

**Teacher practices
in Rwandan secondary
mathematics classrooms:
Findings from classroom
observations**

Leaders in
Teaching Research
and Policy Series

Authors:

Data analysis and drafting of this paper was undertaken by Dr Emma Carter at the Research for Equitable Access and Learning (REAL) Centre, University of Cambridge, under the direction and oversight of Professor Pauline Rose, also at the REAL Centre. who also edited the paper.

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The REAL Centre and Laterite are learning partners for the Leaders in Teaching initiative, responsible for generating evidence on improved teacher performance and student learning.

Video coding of observations was completed by seven researchers, including Gabrielle Arengé, Emma Carter, Gill Francis and Maria Tsapali from the REAL Centre and Collins Kweyamba, Ezron Mucyo and Fabiola Niwenshuti, from Laterite. All researchers undertook intensive training that involved completing the World Bank *Teach* reliability exam and a double coding process of videos from the local Rwandan context. This training was also supported by the *Teach* team at the World Bank. This paper was reviewed by Dr. Phil Leonard at Laterite.

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Summary

As part of a comprehensive approach to measuring teaching quality for the Mastercard Foundation's Leaders in Teaching initiative, Laterite and the REAL Centre conducted classroom observations of mathematics classes in Rwandan secondary schools. Classroom observations enable an unobstructed and situated view of classroom practice (Millman and Darling-Hammond, 1990; Putnam and Borko, 2000; Martinez et al., 2016). Within numerous low- and lower-middle income countries, including Rwanda, they are also recognised as the most critical part of teacher evaluation (Centre for Development and Enterprise 2015; Bruns et al., 2016; Ochoa et al., 2018). For our instrument, we chose to adapt the World Bank's *Teach* observation protocol¹ due to its relevance to low- and middle-income countries and reflection of aspects of teaching quality highlighted as foundational by Rwandan Secondary teachers. In addition, the instrument could be adapted, and we were fortunate to benefit from directed engagement with the World Bank's *Teach* team through this process. An overview of the adaptations of the tool and its use for this study can be found in the research and policy paper 'Video recordings of classroom observations: Using the Teach tool in Rwandan secondary schools' (Ani-Asamoah et al., 2020).

In this paper, we present on findings from observations conducted in 97 mathematics classrooms at the Secondary 3 level in Leaders in Teaching intervention areas of Rwanda. The study included observations of 15 female and 82 male teachers (this skew is due to the smaller number of female teachers teaching mathematics in Rwandan secondary schools). Data collection took place in February 2020, with schools randomly selected from a larger sample of 360 schools included in our quantitative data collection.

We report results relating to the four key areas of *Teach*: Time on Learning, Classroom Culture, Instruction and Socioemotional Skills. We present analysis that includes both the findings of the overall sample, as well as disaggregated analysis according to five key variables of interest, namely: teacher gender, students with disabilities in the classroom, use of local language in teaching, school location, and school type.

Our findings show that the majority of teachers in observed classrooms used their teaching time effectively. Teachers also performed strongly in the area of Classroom Culture and were particularly effective at establishing positive behavioural

expectations for their students. In the area of Instruction, teachers demonstrated strong skills when facilitating their lessons by providing clear learning objectives and explanations of content. Teachers faced the greatest challenges in supporting students' Socioemotional Skills in the classroom, particularly when encouraging student perseverance with learning in the classroom. This is a common pattern identified in other studies where the tool has been used in similar contexts (for example Molina et al., 2020).

With respect to our disaggregated analysis, no significant differences were found for subsamples associated with rural/urban school location, or whether or not there were students with disabilities in the classroom. We did, however, find differences relating to school type, teacher gender and language of instruction. Teachers from Schools of Excellence achieved significantly higher overall scores for *Teach* and in the area of Classroom Culture. Female teachers had significantly higher scores for the element of the instrument related to supporting student autonomy, namely, students being given choices and meaningful roles and students volunteering to participate. Teachers who used Kinyarwanda in the classroom were also found to achieve significantly higher scores for the aspect associated with support of students' critical thinking skills in the classroom compared to teachers who only used English in the classroom.

Introduction

Context

Demand for secondary education within sub-Saharan Africa is increasing at an unparalleled pace. With growing enrolment in and completion of primary school, an increasing proportion of an already expanding population will soon be entering into secondary education (Mastercard Foundation, 2020). This pattern is apparent in Rwanda, with pre-COVID estimates suggesting that secondary enrolment would expand by around 70% between 2012 and 2025 (Laterite, 2020). In response to this growing demand, considerable reform is underway within education systems across sub-Saharan Africa including Rwanda. Whilst many education systems have traditionally been designed to cater for an elite few, a paradigm shift has been taking place, and governments are now seeing secondary education not just as a continuation of primary education, but a critical step in the school to work transition (Mastercard Foundation, 2020).

Quality teaching is central to student success in secondary school. It requires both that there are sufficient teachers, and that these teachers are equipped with the skills to teach in increasingly diverse classrooms. In terms of the need for teachers as a result of the expansion in enrolment, it has been estimated, for example, that by 2030 sub-Saharan Africa will require over 10 million additional secondary teachers (World Bank, 2018b; UNESCO Institute for Statistics, 2016). Countries in sub-Saharan Africa, including Rwanda, face additional challenges affecting the quality of teaching in the context of a rapid increase in enrolment. For instance, due to increased demand for secondary teachers and lack of access for some teachers to quality training, there are a high number of un- and under-qualified teachers. Many students entering the secondary school system also have low levels of foundational literacy and numeracy. Large class sizes and limited resources can also place additional pressures on teachers. In addition, the recent adoption of a competence-based curriculum places new demands on teachers, requiring them to have skills and adopt strategies that may not be familiar to them (Ochoa et al., 2018).

Recognising these challenges, a number of countries within sub-Saharan Africa, including Rwanda, have initiated reforms since 2000 to better manage the influx of adolescents into the secondary education system and better equip students with the

skills they need to successfully transition to the world of work. This has included reforms aimed at curricula and teaching, such as improvements in the quality of teaching and learning with a particular focus on science and mathematics; shifts to competence-based curricula; and greater emphasis on the use of Information Communication Technology. Further priorities include ensuring that learning is meaningful, relevant, and equitable (Mastercard Foundation, 2020).

The Leaders in Teaching initiative

In response to the massive expansion of secondary education and the urgent need for reform, the Mastercard Foundation, has launched the Leaders in Teaching initiative² as part of its Young Africa Works Strategy to help improve the quality, relevance, and equity of secondary teaching across sub-Saharan Africa. Established in Kigali, Rwanda in 2018, the initiative aims to cooperate closely with local and national stakeholders to prepare teachers to deliver quality and relevant learning. Leaders in Teaching aims to support teachers over the entire lifespan of their careers and engages multiple levels of the secondary education system (Mastercard Foundation, 2018). In doing this, its interventions are structured around four pillars of Recruit; Train; Lead; and Motivate.

As Learning Partners, Laterite and the REAL Centre are supporting the Mastercard Foundation in their goals by developing a robust quantitative and qualitative evidence base on how the Leaders in Teaching initiative is working overall to develop teacher quality and student learning in secondary schools, especially for those at the greatest risk of not learning. This evidence aims to bring about continuous improvement within the initiative and provide wider lessons for contexts beyond Rwanda. As part of our role, Laterite and the REAL Centre are developing an approach for assessing teaching quality within the Leaders in Teaching programme for the Rwandan context. A core aspect of this assessment of teaching quality is the use of classroom observation. By observing teaching practice directly, the classroom observation aims to identify and, over time, ascertain changes in teaching quality that may be attributable to Leaders in Teaching interventions.

Why classroom observations?

Classroom observation can be a powerful instrument that can provide an unobstructed and contextualised perspective of teacher quality and classroom practice (Millman and Darling-Hammond, 1990; Putnam and Borko, 2000; Martinez et al., 2016). Within many low- and lower-middle income countries, including Rwanda, observations are often considered the most important aspect of the teacher evaluation process (Centre for Development and Enterprise 2015; Bruns et al., 2016; Ochoa et al., 2018). Increased interest and application of this tool has arisen from the considerable reform of teacher evaluation and improvement policies that is taking place internationally, particularly with respect to a growing focus on formative uses of information (Martinez et al., 2016). In addition, the substantial body of recent evidence showing stronger correlations between student outcomes and observable teacher practices, as opposed to teachers' formal qualifications, is driving this surge in interest (Bruns et al, 2016).

Why did we choose the *Teach* classroom observation tool?

Though a number of observation tools have been designed and used in high-income countries, fewer have been used successfully within low- and lower-middle income countries (Bruns et al., 2016). To address this gap, the World Bank recently designed the *Teach* tool. *Teach* has been informed by an extensive literature review on effective teaching practice in low- and middle- income countries, revised using feedback from over 20 education experts and tested in more than 10 low- and middle-income countries including Mozambique, Uruguay, Pakistan and the Philippines (Molina et al., 2018). For Leaders in Teaching, we chose to use an adapted version of the World Bank's *Teach* observation protocol for a number of carefully considered reasons. Firstly, *Teach* was designed for application within low- and middle-income countries and has been validated in more than 1,000 classrooms, including those within sub-Saharan Africa. Secondly, *Teach* reflected many aspects of teacher quality highlighted as foundational by teachers within Rwanda including having a focus on student centred pedagogy. Thirdly, whilst *Teach* had an existing framework, the instrument could be modified for a particular context of application. Fourthly, we were able to engage directly with the World Bank team who designed the tool for its modifications (see below).

This report

This report identifies the nature of teaching practices within Rwandan secondary schools involved in the Leaders in Teaching initiative, as captured by the classroom observation tool *Teach*. This report is organised as follows: First it describes *Teach's* theoretical framework, content, and development process after which an overview of the sample involved in the study is provided. The next section provides insights into teacher practices in Rwandan secondary school classrooms through presenting results from the *Teach* observation tool. Finally, the last section presents conclusions and implications of our study.

Theoretical framework: Capturing teacher practices

What does *Teach* measure?

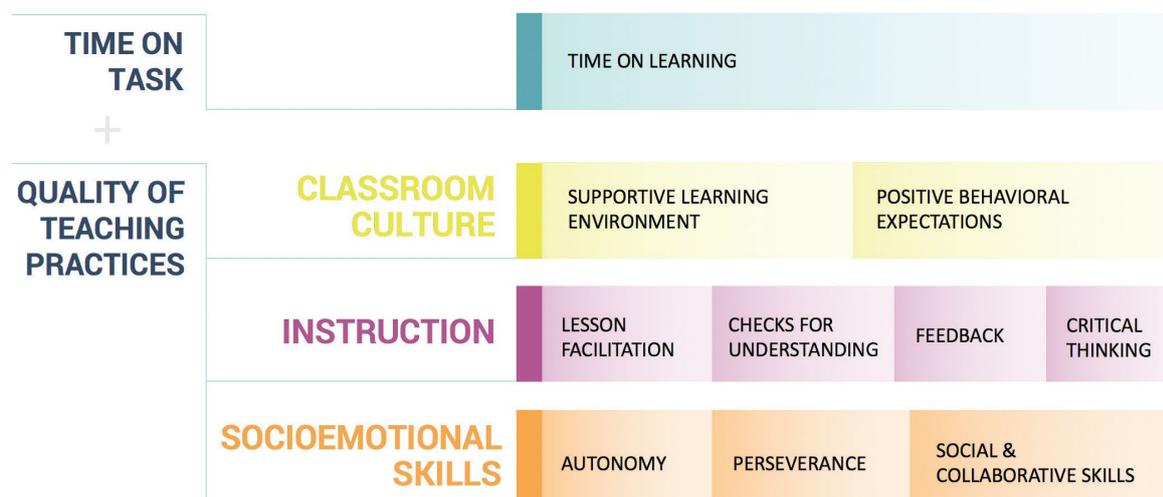
This section of the paper describes the theoretical framework, content, and development process of *Teach*. It also provides an overview of how *Teach* was adapted to the Rwandan and Leaders in Teaching context.

The *Teach* classroom observation tool measures over the course of a teacher's lesson (i) the time teachers spend on learning and the extent to which students are on task, and (ii) the quality of teaching practices that help develop students' socioemotional and cognitive skills.

