What Drives Teachers to Change Their Instruction? A Mixed-Methods Study from Zambia

Andreas de Barros[1], Junita Henry[2], and Jacqueline Mathenge[2]

[1]Department of Economics, Massachusetts Institute of Technology

[2]Teaching at the Right Level (TaRL) Africa

Author Note

Andreas de Barros https://orcid.org/0000-0003-2154-0412

Junita Henry https://orcid.org/0000-0002-5600-7119

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Correspondence concerning this article should be addressed to Andreas de Barros, Abdul Latif Jameel Poverty Action Lab, Department of Economics, Massachusetts Institute of Technology, 400 Main Street, Suite 201, Cambridge, MA 02142. E-mail: debarros@mit.edu

Abstract

There is limited evidence on what drives teachers to change their teaching practices. Using primary qualitative data from 78 Zambian education personnel from the school to provincial level, we combine qualitative thematic analysis with an unsupervised machine-learning technique (topic modeling) to identify drivers of pedagogical shifts. We then combine qualitative analyses with linear probability models to uncover their associations with teacher professional development. Our findings suggest that teaching practices are malleable, with change being predominantly driven by on-site continuous professional development (CPD) opportunities relating to team-based problem-solving, verbal discussions, and skills acquisition. Taken together, this study highlights the potential of school-based CPD opportunities as means to alter teaching practices, in a developing-country setting.

Keywords: continuous professional development, drivers of change, mixed-methods, pedagogical shifts, Zambia

Impact and Implications Statement

What provokes Zambian teachers to change their instruction? The study's findings suggest initial off-site teacher training may be best positioned to promote new teaching skills yet require subsequent on-site training and mentoring that invokes team-based problem-solving and verbal encouragement. The results highlight the potential of school-based teacher development as a means to alter instruction, in a developing-country setting.

What Drives Teachers to Change Their Instruction?
A Mixed-Methods Study from Zambia

High-quality teaching is a key determinant of student success. A growing body of literature documents how a large proportion of classroom-to-classroom variance in student performance can be attributed to teachers' teaching practices (Araujo et al., 2016; Azam & Kingdon, 2015; Bau & Das, 2017; Buhl-Wiggers et al., 2018).[1] Beyond test scores, teaching quality is also a main driver for the development of socio-emotional skill (Jackson, 2018) and other long-term life outcomes (Chetty et al., 2014; Jackson et al., 2014; Rivkin et al., 2005). At the same time, teachers in many developing countries may lack the necessary skills to teach effectively and use teaching methods ill-matched to their students' diverse needs (Bietenbeck et al., 2018; Bold et al., 2017; Bold et al., 2018)—even in countries with comparatively high teacher pay (de Ree et al., 2018; Ramachandran et al., 2018).[2]

In many developing countries, governments and international organizations have, therefore, made it a priority to improve teaching quality through professional development for teachers. In a review for anglophone Africa, for instance, all countries had a national in-service training system for teachers (Mulkeen, 2009). Internationally, cooperation for teacher training and in-service development has been recognized as a formal target of the United Nations Sustainable Development Goals (Target 4c). For example, of the World Bank's education projects, approximately two-thirds include professional development for teachers (Popova et al., 2021) and, between 2013 and 2018, the Bank allocated US$12.1 billion towards these projects (The World Bank, 2018b).

Yet, at the same time, this focus on professional development for teachers operates in

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[1] In contrast, observable characteristics of teachers (rather than their teaching practices) are often considered a poor predictor of student learning (*ibid.*).

[2] In this article, with "developing country", we refer to a country with a comparatively low Human Development Index and a less-developed industrial base. We recognize this term is not without issues; we do not imply any normative statement with it.

a context where teacher training has been declared a failure. For example, the 2018 World Development Report concluded that "most teacher training is ineffective" (The World Bank, 2018a, p. 131). Similarly, the 2020 Global Education Evidence Advisory Panel labelled the most common forms of in-service teacher training a "bad buy" for policy makers in low- and middle-income countries (The World Bank, 2020, p. 21). It is within this tension that we set out to study how professional development may effectively impact teaching practices in a low-resource setting, at scale.

Conceptualizing In-Service Professional Development for Teachers

Our study conceptualizes in-service professional development for teachers as opportunities for professional learning that may cause improvements in instructional quality and, thus, increased student learning. Our focus on in-service development distinguishes these learning opportunities from others that may be provided as part of teachers' pre-service preparation, apprenticeship period, or induction.

We highlight three key features of this conceptualization (cf. Darling-Hammond et al., 2017). First, we understand in-service professional development for teachers as learning opportunities that may be both externally provided or job-embedded. Thus, learning opportunities may not be "done to" but rather actively co-created by teachers. Secondly, our understanding recognizes that learning may happen during dedicated periods or be continuous. Thus, learning may not be constrained to workshops or training events, but can also occur as prolonged, ongoing processes. Third, we highlight that these learning opportunities can be diverse, both formal or informal. Thus, our conceptualization goes beyond "traditional" in-service teacher training activities such as off-site events, and also encompasses collaborative approaches such as on-site peer learning and coaching, for example.

Our theoretical framework of how in-service professional development for teachers

may effectively lead to student impacts is most closely related to Desimone's (2009) model.[3] Accordingly, we focus on a theory of change whereby (a) professional development activities are expected to lead to (b) changes in teachers' attitudes, knowledge, and skills, which in turn affect (c) changes in teaching practices, that (d) impact student learning. However, we depart from Desimone's (2009) model as it posits that five features define professional teacher development (content focus, active learning, coherence, duration, and collective participation). Rather, as we move away from the context of developed countries, we aim to explore whether these—or other—components feature prominently in those observed development activities that are associated with changes in instructional behavior.

Advances in In-Service Teacher Development in Developing Countries

This study intends to contribute to a nascent body of literature that aims to identify novel in-service teacher development activities that work effectively in developing countries. One strand of this literature echos findings from the United States (Kraft et al., 2018), which point to the effectiveness of teacher mentoring and coaching as promising means to improve instruction and raise student achievement. For example, Cilliers, Fleisch, Prinsloo, et al. (2020) document how a South African teacher coaching program led to 0.24 standard-deviation (SD) increases in mother-tongue language and reading proficiency among early-primary grade students.[4] Similarly, Castro et al. (2019) and Majerowicz and Montero (2018) find that a Peruvian teacher coaching system led to 0.25SD improvements in reading comprehension and 0.38SD improvements in mathematics among second graders. Yet another example comes from a coaching program in secondary schools in Brazil, which led to

[3] It also connects to related models by Fishman et al. (2003), Guskey (2002), Opfer and Pedder (2011), Supovitz and Turner (2000), and Timperly et al. (2007). For an overview and discussion of these models, see McChesney and Aldridge (2019).

[4] Here, we follow the common practice of cause-effect research to report effect sizes in standard deviations; for a recent overview of effect sizes in international education studies, see Evans and Yuan (2022). For additional (positive) results from an earlier South African primary school coaching program, see Harvey (1999).

0.05-0.09 SD improvements in grade-10 mathematics and Portuguese and 0.06SD improvements in grade-12 Portuguese (Bruns et al., 2018).

A second strand of this literature suggests teacher development related to structured pedagogy can be an impactful tool to improve teaching quality and student learning (Conn, 2017; Evans & Popova, 2017; Snilstveit et al., 2015). These learning opportunities are usually centrally designed and include teachers' guides and lesson plans with accompanying teaching and learning materials. Often, these materials are practice-based, (at least partially) scripted, and linked to student materials and textbooks. For example, Piper, Destefano, et al. (2018) find that the Kenyan national literacy program "Tusome" led to large (0.6 to 1 SD) impacts in English and Kiswahili, and Piper, Simmons Zuilkowski, et al. (2018) find structured teachers' guides were a significant driver of this impact. Similarly, structured pedagogy is a key component of teacher development programs that have been found to be effective in Brazil (Leme et al., 2012), the Gambia (Eble et al., 2021), and the Philippines (Tan et al., 1999).

Finally, a third strand of this literature focuses on teaching content that allows instructors to adjust their classes to students' learning level (rather than students' age or grade-level curriculum). These teacher development activities recognize that, in developing countries, many students lack foundational skills and lag far behind their respective at-grade content (Azevedo et al., 2021). A series of large-scale randomized controlled trials from India suggests training teachers to target instruction to students' learning levels can effectively improve child learning (Banerjee et al., 2017). Subsequently, revised versions of this approach have been adopted in Botswana, Ghana, Ivory Coast, Madagascar, Mexico, Nigeria, Senegal, and Zambia (Alcott et al., 2018; Duflo et al., 2020), and it is now considered among the most promising strategies to improve student learning in developing countries (Angrist et al., 2020).

Gaps in the Literature

Taken together, these advances connect to three of the core dimensions of professional teacher development as identified in the US education literature, concerning its format (coaching), activities (working with structured pedagogy using teaching guides), and focus (learning how to target instruction to students' learning levels) (cf. Hill et al., 2020). At the same time, however, at least two gaps in the literature limit our understanding of how to successfully deploy in-service professional development for teachers in developing countries. Here, we briefly discuss these two limitations.

Identifying Drivers of Change in Teaching Practices

For developing countries, there is limited research as to which drivers lead teachers to change their instructional behaviors. We recognize that Desimone's (2009) five program features that are expected to successfully drive change, as identified in the US, may not readily transfer to other contexts (Henrich et al., 2010). For example, recent literature from the United States stresses the importance of collective participation through collaborative conversations among teachers (Horn et al., 2017), pedagogically productive teacher talk (Lefstein et al., 2020), and inquiry-focused on-site problem solving through peer facilitation among teachers (Gallimore et al., 2009). Yet, a recent review of teacher professional development programs in developing countries does not confirm teachers' participation and discussions among teaching staff as predictors of improvements in instruction and student learning (Popova et al., 2021).[5]

While this observation calls for work concerning the model's external validity, we also recognize how additional model elaboration may be required. In particular, the model may be incomplete as it does not identify processes that facilitate linkages between model components (that is, between teachers' participation in professional development activities,

[5] At the same time, the same review also notes how models that stress collaboration among teachers (such as "communities of practice") have not yet been rigorously explored in developing countries (cf. Kennedy, 2019).

changes in teachers' attitudes, knowledge, and skills, and changes in teaching practices) (cf. King, 2014).

In-Service Teacher Development That Remains Effective at Scale

The second limitation revolves around how to identify in-service teacher development that remains effective once it is observed at scale. Consistently, teacher development programs have been found to be less effective (or even detrimental) if implemented without researcher oversight, once substantial external supports are removed, and when responsibilities are transferred from a non-governmental organization to the government (Popova et al., 2021). This observation holds for each of the three areas of professional development we identified above—that is, for coaching programs (Albornoz et al., 2020; Cilliers, Fleisch, Kotzé, et al., 2020), programs involving scripted lesson plans (Kerwin & Thornton, 2021), and programs promoting that teachers target their instruction to a child's learning level (Banerjee et al., 2017; Duflo et al., 2020). Thus, one can expect large knowledge gains from research that avoids related implementer effects (Vivalt, 2020), site-selection effects (Allcott, 2015), or publication bias (DellaVigna & Linos, 2020) by observing at-scale programs that are implemented under government oversight.

The Current Study

This is an exploratory study with three main aims. The aims of this study consisted of (Aim 1) verifying that the selected context is one in which public school teachers were likely to have changed their instruction, (Aim 2) identifying key drivers that had led to these changes, and (Aim 3) investigating to what extent these drivers were associated with in-service teacher development activities that operate at scale. With these aims in mind, our research questions included (a) To what extent did teachers change their classroom instruction? (b) What were key drivers that provoked these changes in instruction? (c) To what degree were these drivers of change associated with teachers' exposure to in-service professional development opportunities?

