Technical Note 44

Young Lives

Young Lives School Surveys, 2016-17

The Design and Development of Teacher Measures in Ethiopia, India and Vietnam

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About Young Lives

Young Lives is an international study of childhood poverty, following the lives of 12,000 children in four countries (Ethiopia, India, Peru and Vietnam) over 15 years. **www.younglives.org.uk**

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Contents

The authors **4**

Acknowledgements **4**

1. Introduction **5**

2. Teacher measures **5**

2.1. Teacher psychosocial scales 5

2.2. Teacher Professional Knowledge (TPK) questionnaire 7

2.3. Classroom Instructional Environment (CIE) scales 9

3. Pilot testing and instrument finalisation **12**

3.1. Pilot sample 12

3.2. Pilot data analysis 13

4. Teacher measures – validity and reliability **16**

4.1. Analysis of teacher psychosocial scale data 16

4.2. Analysis of TPK data 17

4.3. Analysis of CIE scale data 18

5. Concluding remarks **19**

References **20**

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1. Introduction

Young Lives is an international study of childhood poverty in Ethiopia, India (Andhra Pradesh and Telangana), Peru and Vietnam. Since 2002, Young Lives household surveys have followed the lives of 12,000 children in these four countries in two age cohorts: an 'Older Cohort' born in 1994-95, and a 'Younger Cohort' born in 2001-02.

In 2010, the study introduced a series of school surveys in all four countries, which included a sub-sample of children in the Younger Cohort. Between 2010 and 2013 the school surveys examined issues of school quality and effectiveness in primary schools in Young Lives sites in Ethiopia, India, Peru and Vietnam.

Building upon the design of the primary school surveys, the 2016-17 Young Lives school surveys examine school effectiveness at upper primary level in Ethiopia, and at secondary level in India and Vietnam (see Rossiter et al. 2017, Moore et al. 2017, and Iyer et al. 2017 for a more detailed discussion of the school surveys in each country). The surveys examine school effectiveness through multiple outcome measures, including students' learning progress in mathematics and functional English. Background data collected from students, teachers and head teachers helps to contextualise the learning outcomes data.

This technical note focuses on the design and development of the measures of teacher attitudes, professional knowledge, and classroom environment used in the 2016-17 school surveys. These measures aim to provide data which can be used to explore how different teacher factors contribute to variation in student learning. The note includes a discussion of the rationale for the inclusion of each of these measures, along with details of the process of developing, piloting and selecting the measures used in Ethiopia, India and Vietnam. It also includes a brief discussion of the initial validation of these measures, using data collected in the second wave of the school surveys in 2017.[1]

2. Teacher measures

2.1. Teacher psychosocial scales

2.1.1. Rationale for including a measure of teacher psychosocial attributes

Teacher attitudes and beliefs play an important role in shaping what a teacher does in the classroom (Muijs and Reynolds 2002; Askew et al. 1997; Creemers and Kyriakides 2011) and how much their students learn. Understanding more about teachers' attitudes and what motivates them is therefore an important aspect of school and teacher effectiveness research. For this reason, the 2016-17 school survey included a number of teacher psychosocial scales measuring different aspects of teacher attitudes and beliefs.

Teacher motivation and contributing factors to motivation are of particular interest, with existing studies revealing that reduced motivation impacts on both the quality and quantity of

1 Validation of psychosocial measures and cognitive tests can be undertaken in a number of ways, and therefore involves a process of decision making by those undertaking the analysis. We have completed some initial validation steps for the purposes of this note, including identifying and excluding items which appear to function less well; however, we are aware that these are subjective decisions and others may come to different conclusions with reference to the same data.

classroom teaching in many countries, particularly in Sub-Saharan Africa and South Asia (Bennell and Akyeampong 2007; Kremer et al. 2005). Low levels of teacher motivation are attributed to a range of factors, including low job satisfaction, de-professionalisation of teaching, and inadequate support and human resource management systems at school and national levels (Bennell 2004). Within a developing country context, low teacher motivation has been found to be a particular problem in rural schools, smaller schools, and at primary level generally (Bennell and Akyeampong 2007), and where teachers are inexperienced, less qualified, or are teaching in a language in which they are less confident or competent (Guajardo 2011). Meetings with stakeholders and policymakers in each country during the design phase of the Young Lives 2016-17 school surveys revealed that teacher motivation was an issue of considerable policy concern, and that there was an interest in understanding more about relative levels of teacher motivation and how these relate to student learning outcomes.

2.1.2. Measure development

There is an extensive and long-standing body of work on the definition and measurement of professional motivation (for example, see the classic work on motivation theory from Maslow 1943; Bandura 1997; Locke 1976). Within much of this literature, motivation is defined as a multi-faceted construct, which overlaps with, and is influenced by, related constructs such as job satisfaction, self-efficacy and personal achievement (for examples relating to teacher motivation specifically, see Abraham et al. 2015; Ramachandran et al. 2005; Mooij. 2008; Guajardo 2011). With this in mind, within this survey we have attempted to measure a number of constructs which the existing literature suggests are related to, or contribute towards, teacher motivation. These constructs are measured through the use of multi-item psychosocial scales. These scales are complemented by 'standalone' items relating to motivation within the teacher background questionnaire, for example items on professional effort or initial motivation for becoming a teacher.