As part of the Time on Task component, three "snapshots" of 1–10 seconds are used to record both the teacher's actions and the number of students who are on task throughout the observation. The Quality of Teaching Practices component, on the other hand, is organised into three primary areas: Classroom Culture, Instruction, and Socioemotional Skills.³

These three primary areas have nine corresponding elements, as seen below in Figure 1. These corresponding elements point to 28 behaviours (please refer to the full *Teach* observation sheet (The World Bank, 2018a).

Figure 1: The *Teach* observation tool framework



Source: World Bank (2018a)

The behaviours are characterised as low, medium, or high, based on the quality of teacher practices observed. These behaviour scores are translated into a 5-point scale that quantifies teaching practices as captured in a series of two 15-minute lesson observations. Below, each area of the quality of teaching practices component of the *Teach* tool is described, along with their associated behaviours.

1. **Classroom Culture:** The observation aims to identify the extent to which the teacher creates a culture that is conducive to learning. The focus is on extent to which the teacher creates:
 - (i) a supportive learning environment by treating all students respectfully, consistently using positive language, responding to students' needs, and both challenging gender stereotypes and not exhibiting gender bias in the classroom; and
 - (ii) positive behavioural expectations by acknowledging positive student behaviour, and effectively redirecting misbehaviour.

2. **Instruction:** This aspect aims to identify the extent to which teachers instruct in a way that deepens student understanding and encourages critical thinking and analysis. The focus is on the extent to which the teacher:

- (i) facilitates the lesson by explicitly articulating lesson objectives that are aligned to the learning activity, clearly explains content, and connects the learning activity to other content knowledge or students' daily lives, and by modelling the learning activity through enacting or thinking aloud;
- (ii) does not simply move from one topic to the next but checks for understanding by using questions, prompts, or other strategies to determine students' level of understanding, by monitoring students during group and independent work, and by adjusting his/her teaching to the level of students;
- (iii) gives feedback by providing specific comments or prompts to help clarify students' misunderstandings or identify their successes; and encourages students to think critically by asking open-ended questions and providing students with thinking tasks that require them to actively analyse content. Students exhibit critical thinking ability by asking open-ended questions or performing thinking tasks.

3. Socioemotional Skills: For this dimension, the observation aims to identify the extent to which a teacher fosters socioemotional skills that encourage students to succeed both inside and outside the classroom. To develop students' social and emotional skills, the teacher:

- (i) instills autonomy by providing students with opportunities to make choices and take on meaningful roles in the classroom. Students exhibit their autonomy by volunteering to participate in classroom activities;
- (ii) promotes perseverance by acknowledging students' efforts, rather than focusing solely on their intelligence or natural abilities, by having a positive attitude toward students' challenges by framing failure and frustrations as part of the learning process, and by encouraging students to set short- and long-term goals; and
- (iii) fosters social and collaborative skills by encouraging collaboration through peer interaction and by promoting interpersonal skills, such as perspective taking, empathising, emotion regulation, and social problem solving. Students exhibit social and collaborative skills by collaborating with one another through peer interaction.

How was *Teach* developed?

Following our extensive review of classroom observations instruments, we identified the World Bank *Teach* tool to be most relevant for use for the quantitative data collection assessing teaching quality in the Rwandan context. This section outlines how the World Bank developed the tool, followed by our adaptations to it, for its use in secondary schools in Rwanda.

The World Bank *Teach* development team rigorously researched, revised, and piloted different iterations of the tool over a two-year timeframe. Please refer to the *Teach* manual (World Bank, 2018a) for a detailed description of this development process. First, the development team — which comprised one education measurement expert, one instructional expert, one psychologist and one teacher — assessed five classroom observation tools widely used in the United States to create an inventory of teacher practices that are commonly evaluated.⁴ The team then built upon this list to include behaviours from international classroom observation tools used in low- and lower-middle income countries.⁵ Based on this preliminary analysis, the team created an inventory of three areas and 43 elements.⁶

Secondly, the development team hosted a working group of education experts and practitioners to help further reduce and prioritise elements for the *Teach* framework. Following this feedback, the development team reviewed the theoretical and empirical evidence from low- and lower-middle income countries to further eliminate elements from the framework. This process resulted in a downsized framework of 14 elements.

These 14 elements comprised the first working version of the tool, which aimed to capture both quality and frequency of teaching practices as measured by each element.⁷ This preliminary tool was piloted in person in Pakistan and Uruguay and using classroom video footage in Afghanistan, China, Pakistan, the Philippines, Tanzania, Uruguay, and Vietnam. From these pilots, it became apparent that observers struggled to code reliably when they had to simultaneously capture the frequency and quality of teaching practices for each element. In response, the development team revised the structure of the tool to address this challenge as well as other errors and logical inconsistencies. This process resulted in a tool that comprised 10 elements.

As a next step, the World Bank development team convened a technical advisory panel to provide written feedback on the tool. Finally, analysis of the psychometric properties of the tool was undertaken. Based on this analysis and feedback from the trainers and observers, the development team revised each element's structure and complementary examples to improve the tool's consistency and clarity. As part of this process, the Time on Learning element was modified to capture teachers' time on instruction and students' time on task through a series of snapshots. This process resulted in a tool that comprised one low-inference element (that is more straightforward to code), namely Time on Learning. Time on Learning involves three equally spaced lesson "snapshots" of 1–10 seconds that record a teacher's actions (e.g., whether or not they are providing a learning activity) and the number of students who are on task during these learning activities. The other part of the tool is comprised of nine high-inference elements (that require interpretation, and so need careful training to ensure consistency in coding) relating to the Quality of Teaching practices (e.g., Lesson Facilitation and Checks for Understanding). These involve rating teachers on a scale of 1-5 (with 1 being low and 5 being high) on the quality of activities and teaching behaviours observed in the lesson. The final stage involved testing these revisions using the *Teach* video library.

How did we adapt to the Rwandan context?

With respect to our use of the *Teach* tool as part of the Leaders in Teaching study, one perceived issue was that it had been predominantly implemented in primary classrooms rather than secondary classrooms. To determine its applicability Laterite and the REAL Centre reached out to the World Bank *Teach* team who confirmed its potential for this stage of schooling as well as their willingness to provide support on adapting the protocol to secondary classrooms within Rwanda. This led to several months of collaboration where behaviours and content examples were revised to better reflect Rwandan secondary classrooms and topics taught within the Competency-Based Curriculum. To ensure our instrument suitably reflected Rwandan secondary school classrooms, adaptations were also informed by focus group discussions we held with teachers in Rwanda to identify their priorities for assessing teaching quality, as well as by feedback from key stakeholders including educators from the African Institute of Mathematics and Sciences (AIMS). Adjustments to the tool reflected the cultural, educational, and programmatic context in the country. See

Table 1 below for examples. For the study, we video-recorded classrooms, and then seven researchers from Laterite and the REAL Centre coded the observations using the tool following extensive training on the instrument, which was supported by the World Bank’s *Teach* team (see Ani-Asamoah et al. 2020).

Table 1: Adaptations made to the *Teach* tool

Cultural adaptations	Educational adaptations	Program adaptations
Including specific culturally relevant behaviours, e.g., making a gesture of a flower to show positive feedback to students, a common practice in Rwanda. This was used as an example of positive language.	Nuancing behaviours to reflect a secondary context, e.g., changing all references of students using pencils in the classroom to pens, as students no longer use pencils in the secondary context.	Focusing examples on STEM subjects at the secondary level, e.g., examples refer to more advanced work in mathematics subjects such as statistics and probability, rather than basic addition and subtraction.

(Source: Ani-Asamoah et al., 2020).

Overview of the sample

This section provides an overview of the sample involved in the classroom observation study. It further outlines the process for obtaining consent from teachers and students.

This study presents findings from observations of 97 Senior 3 mathematics teachers in 97 secondary schools that are in the Leaders in Teaching initiative areas of Rwanda. Data collection occurred in February 2020 with schools randomly selected from a larger sample of 360 schools that had been exposed to Leaders in Teaching interventions. These 360 schools were included in our overall baseline data collection, that also included a teacher and school leader surveys, teacher content and pedagogical content knowledge assessments and student assessments. Both the subsample used for classroom observations and the larger sample of 360 schools were stratified by district as well as Schools of Excellence. For the overall sample,

Schools of Excellence were oversampled to obtain a target sample for the observation study of 105 schools (31 of which were Schools of Excellence) distributed across 75 sectors. For the classroom observation, 24% of teachers were in Schools of Excellence.

For the classroom observations, a total of 15 female and 82 male teachers were observed. The fact that fewer female teachers were observed is due to them comprising a relatively small proportion of mathematics teachers at the secondary level in Rwanda. Class sizes consisted of, on average, 40 students, and ranged from 13 to 70 students in classes observed across the sample. Schools of Excellence were found to have significantly fewer students (mean=36) than non-Schools of Excellence (mean=42).⁸ In total, 3,907 students were observed, 56% of whom were female as reflected in the composition of the classes. At the time of data collection, classes had reached a similar stage within the mathematics curriculum, and therefore the majority of lessons observed were focused on the teaching of algebra. To our knowledge, teachers were unaware of the *Teach* instrument specifically, but were informed prior to the observation that they would be observed. It is acknowledged that this prior information may have impacted both the teacher and student behaviour observed, a point which is elaborated upon further within the conclusions and implications section. This is a more general challenge of any classroom observation, which are recognised as having a potential ‘Hawthorne effect’, which refers to the tendency to act in a way consistent with perceptions of researchers’ expectations (Frey, 2018). While we endeavoured to minimise this effect, for example, by engaging with and visiting schools prior to the observation and positioning the camera and enumerator at the back of the classroom to minimise distraction, it can take time for participants to feel at ease with researchers in the classroom and show their *true* behaviour. As such, we acknowledge that a single observation may be limited in revealing what behaviours and attitudes teachers typically employ in their lessons.

As shown in Table 2, 89% of schools from our sample were from rural areas within Rwanda. Within the classrooms, 20% included at least one student with a disability. While English constitutes the main language of instruction within secondary classrooms of Rwanda, the observations identified that teachers in 38% of classrooms also used Kinyarwanda, mainly to help clarify concepts for students and facilitate

understanding of content.

Written consent was obtained from school leaders for their teachers and students to participate in the classroom observation study. Students participating also were given the opportunity to opt-out prior to the commencement of data collection. Additionally, school leaders were asked to obtain consent from parents, offering them the ability to opt their children out of the study prior to data collection if there were concerns regarding their involvement.

Table 2: Overview of the study

Number of schools	97
Number of teachers observed	97
Mean class size	40 (± 10.9)
Number of students	3,907
Percentage of female teachers	15%
Percentage of female students	56%
Percentage of classrooms with at least one student with a disability	20%
Percentage of teachers with disabilities	3%
Percentage of rural schools	89%
Percentage of Schools of Excellence	24%
Percentage of Kinyarwanda used in teaching	38%

Insights into teacher practices in Rwandan secondary school classrooms

This section presents results from the *Teach* tool. It begins with a summary of findings for each of the areas of the tool, namely Classroom Culture, Instruction, Socioemotional Skills and Time on Learning. This is followed by a more in-depth examination of *Teach* scores according to the Classroom Culture, Instruction and Socioemotional Skills areas of the instrument. Results are presented throughout for both the overall sample involved in the study and for subsamples according to teacher gender, classrooms with students with disabilities, school location (i.e., rural and urban), use of local language in the classroom and school type (i.e., Schools of Excellence and non-Schools of Excellence).