To achieve the study's three aims, we used an embedded mixed-methods design, whereby quantitative analytical methods are concurrently nested within a broader qualitative research project.[6] More specifically, we began by purposely selecting a context in which teachers were likely to have changed their instructional behaviors (with variance thereof). Next, we generated qualitative data, through in-depth telephonic interviews. Thereafter, during thematic analysis, we integrated open coding (treating text as qualitative data) with an unsupervised machine-learning technique (topic modeling, treating text as quantitative data), observed the extent to which the two methods converged, and thus generated a coding framework. We hand coded all responses following this framework, and identified themes of what reportedly drove teachers to change their instructional behaviors. Finally, we investigated how these drivers of change were associated with in-service teacher development activities, both qualitatively and quantitatively, and report the results of the two approaches side-by-side.

Method

We conducted this research with Internal Review Board approvals, both in the United States and in Zambia, in accordance with ethical guidelines for the protection of research participants.

Setting

We conducted this study in a developing-country setting in which (a) teachers had been expected to change their instructional behaviors, and which (b) allowed us to observe a wide array of in-service teacher development opportunities, in public schools, at scale.

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[6] Our use of a single data-set does not fit common convergent designs of mixed-methods research (which usually distinguish qualitative from quantitative data sources). Our exploratory sequencing of analytical steps with a single sample also does not fit common exploratory sequential designs (which usually distinguish qualitative from quantitative samples). See Creswell and Plano Clark (2018), for a discussion of "convergent" and "exploratory sequential" mixed-methods designs.

Our research took place in two provinces of Zambia (Eastern and Southern Provinces), in public and community primary schools. In these schools, teachers (and senior teachers) are the primary provider of educational services to students, including those services that go beyond classroom instruction (such as guidance and counseling).[7] Teachers had been exposed to two large-scale programs, reaching more than 1,800 schools in these provinces, under government oversight. One program introduced teachers to a "teaching at the right level" approach, which entails grouping learners according to their basic numeracy or literacy level rather than by grade. The program focuses on grades three to five and it is locally known as *Catch Up*. Another program introduced teachers to a simplified five-step literacy program. The program runs from pre-primary through grade three, and it is called *Let's Read*.[8]

Teachers were also (expected to be) exposed to a large array of in-service development opportunities—both through these additional programs and within Zambia's national in-service development scheme. More specifically, the two programs held off-site training workshops and provided regular on-site mentoring and monitoring during school visits. In addition, Zambia's Ministry of General Education established the *School Programme of In-Service Training for the Term (SPRINT)* system to carry out both off-site review meetings and biweekly, school-based continuous professional development meetings.

Participants

Our sampling strategy proceeded in two steps. First, we randomly sampled schools. To represent variety in geographical regions, student performance, and school type, we stratified schools based on (1) their province (Eastern; Southern), and (2) above- and below-median student achievement. Student performance was calculated using *Catch Up*

[7] Almost all public schools have a formally-appointed guidance and counseling teacher, but this role is taken on by teachers and schools do not employ dedicated school psychologists. For more information on the provision of guidance and counseling services in Zambian schools, see Ministry of General Education (2019)).

[8] Moreover, the government promoted a few small-scale literacy programs such as the *Teaching Handwriting and Spelling Skills (THRASS)* program.

assessment data from 2020, and we excluded schools not running the program.[9] We then randomly selected two public schools and one community school in each of the four strata, for a total of 12 schools.

Secondly, we sampled staff that either work in or support the sampled schools. Within each school, we sampled a mathematics and a literacy teacher who taught in grades three to five, as well as three additional roles that are expected to oversee and support these teachers (the headteacher, the "school in-service co-ordinator", and a "senior teacher"). We also sampled the respective zonal, district and provincial coordinators, as well as another 50 percent of staff that cover the remaining zonal and district-level cadres supporting these schools. The total number of sampled roles is 103. Accounting for individuals who take on multiple roles (for example, a headteacher may also be a literacy teacher), a total of 83 individuals covered these 103 roles.

Table 1 provides the sample characteristics. The 12 randomly selected schools cover a geographic region of 10 districts and 12 zones across the two provinces. A little over half (58%) of the schools are located in a rural district. Of the 83 sampled individuals, we were able to interview 78 respondents, for a non-response rate of 6%. A little less than half (45%) of the respondents are female. The average respondent has 4.7 years of experience within their interviewed role. The majority of respondents (71%) are based at the school level (as opposed to higher-level support staff).

Data Collection

Participants were recruited via telephone calls. Interviews were conducted by the second and third author during February and March 2021. Interviews were audio-recorded upon receiving verbal consent from participants. Interview time ranged from twenty minutes

[9] At the time of the study, in the two provinces, the *Catch Up* program ran in 83.4 percent of government-run schools. It ran in 33.3 percent of private, community-run schools. Government schools serve the vast majority of primary-school students (85.6 percent of students who attend government and community-run schools).

to two hours and was 57 minutes in length on average. Upon completing data collection, interviewers manually transcribed interviews verbatim from audio recordings. Respondents were compensated with mobile airtime for participation.

Each week, the research team debriefed to share key information on the data collected. The team used this time to discuss the data and determine whether any adjustments on collection and refinement needed to be made. Interview questions were adjusted where appropriate, to probe deeper into systems and methods the research team did not have a clear understanding of. Additionally, interviewers kept field notes that were written during the data collection process. Reflexivity was an important aspect of the research process and we kept a self-critical account of the process in the form of memos (Nowell et al., 2017). We documented the daily logistics of the research, methodological decisions, and rationales, as well as personal reflections and insights.

The phone interviews followed a semi-structured interview guide. In each interview, we asked respondents how teachers had changed their instruction before the COVID-19 pandemic. Specifically, the leading question was: "In the year before the COVID-19 crisis: Do you think you changed the way you (/ your school's teachers) went about your (/their) day-to-day teaching in the classroom? If so, how?" In the case of a COVID-19-related response, interviewers were encouraged to ask the question again.[10] We then asked respondents what provoked these changes or what aided teachers in making these changes easier to adapt (for the complete interview protocol, see Appendix B).

Data-Analytic Strategy

The study's analytical strategy aligns with its three aims. To achieve the study's first aim, we identified themes of change in instructional behavior and documented how frequently different changes occurred. To achieve the study's second aim, we identified themes that

[10] Recall that our study and its aims do not relate to changes in instruction that are due to the COVID-19 pandemic; we exclusively focus on (changes in) teaching practices before the pandemic.

describe what drove teachers to make these changes. Lastly, to achieve its third aim, we identified themes concerning teachers' engagement in in-service professional development opportunities and investigated their association with these drivers of change in instruction.

Our data-analytic strategy employs a novel mixed-methods approach to quantitizing qualitative data and associations in this data. At two main analytical stages of the study, we compare human-generated results with computer-generated results (see Figure 1). First, we use this strategy to recognize patterns, identify themes, and report on their prevalence. Second, we use this strategy to investigate associations between themes. In both occasions, we employ a qualitative review process to resolve conflicting results. Throughout, we aim to balance numerical precision with narrative complexity, during the process of quantitizing. We thus seek to juxtapose alternative judgments concerning what and how to count, and to embrace the complementarity of both human- and computer-generated results—while retaining qualitative decision-making in the end.[11]

Thematic Analysis

Identifying Themes Through Qualitative Open Coding. Treating the interview transcripts as qualitative data, we followed Braun and Clarke's (2006) thematic analysis approach to develop a coding framework. After (1) familiarizing ourselves with the data by reading all transcripts, we (2) generated initial codes. To generate initial codes, transcripts were divided amongst the authors, each author then produced a set of "open codes" based on each response within their set of transcripts. For all coding, we unitized excerpts at the sentence level unless the subsequent sentence(s) conveyed the same meaning or code application. The frequency of each code was documented. We then (3) searched for

[11] In line with Sandelowski et al. (2009), our work sheds light on the process of quantitizing, and it embraces the permeability of quantitative and qualitative research paradigms. Yet, contrary to the approaches discussed by Sandelowski et al. (2009), and "analytic alternation" in particular, ours is a qualitative *and* quantitative (not purely qualitative) study of the process of converting qualitative data into quantitative form.

themes by condensing and collating these codes into groups, omitting codes that occurred less than five times throughout all interviews.

Identifying Themes Through Topic Modeling. To identify themes quantitatively, we treated the interview transcripts as quantitative data to estimate topic models. Topic modeling is a class of unsupervised machine learning methods. The method infers topics, or distributions over words, that represent semantically interpretable themes. More specifically, we rely on a mixed-membership model, whereby individual documents and their words can belong to multiple topics (instead of just one). We conducted our analyses in the R software, using the "quanteda" and "stm" packages (Benoit et al., 2018; R Core Team, 2020; Roberts et al., 2019).

We highlight three key characteristics of topic modeling. First, topic models identify interpret*able* themes, but do not interpret themes—the researcher remains tasked to "make sense" of themes and attribute meaning to them. Secondly, topic models commonly produce a large number of uninterpretable themes—in line with the exploratory nature of our study, and in contrast to related supervised machine-learning techniques, topic modeling is often used for exploratory purposes. Therefore, we may expect a high number of topics that remain uninterpretable. Third, the development of a topic model includes a number of "researcher degrees of freedom"—the researcher remains tasked to take pre-processing decisions as they prepare text for analysis, and select a preferred model, for example. Just below, we describe our respective decisions for the study, in more detail.

As we familiarized ourselves with the data, we removed any text spoken by the interviewers and generated an answer-level corpus (containing 5,879 answers). We then used Rapid Automatic Keyword Extraction (RAKE) to add two- and three-word phrases (bigrams, trigrams) to the words respondents had spoken. In turn, we removed a list of common stop words (such as "me", "my", "myself", "we", or "our"). We also set all words to lower case and "stemmed" them (e.g., by removing suffixes such as "ed", "ing", or "ly").

To decide on the number of topics to extract, we trained a range of topic models with

varying numbers of topics. We then evaluated their performance using common diagnostic plots, judging models by their residuals, semantic coherence, and exclusivity. Our preferred model identified 45 topics. We present their prevalence and their most distinctive terms in Appendix Figure A1.

Reviewing and Defining Themes. Following the next two steps of Braun and Clarke (2006), we (4) reviewed themes, and (5) defined and named themes. We generated and organised themes from the condensed codes to develop a preliminary coding framework. In doing so, we compared themes generated through qualitative hand coding to topics generated by the computational approach. Table A1 in the Appendix shows the extent to which qualitatively identified themes matched quantitatively identified themes. We do not find strong overlap between the qualitative and quantitative approach, with almost half of the topic modeling-based themes remaining uninterpretable. We do however, find stronger convergence for codes and themes that are related to drivers of change in teaching behavior.

During this process, we met bi-weekly to discuss and adapt the framework, which was refined three times before establishing the final code book. Our final coding framework was a family code-based scheme. "Parent" codes were theme-based and we developed several "child" codes. For example, a "parent" code called "drivers of change" contained several "child" sub-codes pertaining to the various drivers of change mentioned (such as "sharing and discussing challenges"). Through the method of open coding and simultaneous use of topic modeling, our overall approach is largely inductive and "data driven". However, since we investigated a predetermined set of research questions, deductive elements around theme development and organization that specifically focused on teacher change and its drivers were also used. These a priori "parent" codes were derived from the study aims and both research and interview questions. These deductive elements, although organized, did not have a predetermined meaning or directionality attached to them. Through further examination of the verbatim transcripts, meaning was given to themes and additional

posterior codes were developed driving the inductive element of analysis.[12]

Coding, Final Analysis and Reporting. Finally, we (6) conducted our final analysis and produced the present article. As with open coding, we used a combination strategy to define units of analysis. We used naturally given units and the meaning of units. We unitized at the sentence level (naturally given unit), but this extended to subsequent sentences if they conveyed the same meaning/code application (meaning of unit). These units, or "meaningful responses" are referred to as excerpts.[13]

Methodological Integrity. We double-coded a random 20% of interviews (16 interviews). We followed Campbell et al. (2013) where one knowledgeable coder identified these meaningful units of analysis, and another coder re-coded the same excerpts. Interviews were coded by the second author and reliability was established by the first and second author.