These measures of teacher motivation have been sourced from existing studies where possible. Those which have been validated through use in similar contexts have been prioritised, as have those which have a clear foundation in theories of professional motivation. This has led us to include several existing measures which, while developed relatively recently, build upon and refer to other work on this topic, often in similar developing country contexts. The constructs measured in the survey are detailed in Table 1.[2]

As shown in Table 1, three of the scales used are from a diagnostic tool developed by the Teacher Motivation Working Group (TMWG) in 2016.[3] This tool is currently still in development, and to date has been used by TMWG members in four countries: India, Vietnam, Uganda and Bangladesh (TMWG 2016b). It has been developed by representatives from several organisations engaged with issues of teacher motivation, including Save The Children, International Rescue Committee (IRC) and UNESCO, and includes items which refer to classical theories of professional motivation, including Maslow's Hierarchy of Needs (Maslow 1943, in TMWG 2016b); Tao's work on Teacher Capabilities and the Capability Approach (Tao 2016, in TMWG 2016b); and Deci's Self-Determination Theory (Deci 1985, in TMWG 2016b). In addition to these three psychosocial scales from the

2 Not all scales have been used in each country, as some were found to function less well in piloting, or to have less policy relevance. Details of this are in Table 5.

3 The Teacher Motivation Working Group comprises individuals and organisations working on issues related to teacher motivation, development and support in low-income contexts around the world. See www.teachermotivation.org.

TMWG diagnostic tool, many of the standalone items in the teacher background questionnaire have also been sourced from this tool.

Table 1. *Teacher psychosocial measures included in Young Lives 2016-17 school effectiveness surveys*

Construct	Source
Well-being	Adapted from TMWG (2016a)
Relationships with others in the school	TMWG (2016a)
Morale and satisfaction within current job	Adapted from TMWG (2016a)
Efficacy	Young Lives (2011) (adapted from Gibson and Dembo 1984)
Equality	Brinkmann (2016)
Professional commitment	Brinkmann (2016)

Alongside these, three psychosocial scales from other sources were included in the survey. A version of one of these scales, the teacher efficacy scale, was used in the Young Lives primary school survey undertaken in Vietnam in 2011-12. The 20-item scale was adapted from Gibson and Dembo's widely used teacher efficacy scale for use in Vietnam (Gibson and Dembo 1984, in Yorke 2013), and it is the adapted version which has been used in the 2016-17 school surveys. Two further psychosocial scales on teacher perceptions of equity and teacher professional commitment have been included in the India survey only. These scales were developed by Brinkmann (2016) and have previously been used in a study into teacher beliefs in three different Indian states.

Each psychosocial scale was translated into the appropriate languages for use in Ethiopia, India and Vietnam (see Table 4). The scales were then pre-piloted and piloted between October 2016 and March 2017 to ensure suitability, contextual relevance, and to identify any items which functioned poorly. Section 3 contains a description of this process.

2.2. Teacher Professional Knowledge (TPK) questionnaire

2.2.1. Rationale for including a measure of teacher professional knowledge

For teachers to be effective, they must have the knowledge required to teach their subjects. A first requirement for mathematics teachers, for example, is that they possess knowledge in the subject that other competent mathematicians commonly hold. This is often demonstrated through certification, qualifications or by other means, and is necessary but not sufficient for good teaching.

Effective mathematics teaching also requires a mathematical reasoning that most adults do not need on a regular basis, a type of Specialised Content Knowledge (SCK) 'which goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching' (Shulman 1986: 9; Ball et al. 2008). Skilful mathematics teaching requires, for example, being able to rapidly identify the source of an error produced by a learner; engage with students about non-standard approaches; and provide sound mathematical responses to learner difficulties efficiently and fluently.

However, defining and measuring SCK has proven elusive (Rowan et al. 2001) and despite widespread interest, what counts as SCK and how it relates to student achievement has remained poorly specified in research (Hill et al. 2005). Much recent work on SCK has focused on mathematics, and although often using different conceptualisations of SCK, the

findings have generally been positive. These include: (i) in the United States, a significant relationship between upper-elementary teachers' mathematical knowledge and their students' mathematics achievement, after controlling for student- and teacher-level characteristics (Campbell et al. 2014); (ii) in Germany, a significant relationship between Grade 10 mathematics student achievement and teachers' mathematical knowledge, as well as between student achievement and teachers' pedagogical content knowledge for mathematics (Baumert et al. 2010); and (iii) in the United States, a significant relationship between a measure of teachers' mathematics knowledge and student gains in mathematics – and an indication that this is a much stronger predictor than a proxy measure such as years of experience or certification (Hill et al. 2005).

