programme. Building on the Young Lives Ethiopia longitudinal research programme, RISE Ethiopia followed students, teachers and schools over time to examine whether and how donor-funded national education reforms improve learning outcomes equitably. The Rwandan study was conducted as part of a collaborative research initiative with Laterite Rwanda to evaluate the Leaders in Teaching (LIT) Rwanda programme, which aimed to improve teaching quality and equitable student learning in secondary education, with a focus on STEM subjects.

Across both contexts, the studies use longitudinal data, direct measures of teaching quality and student learning, and value-added modelling to examine the relationship between

teaching quality and student learning progress. They do not aim to isolate the impact of a single TPD package under controlled conditions. Rather, they address a different but equally important policy question: **how do different dimensions of teaching quality change over time, how are these changes associated with student learning progress, and which groups of students benefit?** This perspective is particularly important for improving TPD at scale, where policy relevance, equity, and scalability are central concerns.

Understanding teaching and learning requires tracking change over time

Understanding how TPD contributes to student learning requires evidence that can track change over time and measure teaching quality directly. These two requirements are closely linked. TPD is intended to improve what teachers know and do in classrooms, but these changes may unfold gradually and may not affect all students in the same way. A single measure of teacher characteristics, classroom practice, or student achievement cannot show how teaching quality changes, how students progress, or how the two are related.

A key limitation of much of the existing evidence is that it relies either on cross-sectional data or on proxy measures of teaching quality. Studies often capture teacher practices, perceptions, or qualifications at a single point in time, making it difficult to assess whether teaching quality has improved or whether students are making progress. Similarly, indicators such as teacher qualifications, years of experience, or participation in TPD do not necessarily show whether teachers have the subject knowledge, pedagogical content knowledge, or classroom practices needed to support learning.

The RISE Ethiopia and LIT Rwanda studies brought together in this brief take a different approach. They do not use identical designs, but they share a common concern with understanding change over time and measuring teaching quality more directly. Some follow cohorts of students across the school year, some compare learning progress across reform periods, and some link repeated measures of teaching quality to student learning progress. The studies provide a stronger basis for examining how teaching quality and student learning evolve within education systems in practice.

Three features are particularly important for policy:

First, the studies use longitudinal or repeated-measures designs to examine learning progress rather than only learning levels. This distinction matters because average test scores at a single point in time can be misleading, especially in systems where access is expanding and the composition of students is changing. Tracking progress over time makes it possible to ask whether students are learning during the school year, even when average starting levels remain low.

Second, the studies use direct measures of teaching quality, including assessments of teachers' mathematics content knowledge and, in the Rwanda case, pedagogical content knowledge and classroom practice. This is important because teacher qualifications, years of experience, or participation in TPD do not necessarily indicate what teachers know or do in classrooms. Direct measures provide a clearer basis for identifying which dimensions of teaching quality are most closely linked to student learning progress.

Third, the studies link measures of teaching quality to student learning progress, often using value-added approaches that account for students' prior achievement. Rather than comparing students' test scores at a single point in time, these methods estimate how much progress students make and examine how teacher and school characteristics are associated with that progress.

The value of this approach lies in the combination of these features. Longitudinal data make it possible to observe learning progress over time; direct measures of teaching quality make it possible to examine what teachers know and do; and value-added approaches help relate differences in teaching quality to differences in student learning progress. Used together, these elements provide a more policy-relevant understanding of how TPD, teaching quality, and student learning are connected.

This does not mean that every study summarised in Appendix 1 includes all of these elements. Rather, the studies form a coherent body of evidence because, together, they move beyond simple correlations between teacher characteristics and student test scores. They help shift the policy question from whether TPD is effective in general to which dimensions of teaching quality improve, which of these matter most for student learning, and how these relationships vary across contexts and groups of students.

Expanding access can mask improvements in learning progress

One of the clearest findings from the RISE Ethiopia studies is that improvements in school and teacher inputs do not automatically translate into higher average learning outcomes, especially when education systems are expanding access.