We determined reliability by dividing the number of times that the initial coder and the second coder used a code (agreements) by the number of times that any coder used it (sum of agreements and disagreements). This is known as percent agreement.[14]

Our codes and re-codes showed 80 percent agreement. Although there is no universally accepted threshold for what indicates acceptable reliability, Miles and Huberman (1994) have suggested a standard of 80 percent agreement. Discrepancies tended to be within the same parent ID and but may have varied in their depth (see Appendix C). Furthermore, our calculation of agreement was stringent in that it required the exact combination of codes

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[12] See Appendix C for a full description of the coding framework.

[13] On average, we identified 71 excerpts per interview.

[14] Although this approach does not take into account the possibility of an agreement by chance, other measures that do—such as Krippendorff's coefficient—rely on the assumption that all codes have an equal probability of being used. In our case, this was not appropriate. Not all questions applied to all interviews (depending on the role, time constraints or network connectivity of interviewee); therefore, not all codes may apply to all interviews. Furthermore, we had a large coding framework, which reduced the likelihood that coders agreed by chance (Bernard, 2013; Campbell et al., 2013).

per excerpt to be considered in agreement. Given our extensive coding scheme, and upon closer examination of discrepancies, we find 80 percent to be acceptable.

In our final analysis, we report on the incidence of excerpts related to changes in teaching behavior. That is, we calculated the percentage of various codes related to change out of the total number of codes related to changes in teaching behavior (Aim 1). We also report on the respective percentage of codes related to drivers of change (Aim 2). We do not report on excerpts that occurred less than five percent of times.

Analysis of Associations

To identify associations between drivers of change and in-service professional development activities (Aim 3), we conducted qualitative and quantitative analyses side-by-side, independently. In qualitative analyses, we rated the relationship of excerpts that pertain to the three main drivers of change with the data's teacher professional development activities as low, medium, or high. To this end, we qualitatively analyzed all excerpts related to professional development and their relation to the various inputs within interviews. In quantitative analyses, we used a series of bivariate linear probability models to quantify these relationships. These analyses estimate the percentage-point increase (decrease) of a driver's occurrence in any excerpt, as a function of whether the same excerpt, or another excerpt immediately before or after, is coded with a given teacher professional development activity. Here, we define "immediately before or after", as a sliding window of ten excerpts around (and also including) the excerpt in question.[15] To assess the robustness

[15] More formally, let Y_{ir} be a binary indicator of whether excerpt i of respondent r was coded with a driver of interest or not (e.g., "sharing challenges"). Let $D_{ir}^{-9,0}$ indicate whether anywhere in a window of nine preceding excerpts up to the same excerpt a professional development activity of interest (e.g., "offsite training") was observed ($D_{ir}^{-9,0} = 1$) or not ($D_{ir}^{-9,0} = 0$). More generally, let integer j denote the first excerpt of a sliding window of ten excerpts around (and including) i, where j reflects the window's starting position relative to excerpt i. We can then calculate the difference in conditional expectations for any sliding window with $[j] \in \{-9, ..., 0\}$ as $E[Y_{ir}|D_1^{j,j+9} = 1] - E[Y_{ir}|D_1^{j,j+9} = 0]$. In the article, we report on the average

of findings, we also show results for a wider window of twenty excerpts.

Results

We report the study's results in three steps. First, we document self-reported changes in teaching behaviors. Second, we extract the top three drivers that reportedly provoked these changes. Third, we investigate how at-scale teacher development activities are associated with these primary drivers of change.

Changes in Teaching Behaviors

Table 2 shows the number of respondents who reportedly changed their instructional behavior, along with the incidence of excerpts referring to change (across 236 excerpts). Altogether, 64 respondents reported on changes in their classroom; only 14 of them did not. More specifically, 77.7% of the excerpts refer to self-reported technical (or pedagogical) changes, and 16.5% refer to self-reported changes in teaching that relate to teachers' attitude or confidence in the classroom. These results lay the foundation that the study operates within a context of changing teaching practices.

Table 2 provides greater details as to what types of self-reported pedagogical changes dominate in our sample. Most often, teachers reportedly increased their use of differentiated instruction, where teachers teach to the ability of the learner (18.6% of excerpts). This is followed by an increased use of teaching and learning materials in the classroom (15.3%). Respondents also frequently referred to the use of the Catch Up program's methodology not only in the program's dedicated classes, but also in students' regular, non-Catch Up classes (14.4%). Other changes relate to teachers' self-reported increased interaction with learners

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difference in conditional expectations $\frac{1}{10}\sum_{j=-9}^{0}(E[Y_{ir}|D_1^{j,j+9}=1]-E[Y_{ir}|D_1^{j,j+9}=0])$. For ease of calculation, we calculate the difference in expectations with regression analysis; however, the comparison of conditional expectations may be calculated in any other way (e.g., by comparing mean proportions) and it does not require more involved modeling assumptions. Finally, for ease of interpretation, we multiply by 100 to report on percentage point differences instead of proportions.

(7.6%), a greater use of lesson planning and preparation (7.6%), and students' engagement in in-class activities, such as group work or games (5.1%). These changes co-occurred with changes in self-reported teachers' attitudes (8.5%) and changes in teachers' intrinsic motivation (8.1%).

We then disaggregate how teachers' instruction reportedly changed across programs (Catch Up, SPRINT, Let's Read, and other programs). By program, we find that changes related to the "Catch Up" program strictly dominate across teaching behaviors.[16] Catch Up was most frequently related to changes in pedagogy, as about half of the excerpts refer to modifications in classroom instruction due to this program (49.6% overall, or 64.6% of the excerpts related to technical changes). The program is most frequently associated with teachers' (self-reported) increased understanding of learners' needs and differentiated instruction, an increased use of teaching and learning materials, and increased interactions between teachers and students. Respondents also noted how these changes spill over to other classes that are not directly targeted by this program.

Drivers of Change

In Table 3, we then examine what provoked these self-reported changes in instructional behaviors, by grouping mechanisms into primary drivers (top three, as per their prevalence across excerpts) and secondary drivers that were mentioned less frequently. The table summarizes 825 excerpts in which respondents explained what had led to (or constitued a "driver" for) the aforementioned changes.

Team-Based Problem-Solving of Challenges through Group Discussions

The most frequently discussed driver of change relates to sharing of challenges and group discussions (11.2% of excerpts referring to drivers of change). This is typically a form

[16] This article does not intend to compare the relative effectiveness of various programs. Also recall that the study sampled teachers who taught in grades three to five; other programs with a different grade-level focus may not expect to affect teaching behavior in these grades.

of peer mentoring where teachers problem-solve challenges that they are struggling with together. In our sample, 51 out of 78 respondents mentioned this mechanism as a driver of change. A teacher states that it is "because teachers are able to come together to find solutions and support each other. You know when you face a challenge but you do not talk to people, you can do nothing. So, working together during these meetings helps." These discussions were commonly described as being inclusive of all teachers, and they reportedly offer an opportunity to identify challenges and use existing knowledgeable personnel who are easily accessible to "sharpen" one another. One teacher mentions that "everyone comes with a certain strength and on the other hand certain weaknesses which can be worked on. Especially if I don't know how to handle certain areas, I find people who can assist there and if I have strength and other teachers don't have that strength, I guide them on how to go about it. So, everyone has a certain weakness and a certain strength. Not everyone can have all strengths or all weaknesses but we share what we can share. Then we see what we need to get from others."

Acquiring New Skills and Learning New Methods

The second most frequently mentioned driver of change relates to teachers' acquisition of new skills and teaching methods (10.3% of excerpts). Within this, a subset of 6.1% of excerpts refer to the learning of new methods at training sessions (not shown in the table). One teacher stated that "knowledge is not like that, it is not static, it changes every now and then". Training equips teachers with a variety of methods and activities that they are able to choose from and use in various situations. Another respondent referred to training by saying that "these programs they have given us knowledge on how we can handle, the teachers have been [given] a basket full of activities or methods that they can pick from, they will not lack anything, they will go into this basket and pick. For example, comprehension, I will go back to my basket and pick one that I think is suitable." Respondents also explained that practical demonstrations were most helpful during training

activities (2.8% of excerpts, not shown in the table).

Verbal Encouragement and Discussions

Individual mentoring in the form of verbal encouragement and discussion in a one-to-one setting is also a commonly reported driver of change, although it is mentioned less frequently than the other two drivers (7.0% of excerpts). These discussions mainly consist of identifying areas of weakness particular to a teacher and sharing solutions, ideas or new approaches they may adopt to improve. One teacher put it as "I know my weaknesses, that's why it helped me." Respondents also mentioned that mere encouragement of program take-up was motivating during these discussions.

Weaker Drivers

Other, secondary elements that reportedly provoked teachers to change their teaching practices are learner outcomes (6.7% of excerpts), access to teaching materials such as flip charts and markers (5.2%), and frequent monitoring (5.0%). Other drivers were mentioned in less than 5% of excerpts and they are omitted from Table 3. It is worth noting that there is little difference in the frequency of excerpts related to verbal encouragement vs. learner outcomes. For simplicity, our following analyses focus on verbal encouragement; however, we note that greater emphasis should be placed on the top two drivers.

Teacher Development Activities Associated With Primary Drivers of Change

Table 4 reports on the prevalence of continuous professional development opportunities and their association with the three most commonly mentioned (or "primary") drivers of change. In terms of prevalence, we note that a large proportion of respondents mentioned teachers' participation in continuous professional development activities. While the range of these activities is broad, on-site capacity building and mentoring through lesson observations dominate the responses. For instance, about twice the percentage of excerpts mention on-site capacity building, as opposed to off-site training (1.7 vs. 0.9 percent of

excerpts). On aggregate, across five broader subcategories of professional development, use of technology is mentioned the least (0.5 percent of excerpts).

In terms of associations, the results from quantitative and qualitative analytical approaches closely track each other, with few exceptions. In particular, we find strong agreement on a positive association between on-site capacity building and teachers' sharing of challenges. We also find strong agreement on a positive association between the various mentoring strategies and verbal encouragement. We further observe convergence related to the potential of both off-site training and one-on-one mentoring as means to introduce new teaching methods.

Our results from the qualitative and quantitative analyses moreover agree on the limited potential of technology-based mentoring solutions to trigger the three primary drivers of change. Both approaches also suggest that off-site vs. on-site capacity building may serve different purposes, whereby the latter appears better suited to encourage team-based problem solving. Lastly, as an exception, we note that the two analytical approaches disagree on the extent to which monitoring through lesson observations induces team-based problem solving and sharing of challenges. An additional qualitative review of the interview data revealed the quantitative analysis strictly focused on respondents' description of the actual observation, and its monitoring aspect only, while not capturing short debrief discussions that commonly occur at the end of a lesson observation.

Discussion and Conclusion

In this article, we examined (self-reported) changes in teachers' instructional practices, main drivers that reportedly provoked these changes, and the extent to which these drivers are associated with teacher professional development activities that operate at scale, in public schools, in a developing country. These analyses and their findings rest on a mixed-methods analytical strategy that examines the extent to which results from qualitative and quantitative analytical approaches converge.

We presented three main findings. First, according to our respondents, teachers had indeed altered their classroom instruction. This finding confirms our selection of a study context that allows us to investigate determinants of such changes. Secondly, in analyses of what provoked these changes, we identified three primary drivers of change. In summary, these main drivers relate to teachers' acquisition of new teaching methods and pedagogical skills, to on-site team-based problem solving among teachers, and—to a lesser extent—verbal encouragement. Third, through a mixed-methods approach we presented results from qualitative and quantitative analyses of how these primary drivers relate to teachers' involvement in professional development activities. Our findings point to different roles of off-site vs. on-site training, whereby off-site training may play a greater role for the acquisition of new skills, yet on-site training appears to be more strongly associated with joint problem solving. Moreover, the mixed-methods results suggest mentoring activities relate most directly to verbal encouragement. Lastly, the qualitative and quantitative findings converge by suggesting a limited role for technology-based solutions in provoking the three main drivers of change.