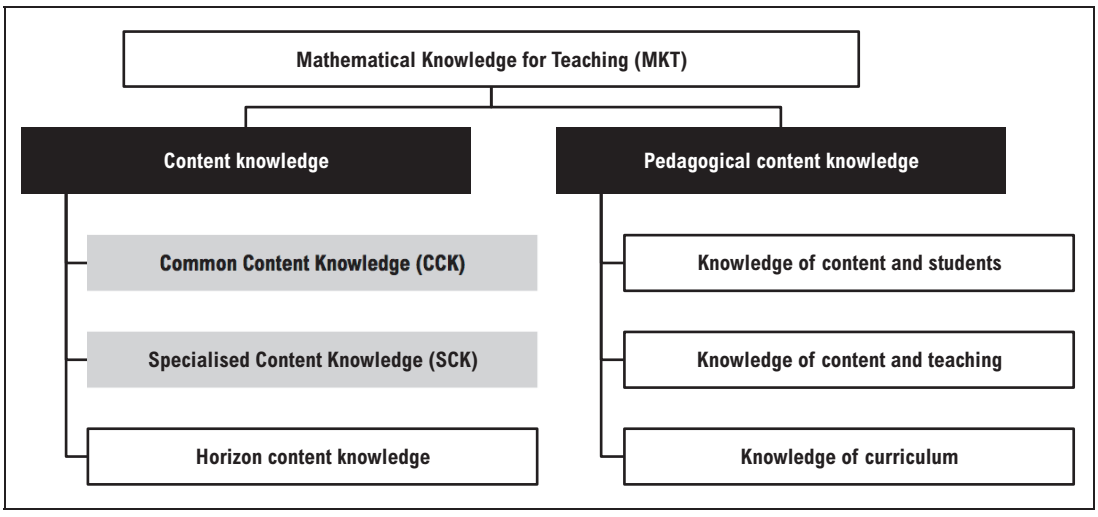
This motivates further research into the measurement of SCK and its association with student achievement. The Young Lives 2016-17 school surveys include repeated measures of student cognitive achievement in mathematics. Assessments are based on the curriculum in each country and students are linked to teachers. The inclusion of a measure of teachers' SCK allows Young Lives to contribute to the quantitative evidence available on the relationship between teacher knowledge, student learning outcomes and learning progress over time. In addition, it will extend this research to developing country education systems, where, to date, little research into teachers' SCK has taken place.

2.2.2. Measure development

In an attempt to specify SCK and how it relates to other domains of knowledge required for teaching, researchers at the University of Michigan have developed a Mathematical Knowledge for Teaching (MKT) framework (Hill et al. 2008) which brings together the widely accepted concepts of content knowledge and pedagogical content knowledge (Shulman 1986; 1987). Within this framework, SCK sits as a distinct and separable domain of content knowledge.

The MKT framework was borne out of empirical research on teacher development and the knowledge teachers require when teaching mathematics. The framework serves as a starting point to investigate: (i) how teachers need to know the mathematics content included in their work; (ii) what else teachers need to know about mathematics; and (iii) how and where teachers use such mathematical knowledge in practice.

Figure 1. *Domains of MKT*



The MKT model is gaining recognition as a reliable foundation for understanding elementary-level teacher knowledge (Hauk et al. 2014), as it offers the clearest – and most readily applicable – conceptualisation of the domains of teachers' knowledge to date. It is also one of the few research endeavours to have shown a link between a measure of SCK and student achievement (Hill et al. 2005). Importantly, it suggests that three types of content knowledge and three types of pedagogical content knowledge may function as non-overlapping domains and therefore may be examined independently (Hauk et al. 2014).

In the 2016-17 Young Lives school surveys, Common Content Knowledge (CCK) and SCK (see Figure 1) were measured in a Teacher Professional Knowledge (TPK) assessment for mathematics teachers. Assessment items were adapted from the Learning Mathematics for Teaching (LMT) project, hosted at the University of Michigan.[4] LMT items were developed based on the MKT framework and are intended to assess teachers' CCK and/or SCK.

From a set of 418 items, covering six mathematical content domains, 36 were selected for piloting. These were chosen based on: (i) their relevance to the grade-specific curriculum content in each of India and Ethiopia;[5] (ii) their relevance to the context in India and Ethiopia (e.g. items that discussed Formula 1 racing would not be included even if the content domain was appropriate according to the curriculum); and (iii) expected translation complexity, where we favoured items with simple question structure and fewer complex or technical terms.

By utilising the joint concepts of CCK and SCK in our research, we can:

(a) measure the amounts of different kinds of content knowledge that groups of teachers possess and explore the interrelationships between these, teachers' professional development backgrounds, and the classroom instructional environment.

(b) study the relationships between teachers' content knowledge and their students' achievement (and change in this achievement over one academic year) and evaluate whether these lead to suggestions about which aspects of teachers' content knowledge are predictive of student achievement.

If a clearer sense of the important categories of content knowledge for teaching can be developed, this might then offer policy guidance for teacher education and professional development approaches in our contexts.

2.3. Classroom Instructional Environment (CIE) scales

2.3.1. Rationale for including a measure of classroom instructional environment

The Young Lives 2016-17 school surveys include a series of background questionnaires at the student, teacher, and principal levels, as well as school and classroom facilities observations. These will help to explain variation in student learning outcomes, but they

4 The LMT project investigates the mathematical knowledge needed for teaching. LMT measures include items that reflect the real mathematics tasks that teachers face in classrooms; for instance, assessing student work, representing numbers and operations, and explaining common mathematical rules or procedures. LMT measures cannot be used for hiring, promotion, pay or tenure, and are not designed to make highly accurate statements about individuals' mathematical knowledge. Instead, they can be used to compare groups of teachers' mathematical knowledge, or examine how a group of teachers' knowledge develops over time. See www.umich.edu/~lmtweb

5 The TPK questionnaire was not included in Vietnam. The Vietnam survey covered students at Grade 10, and there are few suitable existing measures of TPK for teachers at this level. Developing a new measure of TPK suitable for use with upper-secondary teachers would be complex and beyond the capacity of this study. Furthermore, stakeholder consultations indicated that this style of test was not appropriate for, or of interest in, Vietnam.

cannot capture the classroom-level factors beyond basic inputs of personnel, resources and materials. With a growing literature around teacher practice, student-teacher interactions and what goes on inside the classroom (e.g. Allen et al. 2013; World Bank 2015), it is crucial to try to understand what teachers 'do' – and how this creates a Classroom Instructional Environment (CIE) – when trying to explain differences in student achievement.

