

Abstract

Teachers' pitiful performance on a test of primary school Math – as part of the SchoolTELLS survey – suggests that poor teacher competence is a plausible explanation for children's low Math achievement levels in school. The objectively measured Math skills of teachers correspond well with the subjective perceptions of teachers: about 80% of sample teachers agree to some degree with the statement -“I sometimes have difficulties in addressing mathematical queries and problems of my students”. The findings have implications for both recruitment policy and for (pre- and in-service) teacher training curricula.

While there may be many factors behind the low learning achievement levels of primary school children in numeracy skills (ASER, 2005 – 2008), one potentially important factor – the possibility of low teacher competence – has received little attention in research, public debate or in education policy. While anecdotal concern has been expressed about teachers' poor skill levels and their ability to teach the content of prescribed textbooks, to our knowledge there is little systematic evidence on this issue in India

As part of the SchoolTELLS survey (Kingdon, Banerji and Chaudhary, 2008), we tested primary school teachers' cognitive skills in Mathematics (as well as in Hindi language) in 10 districts of Bihar and Uttar Pradesh in the 2007-08 school year. In Math, we measured (a) teachers' knowledge of basic arithmetic operations at the grade 4-5 level, i.e. does the teacher herself know the material that she is meant to teach; (b) teachers' ability to spot children's mistakes, and (c) teachers' ability to explain Math concepts in easy-to-follow simple steps. Assessment tasks for teachers were aligned with the standard Math teaching tasks that teachers in primary school would be required to do in the classroom routinely.

To prepare the teacher tests, we closely examined the material in the primary school Math text books in Uttar Pradesh and Bihar. For example, teachers were given common problems in percentage and calculations of area (Figure 1). These kinds of problems are in the state textbooks at Std 4/5 level.



Teachers were asked to solve the problems (test of knowledge/ability) and to clearly write down step-by-step solutions (test of ability to explain). We also gave teachers tasks that tested their ability to spot mistakes in children's work. For example, we showed teachers 3 examples of children's work in solving a division problem (Figure 2), and asked them to identify which child's solution was the correct one. The tests were marked by senior teachers through Bihar State Council of Educational Research and Training (SCERT) in Patna.



Pitiful teacher performance on primary school Math questions suggests that low teacher competence is a plausible explanation for children's low Math achievement levels in school.

**Questions that test 'Does the teacher know'****Percentage problem**

A class has 55 children. Of these 32 have books. What percent of children do not have books?

Area problem

To plant a litchi tree you need 25 sq meters. Ramesh has a field that is 80 meters long and 70 meters wide. What is the maximum number of trees that he can plant in his field

Figure 1

A question that tests 'Can the teacher spot mistakes in children's work?'

[the teacher had to identify which of these three workings of the division problem is correct]

$$\begin{array}{r} 9 \overline{)927} \text{ (103)} \\ \underline{9} \\ \times 27 \\ \underline{27} \\ \text{XX} \end{array} \quad \begin{array}{r} 9 \overline{)927} \text{ (13)} \\ \underline{9} \\ \times 27 \\ \underline{27} \\ \text{XX} \end{array} \quad \begin{array}{r} 9 \overline{)927} \text{ (92)} \\ \underline{81} \\ \times 17 \\ \underline{9} \\ \text{X8} \end{array}$$

Figure 2

The findings are sobering: Only 25% of teachers could do the percentage sum (Table 1). Bihar teachers had better performance than UP teachers, and government school regular teachers performed significantly better than either para or private-school teachers (though absence rates of regular teachers – not shown here – are also much higher). But even among the best performing group of teachers – Bihar regular teachers – only 43% could do the percentage sum correctly, suggesting large skill deficits to impart primary school Math. Only 28% of teachers could do the area sum (Table 2).

Government school regular teachers' performance was better than para teachers' (and in UP, vis a vis private school teachers). Even so, only 39% of regular teachers in Bihar and 30% in UP could do the area sum correctly. However, the performance of different teacher types (regular, para, private) was more similar to each other in the 'ability to explain' and 'ability to spot mistakes' areas. This meant that in their total Math score they did not differ from each other so much as in the Math 'knowledge' area that was tested only through performance in the percentage and area sums.

Ability to explain in Math was adjudged low because many teachers were not able to show solutions in clear systematic steps. Ability to spot mistakes was better, but still imperfect: 15% of regular teachers and 26% of para teachers could not correctly identify which one of the three children's workings of a simple division sum (927 divided by 9) was correct.

Such pitiful teacher performance on primary school Math questions suggests that low teacher competence is a plausible explanation for children's low Math achievement levels in school.

Table 1

E.g. in UP, the absence rate of regular teachers is 25% and that of para and private school teachers is 12% and 17% respectively. Similarly, the mean salary of regular teachers in UP (about Rs. 12,000 per month in Jan. 2008) was about four times the para teacher salary (Rs. 3000 pm) and more than 12 times the private school teacher salary (Rs. 940 pm). This extreme pay-inequality was further exacerbated following implementation of Sixth Pay Commission salary scales in UP in 2009 whereby regular teachers' starting salary rose to Rs. 18,000 per month. Kingdon (2010 forthcoming) estimates that in UP the ratio of regular teacher pay to state per capita GDP is 17: 1, while showing that the average of this ratio for developing countries is 3:1.