Results from the current study have several implications for education practitioners and researchers. For practitioners, the findings may suggest continuous teacher development operates best when approached through a multi-pronged approach that combines the individual strengths of each type of professional development activity. In particular, initial off-site teacher training may be best positioned to transfer new skills, yet require subsequent on-site training and mentoring to invoke team-based problem-solving and verbal encouragement. In turn, for researchers, our novel mixed-methods approach highlights how qualitative and quantitative analyses can complement each other. Specifically, we showed how topic modeling can supplement the discovery of themes in transcripts of qualitative interviews, however to a limited extent. We find that hand coding remains superior to topic modeling, but can be validated by this machine learning-based technique. We also demonstrated how a combination of qualitative and quantitative methods can uncover

associations among themes. Results from the two approaches tracked each other very closely, but also identified one interesting discrepancy that led us to additional, qualitative analyses.

We conclude by pointing to several limitations of our study, and how they may be addressed by future research. We begin by noting that our associations between changes in instructional behavior, their drivers, and their relationship to professional development activities are correlational and exploratory. They should not be mistaken as causal relationships. In our ongoing follow-up work, we are preparing a large cluster-randomized controlled trial to measure the causal effect of a continuous professional development model that aims to tap into the drivers we identified in the present study. Secondly, our analyses rest on self-reported exposure to professional development activities. Future research may compare independent observations of such activities with self-reports. Similarly, our study relies on self-reported changes in instruction that required respondents to recall their teaching practices. As answers may be subject to Hawthorne effects, social desirability effects, and recall bias, we would welcome future comparisons of our findings with those from studies that employ classroom observations. A third limitation relates to the question of whether practitioners should place focus on those elements of professional development that already appear to provoke changes in instruction, as apposed to other elements that are "not yet working." Future research may unearth whether greater benefits result from efforts that seek to leverage what appears to be a working system, as evidenced by our study's snapshot of existing drivers. In contrast, efforts may be more beneficial if they "fix" those components that are yet to provoke positive changes in teaching behavior (e.g., use of data, or educational technology). Lastly, we highlight that our study's external validity may be limited. Challenges for teacher professional development in the Zambian context may indeed reflect similar issues other developing countries face as well, including high travel costs for example, and a limited role for roving mentors. In contrast, more densely populated countries with low travel costs may find this study's findings less relevant. To scrutinize the study's external validity, it would be insightful if future research replicated the present study

in other contexts.

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Table 1

Sample Characteristics

	n	*%*
Panel A: Schools		
Number of schools	12	
Number of districts	10	
Number of zones	12	
Government school (vs. community school)	8	66.67
Rural school (vs. urban school)	7	58.33
Panel B: Participants		
Number of sampled individuals	83	
Non-response	5	6.02
Average interview time (hours)	0.95	
Female	35	44.87
Years of experience in role ($n = 72$)	4.7	
Works at school level (vs. above school level)	55	70.51

Note. This table displays sample characteristics for the study's schools (Panel A) and participants (Panel B). Schools' classifications (government vs. community schools), and schools' geographic location (rural vs. urban) as per Zambia's 2018 educational management information system (EMIS). For years of experience in interviewed role, data is missing for six respondents. "Works at school level" captures whether a respondent holds a school-based (e.g., a teacher) or non-school-based position (e.g., a district official).

Table 2

Prevalence of Changes in Instruction

	n	% of excerpts				
		Overall	By program			
			Catch Up	SPRINT	Let's Read	Other
Technical changes	64	76.69	49.58	13.56	5.93	7.63
Increase in differentiated instruction based on learners' needs	19	18.60	11.40	5.10	1.70	0.40
Application of Catch Up to non-Catch Up classes	16	14.41	14.41	0.00	0.00	0.00
Increased use of materials	22	15.25	10.59	2.12	1.27	1.27
Increased interaction with learners	12	7.63	5.51	1.27	0.85	0.00
Increased lesson preparation	14	7.63	4.24	1.69	0.85	0.85
Increased student participation in activities	12	5.08	2.97	1.27	0.42	0.42
Teacher attitude / confidence	22	16.53	9.32	3.39	1.69	2.12
Attitude change	13	8.47	5.08	1.69	0.85	0.85
Change in intrinsic motivation / commitment to learners	15	8.05	4.24	1.69	1.27	0.85
No change	14	9.75	2.12	6.36	1.27	0.00
Total			63.98	31.36	8.90	11.86

Note. This table presents the reported prevalence of changes in teachers' instructional behaviors. "Excerpts" refers to 236 excerpts in which respondents discussed changes in instructional behaviors (including absence thereof). The first column shows the number of respondents that mentioned a given change. The remaining columns reflect the percentage of excerpts that pertain to various types of change (overall, and by programs). "Technical changes" include 14.8% of excerpts that were related to pedagogy with no further specification. Changes due to COVID-19 (13%) and codes with incidence rates lower than 5 percent are omitted. Totals may exceed 100% due to excerpts that refer to more than one program or denote more than one change.

Table 3

Drivers of Change in Instruction

	n	% of excerpts		
		Overall	**By cadre**	
			Teachers	Other respondents
Primary drivers				
Sharing and discussing challenges	51	11.15	6.18	4.97
Acquisition of new skills and teaching methods	34	10.30	7.39	2.91
Verbal encouragement and/or discussions	36	7.03	2.30	4.73
Secondary drivers				
Learner outcomes	37	6.67	2.42	4.24
Materials (such as flipcharts and markers)	26	5.21	2.42	2.79
Frequent monitoring	29	4.97	1.09	3.88

Note. This table presents the reported prevalence of drivers that provoked teachers to change their instructional behaviors. "Excerpts" refers to 825 excerpts in which respondents discussed such drivers of change in instructional behaviors. The first column shows the number of respondents that mentioned each driver. The remaining columns reflect the percentage of excerpts that pertain to various drivers (overall, and by respondent cadre). Codes with incidence rates lower than 5 percent are omitted. Totals may exceed 100% due to excerpts that refer to more than one cadre or denote more than one driver of change.

Table 4

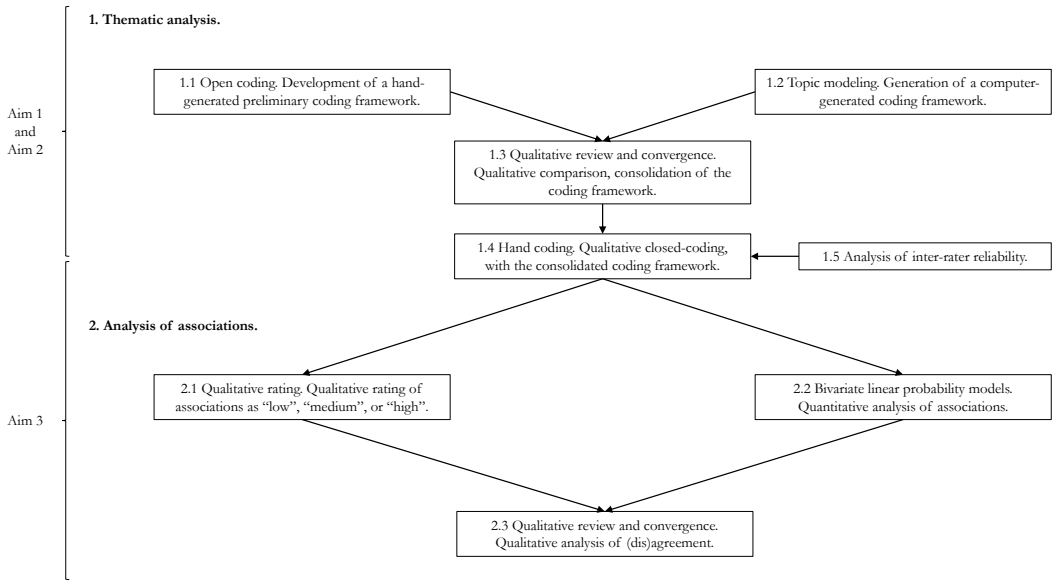
Prevalence of Professional Development Opportunities, Their Association With Primary Drivers of Change

	Prevalence		Association with primary drivers of change					
			Sharing challenges		Verbal encouragement		Learning new methods	
	% Respondents	% Excerpts	Qual.	Quant.	Qual.	Quant.	Qual.	Quant.
Training								
Offsite training	38.46	10.97	M	-11.65	M	10.80	H	7.81
Onsite training	67.95	20.25	H	26.75	H	1.98	H	-2.79
Monitoring								
Monitoring through lesson observations	71.79	31.43	H	-9.29	H	3.67	M	-2.17
Monitoring through file-checking	24.36	4.43	M	-7.32	M	-3.29	M	-10.10
Monitoring by walking-around	6.41	1.27	M	0.54	M	-3.98	M	-4.54
Mentoring								
Capacity building during 1:1 mentoring	55.13	14.98	M	5.49	H	9.80	H	5.82
Encouragement during 1:1 mentoring	24.36	6.96	M	-2.54	H	5.11	M	-9.20
Lesson planning support during 1:1 mentoring	16.67	3.59	M	-5.13	H	8.57	M	-5.55
Technology								
Mentoring over technology	29.49	5.49	L	-6.61	M	n.a.	L	-10.45
Data use	60.26	5.27	M	-2.41	M	4.39	M	5.10

Note. This table provides the prevalence of continuous professional development (CPD) opportunities and their association with primary drivers of change in teaching behaviors. Continuous professional development opportunities are shown in rows. "Prevalence" reports on the percentage of respondents and excerpts that related a given CPD opportunity to changes in instruction. Results from qualitative analyses are shown in three levels, whereby "H" highlights high and positive, "M" highlights medium to weak, and "L" highlights low and negative associations. Results from a quantitative analysis report on the percentage point increase (/decrease) in the probability of a driver being mentioned in an excerpt, if a CPD opportunity is mentioned within the neighborhood of ten excerpts.

Figure 1

Data-Analytic Strategy



Note. This figure presents the study's mixed-methods data-analytic strategy along with the study's three main aims.

Appendix A

Additional Tables and Figures

Table A1

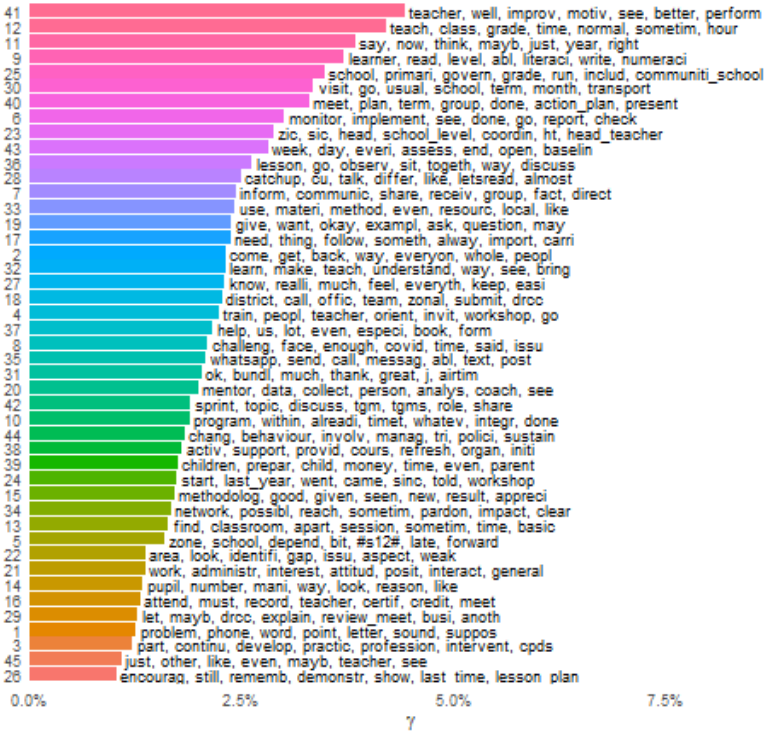
Comparison of Qualitatively Identified Themes With Quantitatively Identified Themes

	Number of codes in qualitative coding framework	**Number of topics in text analysis**
Changes in teaching practices	27	2
Drivers of change	52	4
Professional development inputs	243	6
Training	73	1
Monitoring	78	1
Mentoring	55	3
Technology	16	1
Data use	21	0
Other categories	86	14
Nonsensical categories	-	19
Total	**408**	**45**

Note. This table presents the number of codes as per the qualitative coding framework and as per the quantitative text analysis, respectively. Each row represents a category. We focus on categories of codes that were included in the current study. "Other" categories represent unrelated codes, such as background information on the setting of a school. "Nonsensical" categories represent topics as per the quantitative text analysis that, after review, did not prove meaningful (e.g., topic 11 in Appendix Figure A1: say, now, think, mayb, just, year, right).