A number of research reviews have consolidated findings in an effort to present behaviours that show consistent relationships to student achievement (e.g. Goe et al. 2008). While there are differences between these reviews, there is substantial overlap. For instance, providing high-quality academic feedback is often noted as having an association with higher student achievement. Other categories that overlap among the reviews include clarity of presentation, managing behaviour promptly, reinforcing student effort, and maintaining appropriate pacing (Balch 2012).

To obtain a measure of the CIE, one might (a) interview teachers, (b) analyse classroom artefacts, or (c) observe lessons. In addition to these, one might survey students and ask them to provide information about the teaching practices and processes that they are exposed to. Such an approach is becoming increasingly common to support teacher evaluations in the United States (e.g. Bill and Melinda Gates Foundation 2013).

Each of these approaches offers different advantages. Student perception surveys of the CIE can, if well-designed, be more reliable than other measures of teaching practice, primarily because students are the direct consumers of a teacher's service and see their teachers every single day, not just for an observational lesson. There are critiques of student perception surveys, however, including: (i) such an approach may lose validity if students do not feel that they can respond freely; (ii) students are not qualified to rate teachers on curriculum, classroom management, content knowledge and other specific topics in which they are not expert; and (iii) students may be inclined, for whatever reason, towards common viewpoints. On the other hand, students responding to a perceptions survey can reflect on a large variety of lessons when making their judgment, not just on those lessons that occur at the time of observation. Even if there is misunderstanding by a share of students, the opportunity to aggregate responses from all students in a class allows the construction of a *typical* instructional environment in each sampled class.

Some student assessments of the CIE have been designed with predictive validity for learning in mind, although few, if any, have been used in a developing country context. It might be possible to link an individual classroom and teacher to an indication of the environments that shape students' learning experiences. While more research is needed, preliminary findings from existing studies 'provide convincing evidence that student ratings of teaching are worth considering for inclusion in teacher evaluation systems', as they repeatedly show relationships with learning outcomes (Goe et al. 2008: 40).

2.3.2. Measure development

Referring to the available literature on measurement of 'school climate' and 'school instructional environment' using student perceptions surveys, eight instruments were identified with potential to capture the information we sought from students. Student psychosocial characteristics were measured in other instruments (see Little and Azubuike 2017), and so our focus for this measure is on the teacher/class level constructs that are included in these instruments, rather than, for example, a measure of student self-determination or student home-school relationships.

Each instrument was reviewed in terms of: (i) its number of relevant constructs; (ii) apparent suitability to our contexts (note that these instruments were not produced for implementation

in developing countries or in a language other than English); and (iii) scale availability (some are available for a fee, others are freely available). The eight instruments and relevant constructs are shown in Table 2.

Table 2. *Eight instruments that include constructs relevant to the CIE*

Instrument	Number of relevant constructs	Names of relevant constructs
ClassMaps Survey	1	Teacher-student relationships
Panorama	4	Classroom climate; Teacher pedagogical effectiveness; Teacher rigorous expectations; Teacher-student relationships
Questionnaire on Teacher Interaction	8	Teacher leadership; Teacher helpfulness/friendliness; Teacher understanding; Teacher giving students responsibility; Teacher certainty; Teacher satisfaction; Teacher admonishment; Teacher strictness/control
Responsive Environmental Assessment for Classroom Teaching	6	Teacher positive reinforcement; Teacher instructional presentation; Teacher goal orientation; Teacher differentiated instruction; Teacher formative feedback; Classroom connectedness
Student Engagement Instrument	2	Teacher-student relationships; Teacher control and relevance of schoolwork
Survey of Teacher Practice	11	Teacher presentation style; Teacher lesson structure; Teacher behaviour management; Teacher productivity; Teacher-student relationships; Teacher awareness of student need; Teacher feedback; Teacher challenge; Teacher investment in students; Teacher content knowledge; Teacher encouragement to think
Teacher Image Questionnaire	6	Teacher knowledge of subject; Teacher fairness; Teacher control; Teacher encouragement for student participation; Teacher sense of humour; Teacher assignment design
TRIPOD 7Cs of Effective Teaching	7	Teacher care; Teacher ability to confer; Teacher ability to captivate; Teacher ability to clarify; Teacher ability to consolidate; Teacher challenge; Teacher control

Following this review, it was determined that no single scale was appropriate for our purposes. Scales either covered some constructs of interest and relevance but not others; included item wording that was not suitable for our contexts; or included items that focused too much on student feelings about themselves, rather than student evaluations of their teaching and learning experiences.

For this reason, rather than using any item from scales reviewed, a set of five constructs was identified for piloting, which covered recurring themes from identified scales and which were relevant to our research contexts (Table 3). Using these constructs and the types of items used in existing instruments (including those outlined in Table 2), we developed 40 pilot items designed to measure student perceptions of the CIE.

Table 3. *Five constructs for item development and piloting*

Construct				
Teacher empathy	Teacher awareness	Teacher control	Teacher expectations	Teacher engagement

3. Pilot testing and instrument finalisation

The teacher measures were pilot tested between October 2016 and March 2017 in Ethiopia, India and Vietnam (see Table 4). This piloting involved teachers (for the teacher psychosocial measures and the TPK questionnaire) and students (for the CIE measures). In all three countries, the piloting included both qualitative and quantitative elements.

As part of the qualitative piloting, maths and English teachers were consulted in each country to confirm the suitability of items, to ensure that teachers were able and happy to answer questions, and to identify any issues with the translation. Additionally, a larger number of teachers in each country were asked to complete the psychosocial scales and TPK questionnaire to collect pilot data for quantitative analysis. Meanwhile, the CIE scales were piloted with students from a range of school types, localities and language groups (see Table 4).