Analysis of education reform under the GEQIP programme shows that students often began Grade 4 with lower mathematics scores in 2018/19 than comparable cohorts in 2012/13, despite measurable improvements in school and teacher quality. At the same time, the later cohorts made somewhat greater progress over the course of the school year. This points to an important policy lesson: average test scores can decline or stagnate even when schools are becoming better able to support learning, because more disadvantaged learners are entering and progressing through the system.

The studies from Ethiopia by Rolleston et al. (2025), Araya et al. (2025), and Hoddinott et al. (2025) converge on this finding. They show that improvements in teacher qualifications and content knowledge, alongside broader investments in school quality, can coincide with stagnant or declining average numeracy learning outcomes when the composition of students is changing rapidly.

This finding matters for how governments and development partners interpret learning trends. Flat or declining average test scores in low-income contexts should not automatically be read as evidence that education reforms have failed. Instead, they need to be interpreted alongside evidence on learning progress, student background, and changes in school access. In contexts of rapid expansion, improvements in educational quality may take time to appear in average learning outcomes, even if students are making greater progress during the school year.

Teacher content knowledge consistently linked to student learning progress

Across the Ethiopia and Rwanda studies, the most consistent finding is the importance of teacher mathematics content knowledge for student learning progress.

Evidence from the RISE Ethiopia studies shows that teacher mathematics content knowledge is associated with students' numeracy progress in primary education. Tiruneh et al. (2021) find that teachers' mathematics content knowledge is significantly associated with students' progress in numeracy over the school year, even after accounting for prior achievement and a range of student background characteristics. Araya et al. (2025) and Hoddinott et al. (2025) reinforce this finding, showing that the relationship appears stronger in later cohorts and particularly important for lower-performing students.

Evidence from the LIT Rwanda study (Tiruneh, Leonard & Rose, 2026) extends this finding to secondary education. It shows that improvements in teachers' content knowledge over time are associated with gains in student mathematics learning, even when other dimensions of teaching quality show weaker relationships.

The Ethiopia and Rwanda studies suggest that teacher content knowledge is one of the most consistently observable and policy-relevant dimensions of teaching quality. It is not sufficient on its own to explain student learning outcomes, and it needs to be combined with effective pedagogy and classroom practice. However, the evidence suggests that it plays a central role across primary and secondary education in both Ethiopia and Rwanda.

This has a clear implication for TPD policy. Teacher development programmes should not assume that teachers already have the subject knowledge needed to support foundational

and secondary-level learning. Strengthening teachers' content knowledge should be treated as a core component of TPD design, alongside support for pedagogical content knowledge, assessment, and classroom practice.

Improvements in pedagogical content knowledge do not automatically translate into learning gains

A second important finding is that improvements in pedagogical content knowledge do not necessarily translate immediately into gains in student learning.

In the LIT Rwanda study, teachers' pedagogical content knowledge improved substantially during the programme. However, these improvements were not significantly associated with student learning outcomes within the study period. This does not mean that pedagogical content knowledge is unimportant. Rather, it suggests that its relationship with student learning is likely to be mediated by other factors, particularly whether teachers are able to translate new knowledge into classroom practice (Tiruneh et al., 2025).

This finding highlights a key challenge for TPD policy and design. Acquiring new knowledge is only one part of teacher development. For this knowledge to influence student learning, teachers need time, structured opportunities to practise, feedback on their teaching, and enabling conditions within schools.

Overall, the evidence suggests that the pathway from TPD to student learning is gradual and sequential rather than immediate. Gains in pedagogical content knowledge may precede changes in classroom practice, and changes in classroom practice may, in turn, precede improvements in student learning. For policymakers, this means that TPD should not be judged only by short-term changes in test scores. It should also track intermediate outcomes, including teacher knowledge, classroom practice, and the quality of support teachers receive to apply new approaches.