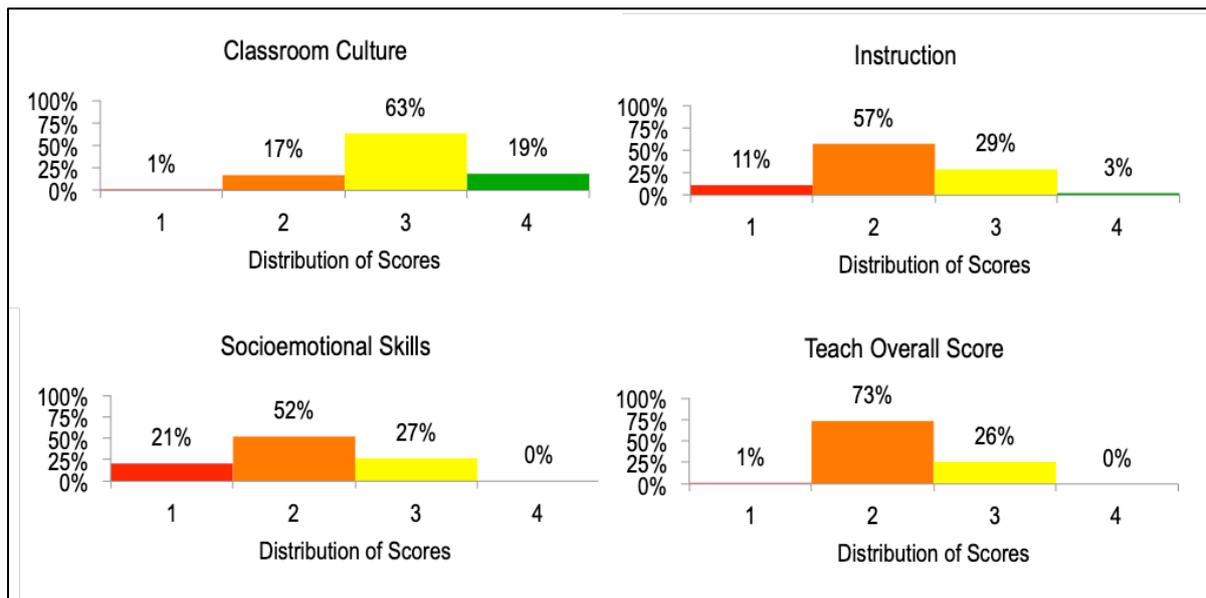
Summary of findings

Overall, the analysis of the classrooms using the *Teach* tool indicate that, in our sample, Rwandan secondary mathematics teachers have strong ability in Classroom Culture (Figure 2).⁹ This is defined by the tool as the teacher creating a supportive learning environment by using, for example, positive language with students and the teacher setting positive behavioural expectations for students. However, they exhibit weaker ability in Instruction, as defined by the tool as the teacher facilitating lessons by stating, for instance, clear instructional objectives; and providing checks for student understanding, feedback on student progress and activities that require students to

actively analyse content. They also exhibit weaker ability in Socioemotional Skills, as defined by the tool as the teacher promoting student autonomy (e.g., by providing students with choices in relation to their learning) encouraging perseverance (e.g., by helping students understand that challenges are a natural part of learning when they make mistakes) and by providing opportunities for students to interact with one another during lessons. These findings are similar to *Teach* findings in other countries (Molina et al., 2018; Molina et al., 2020), which found that teachers perform better in Classroom Culture compared to other areas of the tool. This is in part attributed to socioemotional skills being a relatively new area of pedagogical focus.

No significant differences were observed between subgroups associated with teacher gender; whether classrooms included students with disabilities; use of local language in the classroom; and school location for the overall *Teach* score, nor for the area scores. For school type, however, teachers who were from Schools of Excellence achieved significantly higher overall scores compared with teachers from other schools.¹⁰ They also achieved significantly higher scores for the area of Classroom Culture compared to those from other schools.¹¹

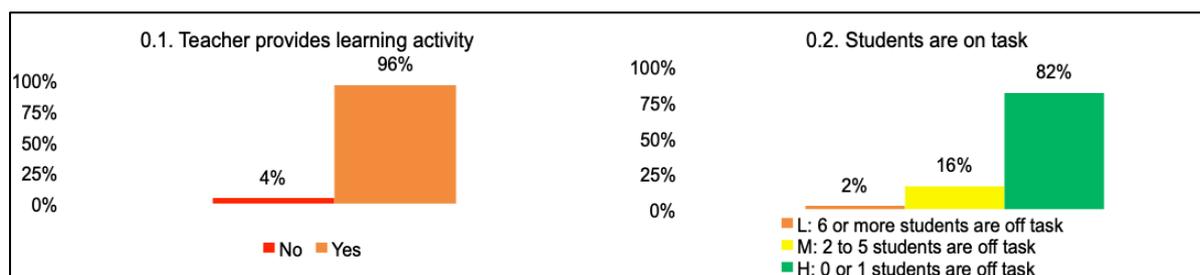
Figure 2: Distribution of average *Teach* scores by area and overall



Note: Different colours are used within this graph to distinguish between score levels for each area of the *Teach* observation protocol associated with the Quality of Teaching component of the tool, as well as the overall score. This is also done for other graphs throughout the paper

With respect to the Time on Learning area of the tool, secondary mathematics teachers in Rwanda were further found to provide a learning activity to students for the vast majority of their lesson time. Moreover, when teachers provided a learning activity, all students were on task for most of the lesson time. This indicates that minimal time was wasted during class time within observed lessons on activities unrelated to class content such as disciplining students, taking attendance or other activities which leave students waiting unnecessarily (Figure 3).

Figure 3: Distribution of time on learning variables¹²



Insights into Classroom Culture, Instruction and Socioemotional Skills results

The following sections provide insights into each of the three areas covered by the tool in more detail by providing a summary of each element score related to the three areas of Classroom Culture, Instruction and Socioemotional Skills. This is then unpacked by examining behaviour scores related to each of the elements of *Teach*.

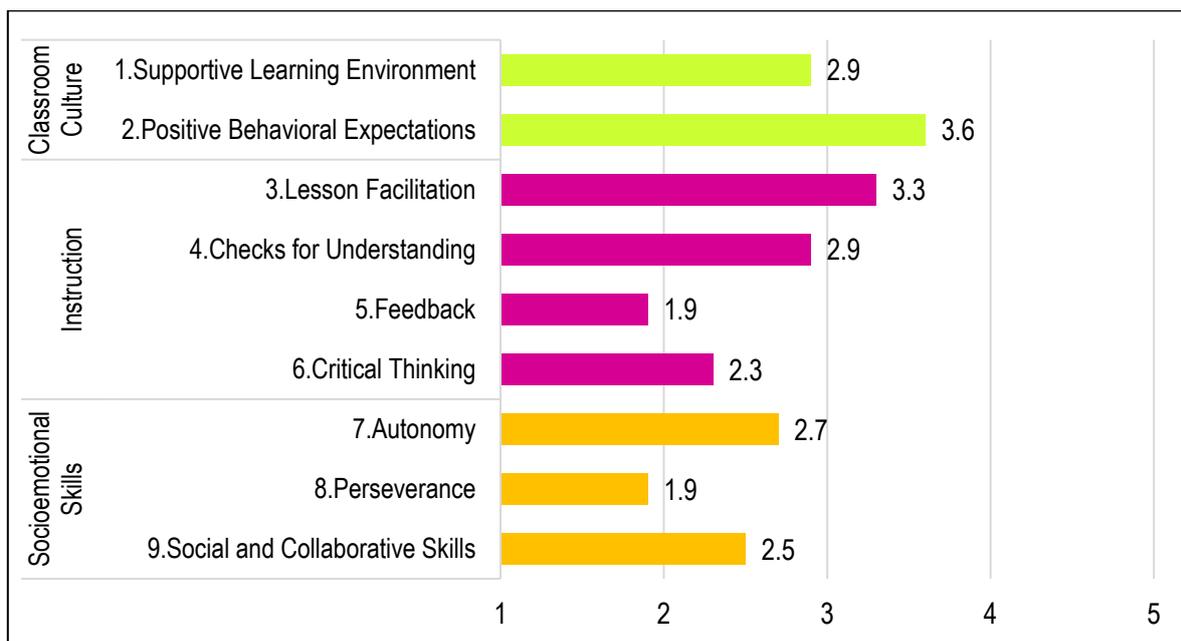
Firstly, for the area of Classroom Culture, secondary school teachers in Rwanda were found to score 3.6 out of 5 possible points for Setting Behavioural Expectations (e.g., the extent to which teachers explicitly state clear behaviour expectations). This is higher than the midpoint (i.e. 3) of the score range (i.e. 1-5). These scores are intended to help identify areas of strength and weakness, with a score below the midpoint likely to indicate the area as being one for improvement. They scored lower in creating a Supportive Learning Environment (e.g., how often teachers use positive language in the classroom).

Secondly, for the area of Instruction, teachers scored strongest in Lesson Facilitation (e.g., whether teachers explicitly articulate lesson objectives aligned to the learning activity). They achieved lower scores for Checks for Understanding (e.g., the extent to which teachers use questions to determine student understanding), Feedback (e.g., whether teachers provide specific comments to help clarify student misunderstandings), and Critical Thinking (e.g., whether teachers use open-ended questions and provide activities that require students to actively analyse content by predicting, interpreting, or making connections).

Lastly, Rwandan Secondary teachers scored below the midpoint of the score range for all three elements of Socioemotional Skills including: Autonomy (e.g. whether the teacher give students choices in relation to their learning, Perseverance, (e.g. the

extent to which the teacher acknowledges student efforts rather than just focusing on outcomes and abilities) and Social and Collaborative Skills (e.g. whether teachers encourage collaboration through peer interaction and promote interpersonal skills). In summary, the teachers' strongest observed behaviour, on average, was setting positive behavioural expectations, whereas their weakest was providing feedback on learning and support for the development of perseverance (Figure 4).

Figure 4: Distribution of average *Teach* scores by element



Area 1: Classroom Culture results

Classroom Culture measures the extent to which the teacher creates a culture that is conducive to learning. The focus here is on the extent to which the teacher creates: (i) a **supportive learning environment** by treating all students respectfully, consistently using positive language, responding to students' needs, and both challenging gender stereotypes and not exhibiting gender bias in the classroom; and (ii) **positive behavioural expectations** by setting clear behavioural expectations, acknowledging positive student behaviour, and effectively redirecting misbehaviour.

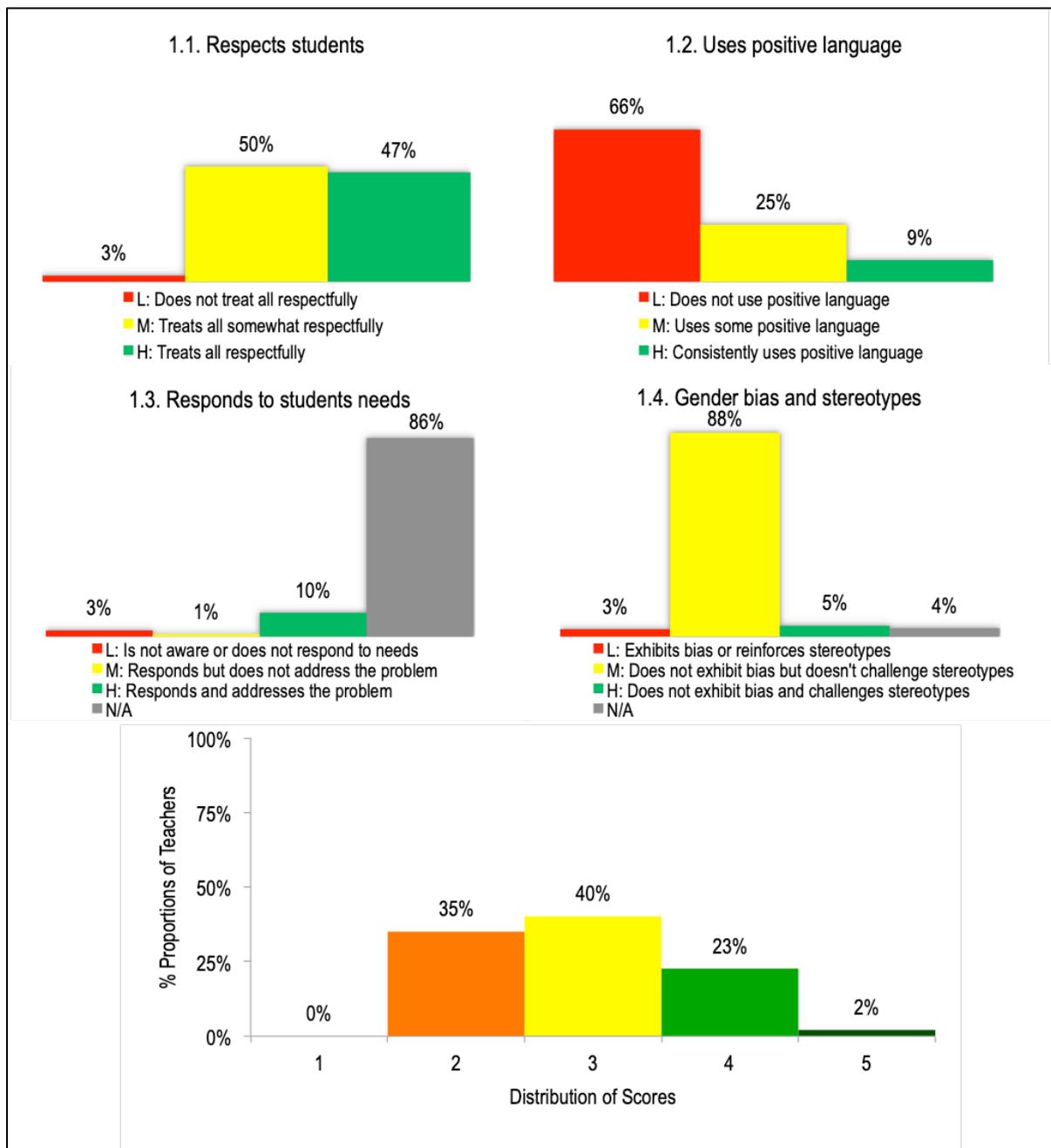
Overall, teachers performed relatively well on Classroom Culture on average: they score 3.3 points out of the 5 points possible in this element. They were observed to be most effective at Positive Behavioural Expectations, but less effective at Supportive Learning Environment (See Figure 4). We did not find any significant differences for subgroups according to teacher gender, classrooms with students with disabilities,

school location, use of local language in the classroom or school type for the overall Supportive Learning Environment or Positive Behavioural Expectations scores.