To maximise the data available for item selection, some measures were piloted using multiple forms. For the TPK questionnaire, two forms were piloted with teachers (A and B, each with 17 items in Ethiopia and 18 items in India). For the CIE scales, two forms (A, with 22 items and B, with 18 items) were piloted with students in all three countries. The teacher psychosocial scales were piloted using just one form in all three countries.

3.1. Pilot sample

In each country, the pilot sample included teachers and students from different school types, regions and localities. The aim was not to be representative of the full sample, but to cover the range of different circumstances and language groups. Table 4 provides an overview of the pilot sample for these measures in each country.

Table 4. *Sample for pilot testing of teacher measures*

	Ethiopia	India	Vietnam
Student respondents to CIE scale	835	219	355
Teacher respondents to psychosocial scales	36 (Maths and English)	27 (Maths and English)	24 (Maths and English)
Teacher respondents to TPK questionnaire	53 (Maths only)	15 (Maths only)	*Not administered*
Number of provinces/districts/regions	5	2	3
Locations	Urban and rural	Urban and rural	Urban and rural
Ownership	Government	Private and government	Government
Languages used [6]	Amharic Afaan Oromo Af Somali Tigrigna Wolaitigna Sidamigna Hadiyissa English	Bilingual: Telugu/English Urdu/English	Vietnamese

6 In each country, the teacher measures were administered in a language which teachers and students could be expected to be literate in; this was usually either the local language or the school medium of instruction. In Ethiopia and India, this meant that the measures were administered in more than one language. Equating measures across languages is a very complex endeavour, and one which we do not attempt in this note (see, for example, Chen et al. 1995).

In Ethiopia, the pilot sample included 835 students from Grade 7 and Grade 8 in government primary schools. Nine schools were included, across urban and rural settings in five regional states. The need to include seven national language groups during piloting necessitated a relatively large sample in Ethiopia. In each school visited, four teachers completed psychosocial scales, of which two maths teachers also completed the TPK questionnaire. In order to improve reliability of pilot analysis and breadth of qualitative feedback, TPK questionnaires were also piloted with teacher trainers and trainees during a half-day workshop at Kotebe University College of Teacher Education in Addis Ababa.

In India, the pilot sample included 219 Class 9 students attending four schools: two private schools and two government schools. The student sample was drawn from urban and rural schools in two areas: Hyderabad and Nalgonda district. Pilot testing was also undertaken with a sample of teachers. Of these, 12 were employed in the four schools where student piloting was undertaken, as teachers were asked to complete the teacher psychosocial measures during visits to these schools. An additional 15 teachers were invited to take part in a workshop at the Centre for Economic and Social Studies (CESS), Hyderabad, to collect feedback on the TPK questionnaire and teacher psychosocial measures. These teachers were from government and private schools in and near to Hyderabad. A bilingual form was piloted in India, with each item presented in both English and Telugu. A smaller qualitative pilot was also undertaken with Urdu medium students and teachers at a later date, using a bilingual form with each item presented in both English and Urdu.

In Vietnam, the pilot sample included 355 Grade 10 students attending six schools in three provinces (Ben Tre, Hung Yen and Hanoi). The student sample was drawn from urban and rural schools in Ben Tre and Hung Yen, and from advantaged and disadvantaged areas in Hanoi. Pilot testing was also undertaken with a sample of 24 teachers (four from each school). Half of the sampled teachers taught maths and half taught English. Teachers at each school were asked to complete the teacher psychosocial measures and were then asked for qualitative feedback about the measures. In Vietnam, all of the forms were piloted in Vietnamese.

3.2. Pilot data analysis

Following pilot testing in each country, item data were analysed to generate a range of statistics that would aid the selection of measures for the survey. Pilot data for each country were analysed separately, as the priority was to select measures which were accurate and appropriate to each context. The different timelines for the survey pilots in each country also meant that it was not possible to jointly analyse pilot data for all three countries.

It is important to note that the reliability of the analysis techniques used increases with sample size (Field 2009). Due to the small number of teachers from whom it was possible to collect pilot data, these analyses were treated with some caution. Item selection decisions were made using quantitative item analysis in combination with qualitative feedback from teachers and from fieldworkers who had been involved in the piloting. Because of the small pilot sample and the limited prior use of these or similar measures in these three country contexts, the inclusion of many of these measures in the survey was largely exploratory.

3.2.1. Teacher psychosocial scale analysis: exploratory factor analysis and Cronbach's alpha

Pilot data for the teacher psychosocial measures were reviewed for scale reliability (internal consistency using Cronbach's alpha, see Multon and Coleman 2005) and using exploratory factor analysis (EFA) to explain the variance in the observed variables in terms of underlying

latent factors (see, for example, Rietveld and Van Hout 1993; Thompson et al. 1996; Hayashi and Yuan 2010; Field 2009). Histograms were generated from raw data to review the distributions of responses for each item and scale.

The aim of pilot analyses was to identify whether the teacher psychosocial scales were appropriate for measuring the specified underlying latent traits in our contexts. In particular, at this stage of instrument development, this involved identifying poorly functioning items and/or scales. This includes items with low or negative loading on the first factor (meaning that we observe a low or negative correlation between the main factor and the item), items which, if removed, would increase the Cronbach's alpha value (meaning that the deletion of that item improves reliability), or scales which had a very low overall Cronbach's alpha score (indicating fairly low internal consistency). Along with a review of factor structures and loadings, scree plots were produced as a graphical representation of the relative importance of each factor (Costello and Osbourne 2005).