Figure A1

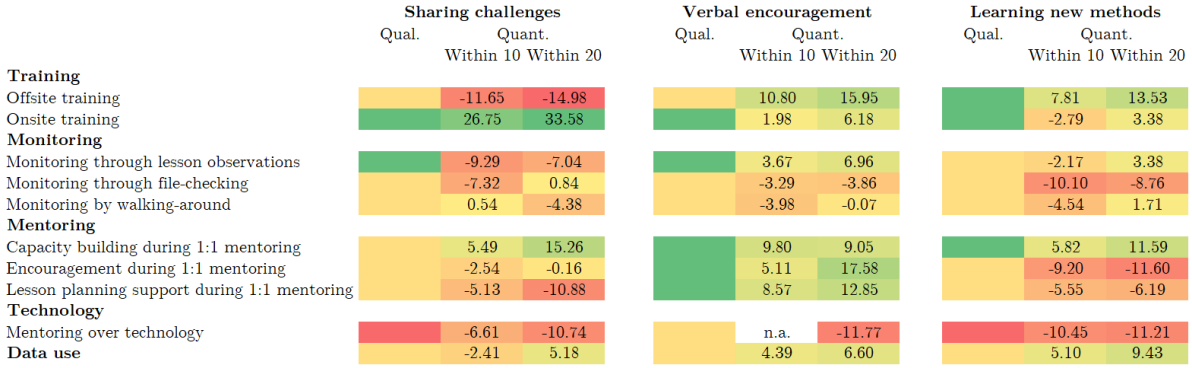
Identification of Themes Through Topic Modeling



Note. This figure presents the 45 themes identified through topic modeling. Themes are ordered by prevalence (γ) and presented along with their seven most distinctive terms. The corpus of text relies on all sentences spoken by respondents (5,879 answers); it excludes any text spoken by interviewers. Bi- and trigrams were added via Rapid Automatic Keyword Extraction (RAKE). The analysis excludes common stopwords (such as “me”, “my”, “myself”, “we”, or “our”), sets all text to lower case, and “stems” words (e.g., by removing suffixes such as “ed”, “ing”, or “ly”).

Figure A2

Robustness Check, and "Heatmap", of Associations Between Continuous Professional Development Opportunities and Primary Drivers of Change



Note. This figure shows the association of continuous professional development opportunities with primary drivers of change in teaching behaviors. Continuous professional development opportunities are shown in rows. In the heatmap, "associations" are color coded, whereby green highlights high and positive, yellow highlights medium to weak, and red highlights low and negative associations. Results from qualitative analyses are shown in three discrete colors, only. Results from quantitative analyses are shown with a continuous color scale. They report on the percentage point increase (/decrease) in the probability of a driver being mentioned in an excerpt, if a CPD opportunity is mentioned within the neighborhood of ten or twenty excerpts, respectively. Compare to Table 4, which shows results for a neighborhood of ten excerpts, only.

Appendix B

Interview Protocol

Prioritize questions in bold.

1. Individual

1.1. How long have you been a [insert interviewee cadre]?

1.2. How many primary schools do you supervise?

1.3. Do you know [sampled school name]?

1.4. Can you tell me anything specific about [sampled school name]?

Tell the interviewee that you would like general information as well as information pertaining to this specific school if possible.

1.5. [if the role above is at the school level] Think about the classes you taught / that were taught in your school, in the year before the Covid-19 crisis. Focus on their recent experience, not overall experience. Remember to ask respondents to elaborate on vague terms such as "support"

1.5.1. In the year before the Covid-19 crisis: Do you think you changed the way you / your school's teachers went about their day-to-day teaching in the classroom? [probe for matters related to in-classroom instruction] If so, how?

1.5.2. Why did you / your teachers make this change? (what helped to make these changes)

1.6. If there are any teacher training and mentoring initiatives in the school/schools you work with, which do you like best so far? Why? [Probe for multiple answers]

1.7. Concerning teacher training and mentoring, if any, what are some of the important activities you undertake as a [insert role]? [Focus on the last training/mentoring activity the participant undertook, what structures are in place that contribute to teacher change; are there clear expectations and structure?] [Probe: Focus on SPRINT, Catch Up, other teacher training and mentoring delivery process implemented in primary schools (e.g.,

USAID Let's Read)]

2. SPRINT

2.1. Please could you describe the SPRINT system as you understand it?

2.2. What are the ways in which you provide (or are provided) training under the SPRINT system at [sampled school name]? [Probe: how was it carried out, who was involved, what was the content/focus, what resources were used] Focus on a recent experience, if a teacher says TGM for example, ask what issues were discussed at the last meeting, ask about who heads these meetings and what is the motivation to go to these meetings.

2.3. What are the ways in which you provide (or are provided) mentoring support under the SPRINT system at [sampled school name]? [Probe: when and how was it carried out, how often, who was involved, what was the content/focus, what resources were used]

2.4. What are the ways in which you provide (or are provided) monitoring under the SPRINT system at [sampled school name]?

2.4.1. How does SPRINT data play a role in your day-to-day activities?

2.5. What are the ways in which the current SPRINT system changes teacher behaviour in the classroom at [sampled school name]? Focus on a recent experience, if a teacher says TGM for example, ask what issues were discussed at the last meeting, ask about who heads these meetings, and what is the motivation to go to these meetings

2.5.1. What are the main drivers of this change?

2.5.2. Is this change sustained?

2.5.3. If not, why? If yes, why?

2.5.4. How does the point system under SPRINT influence teacher motivation and mentor/monitoring/training activity?

2.5.5. Without SPRINT, what changes do you expect to happen in the classroom?

2.6. What are some of the challenges you face implementing SPRINT?

2.7. How can SPRINT be more helpful in contributing to changing

teacher behaviour in the classroom?

2.8. What are potential changes you would like to see in the SPRINT system?

3. Catch Up

3.1. What are the ways in which you provide (or are provided) training under Catch Up at [sampled school name]? Focus on recent training, what is currently happening at the school, ask about the training structure

3.2. What are the ways in which you provide (or are provided) mentoring support under Catch Up at [sampled school name]? If they themselves are a mentor – who supports them?

3.2.1. If you are unsure about a particular aspect of teaching, who do you turn to for support?

3.3. What are the ways in which you provide (or are provided) monitoring under Catch Up at [sampled school name]?

3.3.1. Who ensures that monitoring is taking place (i.e. SIC or HT)?

3.3.2. How many classroom visits do you conduct in a month on average? [Probe on the formality of these visits, what is required by the district/zone? What is the actual number of visits?]

3.3.2.1. How many times in a month do you visit [sampled school name]?

3.3.3. What activities do you undertake during these visits?

3.3.3.1. What is the most important aspect of these visits?

3.3.3.2. Are they useful?

3.3.3.3. What would you recommend changing about these visits?

3.3.4. What data is collected or looked at during these visits?

3.3.5. How is this data used further?

3.4. Have you picked up a particular teaching practice as a result of Catch Up? Why?

3.4.1. What are the main drivers of this change?

3.4.2. Is this change sustained?

3.4.3. If not, why? If yes, why?

3.5. What are some of the challenges you face implementing Catch Up?

3.5.1. What are some of the potential solutions?

3.6. What are the most important characteristics or skills of an effective Catch-Up Mentor?

4. Questions related to other teacher training and mentoring delivery process implemented in primary schools (e.g., USAID Let's Read)

4.1. What are the other programs in which you provide

(or are provided) training at [sampled school name]?

4.1.1. How is this training carried out?

4.2. What are the other programs in which you provide (or are provided) mentoring at [sampled school name]?

4.2.1. How is this mentoring carried out?

4.3. What are the other programs in which you provide (or are provided) monitoring at [sampled school name]?

4.3.1. How is this monitoring carried out?

4.4. What are the ways in which [insert other program name] changes teacher behaviour in the classroom? [Probe: motivation / professional development / behaviour]

4.4.1. What are the main drivers of this change?

4.4.2. Is this change sustained?

4.4.3. If not, why? If yes, why

4.5. How does [insert program name] differ from Catch Up or SPRINT?

4.5.1. Do these programs clash or overlap?

4.5.1.1. If yes, how?

4.5.1.2. How would you propose these clashes be addressed?

4.5.2. How are these programs unique?

5. Integration

5.1. For each program, please tell me about one or two features that you like the best?

5.2. What aspects of Catch Up's approach and delivery process in supporting teachers are similar to other initiatives that already exist in the school/schools you work with? Describe. [Probe: Classroom activities/school day, materials, training, mentoring, and monitoring and data collection]

5.3. What aspects of Catch Up would be hard and easy to combine with existing teacher training and mentoring programs? [Probe: Teacher training, mentoring, incl. mentor training (Classroom activities/school day, materials, training, mentor selection, mentor training, mentor visits, review mechanisms, resource needs, monitoring and data collection, etc.)]

5.3.1. Why?

5.4. Currently, do you integrate any training/mentoring/monitoring activities across [insert program names]?

5.5. In your opinion, how can Catch Up be better integrated into the current systems?

6. Technology

6.1. Do you have WhatsApp (or a smartphone if not)?

6.1.1. How often do you use WhatsApp on your phone?

6.1.2. How often do you watch videos or YouTube on your phone?

6.2. How often are you able to communicate with your mentor or mentees remotely?

6.2.1. Do you call / text?

6.2.2. How often do you communicate with work colleagues over WhatsApp?

6.3. How do you communicate with other schools/teachers within your school?

6.3.1. How many have access to WhatsApp groups?

6.3.2. List the most popular method

6.4. Are you on any of the WhatsApp teacher groups? If Not: Is there someone in

your workplace who is in these groups?

6.4.1. What kind of information is communicated here? Information that is shared that could contribute to teacher change. Elaborate on vague/ generic terms

6.4.2. Have you ever sent/been sent mentoring support on WhatsApp or any other form of technology?

6.4.3. Do you send any SPRINT, Catch Up, or any other program-related data using WhatsApp or any other form of technology?