Supportive Learning Environment. On average, teachers score 2.9 points out of the 5 points possible with respect to Supportive Learning Environment (Figure 4). Figure 5 shows the distribution of scores for each of the behaviours associated with this area. The majority of teachers were observed to treat students somewhat respectfully (e.g., by not ridiculing or yelling at students when they made mistakes or entered a lesson late), or to explicitly use respectful language or actions during their lessons, for example, by using students' names, saying 'please' or 'thank you'. However, less than a quarter of teachers used positive language in their lessons such as 'well done', 'let's give a round of applause' or a 'give the student a flower'. When this did occur, it was usually infrequent.

For the most part, few students were observed having material (e.g., not having a pen), physical (e.g., needing to use the bathroom) or emotional needs (e.g., being upset due to having made a mistake) during lessons but for those who did, teachers were on the whole responsive. Gender bias and stereotypes was rarely observed with respect to teachers providing equal opportunities for girls and boys to participate in lessons and expressing equal expectations for students' behaviours or capabilities. This was observed through the teacher giving male and female students equal opportunities to answer questions, clean the black board and demonstrate to the class how to solve an equation. However, there were minimal examples of teachers challenging gender stereotypes, such as giving female students leadership roles during group work in the lessons observed. No significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location, use of local language in the classroom or school type were found for the overall Supportive Learning Environment score.

Figure 5: Supportive learning environment

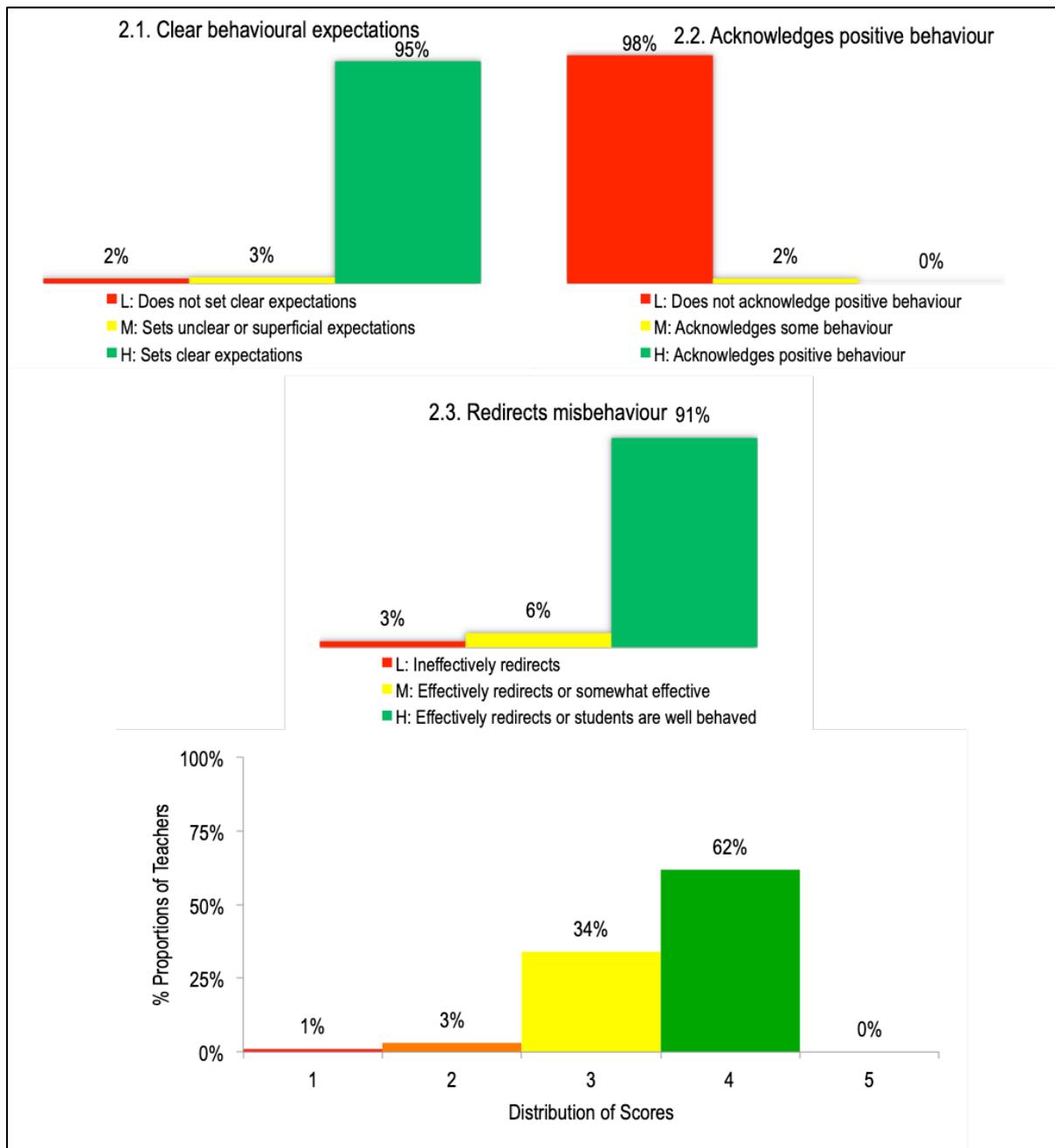


Positive Behavioural Expectations. On average, teachers score 3.6 points out of the 5 points possible for Positive Behavioural Expectations (Figure 4). Figure 6 shows the distribution of scores for each behaviour associated with positive behavioural expectations. Rwandan secondary mathematics teachers who were observed predominantly set clear behavioural expectations. In our observations, this was largely indicated through students being well-behaved throughout lessons rather than through teachers explicitly articulating behaviour expectations during lessons such as ‘Please

raise your hand' or 'Please work quietly'. Despite students' exemplary behaviour, teachers were very rarely seen to acknowledge their positive behaviour. For example, there were minimal instances of teacher comments relating to students' efforts during learning, such as, 'I like how you each shared your ideas or approaches for solving this problem' or 'You used your time productively during this activity'. For the behaviour relating to the redirection of misbehaviour, the vast majority of teachers observed attained high scores, however, as with setting clear expectations, this score was mainly due to students being well-behaved throughout the lesson.

No significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location, use of local language in the classroom or school type were found for the overall Positive Behavioural Expectations score.

Figure 6: Positive behavioural expectations



Area 2: Instruction results

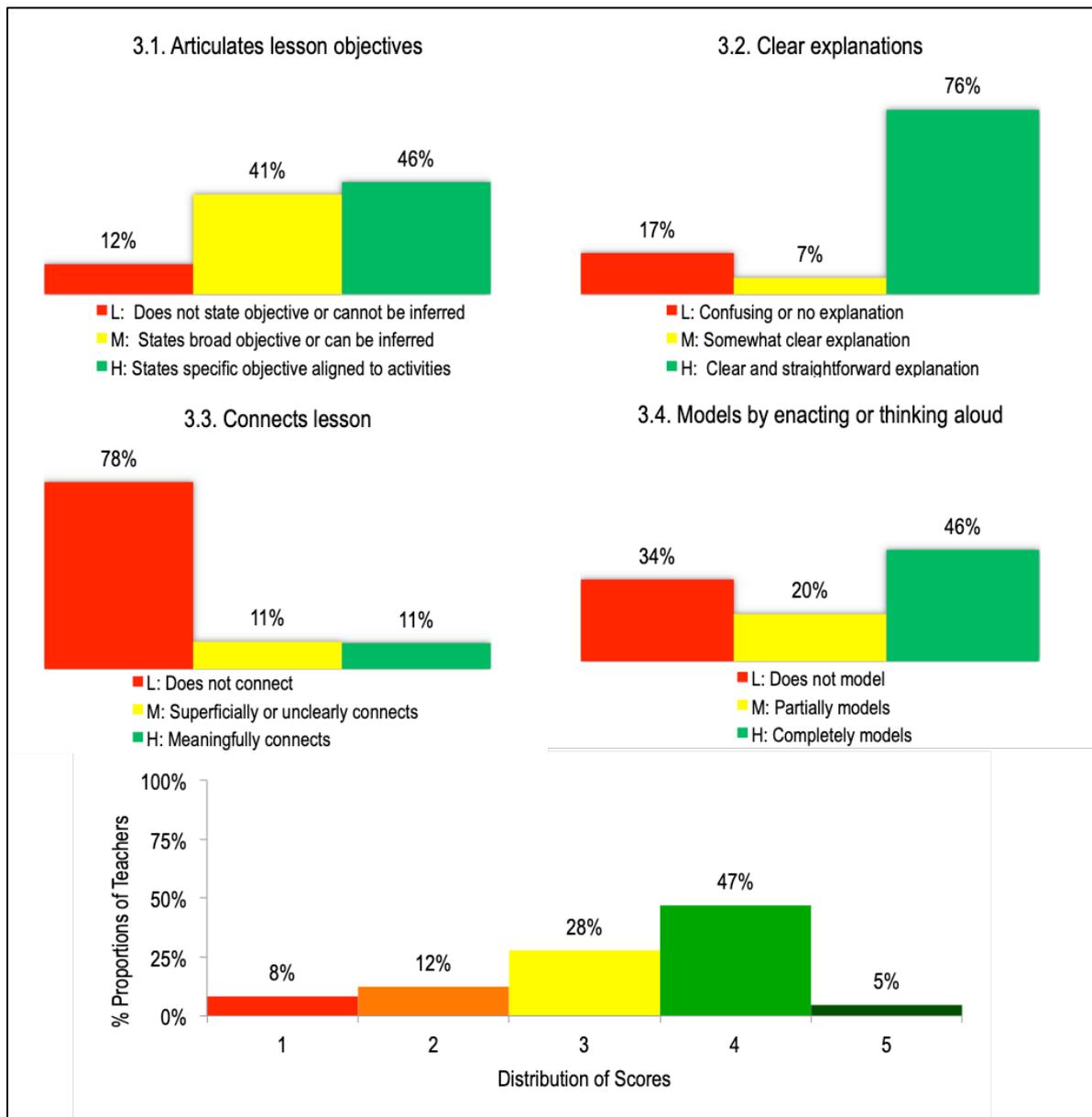
The Instruction area of the *Teach* tool measures whether the teacher instructs in a manner that deepens student understanding and encourages critical thinking and analysis. The focus here is on the extent to which the teacher: (i) **facilitates the lesson** by explicitly articulating lesson objectives that are aligned to the learning activity, clearly explains content, and connects the learning activity to other content knowledge or students' daily lives, and by modelling the learning activity through enacting or thinking aloud; (ii) does not simply move from one topic to the next but **checks for understanding** by using questions, prompts, or other strategies to determine students' level of understanding, by monitoring students during group and independent work, and by adjusting his/her teaching to the level of students; (iii) gives **feedback** by providing specific comments or prompts to help clarify students' misunderstandings or identify their successes; and (iv) encourages students to **think critically** by asking open-ended questions and providing students with thinking tasks that require them to actively analyse content. Students exhibit critical thinking ability by asking open-ended questions or performing thinking tasks.