Teachers' performance on the percentage sum question

PERCENTAGE PROBLEM	Bihar				UP			All
	Reg.	Para 05	Para 06	Priv.	Reg.	Para	Priv.	
Not attempted	14.4	12.0	26.4	37.0	16.7	23.5	28.6	20.6
Incomplete	32.7	48.8	46.2	25.9	40.0	40.0	54.6	42.6
Wrong steps & wrong answer	5.8	6.4	5.5	11.1	10.0	3.5	1.3	5.7
Correct steps, wrong answer	3.9	6.4	3.3	3.7	4.4	7.0	1.3	4.6
Only correct answer, no steps	0.0	1.6	3.3	0.0	1.1	4.4	2.6	2.1
Solved correctly	43.3	24.8	15.4	22.2	27.8	21.7	11.7	24.5
% of teachers struggling with the task (rows 1 to 3)	52.9	67.2	78.1	74.0	66.7	67.0	84.5	68.9

Table 2
Teachers' performance on the area sum question

AREA PROBLEM	Bihar				UP			All
	Reg.	Para 05	Para 06-07	Priv.	Reg.	Para	Priv.	
Not attempted	27.9	28.8	38.5	51.9	30.0	48.7	41.6	36.6
Incomplete	19.2	25.6	26.4	7.4	18.9	19.1	26.0	21.8
Wrong steps & wrong answer	5.8	4.0	1.1	3.7	7.8	3.5	2.6	4.1
Correct steps, wrong answer	3.9	3.2	8.8	0.0	4.4	1.7	5.2	4.1
Only correct answer, no steps	4.8	5.6	3.3	0.0	8.9	4.4	9.1	5.5
Solved correctly	38.5	32.8	22.0	37.0	30.0	22.6	15.6	27.9
% of teachers struggling with the task (rows 1 to 3)	52.9	58.4	66.0	63.0	56.7	71.3	70.2	62.5

Apart from measuring primary school teachers' competence in imparting numeracy skills, we also asked teachers about the extent to which they agreed with the statement "Sometimes I have difficulty in addressing the Math queries and problems of my students". Table 3 is self reported data. It shows that only about 18% of government school teachers in Bihar and 22% in UP say they disagree with the statement, i.e. about 80% of teachers admit that they have some difficulty in addressing the Math queries and problems of their students. Of these, 25 percentage points of teachers in Bihar and 15 points in UP fully agree with the statement.

Table 3
Percentage of teachers who say they agree with the statement
"I sometimes have difficulties in addressing Mathematical queries and problems of my students"

	BIHAR				UP			
	Fully agree	Partially agree	Some-what agree	Disagree	Fully agree	Partially agree	Some-what agree	Disagree
Govt. school teachers	24.5	11.0	46.8	17.7	15.2	18.3	43.1	22.3
Private school teachers	16.7	12.5	45.8	25.0	16.9	18.5	36.9	27.7

Implications of the findings

Content knowledge of the material in the primary school textbooks is not tested as a criterion for teacher recruitment for primary schools. This is presumably because it is assumed that teachers' educational qualifications and pre-service teacher training will ensure that they have adequate knowledge and skills for teaching primary grades, or because it is assumed that any deficits in such skills can be plugged later, via in-service training.

However, these assumptions seem risky and untrue, in light of our finding that (a) competency scores are low even among the 'best' group of teachers – the government-school regular teachers who mostly have BA and MA qualifications as well as pre-service teacher training. The assumption is also risky in light of evidence (not presented here) that teacher competency scores were only weakly related to teacher educational qualifications and pre-service training.

Such weak correlation could arise if there was much variability in the quality of education/training received by different teachers.

While teachers may fear and oppose testing – especially if it is high-stakes (i.e. linked to pay, promotion or contract renewal) – it is inappropriate to subject children to teachers who themselves cannot tackle the textbooks they are meant to teach.

Our findings have important policy implications. Firstly, the skill deficits identified through tests can usefully guide the future pre-service training curriculum

of teacher training colleges. Secondly, teacher tests can assist with future recruitment by helping to identify individuals who are competent to teach. Thirdly, teachers should welcome testing as it will reveal their in-service training needs and give them an opportunity to upgrade their skills before they are tested in a high-stakes way. Lastly, there is no provision for subject-specialist teachers in primary grades in most Indian states but it may be useful to make an exception in the case of Math since this is an area of particularly weak skills amongst teachers and it may be a difficult area in which to upgrade the skills of all teachers.

References

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Geeta Kingdon holds the Chair of Education Economics and International Development at the Institute of Education, London University. Her research in Economics of Education involves statistical analysis of issues of school effectiveness, teacher incentives, impact evaluation, political economy of education, and gender discrimination in both intra-household allocation of education and in the labour market rewards of education. She can be contacted at G.Kingdon@ioe.ac.uk

Rukmini Banerji has been with Pratham since 1996 (www.pratham.org). She is also Director of the ASER Centre (www.asercentre.org). She can be contacted at rukmini.banerji@gmail.com