6.5. How often are you able to top up with bundles?

7. For the Airtime transfer

7.1. Should the airtime code be sent via WhatsApp or SMS?

7.1.1. What is the number the top-up code should be sent to?

7.2. What is your network provider? (i.e., Airtel?)

7.3. If you were given the option, would you prefer bundles or airtime?

Appendix C

Coding Scheme

Table C1

Coding Scheme

ID	Parent ID	Depth	Title	Description	How codes relate to themes
1		0	Doesn't apply	Excerpt does not apply to our coding framework	
2	2	0	1. Program		
3	3	1	**CU program**	Text is CU specific	Each excerpt was tagged with the program the respondent was speaking about in order to identify differences across programs.
4	3	1	**General / Other programs**	Text is not program specific or relates to another program i.e. THRASS	
5	3	1	**Let's Read**	Text is Let's Read specific	
6	3	1	**SPRINT program**	Text is SPRINT specific	
7		0	2. Cadre		
8	7	1	**DEBS**	DEBS	Similarly, where applicable -- cadre roles or individuals spoken about were tagged. This allowed us to understand the roles of various cadre better and feedback into understanding
9	7	1	**DH**	Deputy head	
10	7	1	**DRCC**	DRCC	
11		1	**ESO**	Education Standards officer	
12	7	1	**HT**	Headteacher	
13	7	1	**Peer Teacher**	Colleague / another teacher at the school	
14	7	1	**SEST**	School Education Support Team	
15	7	1	**SIC**	School-inset Coordinator	
16	7	1	**ST**	Senior Teacher	
17	7	1	**ZHT**	Zonal head teacher	
18	7	1	**ZIC**	Zonal inset-coordinator	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
					monitoring and evaluation processes better.
19		0	3. General Setting	Part A: General setting of sampled school	
20	19	1	**Community: PTA**	Respondent refers to PTAs	
21		1	**Community: Importance on learner engagement**	Respondent refers to the importance of community on learner engagement	
22	19	1	**Community: Supportive**	Respondent refers to the community as being supportive	
23	19	1	**COVID related timetabling challenge**	School is facing challenges relating to the adjusted COVID timetable.	
24	19	1	**Large school**	Respondent shares that this is a large school in terms of grade span / enrolment.	This section was not used in the study but rather as a base for understanding school contexts and general settings better.
25	19	1	**Locality: far/difficult to reach**	Participant considers this school far/difficult to reach	
26	19	1	**School performance: Perception**	Respondents perception of learner performance at sampled school	
27	26	2	*low/negative*	Respondent has a negative perception of the school	
28	26	2	*neutral*	Respondent has a neutral perception of the school	
29	26	2	**positive/good**	Respondent has a positive perception of the school	
30	19	1	**Teacher accommodation lacking**	There is a lack of teacher accommodation at the school or a shortage of teacher accommodation.	
31	19	1	**Understaffed**	School is understaffed / does not have enough teachers	
32	19	1	**Unlicensed teachers**	School has unlicensed or informally trained teachers	
33		0	4. Teacher change		
34	33	1	**a. Technical**	Technical teacher changes	These codes directly relate to
35	34	2	*Application to other grades*	School / staff have expanded the CU program	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
				to other grades on their, i.e. they actively include the grade 2s or 6s in the normal CU (afterschool/remedial) program	understanding reported teacher changes (Aim 1) of the study
36	35	2	*Application to non-CU classes*	Teacher applies CU methods to other non-CU related classes within the school time period	
37	34	2	*Increased data use*	Teacher has increased their usage of data such as learner performance progression	
38	34	2	*Increased interaction*	Program has resulted in increased learner interaction / contact between teacher and student	
39	34	2	*Increased lesson preparation*	Program has resulted in teachers creating lesson plans and being more prepared for classes	
40	34	2	*Increased understanding of learner*	Program has resulted in teachers understanding the differentiated needs of learners and adapting lessons to be all inclusive of these levels	
41	40	3	***Methodology: Learner centered approach***	Specific reference to the increased use of learner-centered methodology. Learner-centered methodology is defined as an approach that focuses more on the learner rather than the usual "chalk and talk" approach. Learning is centered around the student, and the teacher acts as a facilitator.	
42	34	2	*Increased use of activities*	Program has resulted in the increased use of activities or examples	
43	34	2	*Increased use of materials*	Program has resulted in the increased use of materials such markers /manila paper /chalk	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
44	43	3	***Increased use of localised materials***	Program has resulted in the increased use of localised materials specifically, sticks/stones	
45	34	2	*Methodology*	Program has resulted in a methodology related change	
46	34	2	*Methodology: Specific*	Program has resulted in a specific methodological change such as:	
47	46	3	***clarity of instructions***	Program has resulted in an increased clarity of instructions	
48	46	3	***classroom management & organisation***	Program has resulted in improved classroom management and organisation	
49	46	3	***improved pronunciation / intonation***	Program has resulted in improved pronunciation or intonation	
50	46	3	***increased use of examples***	Program has resulted in an increased use of examples provided to learners when teaching	
51	46	3	***introduction***	Program has resulted in an improved delivery of the introduction of the lesson	
52	46	3	***lesson flow***	Program has resulted in a smoother lesson flow between activities	
53	46	3	***time management***	Program has resulted in improved time management	
54	34	2	*More innovative/creative*	Program has resulted in enhanced innovation and creativity among teachers	
55	33	1	**b. Teacher attitude / confidence**	Program has resulted in changes relating to attitude/confidence	
56	55	2	*Attitude change*	Program has resulted in a more positive attitude from staff	
57	55	2	*Change in approach to learners/commitment*	Program increased teacher commitment and interest to learners	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
58	55	2	*Teacher confidence*	Program has resulted in improved teacher confidence	
59	33	1	**c. Other**	Program has resulted in other changes	
60	59	2	*Code of conduct*	Teachers are punctual, orderly, better dressed	
61	59	2	*COVID related change*	Teachers have changed their behaviour in response to COVID (i.e. social distancing protocols)	
62	33	1	**d. No change**	Program has not changed teacher behaviour in anyway	
63		0	5. Sustaining Change	How is the change mentioned sustained over time?	
64	63	1	**a. Mentorship**	Change is sustained by mentorship such as:	
65	64	2	*Administrative support*	Change is sustained by administrative support and motivation	
66	64	2	*Appreciation / recognition*	Change is sustained through appreciation and recognition such as verbal encouragement or certificates	These codes do not directly relate to the themes of the current study but were used to inform the design of the broader quantitative project
67	64	2	*Consistent implementation*	Creating routine or consistent implementation / habit formation results in sustained changed behaviour.	
68	64	2	*Expand training to all teachers to avoid adverse effects of frequent transfers*	Change would be sustained if all teachers were trained in methodology to avoid adverse effects of frequent transfers	
69	64	2	*Learner outcomes improvement*	Continuous learner improvement leads to sustained change	
70	63	1	**c. Request: Expand CU to all grades**	Change would be sustained if the program is expanded to all grades.	
71	63	1	**d. Monitoring**	Change is sustained through monitoring	
72		0	6. Drivers of change	Drivers of change codes	
73	72	1	**a. Learner outcomes**	Learner outcomes are a driver of change	These codes directly