Overall, teachers were found to perform below the midpoint of the score range in Instruction. On average, they score 2.6 points out of the 5 points possible in this element. As described in more detail below, they were most effective at Lesson Facilitation, but less effective at Checks for Understanding, Feedback and Critical Thinking (See Figure 4). We did not find any significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location, use of local language in the classroom or school type for the overall Lesson Facilitation, Checks for Understanding or Feedback scores.

Lesson Facilitation. On average, teachers score 3.3 points out of the 5 points possible for Lesson Facilitation (Figure 4). Figure 7 shows the distribution of teacher's scores for each behaviour associated with lesson facilitation. As shown, most teachers scored well for Articulates Lesson Objectives. Specifically, just under half of teachers were found to explicitly state a specific lesson objective such as 'Today we're going to learn about simultaneous linear equations and inequalities' or 'Within this lesson we will be learning about algebraic fractions' and had activities aligned to this objective. A similar frequency of teachers were also found to either state a broad lesson objective

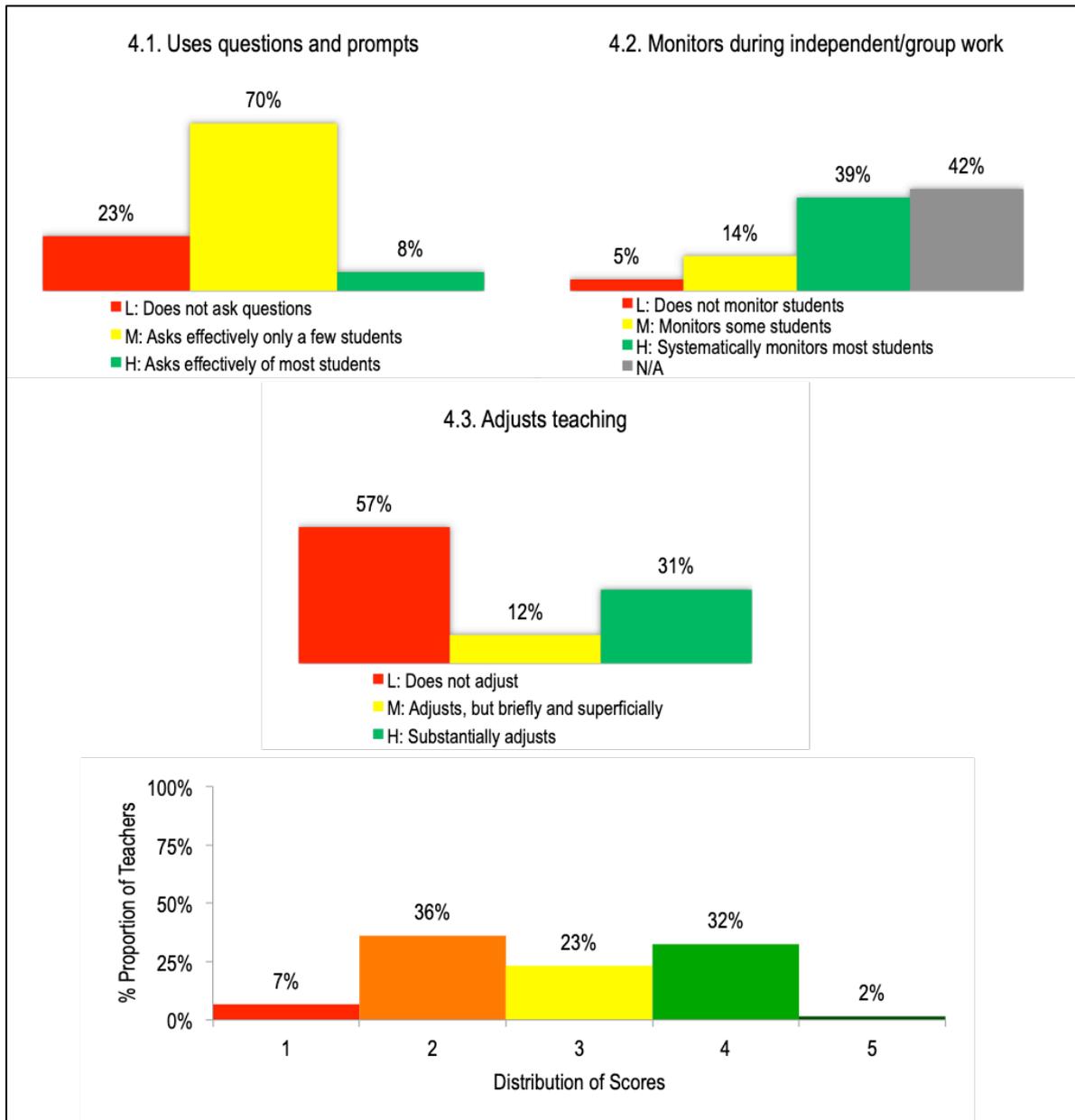
such as 'Today we are learning about algebra' or this was inferred from the lesson activities. Over three quarters of teachers were also observed giving clear explanations of content that were easy to understand, logical and often accompanied by written representations or examples on the board. Conversely, teachers observed performed poorly with respect to making connections in the lesson that relate to other content knowledge or students' daily lives. For example, over three quarters of teachers did not make any connections in their lessons. We appreciate that this may be somewhat more challenging in lessons focused on algebra, which was the topic for instruction for the majority of lessons observed. For the teacher modelling behaviour, over half of teachers were found to either partially or completely model learning activities in their classroom. In our study, this was often observed through co-constructions of learning, i.e., with teachers and students enacting a method to solve algebraic equations while thinking aloud through the process. No significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location, use of local language in the classroom or school type were found for the overall Lesson Facilitation score.

Figure 7: Lesson Facilitation



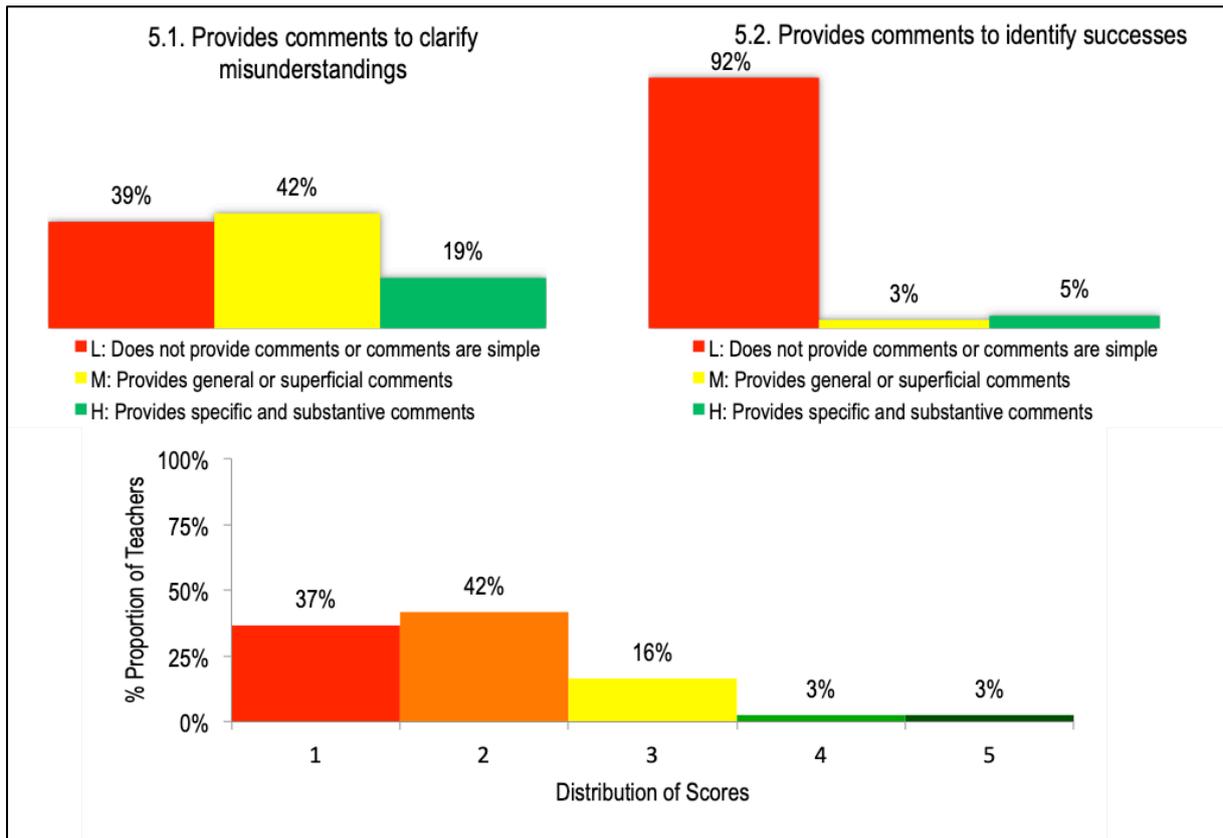
Check for Understanding. On average, teachers score 2.9 points out of the 5 points possible for Checks for Understanding (Figure 4). Figure 8 shows the distribution of teachers' scores for each behaviour associated with checks for understanding. In terms of Uses Questions and Prompts, while over two thirds of teachers were found to ask questions to their students, these were mainly directed at a few learners and not over half of the class. As such, teachers, in general, ineffectively determined all students' level of understanding during lesson segments observed. Teachers were further found to systematically monitor students' learning most of the time when independent of group work occurred. This monitoring constituted roving the classroom to check groups were on task, checking work for accuracy, clarifying concepts, and asking questions. Just under half of teachers also adjusted their teaching to the level of the student during checks for understanding. For example, a small proportion of teachers were found to adjust briefly and superficially to students during checks for understanding, for example, by reminding students if they had forgotten a step in the process of solving an algebraic equation or to give students more time to complete an activity. Approximately a third of teachers were also observed as substantially adjusting their teaching to students' understanding level. This constituted more involved back and forth exchanges when students did not grasp concepts taught which provided opportunities for learning improvement. No significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location, use of local language in the classroom or school type were found for the overall Checks for Understanding score.