Decisions to retain scales were made on a country-by-country basis, combining qualitative pilot feedback with statistics from data analyses. Table 5 shows the final selection for use in each country.

Table 5. *Teacher psychosocial scales included in the survey*

Construct	Measure	Country
Well-being	8-item scale	India, Vietnam, Ethiopia
Relationships with others in the school	7-item scale	India, Vietnam, Ethiopia
Morale and satisfaction within current job	13-item scale	India, Vietnam
Efficacy	20-item scale	India, Vietnam, Ethiopia
Equality	7-item scale	India
Professional commitment	6-item scale	India

3.2.2. TPK item analysis using qualitative and quantitative pilot data

The number of teachers involved in TPK piloting was small (15 in India and 53 in Ethiopia). At these levels, extensive quantitative analysis to inform item selection adds little value. Instead, for each TPK item, qualitative feedback on respondents' judgment of (i) item grade-level, (ii) relevance to curriculum, and (iii) suitability of translation or adaptation, was combined with item difficulty, represented by percentage correct, and item discrimination. With this information, items were selected for final scales. Items were selected based on within-country data, not on cross-country performance.

Items were retained if the pilot percentage correct showed that they were neither too easy nor too hard, if they were judged by teachers to be of the appropriate grade level (e.g. did not relate to curriculum content taught in grades higher than Grade 9 in India, or Grade 8 in Ethiopia), and if teachers' feedback was that they were of an appropriate difficulty level. Once items which were not appropriate had been excluded, items were selected according to their content domain to ensure a range of content would be covered in the final form.

Piloting also provided an indication of how many items should be included in the questionnaire, based on how long it took teachers to complete the pilot items and the variation in responses. In each country, 15 items were selected for inclusion in survey questionnaires. The final composition of the TPK questionnaire is shown in Table 6.

Table 6. *TPK items included in survey questionnaires*

Country	Number of items	Content domain
Ethiopia	4	Geometry
	7	Numbers, concepts and operations
	4	Patterns, functions and algebra
India	3	Geometry
	8	Numbers, concepts and operations
	4	Patterns, functions and algebra

3.2.3. CIE scale analysis using factor analysis and Cronbach's alpha

Pilot data for the CIE scales were evaluated using the same two techniques that were applied to the teacher psychosocial scale data. As with the teacher data, the aim of these pilot analyses was to identify which CIE items and sub-scales were appropriate for measuring the underlying latent constructs of interest in our survey contexts.

Our evaluation of the CIE scale identified a set of items to be removed from the scale because they either showed low or negative loading onto main factors or they had a negative relationship with other items in the scale.

After removing these items, our subsequent analyses pointed us towards two possible factors: a first factor within which our *Empathy* and *Engagement* constructs were clustered and a second factor within which our *Awareness*, *Expectations* and *Control* constructs were clustered. Underneath these possible factors, between 20 (India and Ethiopia) and 33 (Vietnam) items were taken to the final survey, with substantial overlap between countries. Although items appeared to cluster into two factors, we will use full student-level data for a final review of scales.

Scales were retained for use in the final survey instruments based on pilot performance, with a slightly different selection of items retained in each country. Table 7 shows the scales which were selected for use in each country.

Table 7. *CIE scales included in survey questionnaires*

Possible factor	Construct	Country (number of items)
Teacher support and encouragement	Empathy	India (4), Ethiopia (4), Vietnam (7)
	Engagement	India (4), Ethiopia (4), Vietnam (8)
Teacher organisation and instruction	Awareness	India (4), Ethiopia (4), Vietnam (7)
	Control	India (4), Ethiopia (4), Vietnam (5)
	Expectations	India (4), Ethiopia (4), Vietnam (6)

4. Teacher measures – validity and reliability

Following pilot testing, data collection using the final survey instruments for teacher measures described above (Tables 5 to 7) for all teacher measures was conducted between March and June 2017 across the three countries. The data collected from the full set of survey respondents were used to validate the measures discussed above and identify poorly functioning items or scales. It is important that measure validity is investigated in relation to each population with which a set of measures has been used (Yorke 2013). For this reason, the methods we have used to check the validity and reliability of the teacher measures have been undertaken separately for Ethiopia, India and Vietnam. Table 8 gives details of the number of respondents in each country.

Table 8. *Survey respondents for each teacher measure*

	Ethiopia	India	Vietnam
Student respondents to CIE scale	10,305	8,300	7,844
Teacher respondents to psychosocial scales	211 (Maths and English)	554 (Maths and English)	284 (Maths and English)
Teacher respondents to TPK questionnaire	109 (Maths only)	284 (Maths only)	Not administered

4.1. Analysis of teacher psychosocial scale data

Teacher psychosocial data were collected from maths and English teachers in all three countries (211 teachers in Ethiopia; 554 in India; and 284 in Vietnam). Prior to undertaking validation analyses, survey data for each country were cleaned to remove invalid responses, and negative items were recoded. We then used exploratory factor analysis (EFA) and Cronbach's alpha, as had been done earlier with the pilot data, to investigate the validity and reliability separately for each scale used in each country. Histograms were produced for each scale in each country to review the variation in responses to each item within each scale.