ID	Parent ID	Depth	Title	Description	How codes relate to themes
74	73	2	*Learner outcomes*	Seeing learner improvement is a driver of teacher change.	relate to Aim 2 of the study -- understanding what the primary self-reported drivers of change are.
75	73	2	*Tangibility of learner progression across levels*	Respondent mentions that because it is easy to see progression of the learner, it is easy to change behaviour	
76	72	1	**b. Methodology**	The program's procedures and practices are a driver of change	
77	76	2	*Essence of the program: Grouping*	Respondent mentions that teaching learners according to groups/ ability is a specific motivator or driver of change.	
78	76	2	*Increased learner contact*	Teachers are motivated to use the program because they are able to spend more time with the learners	
79	76	2	*Learner enjoyment*	Learners enjoy the program so teachers are motivated to teach	
80	76	2	*Learners grasp concepts quickly*	Program enables learners to grasp concepts quickly which is motivating for teachers.	
81	76	2	*Methodology: Learner-centered*	Program methodology of learner-centered approach is a driver [teacher acts as a facilitator encouraging learner critical thinking]	
82	76	2	*Methodology: Other*	Methodology is easy to adapt / handle. Other defined as anything else that is not learner-centered	
83	76	2	*Program activities*	Program specific activities have increased teacher motivation to change. Teacher specifically mentions an activity related to the program such as numeracy games in CU (i.e. bundles and sticks/number jump/fine with nine etc.) or other activities such as the 5 steps to literacy in Let's Read	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
84	76	2	*Program is inclusive of all learners*	Respondent mentions that the program is inclusive of all learners as a driver of change.	
85	72	1	**c. Teacher motivation / attitude**	Teacher motivation/attitude as a driver of change	
86	86	2	*Attitude*	Positive or negative attitude as a driver or inhibitor of teacher change	
87	86	2	*Contractual obligation*	Not taking up the program will result in disciplinary action from a higher level / text refers to contractual obligations and consequences.	
88	86	2	*Peer motivation*	Motivation to want to learn / motivation from colleagues	
89	86	2	*Teacher approach*	Teachers reason for being a teacher, motives and intrinsic motivation is a driver for change. Relates more to teachers understanding of why they are a teacher and the effect that they have on learners	
90	72	1	**d. Knowledge**	Acquiring knowledge is what drives change	
91	91	2	*Training*	Acquiring knowledge as a result of various form of training as a driver of teacher change	
92	92	3	***Guidelines / manual***	Access to guides/manuals provided as a driver of change	
93	92	3	***Importance of planning***	Planning as a driver of change (encourages critical thinking of the lesson)	
94	92	3	***Learn how to be creative with or without materials***	Being creative with materials usage as a driver of change	
95	92	3	***Learning new methods***	In particular, learning new procedures or practices drive change	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
96	96	4	Methods: Learner centered	New methods are learner centered which is what drives change	
97	92	3	***Practical demonstration***	Importance/usefulness of demonstrations at training	
98	92	3	***Understanding intervention to create ownership***	a deeper understanding of the program results in a greater sense of ownership and drives change	
99	91	2	*Training: Mechanism for identifying areas that are lacking*	Training / program is a mechanism to identify areas where teachers are lacking and motivates teacher change	
100	91	2	*Training: Refresher*	Refresher training as a driver of teacher change	
101	72	1	**e. Mentoring**	Being mentored encourages change in teacher behaviour	
102	103	2	*SEST / Administrative support*	Administrative support as a driver of teacher change. I.e. encouragement	
103	103	2	*Verbal encouragement and/or Discussions*	Mentorship in the form of verbal encouragement and/or discussion of challenges as a driver of teacher change	
104	72	1	**f. Incentive: Non-monetary rewards**	Non-monetary awards such as a certificate of recognition as a driver of change	
105	72	1	**g. Monetary incentives**	Monetary incentives are a driver of change	
106	72	1	**h. Structural**	Structural:	
107	109	2	*Infrastructure*	Infrastructure related indicators such as classrooms / environment drive change	
108	110	3	***Infrastructure: Conducive environment***	Infrastructure that results in a conducive environment drive change	
109	109	2	*Localised materials*	Programs use of localised materials is a driver for teachers / also mentions the ease that this provides	
110	109	2	*Materials*	Materials access / materials production as a driver of teacher change	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
111	109	2	*T:S Ratios / understaffing*	Having lower T:S ratios and adequate staff as a driver for change	
112	72	1	**i. Monitoring**	Being monitored encourages change in teacher behaviour	
113	115	2	*Administrative management monitoring*	Monitoring by administrative support is a driver of change	
114	115	2	*Frequent monitoring*	Frequent monitoring is a driver of change	
115	115	2	*Lesson observations*	Lesson observations is a driver of change	
116	115	2	*Monitoring of lesson plans*	Monitoring or checking of lesson plans is a driver of change	
117	72	1	**j. Program**	Program features:	
118	120	2	*Importance of topic selection*	Topic selection for the action plan is an essential component that drives teacher change	
119	120	2	*Inclusive of all teachers*	Program is inclusive of all teachers and / results in a sense of ownership	
120	120	2	*Sharing and discussing challenges*	TGM: Sharing of challenges and discussion of topics Program aspect of providing a platform to share and discuss challenges is effective for driving teacher change	
121	120	2	*TGM: Lesson Study/Cycle*	Program aspect of Lesson Study -- the development of communal lesson plans at TGMS encourages change.	
122		0	6.1 Training / Knowledge	Features of training or knowledge acquisition as an input	
123	125	1	**Refresher: Facilitator**	Respondent facilitates refreshers or refers to cadre	These codes describe each of the inputs described in Table 4 of the study. These codes were used to
124	125	1	**Accountability**	School level: Responsibility is on the school to ensure all teachers are trained	
125	125	1	**Activities**	Importance/usefulness of activity demonstration at training	
126	125	1	**Attendance incentive**	Food/drink/travel allowance as an incentive to	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
				attend training and all other CPD activities.	understand the
127	125	1	**Cascaded training: Ineffective**	Respondent refers to the ineffectiveness of the cascaded model or mentions problems that occur as a result	mechanims behind inputs and how they work.
128	125	1	**Challenge: Grouping**	Teachers find grouping children difficult, a challenge focused on at training	Further, these codes were analysed
129	125	1	**Challenge: Homogeneous grouping**	Homogenous: Teachers do not know learners, a challenge focused on at training	side by side with drivers of change codes above
130	125	1	**Challenge: Lesson planning**	Teachers find lesson planning difficult, a challenge focused on at training	in order to qualitativel y deduce how drivers
131	125	1	**Challenge: Methodology**	Teachers need additional methodology support. Methodology support defined as technical support such as lesson flow/introductions.	are associated with various inputs.
132	125	1	**District Frequency: Actual**	Last district training occurred: Within the last 6 months; Within the last year; Longer than a year ago	
133	132	2	*Longer than a year ago*	The last time the respondent received training at the district level	
134	132	2	*within the last 6 months*	Respondent received district training within the last 6 months	
135	132	2	*within the last year*	Respondent received district training within the last year	
136	125	1	**Frequency (level not mentioned)**	What is the frequency of the last training if district or zonal level was not mentioned?	
137	137	2	*longer than a year ago*	Last training (at either the district or zonal level) was longer than a year ago	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
138	137	2	*within the last 6 months*	Last training (at either the district or zonal level) was within the last 6 months	
139	137	2	*within the last year*	Last training (at either the district or zonal level) was within the last year	
140	125	1	**Length of training**	General: Training length	
141	125	1	**Lesson planning**	Importance/usefulness of lesson planning at training	
142	125	1	**Logistical challenges for training**	Location of schools or geographic circumstances make organising training logistically difficult (school, zone or district level)	
143	125	1	**Monitoring leads to training**	Respondent shares that it is through monitoring that training needs and gaps are identified	
144	125	1	**More frequent training**	Respondent expresses that training should be more frequent, or requests or suggests that training should be more frequent	
145	125	1	**Other programs: Literacy focused**	Other programs such as Let's Read/THRASS are literacy focused, only.	
146	125	1	**Other programs: Spill over**	There are spillover effects from other programs into CU / SPRINT therefore they do not clash	
147	125	1	**Participants: Grade determined / SEST selected**	Participants of training are grade determined, for example all the grade 3 teachers are called to training at once	
148	125	1	**Participants: Include all**	Respondent expresses that training should be given to all teachers (or stakeholders) not a select few	
149	125	1	**Refresher training**	Information relating to program refresher training	
150	125	1	**Refresher: Needs based**	Respondent expresses that zonal refreshers are organised or determined based on pooling common needs, or are needs based	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
151	125	1	**Request: Heterogeneous grouping**	Teachers find grouping learners across grades difficult and request within grade grouping.	
152	125	1	**Resource constraints**	Expresses challenge of resource constraints / lack of funding when organising training	
153	125	1	**TGM: Experts**	Program uses knowledgeable staff to train and share knowledge with peer teachers	
154	125	1	**TGM: Facilitator**	Respondent has led or facilitated a TGM meeting (actively involved)	
155	125	1	**TGM: Frequent (fortnightly)**	TGMs are held regularly (every two weeks OR at least once a month)	
156	155	2	*TGMs: Not frequent*	TGMS are not held regularly (less than once per month)	
157	125	1	**TGM: Perception**	Positive or negative perception to TGM meetings	
158	157	2	*Negative*	Respondent has a negative perception of TGM meetings	
159	157	2	*Positive*	Respondent has a positive perception of TGM meetings	
160	125	1	**TGM: Point system**		
161	160	2	*TGM: Point system being implemented*	Respondent does not remember the last time a certificate was issued under the credit system but says it is still being implemented	
162	160	2	*TGM: Point System inactive*	Respondent mentions that the TGM point system is inactive	
163	125	1	**TGM: Point system negative**	Respondent is aware of the point system and has a negative perception because:	
164	163	2	*credits viewed as unimportant / diminished in value*	TGM point system credits are viewed as unimportant or have diminished in value	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
165	163	2	*lack of follow through*	TGM point system is not followed through	
166	163	2	*other*	Other reason for negative perception of TGM point system \	
167	125	1	**TGM: Point system positive**	Respondent is aware of the point system and has a positive perception because:	
168	167	2	*increased attendance*	TGM system results in increased attendance to biweekly meetings	
169	167	2	*leads to promotions*	TGM system of points results in an increased opportunity to receive promotions	
170	167	2	*motivates teachers*	TGM point system motivates teachers	
171	167	2	*other*	Other reason for positive perception	
172	125	1	**TGM: Point system unaware**	Respondent is unaware of the SPRINT credit system	
173	125	1	**TGM: Recent**	TGM was held recently (within the past month)	
174	173	2	*TGM recent: No*	Not within the past month.	
175	173	2	*TGM recent: Yes*	TGM was held recently	
176	125	1	**TGM: Topic challenge**	Selecting topics to discuss at TGMs (developed at HIM meetings) is difficult.	
177	125	1	**TGM: Topics**	The most recent TGM topic was on:	
178	177	2	*TGM topics: Assessments*	The most recent TGM topic focused on: How to administer assessments	
179	177	2	*TGM topics: Data entry*	The most recent TGM topic focused on: Data entry	
180	177	2	*TGM topics: Lesson planning*	The most recent TGM topic focused on: Lesson planning	
181	177	2	*TGM topics: Literacy*	The most recent TGM topic focused on: Literacy	
182	177	2	*TGM topics: Materials production*	The most recent TGM topic focused on: making materials to use in class	
183	177	2	*TGM topics: Numeracy*	The most recent TGM topic focused on: numeracy	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
184	177	2	*TGM topics: Other*	The most recent TGM topic focused on: Other	
185	177	2	*TGM topics: Phonetics*	The most recent TGM topic focused on: Phonetics	
186	125	1	**TGM: Training platform**	SPRINT TGM meetings is a school based training platform or CPD activity	
187	125	1	**Transfers: Inter-school**	Respondent refers to the transfer of trained teachers being problematic	
188	125	1	**Untrained teacher gaps**	Untrained teachers tend to have more gaps and require more training	
189	125	1	**Zambian Teacher Council**	Refers to the ZTC revamping the credit system	
190	125	1	**Zonal Frequency: Actual**	Last zonal training occurred: Within the last 6 months; Within the last year; Longer than a year ago	
191	191	2	*Longer than a year ago*	Last zonal training occurred longer than a year ago	
192	191	2	*within the last 6 months*	Last zonal training occurred within the last 6 months	
193	191	2	*within the last year*	Last zonal training occurred within the last year	
194		0	6.2 Monitoring	Monitoring as a PD input	
195	194	1	**CU in AP**	Catch up is integrated in the SPRINT action plan (AP).	
196	194	1	**Expectations**	Respondent mentions the importance of understanding expectations	
197	194	1	**Frequency**	Respondent receives or provides frequent monitoring (at least once per month)	
198	194	1	**HIM Meeting**	Action plans are created at a termly HT meeting where topics for TGMs are laid out	
199	194	1	**Lack of funds for monitoring**	There are a lack of funds to carry out monitoring visits	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
200	194	1	**Lesson observation activities**	Lesson observation activities include:	
201	201	2	*activity selection*	Observing and thinking critically about the activities the teacher chose	
202	201	2	*environment*	Observing the class environment	
203	201	2	*flow*	Observing the flow of the lesson	
204	201	2	*follow up discussion*	Engaging with the teacher in a follow up discussion	
205	201	2	*follow up discussion done in a supportive way*	Engaging with the teacher in a follow up discussion but respondent mentions that this is done in a supportive way	
206	201	2	*form/guide*	Using the observation form or guide	
207	201	2	*group discussion (peer monitoring)*	Engaging in a group discussion with the teacher(s) and other heads	
208	201	2	*identify teachers who deserve an award*	Use the observation as an opportunity to identify teachers who deserve an award	
209	201	2	*learner engagement*	Observe learner engagement	
210	201	2	*look at lesson plan*	Evaluate the lesson plan	
211	201	2	*material use*	Evaluate materials use	
212	201	2	*methodology*	Evaluate teacher procedures and practices used during the lesson	
213	201	2	*teacher competence*	Evaluate teacher competence	
214	201	2	*teacher confidence*	Evaluate teacher confidence	
215	194	1	**Lesson observation usefulness**	Reasons why lesson observations are useful:	
216	215	2	*correct bad habits*	Lesson observations offer an opportunity to correct bad habits	
217	215	2	*encourage/motivate*	Lesson observations offer an opportunity to encourage or motivate the teacher	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
218	215	2	*engage in peer monitoring*	Lesson observations offer an opportunity to engage in peer monitoring	
219	215	2	*identify areas of weakness*	Lesson observations offer an opportunity to identify areas of weakness	
220	215	2	*program fidelity*	Lesson observations offer an opportunity to evaluate how the teacher is adhering to the program	
221	215	2	*track learner progression*	Lesson observations offer an opportunity to track how learners are progression	
222	194	1	**Main monitor cadre: School level**	Main or most frequent monitor at the school level (tag cadre)	
223	194	1	**Monitoring is needs-based**	Monitoring visits are planned on a needs-based method	
224	194	1	**Monitoring method**	Method used to monitor teachers or what monitors check on:	
225	224	2	*Lesson observations*	Uses lesson observations to monitor teachers	