Figure 8: Checks for Understanding



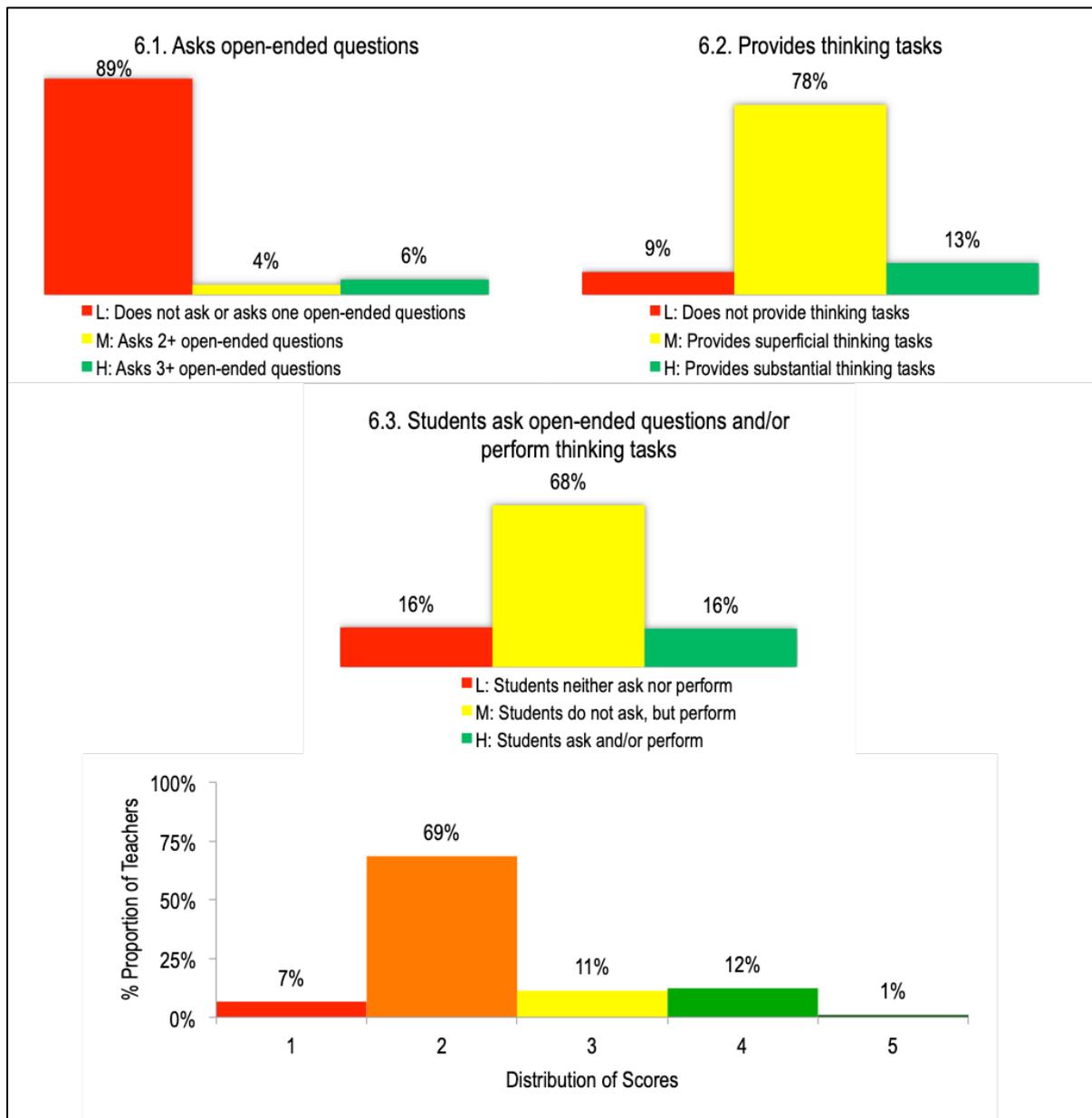
Feedback. On average, teachers score 1.9 points out of the 5 points possible for Feedback (Figure 4). Figure 9 shows the distribution of teacher's scores for each behaviour associated with feedback. Just under half of secondary teachers were found to provide general or superficial comments to clarify misunderstandings, whereas approximately one fifth were observed giving students specific and substantive comments that helped improve knowledge or allowed pupils to come to answers themselves. With respect to identifying students' successes in the classroom, such as when they solved equations correctly, the vast majority of teachers either did not comment on this in the classroom or provided comments that were simple such as 'That is correct', before continuing with the lesson. Based on our sample of observations of classrooms, this suggests that feedback is an area that would potentially benefit from support for Rwandan secondary mathematics teachers. Teachers may benefit from support in providing students with specific comments and substantive information that helps make students aware of when they have done something correctly. For example, rather than saying 'Good job on your graph', the teacher might say 'You did a good job on constructing this graph. Your horizontal and vertical axes are clearly marked, equally spaced and correctly labelled'. No significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location, use of local language in the classroom or school type were found for the overall Checks for Understanding score.

Figure 9: Feedback



Critical Thinking. On average, teachers score 2.3 points out of the 5 points possible for Critical Thinking (Figure 4). Figure 10 shows the distribution of teacher's scores for each behaviour associated with critical thinking. The majority of teachers observed (87%) were found to never ask open-ended questions in their lessons such as 'How did you come to that answer?' With respect to the provision of thinking tasks, namely activities that require students to actively analyse content (e.g., by making predictions, explaining thinking or identifying patterns) as opposed to simply receiving information or rote learning tasks - most teachers were observed to implement these at only a superficial level within the classroom. For example, most tasks were observed as applying learned information or techniques similar to those already demonstrated by the teachers. This often occurred when students were instructed to solve a similar equation to one which had been previously modelled by the teacher. These findings were also identified when observing students, i.e., students were rarely observed as performing substantial thinking tasks which required them to make their own connections between mathematical concepts, make predictions, interpret information, or apply learned information or techniques to new tasks not demonstrated by the teacher. We only saw a few examples of teachers providing substantial thinking tasks. Overall, our observations indicate that Critical Thinking is another area of practice in which Rwandan secondary teachers could benefit from further support for their teaching.

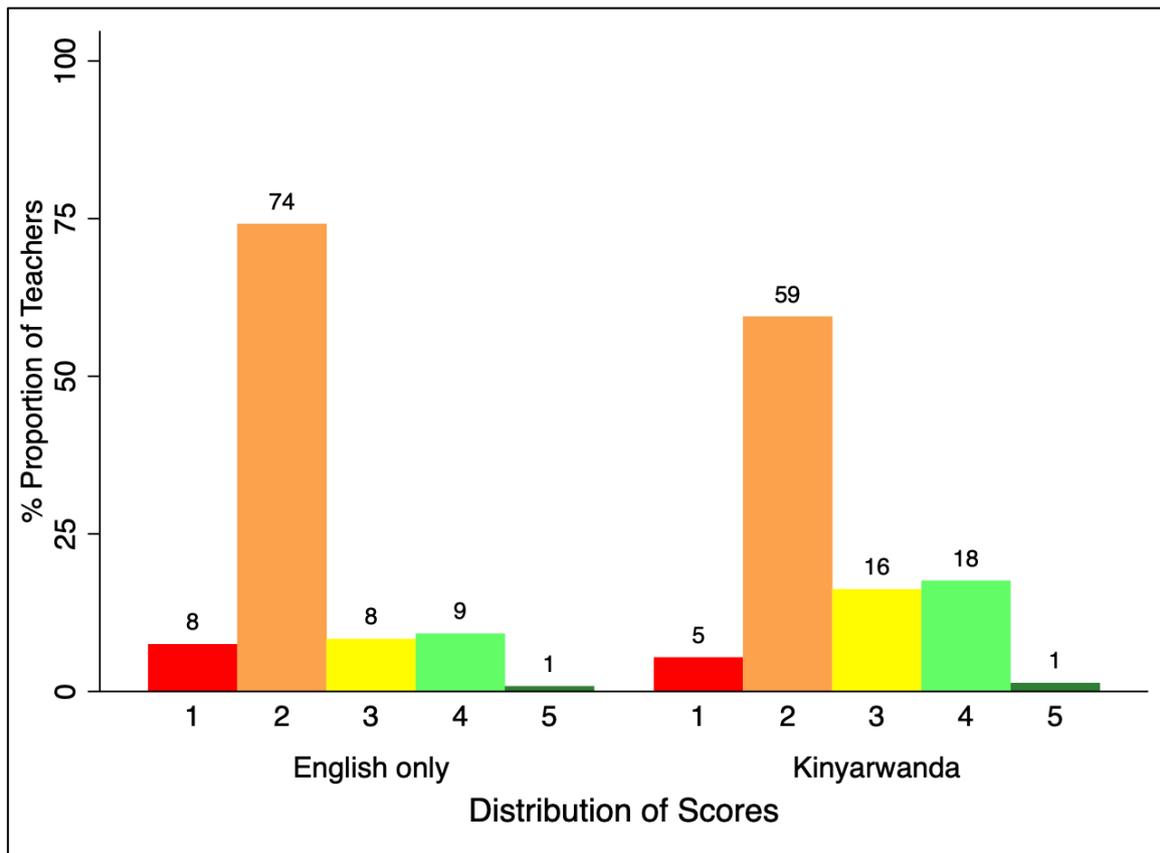
Figure 10: Critical Thinking



No significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location or school type were found for the overall Critical Thinking score. For use of local language in the classroom, however, we did find evidence that teachers who used Kinyarwanda in their classrooms achieved significantly higher scores (2.5) than those who did not (2.2).¹³ It is important to note, however, that both these scores were below the midpoint of the score range indicating that both subgroups of teachers were largely ineffective at supporting students use of higher-order thinking skills in the classroom. Figure 11 indicates, however, that teachers using Kinyarwanda had higher scores for the three behaviours associated

with Critical Thinking compared with teachers who only used English. These three behaviours included using open-ended questions, providing thinking tasks for students and students performing thinking tasks and/or asking open-ended questions.

Figure 11: Critical Thinking by use of local language in the classroom



Area 3: Socioemotional Skills results

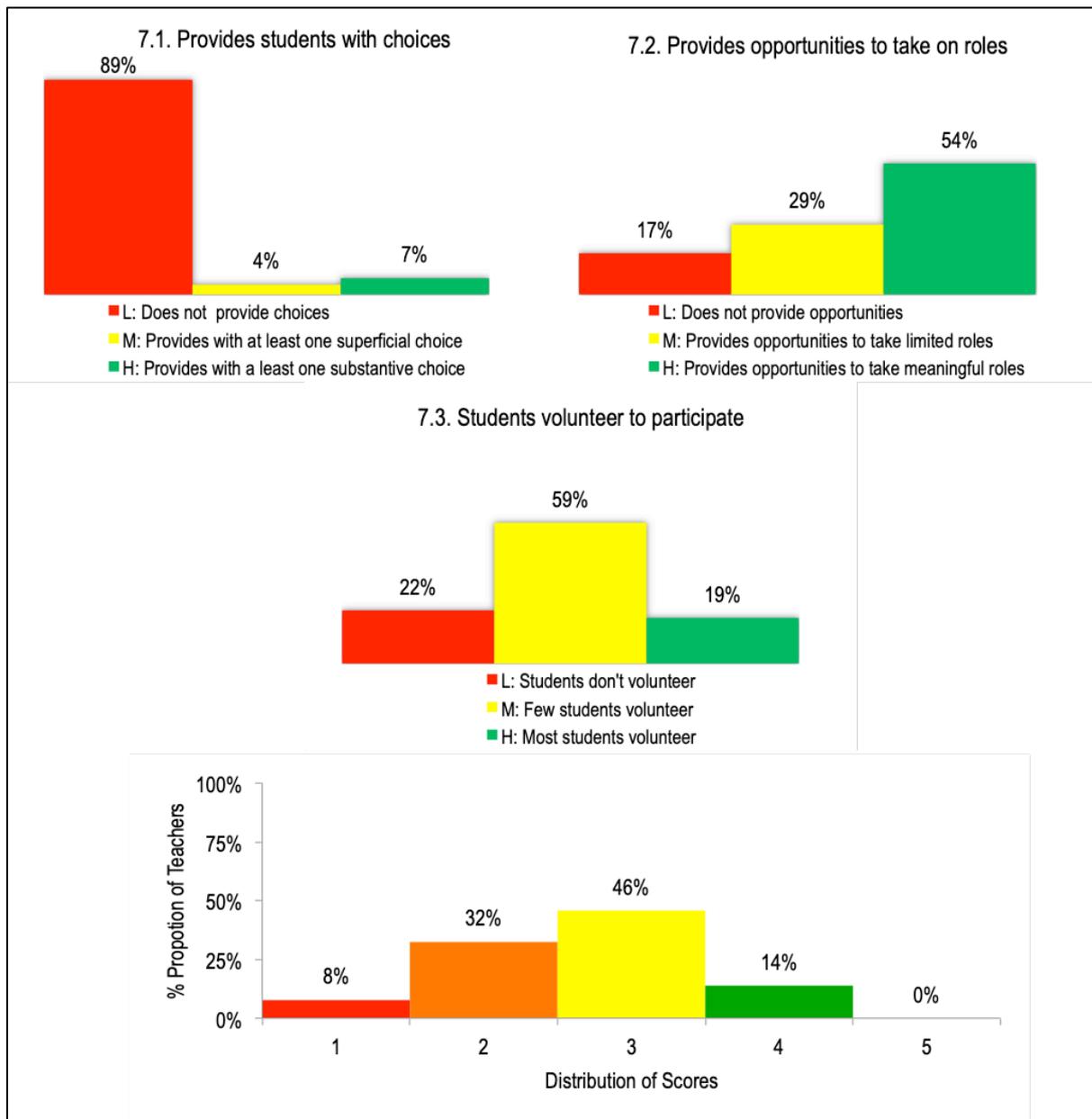
The Socioemotional Skills area measures whether the teacher fosters the social and emotional skills that encourage students to succeed both inside and outside the classroom. To develop these skills, the teacher (i) instils **autonomy** by providing students with opportunities to make choices and take on meaningful roles in the classroom. Students exhibit their autonomy by volunteering to participate in classroom activities; (ii) promotes **perseverance** by acknowledging students' efforts, rather than focusing solely on their intelligence or natural abilities, by having a positive attitude toward students' challenges by framing failure and frustrations as part of the learning process, and by encouraging students to set short- and long-term goals; and (iii) fosters **social and collaborative skills** by encouraging collaboration through peer

interaction and by promoting interpersonal skills, such as perspective taking, empathising, emotion regulation, and social problem solving. Students exhibit social and collaborative skills by collaborating with one another through peer interaction.