Not all classroom practices contribute equally to student learning

The LIT Rwanda study provides further insight by distinguishing between different domains of classroom practice.

Using the World Bank's *Teach* classroom observation tool, the study shows that only certain aspects of classroom practice, particularly those related to *facilitating instruction*, are significantly associated with student learning progress.

These practices include explaining content clearly, checking for student understanding, and engaging students in cognitively demanding tasks. Other dimensions of classroom practice,

such as classroom climate or socioemotional support, show weaker or non-significant associations with learning outcomes within the study period (Tiruneh, Leonard & Rose, 2026).

This does not mean that classroom climate or socioemotional support are unimportant. Rather, it suggests that TPD programmes aiming to improve learning outcomes need to be explicit about which classroom practices they are trying to strengthen and how those practices are expected to support learning. Broad commitments to learner-centred pedagogy are unlikely to be sufficient unless teachers receive practical support to improve specific instructional routines that help students understand, practise, and apply subject content.

For policy and programme design, the implication is clear: TPD should move beyond general messages about active learning and focus more directly on the instructional practices most closely linked to learning progress. This includes supporting teachers to explain concepts clearly, diagnose student misunderstanding, adapt instruction to different learning levels, and provide opportunities for students to engage with challenging subject content. Evidence from our recent qualitative study of school-based TPD implementation in Ethiopia (Tiruneh et al., 2025) reinforces this point, showing that TPD topics were often generic and poorly aligned with teachers' subject-specific instructional needs, while teachers received limited coaching, feedback, and opportunities for structured collaboration.

Value-added models improve estimates of teacher contribution, but have limitations

The use of value-added modelling is another important feature of the RISE Ethiopia and LIT Rwanda studies. By taking account of students' prior achievement and background characteristics, value-added models provide a more informative way of examining student learning progress than simple comparisons of test scores.

This matters for policy because raw test scores can reflect many factors beyond the quality of teaching, including students' prior learning, household background, school resources, and the composition of classrooms. Value-added approaches help to estimate how much progress students make over time and how teacher and school characteristics are associated with that progress.

The RISE Ethiopia studies, including Oketch et al. (2025) and Rolleston et al. (2025), and the LIT Rwanda study (Tiruneh et al., 2026), show that models that account for prior student learning provide more useful estimates of learning progress than models based only on

endline achievement. They help identify which teacher characteristics and teaching quality measures are most closely associated with student progress.

At the same time, these estimates need to be interpreted carefully. Value-added models do not fully establish that TPD caused improvements in teaching quality or learning. Teacher effects are sensitive to model specification and may reflect factors such as student composition, school context, teacher motivation, or differences in support available to teachers.

For policymakers, the key lesson is that value-added models are useful tools for understanding learning progress, but they should not be used in isolation or treated as simple rankings of teacher effectiveness. They are most valuable when combined with direct measures of teaching quality, information about school context, and evidence on how TPD is actually implemented.

Improvements in teaching quality can have stronger effects for disadvantaged students

A further contribution of these studies is their ability to shed light on distributional patterns in learning: not only whether students learn on average, but which students benefit most from improvements in teaching quality.

The RISE Ethiopia studies show that, while average learning outcomes remain low, students make significant progress over the school year. Gains associated with teacher content knowledge appear particularly important for lower-performing students, suggesting that improvements in teaching quality may have equity-enhancing effects (Hoddinott et al., 2025).

Similarly, in the LIT Rwanda study, improvements in teacher content knowledge are observed across different groups of teachers, including those in highly selective and less selective schools. Students in less selective schools often start from lower baseline test scores but still make significant progress over time (Tiruneh, Leonard & Rose, 2026).