226	224	2	*Monitoring teacher files / lesson plans*	Monitors teacher files / lesson plans	
227	224	2	*other*	Uses another method to monitor teachers	
228	224	2	*peer monitoring*	Engages in peer monitoring (monitoring with multiple teachers/staff present)	
229	224	2	*pupil and/ teacher attendance*	Monitors teachers by their or their students' attendance	
230	224	2	*pupil's books*	Monitoring teachers using pupil's books	
231	224	2	*teacher performance*	Monitoring is done by evaluation of performance	
232	224	2	*Walk around monitoring*	Monitoring is done by walking around	
233	194	1	**Monitoring Strategy**	Visits are pre-planned/random	
234	233	2	*pre-planned*	Monitoring visits/schedules are pre-planned	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
235	233	2	*random*	Monitoring visits/schedules are not pre-planned	
236	194	1	**Monitoring: Integration of programs into one visit**	Integration of numerous programs into one visit or kept separate	
237	236	2	*Monitoring visits by program: integrate*	More than one program is monitored at a time	
238	236	2	*Monitoring visits by program: keep separate*	Only one program is monitored at a time	
239	194	1	**Other programs**	Other programs other than CU & SPRINT have either infrequent or frequent monitoring	
240	239	2	*frequent monitoring of other programs*	Other programs other than CU & SPRINT are frequently monitored	
241	239	2	*infrequent monitoring of other programs*	Other programs other than CU & SPRINT are infrequently monitored	
242	194	1	**Role**	Monitoring role is to:	
243	242	2	*Check/document*	Check or document what is happening	
244	243	3	***analyse data***	Analyse data	
245	243	3	***correct grouping***	Ensure that there is the correct grouping	
246	243	3	***data verification / collection***	Ensure that the data collected is accurate	
247	243	3	***ensure assessments are done correctly***	Ensure that assessments are done correctly	
248	243	3	***ensure implementation / program fidelity***	Ensure that the program is being implemented as intended	
249	243	3	***ensure visits are done***	Role is to ensure that monitoring visits are done	
250	243	3	***learner progression***	Role is to monitor learner progression	
251	239	2	*Knowledge*	Role is to impart knowledge	
252	243	3	***ensure correct activities***	Role is to ensure that the correct activities are being done	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
253	251	3	***ensure methodology understanding***	Role is to ensure that the teacher is using the correct procedures or processes	
254	251	3	***improved teacher performance***	Role is to ensure that teacher performance is improving	
255	239	2	*Other*	Role is other	
256	255	3	***engages community***	Role is to engage the community	
257	255	3	***ensures follow up***	Role is to ensure a follow up visit is scheduled/completed	
258	255	3	***facilitates AP***	Role is to facilitate the school termly action plan	
259	255	3	***other***	Role is not mentioned	
260	239	2	*Structural*	Role is to monitor/ensure that structural indicators are taken care of such as:	
261	260	3	***Conducive environment***	Role is to ensure that there is a conducive environment for learners to learn	
262	260	3	***materials access***	Role is to ensure that teachers have access to materials	
263	194	1	**SIC: AP**	SIC ensures that action plans are carried out.	
264	194	1	**Transport/mobility**	lack of transport to carry out monitoring visits	
265	194	1	**ZIC: AP**	ZIC addresses challenges on action plan and follows up	
266		0	6.3 Mentoring	MENTORING as a PD activity	
267	266	1	**a. Cadre**	Cadre [tag cadre] that carries out mentoring	
268	267	2	*Administrative support*	Respondents express the need / lack of mentoring support from the administration / SEST team. OR administrative support is adequate	
269	267	2	*Mentor cadre*	Respondent receives mentor support from: [tag cadre]	
270	267	2	*Mentor of Mentors (MOM)*	If the role of the respondent is a mentor, which individuals provide	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
				mentorship support to him/her?	
271	267	2	*SIC is the main mentor at the school level*	SIC is the main mentor at the school level	
272	267	2	*ST is the main mentor at the school level*	ST is the main mentor at the school level	
273	266	1	**b. Process**		
274	273	2	*Effective characteristics*	Effective characteristics of a mentor	
275	274	3	***Activities***	Activities that an effective mentor should be able to handle	
276	275	4	computer literate	An effective mentor is computer literate	
277	275	4	encourage	An effective mentor is there to encourage	
278	275	4	ensure accurate and timely data	An effective mentor is ensures accurate and timely data collection	
279	275	4	involve community	An effective mentor involves the community	
280	275	4	know intervention	An effective mentor is knowledgeable on all aspects of the intervention	
281	275	4	knowledgeable on activities	An effective mentor is knowledgeable on a variety of activities	
282	275	4	knows how to address challenges	An effective mentor knows how to address challenges	
283	275	4	materials	An effective mentor ensures that there are materials available to use in lessons	
284	275	4	monitor	An effective mentor monitors teachers	
285	275	4	not engaged in other activities	An effective mentor is not engaged in other activities and only has the role of a mentor	
286	275	4	other	An effective mentor does other activities not mentioned here	
287	275	4	role model/coach	An effective mentor is a role model/coach	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
288	257	4	supported by SEST	An effective mentor is supported by the School management team	
289	274	3	***Personality***	Personality traits of an effective mentor	
290	289	4	creative	An effective mentor is creative	
291	289	4	dedicated	An effective mentor is dedicated	
292	289	4	flexible	An effective mentor is flexible	
293	289	4	good listener	An effective mentor is a good listener	
294	289	4	honest	An effective mentor is honest	
295	289	4	humble	An effective mentor is humble	
296	289	4	leader	An effective mentor is a leader	
297	289	4	other	Other characteristics of an effective mentor	
298	289	4	passionate	An effective mentor is passionate	
299	289	4	self-motivated	An effective mentor is self-motivated	
300	289	4	supportive/accommodating	An effective mentor is supportive/accommodating	
301	273	2	*Form of mentorship*	Form that mentorship is actually delivered (non-hypothetical)	
302	301	3	***Capacity build***	Mentors capacity build teachers	
303	301	3	***classroom management & organisation***	Mentors help with handling classroom management and organisation	
304	301	3	***Demonstrations***	Mentors demonstrate lessons/activities to others	
305	301	3	***Encouragement***	mentors encourage	
306	301	3	***lesson planning support***	mentors assist with lesson planning support	
307	301	3	***materials support***	mentors assist with providing materials	
308	301	3	***Offer alternatives***	mentors offer alternative strategies/solutions	
309	301	3	***other***	Other forms of mentorship	
310	301	3	***pedagogy support***	Mentors offer pedagogical support	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
311	301	3	***positive criticism***	Mentors offer positive criticism	
312	273	2	*Other programs*	Programs other than CU & SPRINT have infrequent or frequent mentorship	
313	312	3	***frequent***	Other programs have frequent mentorship (frequent is defined as at least once per month)	
314	312	3	***infrequent***	Other programs have infrequent mentorship (infrequent is defined as less than once per month)	
315	273	1	**c. Receives/provides frequent mentor support**	Respondent receives/provides frequent mentor support (at least once per month)	
316	315	2	*No*	Respondent does not receive frequent mentor support (less than once per month)	
317	315	2	*Yes*	Respondent receives frequent mentor support (at least once per month)	
318	273	1	**d. Importance of administrative / SEST support**	HT/SEST team is an essential component of effective monitoring	
319		0	6.4 Structural	Structural indicators as an input	
320	319	1	**a. Absenteeism**		
321	320	2	*Reason for learner absenteeism*	Learners are absent due to season; resistance to the program; tired/hungry; distance/travel time; COVID; other	
322	321	3	***Reason for learner absenteeism: COVID***	The reason for learner absenteeism's is due to COVID	
323	321	3	***Reason for learner absenteeism: distance time/travel***	The reason for learner absenteeism is due to long distances or travel time to school	
324	321	3	***Reason for learner absenteeism: other***	The reason for learner absenteeism another reason	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
325	321	3	***Reason for learner absenteeism: resistance to the program***	The reason for learner absenteeism is due to resistance to the program	
326	321	3	***Reason for learner absenteeism: Season***	The reason for learner absenteeism is due to seasonal changes such as rain/flooding during summer	
327	321	3	***Reason for learner absenteeism: tired/hungry***	The reason for learner absenteeism is due to learners being tired and hungry	
328	320	1	**b. Infrastructure**		
329	328	2	*Challenge: High T:S ratios / understaffing*	A challenge is that T:S ratios are high	
330	328	2	*Challenge: Infrastructure*	A challenges is that there is not enough infrastructure	
331	330	3	***Infrastructure challenge: furniture/desks***	A challenge is that there are not enough furniture/desks	
332	330	3	***Infrastructure challenge: general (not specified)***	There is a general infrastructure challenge that is not specified	
333	330	3	***Infrastructure challenge: Insufficient classrooms***	Lack of infrastructure makes implementing program difficult	
334	320	1	**c. Logistics**	Responses relating to logistics	
335	334	2	*Challenge: Commitment*	Teacher challenges of committing to the hour	
336	334	2	*Other programs: Normal hours*	Other programs such as Let's Read / THRASS are incorporated into the normal curriculum making it easier for teachers.	
337	334	2	*Program is done after hours*	Teachers are not happy with the program being afterhours.	
338	334	2	*Request: Normal hours*	Teachers request to move the program to normal school hours.	
339	334	2	*Timetabling challenges*	Timetabling challenges	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
340	328	1	**d. Materials**		
341	340	2	*Challenge: Materials*	Lack of materials/resources makes implementing program difficult	
342	340	2	*Material integration*	Programs other than CU & SPRINT have materials that are integrated into CU such as story books/readers	
343		0	6.5 Teacher attributes / attitude	Teacher attitude	
344	343	1	**a. Attitude**	Responses relating to the attitude of teachers	
345	344	2	*Perception*	Respondent perception of program or attitude towards the program	
346	345	3	negative	Respondent has a negative perception of the program	
347	346	4	Negative perception: Reason	Reason for negative perception of program	
348	347	5	no monetary incentive	Respondent has a negative perception of the program because there is no monetary incentive	
349	347	5	overload/seen as extra burden	Respondent has a negative perception of the program because there is overload and additional work is seen as an extra burden	
350	345	3	positive	Respondent has a positive perception of the program	
351	346	4	Positive perception: Reason	Reason for positive perception of program	
352	347	5	Activities	Reason for positive perception of program is that teachers enjoy the activities	
353	347	5	grouping	Reason for positive perception of program is that teachers enjoy the way the program groups learners	
354	343	1	**b. Demotivator: Inefficiency**	Corruption/promotions based on nepotism as a demotivator	
355	343	1	**c. Incentives offered**	Teacher incentives include: Promotions; goods; certificates; education opportunities;	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
				motivation/recognition; other	
356	355	2	*certificates*	Certificates offered as teacher incentives	
357	355	2	*education opportunities*	Educational opportunities (such as courses) offered as teacher incentives	
358	355	2	*goods*	Goods such as a mattress offered as teacher incentives	
359	355	2	*motivation/recognition*	Motivation or recognition offered as teacher incentives	
360	355	2	*other*	Other offered as teacher incentives	
361	355	2	*promotions*	Promotions offered as teacher incentives	
362		0	7. Learner change	Ways that learners have changed	
363	362	1	**Learner attendance**	Program has resulted in improved learner attendance	
364	362	1	**Learner independence**	Program has resulted in improved learner independence	
365	362	1	**Learner outcomes**	Program has resulted in improved learner outcomes	
366	362	1	**Learning loss**	Learners have experienced learning loss due to	
367	366	2	*Learning loss: absenteeism*	Learners have experienced learning loss due to their frequent absenteeism	
368	366	2	*Learning loss: COVID*	Learners have experienced learning loss due to COVID	
369	366	2	*Learning loss: other*	Learners have experienced learning loss due to other reasons	
370	366	2	*Learning loss: vacation*	Learners have experienced learning loss due to vacation/holiday times	
371		0	8. Technology	Technology use as an input	
372	371	1	**Information type**	Type of information that is currently being shared via technology	
373	372	2	*advice/mentoring*	Advice/mentoring information is being shared over technology	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
374	372	2	*data*	Data information is being shared over technology	
375	372	2	*lesson plan prep*	Lesson plan prep information is being shared over technology	
376	372	2	*Logistical information*	i.e. reminders deadlines, notifications	
377	372	2	*materials*	Materials production information is being shared over technology	
378	372	2	*other*	Other type of information is sent/shared via technology	
379	372	2	*pedagogy support*	Pedagogical support information is being shared over technology	
380	372	2	*timetable support*	Timetable information is being shared over technology	
381	372	1	**Top two methods of communication**	Dedoose descriptor (raw data suggests WhatsApp + Phone calls). WhatsApp/Text (SMS)/ Phone calls/ physical visits/ letters / other	
382	381	2	*Letters*	Letters are used to communicate	
383	381	2	*Other*	Teachers use other methods to communicate (i.e. social media/ Facebook)	
384	381	2	*Phone calls*	Phone calls are used to communicate	
385	381	2	*Physical visits*	Teachers communicate through physical visits	
386	381	2	*Text/SMS*	Teachers communicate via text messages / SMSs	
387	381	2	*WhatsApp*	Teachers communicate via WhatsApp	
388		0	9. Data use & Collection	Use of data and collection of it	
389	388	1	**Assessments**	Data collection of assessment	
390	389	2	*Assessment: Week 5, 10, 13*	Assessment periods for Let's Read are Weeks 5, 10 & 13.	
391	389	2	*Assessments: clash*	Assessment periods clash making it difficult for	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
				teachers/assessment periods do not clash	
392	389	2	*Challenges*	Assessment period is challenging due to	
393	492	3	***competing responsibilities***	Assessment period is challenging due to competing responsibilities	
394	392	3	***following correct procedure***	Assessment period is challenging because following the correct procedure is difficult	
395	392	3	***learner absenteeism***	Learner absenteeism is high making it difficult for assessments to be completed	
396	392	3	***period is too short***	Assessment period is challenging because the assessment period is too short	
397	392	3	***teachers take shortcuts***	Teachers take short cuts during the assessment period	
398	388	1	**Data collected**	Types of data collected	
399	398	2	*Credit forms / teacher forms (attendance)*	Data on credit forms (TGM points) and other attendance forms are collected	
400	398	2	*Learning outcome data*	Learning outcome data is collected	
401	398	2	*Lesson plans (teacher files)*	Data on lesson plans from teacher files are collected	
402	398	2	*Mentoring & Monitoring visit data*	The number of mentoring & monitoring visits are collected	
403	398	2	*other*	Other forms of data are collected	
404	398	2	*Recorded in SABU book / file*	SABU book is a book where all TGM activities are recorded: Topics / facilitator / attendance sheet / minutes of the meeting	
405	388	1	**Data use**	Ways in which the data is used	
406	405	2	*Data use (other)*	Text refers to other forms of data use	
407	405	2	*Data use- CPD*	Data is used to inform CPD activities	

ID	Parent ID	Depth	Title	Description	How codes relate to themes
408	405	2	*Learner outcome use*	Use learning outcome data to identify challenges/trends/needs/schools that require more support	
409	405	2	*Termly use*	Data is analysed and discussed termly at meetings	

Note. The first column indicates the code ID. The second column indicates the "Parent" code. The third column indicates the depth of the code (how far in terms of codes it is from the corresponding parent ID). The title and description columns provide the name and definitions of the codes as they appeared in the coding framework. The final column provides comments, incl. on how codes relate to the study's aims.