As shown in Table 9, most of the scales initially had an alpha value of below 0.7 across the three countries, suggesting a lack of internal consistency.[7] However, after removing items which appeared to be measuring something other than the overall latent trait (e.g. those which lowered the overall scale alpha, or which were negatively associated with the first factor), almost all of the revised psychosocial scales were shown to have an alpha of above, or close to, 0.7. Factor analysis also showed that many of the revised scales (i.e. with less well-performing items excluded) had just one or two factors with an eigenvalue greater than 1, and therefore could be understood as relating most strongly to one or two underlying factors or traits (Hinkin et al. 1997). In addition, even in those scales where items load strongly onto more than one factor (for example the 'morale and satisfaction' scale in Vietnam), scree plots revealed that the first factor accounts for by far the largest proportion of variance.

7 An alpha value of at least 0.7 or above is generally accepted to indicate that a measure is reliably capturing one underlying trait (Tavakol and Dennick 2011).

Table 9. *Teacher psychosocial scale validation*

	Items in full scale			Alpha for full scale			Items in revised scale			Alpha for revised scale			Revised scale - factors with eigenvalue > 1		
Construct	**ET**	**IN**	**VN**	**ET**	**IN**	**VN**	**ET**	**IN**	**VN**	**ET**	**IN**	**VN**	**ET**	**IN**	**VN**
Well-being	8	8	8	0.58	0.63	0.62	6	6	4	0.64	0.64	0.68	2	2	1
Relationship with others in the school	7	7	7	0.59	0.37	0.68	5	3	4	0.72	0.73	0.81	1	1	1
Professional commitment	–	6	–	–	0.65	–	–	6	–	–	0.65	–	–	2	–
Morale and satisfaction within current job	–	13	13		0.76	0.64		10	11		0.82	0.67	–	2	4
Equality	–	7	–	–	0.69	–	–	6	–	–	0.71	–	–	1	–
Self-efficacy	20	20	20	0.44	0.70	0.73	10	12	16	0.81	0.77	0.75	3	3	4

4.2. Analysis of TPK data

TPK questionnaires were administered in Ethiopia (109 mathematics teachers) and India (284 mathematics teachers). Few examples exist of questionnaires of this type being used in developing country settings, so our administration was largely exploratory.[8]

In Ethiopia, the average score on the TPK questionnaire was 32 per cent and with a standard deviation of only 12 per cent, two-thirds of teachers scored between 20 and 45 per cent.[9] This is lower than we expected based on pilot data analysis for the selected items. In addition, internal consistency of items is exceptionally low, with Cronbach's alpha of 0.12 for the full scale. Combined, these statistics suggest that teachers were perhaps confused by the unfamiliar item type, that item difficulty was simply too high, leading to much guessing, or that there were other reasons for misunderstanding.

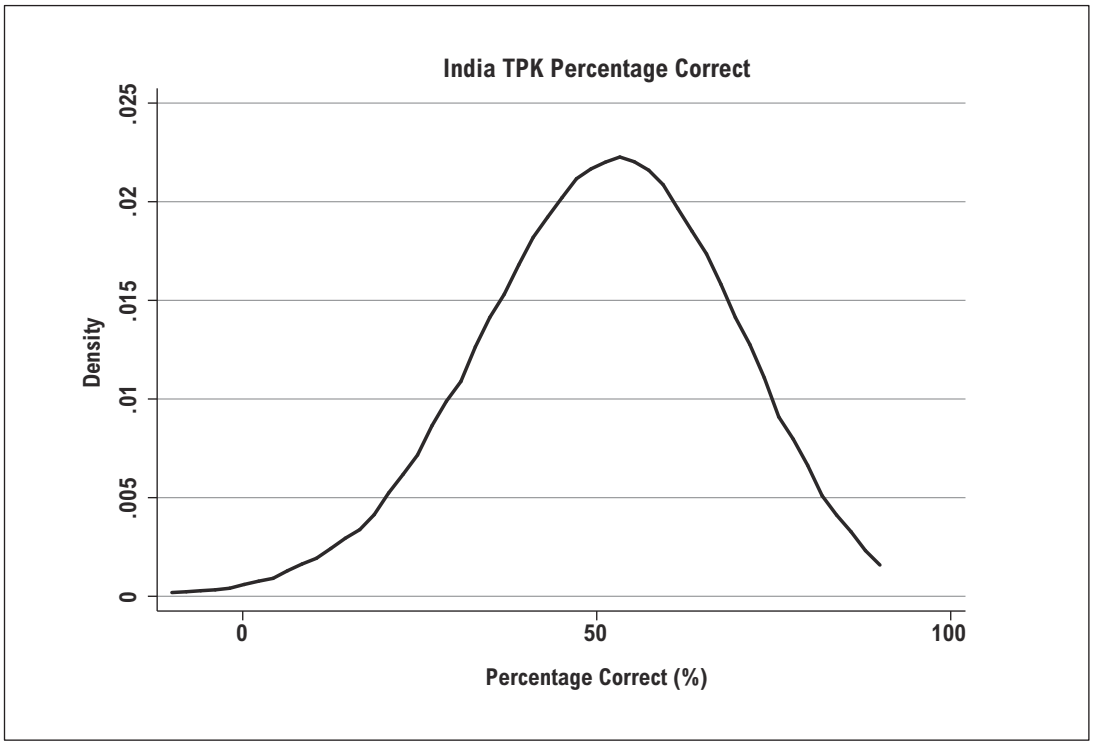
Attempts were made to break the *common* and *specific* items into sub-scales. This approach failed to increase scale reliability. As a result, we do not feel that the measure used in Ethiopia is a fair or reliable indicator of TPK among Ethiopian teachers. Further work will be needed to improve the measurement of CCK or SCK in a setting such as this and our attempt can serve as a reference for that endeavour.