Overall, our observations identified that teachers' performance was lowest in the area of Socioemotional Skills compared with the other two areas. As described in more detail below, on average, they score 2.4 points out of the 5 points possible in this element. As seen, they performed strongest in Autonomy with slightly lower scores for Social and Collaborative Skills. They performed weakest in Perseverance (See Figure 4).

Autonomy. On average, teachers score 2.7 points out of the 5-points possible for Autonomy (Figure 4). Figure 12 shows the distribution of teacher's scores for each behaviour associated with autonomy. As seen, most teachers did not explicitly provide students with choices in relation to their learning. For those that did, superficial choices (scored as medium) included having students select which coordinates to plot on a graph (e.g., 2 on the x axis; 5 on the y axis) or choose a partner to work with. More substantial choices (scored as high) included allowing students to decide which method to use when solving an equation. By contrast, over half of teachers were seen to provide students with opportunities to take on meaningful roles in the classroom, which mostly constituted students solving equations on the board and verbalising their thinking through this process. In over three quarters of classrooms observed, less than half of students volunteered to participate in lessons. In fewer than 20% of classrooms observed, this was over half of students in the classroom.

Figure 12: Autonomy

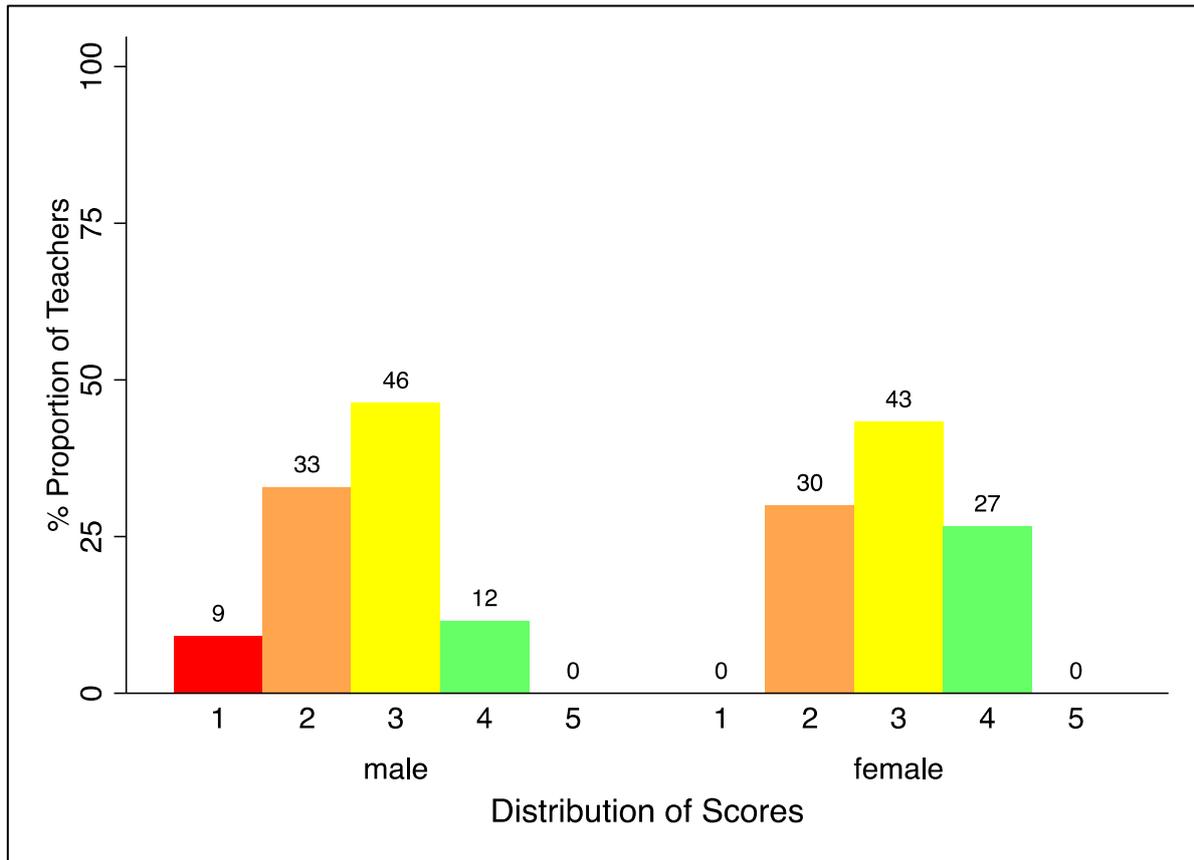


No significant differences for subgroups according to use of local language in the classroom, classrooms with students with disabilities, school location or school type were found for the overall Autonomy score. For teacher gender, however, we did find evidence that female teachers had significantly higher scores (3.0) than males (2.6) in their support of student Autonomy.¹⁴

Figure 13 demonstrates that females achieved greater proportions of teachers achieving high scores across the three behaviours associated with Autonomy including providing students with choices in the lesson, providing students with

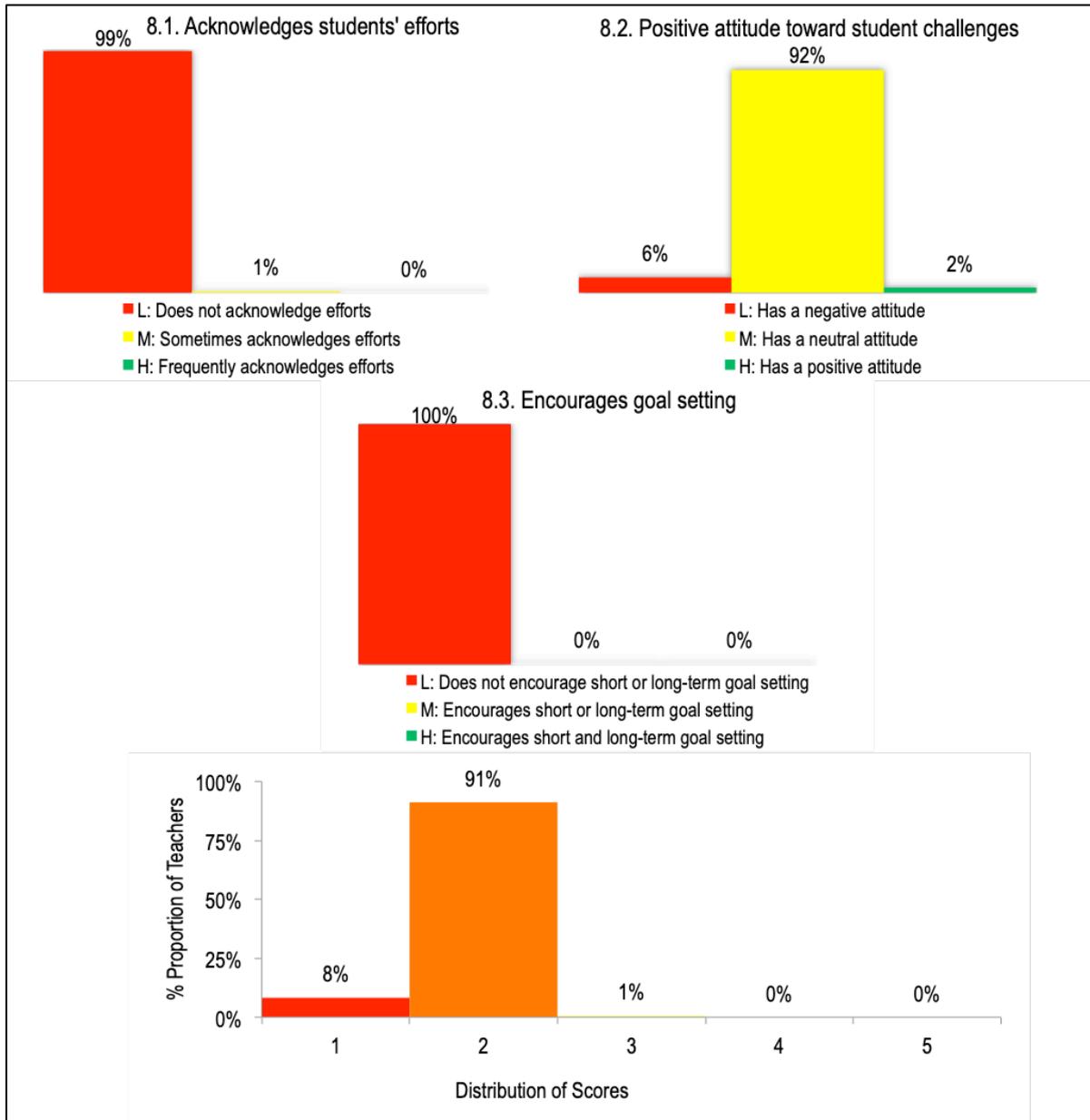
opportunities to take on roles and students volunteering to participate. Of these three behaviours, the biggest differences in results were seen for the level of student voluntary participation in the classroom suggesting that female teachers are more effective at encouraging this student behaviour in the classroom.

Figure 13: Autonomy by teacher gender



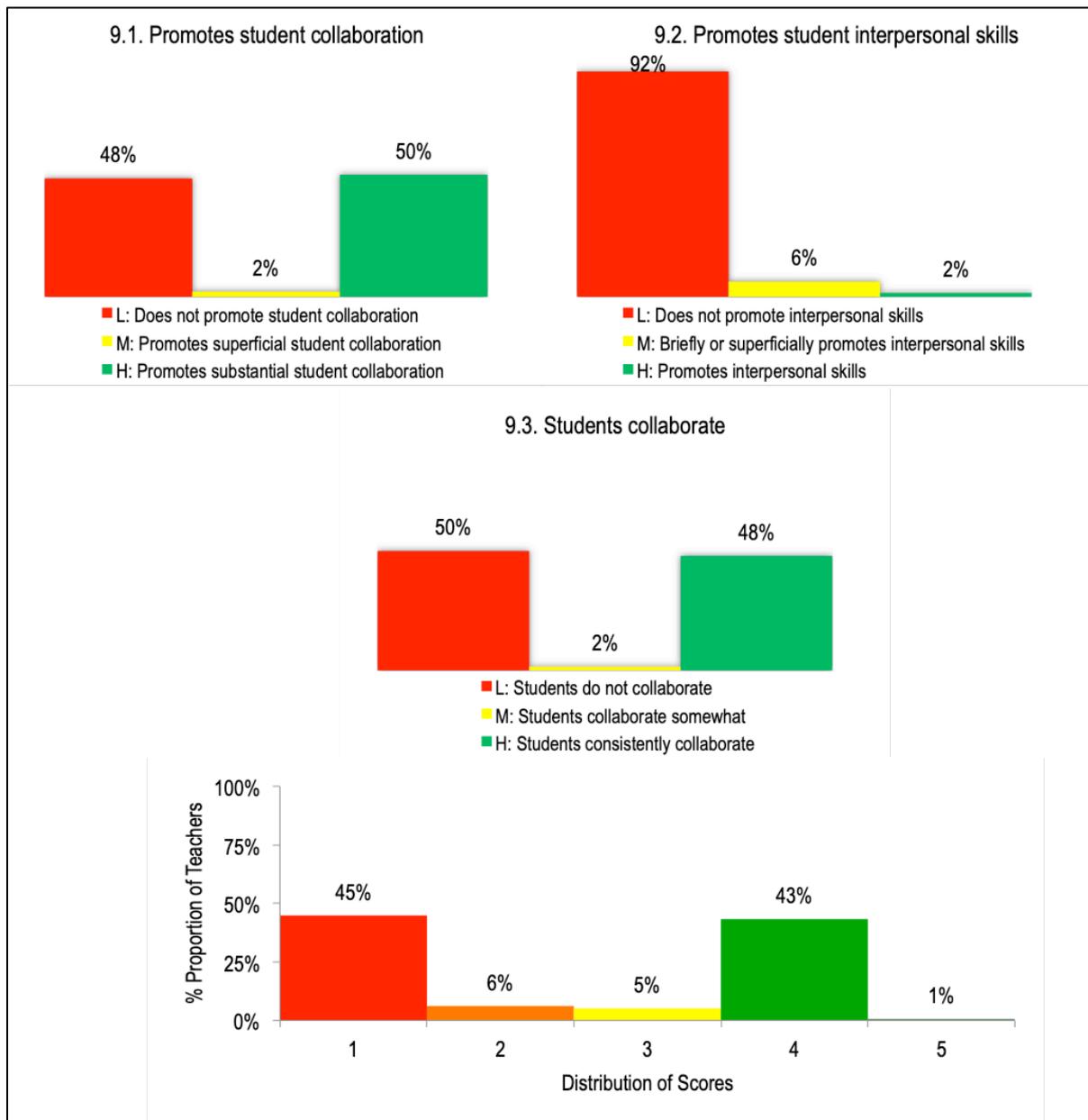
Perseverance. On average, teachers score 1.9 points out of the 5-points possible for Perseverance (Figure 4). Figure 14 shows the distribution of teacher's scores for each behaviour associated with perseverance. As shown, the vast majority of teachers observed did not acknowledge students' efforts in the classroom. For example, while teachers were found to praise students when they answered a question correctly in class by saying for example 'Well done' or 'Good', we saw no acknowledgement of the effort students invested in their work or mastering new skills or concepts taught in class. Teachers' attitude towards students' challenges was primarily seen to be neutral throughout lessons. For instance, while teachers were not observed penalising a student for errors, they also did not make it clear that failure and frustration are a normal and important part of learning. In respect to goal setting, no teachers were observed as encouraging either short or long-term goal setting within their lessons.