These findings are important for policy because they show why equity cannot be assessed only through average learning outcomes. If improvements in teaching quality benefit lower-performing or more disadvantaged students, average scores may not fully capture the contribution of TPD and wider education reforms. Policymakers therefore need evidence that tracks learning progress across different groups of students, including girls, students who start from lower learning levels, those attending less advantaged schools, and other learners at risk of being left behind.

The implication is that TPD policy should be designed and evaluated with equity in mind. This means asking not only whether teaching quality improves overall, but whether improvements reach teachers and students in schools serving disadvantaged communities, and whether these improvements help narrow gaps in learning progress.

Longitudinal evidence helps explain how TPD, teaching quality, and learning are connected

Overall, our six studies summarised in Appendix 1 make an important contribution to the evidence base on teaching quality and student learning in sub-Saharan Africa. They show how longitudinal observational data, direct measures of teaching quality, and value-added approaches can be combined to examine how teaching quality and student learning change over time.

This contribution is important because large-scale TPD reforms require more than evidence on whether teachers participated in training or whether average test scores improved. Policymakers also need to understand which dimensions of teaching quality improve, whether these changes are associated with student learning progress, and whether the benefits reach different groups of students. The Ethiopia and Rwanda studies reviewed in this brief address this need by linking measures of teacher content knowledge, pedagogical content knowledge, and classroom practice to students' learning progress over time.

The findings strengthen the evidence that teacher content knowledge is consistently linked to learning progress and should be an important focus of TPD. They also show that pedagogical content knowledge and classroom practice matter in more complex ways, and that the pathway from TPD to student learning is likely to be gradual rather than immediate. This is why longitudinal evidence is particularly valuable: it helps policymakers follow the chain from teacher development, to changes in teaching quality, to student learning progress.

The studies should therefore be read as system-oriented longitudinal evidence rather than as evaluations of a single TPD package under controlled conditions. Their purpose is not to isolate one treatment effect, but to understand how teaching quality and learning progress are connected within large-scale reform contexts. This is especially relevant where reforms are implemented unevenly, where student populations are changing, and where external conditions such as conflict, school closures, or resource constraints may shape implementation and outcomes.

As with all evidence, the findings need to be interpreted carefully. The studies identify associations between teaching quality and student learning progress; they do not claim that

specific TPD interventions alone caused the observed changes. However, this does not make the evidence secondary or merely preliminary. Rather, it makes it directly relevant to a different policy question: how can governments and development partners design, monitor, and adapt TPD reforms in ways that strengthen the dimensions of teaching quality most closely linked to learning?

In this sense, the RISE Ethiopia and LIT Rwanda studies do not simply narrow an evidence gap. They show why longitudinal evidence, when linked to direct measures of teaching quality, is essential for understanding TPD at scale.

Conclusion

The findings synthesised in this policy brief point to a more policy-relevant way of understanding the relationship between TPD, teaching quality, and student learning. They show that improvements in different dimensions of teaching quality, such as content knowledge, pedagogical content knowledge, and classroom practice, do not happen automatically, nor do they lead immediately or consistently to gains in student learning. Understanding these relationships requires evidence that tracks change over time and links direct measures of teaching quality to student learning progress.

The RISE Ethiopia and LIT Rwanda studies therefore help shift the focus of the debate. Rather than asking only whether TPD ‘works’, a more useful policy question is: which aspects of teaching quality improve through TPD programmes, which of these matter most for student learning, for whom, and under what conditions? This question is especially important for large-scale reforms, where implementation is uneven, student populations are changing, and wider system conditions, including conflict, displacement, school closures, or resource constraints, may shape both reform processes and outcomes.

The evidence reviewed in this brief shows the value of longitudinal observational data when they are linked to direct measures of teaching quality and student learning. Such evidence can help policymakers understand how education systems function in practice, identify which dimensions of teaching quality are most closely associated with learning progress, and interpret learning trends in contexts where access, student composition, and system conditions are changing. It also helps make equity more visible by showing which teachers and students benefit, including girls, lower-performing students, and learners in less advantaged schools.