In India, scale performance was much better (note that items were not identical across the two countries, and so cross-country performance comparisons are not possible). The average score on the full TPK questionnaire was 51 per cent, with approximately two-thirds of teachers scoring between 35 and 65 per cent (Figure 2). This level of performance is in line with our expectations following piloting.

8 Although others have tested teacher pedagogical knowledge or teacher content knowledge in developing country contexts in different ways; for example, see Cueto et al. 2017; Singh and Sarkar 2015.

9 Note that the percentage correct score has no interpretation in relation to teacher performance standards. It would have been possible, based on the specific items selected, for the benchmark of expected proficiency to be set at 20 per cent correct or at 90 per cent correct.

Figure 2. *Kernel-density distribution of percentage correct scores on full TPK scale in India*



However, looking beyond the total percentage correct, internal consistency of TPK items in India is quite low (Cronbach's alpha of 0.43 for the full scale). This is not entirely surprising, as the items included in the TPK questionnaire covered both CCK and SCK and three content domains (number, concepts and operations; patterns, functions and algebra; and geometry). When relevant sub-scales are produced for SCK and CCK dimensions, even though the number of items becomes quite small the internal consistency increases (although does not pass 0.60 for any relevant sub-scale).

The raw scores or the percentage correct statistics from the overall scale in India, or from selected sub-scales, may be used as indicators alongside observable characteristics such as teacher qualifications and teacher experience to improve the picture of who the teacher is and how such characteristics relate to learning progress. In future work, we will seek to make these associations, albeit with caution and transparency, based on observed scale function. It will also be possible to investigate how teacher CCK and SCK are associated (or not) to one another and to other teacher measures; and whether or not there are important associations with student progress.

4.3. Analysis of CIE scale data

CIE scales were administered in all three countries, with a large sample of students in each. Using these data, a repeat of earlier scale evaluation was conducted, with the results shown in Table 10. Prompted by clusters emerging from pilot data analysis, we return to the two suggested overarching constructs: 'teacher support and encouragement' and 'teacher organisation and instruction'. The former includes items from our *Empathy* and *Engagement* constructs, the latter items from our *Control*, *Awareness* and *Expectations* constructs.

These overarching constructs (*'scales'*) exhibit high internal consistency (Cronbach's alpha values of 0.72 to 0.82) and apparent construct validity, returning one factor (with eigenvalue > 1) in the case of India and Ethiopia, two factors in the case of Vietnam. Further work would be required to investigate the possibility of distinguishing between factors present in the scales used in Vietnam. Choices on how to combine items would be at the discretion of the researcher, depending on objectives.

The approach that we have taken is only one way of combining student responses to the CIE survey, and one which we intend to explore further. It serves as an example of how our original constructs may be used individually or in combination, based on analysis of common factors within the data. After identifying and validating CIE scales, other researchers could then investigate their predictive validity (at the individual or the group level) in relation to learning progress, teacher psychosocial measures, student background characteristics, and so on.

Table 10. *Statistics for two scales based on constructs included in the CIE instrument*

Suggested overarching construct	**'Teacher support and encouragement'**			**'Teacher organisation and instruction'**		
Constructs within	*Empathy* *Engagement*			*Control* *Awareness* *Expectations*		
Country	Ethiopia	India	Vietnam	Ethiopia	India	Vietnam
Total items available	8	8	15	12	12	18
Items retained in scale	6	6	15	8	9	18
Cronbach's alpha	0.72	0.76	0.82	0.75	0.79	0.82
Factors with eigenvalue > 1	1	1	2	1	1	2

5. Concluding remarks

This technical note has provided background information on the selection, use and validation of a set of contextual measures at teacher and class level which have been used in the Young Lives 2016-17 school surveys. Forthcoming publications will make use of data collected through the measures presented here to explore some of the factors which may be associated with variation in student learning outcomes in Ethiopia, India and Vietnam. Further details about the design of the Young Lives school surveys, including copies of the instruments used and information on accessing the publicly archived data, can be found at www.younglives.org.uk.

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Young Lives School Surveys, 2016-17: The Design and Development of Teacher Measures in Ethiopia, India and Vietnam

This technical note provides background information on the design, selection, use and validation of a set of contextual measures at teacher and class level which have been used in the Young Lives 2016-17 school surveys. These measures aim to provide data on teacher attitudes, professional knowledge, and classroom environment which can be used to explore how different teacher factors contribute to variation in student learning.

The note includes a discussion of the rationale for the inclusion of each of these measures, along with details of the process of developing the measures used in Ethiopia, India and Vietnam. It also includes a brief discussion of the initial validation of these measures, using data collected in the second wave of the school surveys in 2017.

Building upon the design of the Young Lives primary school surveys between 2010 and 2013, the 2016-17 school surveys examine school effectiveness at upper primary level in Ethiopia, and at secondary level in India and Vietnam. The surveys examine school effectiveness through multiple outcome measures, including students' learning progress in mathematics and functional English. Background data collected from students, teachers and head teachers helps to contextualise the learning outcomes data.

Young Lives

An International Study of Childhood Poverty

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Young Lives is an international study of childhood poverty, involving 12,000 children in four countries over 15 years. It is led by a team in the Department of International Development at the University of Oxford in association with research and policy partners in the four study countries: Ethiopia, India, Peru and Vietnam.

Through researching different aspects of children's lives, we seek to improve policies and programmes for children.

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