Figure 14: Perseverance



Social and Collaborative Skills. On average, teachers score 2.5 points out of the 5-points possible for Social and Collaborative Skills (Figure 4). Figure 15 shows the distribution of teacher's scores for each behaviour associated with social and collaborative skills. Half of teachers were found to promote substantial student collaboration in their classrooms which predominantly involved students working together at their desks to solve mathematical equations. This was also observed when the focus was on students with few observed instances of negative behaviour. However, around half of teachers also did not implement any collaborative work in observed lesson segments. Whilst collaborative work was apparent in many lessons, very few examples were observed of teachers promoting interpersonal skills by encouraging perspective-taking (the ability to consider a situation from a different point of view), empathising, emotion regulation (the ability to effectively manage and respond to an emotional experience), or social problem solving. Among the examples observed, one teacher explained to students that they should not be competitive with each other in the classroom, as they were there to help each other to do their best. In general, Social and Collaborative Skills are potentially areas of practice that Rwandan secondary mathematics teachers could benefit from further support. We did not find any significant differences for subgroups according to teacher gender, classrooms with students with disabilities, school location, use of local language in the classroom or school type for the overall Social and Collaborative Skills score.

Figure 15: Social and Collaborative Skills



Conclusions and implications

This study has highlighted that Rwandan secondary mathematics teachers were observed to use a number of effective pedagogical strategies in their classrooms. As shown through results for the Time on Learning area of *Teach*, they excelled in using their time effectively during lessons and are competent at engaging students in learning, as evidenced by the high prevalence of on-task student behaviour observed in lessons. They were also skilled at creating a classroom environment that is conducive to learning and students feeling valued. This is evident from their strong scores in the Classroom Culture area of *Teach* and its behaviours relating to the use of respectful language in the classroom and the absence of gender bias and stereotyping in classrooms.

Other strengths revealed through this study include Rwandan secondary mathematics teachers' ability to set positive behavioural expectations for their students, as evidenced through students' focused behaviour during learning and the absence of disruptive behaviour that can detrimentally impact learning. Scores relating to the Instruction area of *Teach* further revealed Rwandan teachers' abilities in Lesson Facilitation, particularly their ability to explicitly state learning objectives and clearly express content to students.

Whilst this study has elucidated a number of pedagogical strengths, it has also identified some aspects of teaching where support would be beneficial. With respect to the Classroom Culture area, for example, approximately two thirds of teachers were found to use no positive language in their lessons. This highlights an aspect of teaching practice that could be given further attention, particularly given the body of evidence attesting to the importance of praise in improving student academic and psychosocial outcomes at the secondary level (see Carter et al., 2020, for review). It is also important to note that this constitutes a focus within the existing lesson evaluation tool developed by the Ministry of Education in Rwanda, which is used to determine teaching quality (Ministry of Education Rwanda, n.d.).

For Instruction, teachers were also found to give limited feedback to students when they made errors and did not make it clear what students did well in lessons when they were correct. This therefore shows that feedback given in lessons is insufficient in the

mathematics lessons we observed. Research conducted in secondary classrooms from both the Global North and South has shown that different teacher feedback types can impact students' learning in different ways, with more specific and substantial expressions associated with better outcomes than brief and superficial comments (Hattie and Timperley, 2007; James and Florunso, 2012; Kyruzi et al., 2019). Research conducted in European secondary classrooms further indicates that feedback types can differ according to subject and that there is more emphasis on giving correct answers and correcting mistakes in mathematics, compared to other subjects such as language arts. However, it is important to note that research of this nature has not, to our knowledge, been conducted in the Global South (Havnes et al., 2012). In other words, our finding for this element of the tool may have been influenced by the fact we were observing mathematics lessons. Nonetheless, the provision of formative feedback within lessons is a clear goal for teachers within Rwanda, as evidenced by the indicator with the Ministry of Education's lesson evaluation protocol: 'The teacher provides constructive feedback to learners so that they know how to improve' (Ministry of Education Rwanda, n.d.).

Of all areas of the tool, the performance of teachers observed for the study was found to be weakest for supporting students' Socioemotional Skills. This finding that is not unique to Rwandan teachers, but has been observed in the majority of contexts where *Teach* has been applied (Molina et al., 2018; Molina et al., 2020). Specifically, we found that student choices in learning were largely absent from observed lessons. This is an aspect of pedagogy where Rwandan teachers may benefit from further support, particularly given that the competency-based curriculum in Rwanda is based upon learner-centred principles that promote student agency and ownership of learning. Additionally, in relation to teachers' encouragement of student perseverance, examples of teachers acknowledging students' efforts, expressing a positive attitude towards students' challenges, or encouraging goal setting by students were minimal to none. These pedagogical behaviours, whilst possibly not perceived as a priority for Rwandan secondary teachers, could increase in importance, especially given the challenges students are likely to face upon returning to school following prolonged closures due to COVID-19. In such an environment where learning loss is to be expected, it will be important that students feel comfortable in expressing challenges that they may be having and are supported in understanding that setbacks are a

normal part of learning and development.

The promotion of students' interpersonal skills was another rarely observed practice. Rwandan teachers may also seek to develop their skills in this area given priorities of the competency-based curriculum in developing students' cooperation skills, and enabling learners to work in diverse group settings to increase tolerance and understanding of diversity (see Rwandan Education Board, 2015).

Our disaggregated analysis also revealed several findings of interest that, in our view, warrant further examination and understanding. For example, the fact that female teachers were found to score higher in their support of student Autonomy, a result largely driven by differences in students' voluntary participation in lessons, suggests that female teachers may be acting as important role models for students and possibly enhancing students' motivation to learn. Understanding the impact that female teachers have on students, especially girls, would therefore be an interesting area to pursue further. This is of particular relevance given the current imbalance of male and female STEM teachers and the efforts of the Rwandan government in encouraging females to enter into this teaching discipline. Additionally, we found evidence that teachers using local language alongside English in their lessons showed teaching practices that were more likely to facilitate thinking tasks that required students to actively analyse content. For example, these practices required students to make predictions, interpret information or make connections between mathematical concepts. Based on this finding, understanding why and how teachers use local language in the classroom alongside English, and the perceived advantages as well as disadvantages of this practice would also be interesting lines of inquiry to pursue further. These findings could also help inform government guidelines on ways in which local language might be used to enhance learning at the secondary level.

Lastly, differences between teachers from different school types on overall scores of *Teach* as well as the Classroom Culture area score specifically revealed that the quality of learning and instruction tends to be higher in Schools of Excellence compared to non-Schools of Excellence. These results, however, must be contextualised by the following points: Schools of Excellence select the highest performing students who also come from relatively wealthier backgrounds than those from non-Schools of Excellence; Schools of Excellence also have smaller class sizes,

on average, fewer overage students and fewer repeating students compared to non-Schools of Excellence; and teachers from Schools of Excellence tend to be more qualified than those from other school types (Cheriyana et al., 2020). Bearing these differences in mind, understanding more about the pedagogical strategies of teachers from Schools of Excellence along with the nature of the training and support they receive could be informative for teachers from other school types as well as Implementing Partners from the Leaders in Teaching initiative providing Continuous Professional Development.

Finally, while our classroom observations using the *Teach* tool have shed light on a number of areas, the tool is not without its limitations. For example, while the tool reveals that explicit gender bias and discrimination are not apparent in Rwandan secondary mathematics classrooms, it does not give us an understanding of exactly what pedagogical practices teachers are using to ensure they provide equal opportunities for boys and girls, nor if more subtle signs of gender bias or discrimination are occurring (see also Ani-Asamoah et al., 2020). In addition, the tool does not currently provide insight into whether other groups of students, such as those with disabilities, are experiencing bias and discrimination in the classroom. Given the importance of equity as a focus of the Leaders in Teaching initiative, understanding how teachers are ensuring quality learning is occurring for the most marginalised will be an important priority of Laterite and the REAL Centre going forward.

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Endnotes

¹ <https://www.worldbank.org/en/topic/education/brief/teach-helping-countries-track-and-improve-teaching-quality>.

² <https://mastercardfdn.org/all/leaders-in-teaching/>

³ It should be noted that it is not straightforward to draw a clear line between teacher practices linked to academic versus socioemotional learning. Many teacher practices included in common professional teaching frameworks do impact student's socioemotional development, though are usually thought of in terms of academic rather than socioemotional learning. Explicitly linking teacher practices with socioemotional outcomes in measures used for assessment will serve to increase the salience of student's socioemotional skills to teachers, as well as to other stakeholders and policymakers, thus ensuring a focus on both academic and socioemotional learning in the classroom.

⁴ The *Teach* framework built upon the inventory created by Gill et al (2016), who conducted a content analysis of the differences in dimensions of instructional practice of five commonly used classroom observation tools comparing the behaviours they measure with the extent to which they predict student learning. The tools included Classroom Assessment Scoring System (CLASS), Framework for Teaching (FFT), Protocol for Language Arts Teaching Observations (PLATO), Mathematical Quality of Instruction, and UTeach Observational Protocol. The content, predictive power, and potential bias of these instruments were also analysed as part of this preliminary framework.

⁵ These included Observation of Teaching Practices in Relation to Pupil Learning (OPERA), Standards-based Classroom Observation Protocol for Egypt (SCOPE), Service Delivery Indicators (SDI), Stallings, and Teacher Instructional Practices and Processes System (TIPPS).

⁶ Elements refer to groups of multiple, similar behaviours that aim to capture teaching practices related to positive learning outcomes.

⁷ For example, the tool aimed to capture not just the quality with which a teacher checked for understanding (adjusting the lesson, prompting students to determine their level of understanding, etc.), but the frequency with which the teacher checked for understanding in each lesson.

⁸ $t(192) = 3.2, p = .002$

⁹ Different colours are used within this graph and others throughout the to distinguish between score levels for each area of the Teach Observation protocol associated with the Quality of Teaching component of the tool, as well as the overall score.

¹⁰ $t(192) = -2.0, p = .046$.

¹¹ $t(192) = -2.3, p = .022$.

¹² The numbers on the graphs (such as 0.1 and 0.2) refer to the item numbers on the Teach instrument.

¹³ $t(192) = -2.4, p = .018$.

¹⁴ $t(192) = -2.3, p = .025$.



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