For governments and development partners, the implication is clear. Improving TPD at scale requires evidence systems that can track teacher knowledge, classroom practice, student learning progress, and equity over time. These systems should not only measure whether

teachers participate in professional development, but also whether TPD is strengthening the forms of knowledge and practice that matter for student learning.

The contribution of the RISE Ethiopia and LIT Rwanda studies is therefore not only to provide new empirical evidence, but also to show how longitudinal evidence can generate policy-relevant insights into what improves, what matters for learning, for whom, and under what conditions. Governments and development partners should invest in longitudinal data systems, analytical capacity, and closer links between research and policy, so that TPD programmes can be designed, monitored, and adapted to improve student learning equitably.

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Appendix 1

Table 1. Summary of six longitudinal studies examining teaching quality and student learning in Ethiopia and Rwanda

Study	Data and design	Measures of teaching quality	Key finding
Tiruneh et al. (2021)[a]	Longitudinal data; multilevel analysis	Direct measure of teacher mathematics content knowledge, and additional teacher- and school-related characteristics	Teacher content knowledge is positively associated with students' numeracy progress over a school year, even after accounting for prior achievement and contextual factors. This paper provided early RISE Ethiopia evidence that direct measures of teacher knowledge can help explain differential learning progress.
Rolleston et al. (2025)[a]	Repeated cohort / system-level analysis of access, school quality, and learning outcomes over time	Teacher-related system indicators, including teacher qualifications, content knowledge, and quality-related school inputs	Expanding access and improvements in some school quality indicators can coexist with falling average learning outcomes. The paper shows why system expansion and changing student composition must be considered when interpreting trends in learning.
Araya et al. (2025)[a]	Longitudinal cohort comparison across reform period	Teacher content knowledge and other education quality indicators	Although students in 2018/19 had lower average mathematics scores than those in 2012/13, they made greater progress during the school year. Progress was associated with teacher content knowledge, especially for weaker students, suggesting that reforms may improve learning progress even when average learning outcome remains under pressure.
Hoddinott et al. (2025)[a]	Student-level data from 2012 and 2018; reform-period comparison	Teacher educational qualifications and teacher content knowledge in mathematics as reform-related quality indicators	This paper shows the 'paradox' of reform: despite improvements in teacher qualifications and content knowledge, average mathematics scores were lower in 2018/19, while student progress over the year was greater. The

			association between teacher content knowledge and student progress was stronger in 2018/19 and particularly important for weaker students.
Oketch et al. (2025)[a]	Longitudinal learning data; multilevel analysis	Teacher contribution estimated through conditional and unconditional teacher value-added models	The paper advances the methodological contribution of this body of work by showing how value-added modelling can estimate teacher contribution to student learning progress more effectively than raw outcomes, especially when prior achievement and student background are taken into account. It also cautions that teacher effects must be interpreted within their wider classroom and social context.
Tiruneh et al. (2026)[b]	Longitudinal teaching quality and student learning outcomes data; classroom observation	Direct measures of content knowledge, pedagogical content knowledge, and classroom practices (*Teach* tool)	This study provides rare secondary-level longitudinal evidence linking multiple dimensions of teaching quality to student learning. It finds significant improvements in teacher content knowledge and pedagogical content knowledge over time, more limited improvement in classroom practice overall, and shows that teacher content knowledge and the 'facilitating instruction' domain of classroom practice are the dimensions most clearly and significantly associated with student mathematics learning progress.

Note. [a] The RISE Ethiopia studies focus on primary education; [b]The LIT Rwanda study focuses on secondary education. In addition to student learning data, each study includes a range of student-, school-, and household-level characteristics.

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REAL Centre
Faculty of Education
University of Cambridge
184 Hills Road, Cambridge, CB2 8PQ, UK
Email: REALCentre@educ.cam.ac.uk
LinkedIn @real-centre

www.educ.cam.ac.uk/centres/real

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