This working paper summarises a very interesting study conducted on over 30,000 students in India’s leading schools in 2006. The results suggest that rote learning dominates learning even in our top schools.

We acknowledge the support of India Today magazine – many graphics used in this paper are from its November 2006 issue which featured this study as the cover story.

Educational Initiatives (EI) believes that significantly improved student learning can happen only through systematic research into learning which includes assessment, as well as areas like misconception research. This working paper series will share learnings from various past and present EI projects as well as path-breaking work in these areas elsewhere in the world. Please write to us at assessment@ei-india.com for questions or comments.
WHY THIS PROJECT HAS LARGER RELEVANCE

How well are students in our 'top' schools learning? In order to try and understand this, Educational Initiatives (EI) and Wipro Ltd. conducted a research study in the 5 metros – Mumbai, Kolkata, Chennai, Delhi and Bangalore in 2006.

These ‘top’ schools in our largest cities arguably represent the best education that is available in the country. These schools are likely to be the least constrained for different types of resources. Facilities like libraries, computers, playgrounds as well as access to resources (being located in the metros) are the best in the country. Partly for these reasons, these schools, in general, are the most coveted among parents and serve as role models to other schools. Often they are the thought leaders and their ideas and practices set the tone for others. It is therefore interesting to study how these ‘role models’ are faring.

In a limited sense, the purpose of this study was to understand how well students are learning in our ‘top’ schools. However the larger goal was to take a critical issue - the quality of student learning - and to try and gain insights about it based, not on opinion or ‘experience’, but on hard data.

SALIENT FEATURES OF THE STUDY

- **Expert Panel**: A group of eminent educationists and school principals formed an expert panel that oversaw and was consulted on various aspects of the study.

- **Selection of Top English Medium Schools**: The ‘top’ 40 schools were identified through a popular survey in each metro and then invited to participate in the study. In each metro, the survey covered about 200 people across 10 categories based on their profession and location in different geographical areas.

- **Specially Assembled Test Paper**: Students of classes 4, 6 and 8 from these schools were assessed through a test. The test consisted of objective, multiple-choice questions in English, Mathematics, and Science as well as a writing task. The questions were carefully selected from a pool of ASSET items which have already been extensively tested with thousands of students.

- **International Benchmarking**: Some questions from an international test, the TIMSS, were also included in this to provide a comparison with the performance of international students.

- **A Writing Task**: All students were administered a writing test, where they had to write a paragraph, story or report. This revealed insights about the writing competencies of students in these top schools.

- **Completely Invigilated Tests**: All the tests were invigilated by EI representatives, to ensure that the processes were standardised and possibilities of copying or collusion were minimised.

- **Background Questionnaires**: The test papers given to the students include 4 questions seeking information about student preferences and interests. School principals were also asked to fill a questionnaire seeking information about the school and its facilities.

- **Analysis**: Different types of analyses were carried out on the collected data to extract patterns in performances and to understand differences in learning levels across different groups. Advanced statistical methods and Item Response Theory were used to confirm patterns. Analysis was also done to check if copying had occurred.

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<th>Number of students schools who took the tests in the different cities</th>
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<td>Schools Tested</td>
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<td>Students tested (Main Study)</td>
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<td>Students tested (Secondary Study)*</td>
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*The secondary study used common papers for classes 4, 6 and 8.

QUESTIONS THAT CHECK UNDERSTANDING

In this test, students were assessed on concepts that are part of their curriculum. However, the test used questions that checked for conceptual understanding, unlike the standard school tests which generally check rote learning. For example, the universalities of laws and rules is also often not understood by students. As shown in the example alongside.

"When light is reflected from a smooth surface, the angle of incidence must be equal to the angle of reflection."**

Under which of the following situations is the above statement true?

A. It is always true, (20%) B. It is true only if the surface is CBM (CAVE or PLANE). (17%) C. It is true only if the surface is made of GLASS (13%) D. It is true only if the surface is PLANE (42%)
### MAIN FINDINGS

1. Students across classes answer rote-based or procedural questions relatively well. The flip side of this, however, is that students seem to rely on memory or learnt procedures to answer almost all questions, rather than trying to think through and solve the unfamiliar ones.

2. It appears that many practical competencies, important in real life, are not being developed very well. Students' performance on questions based on measurement, estimation, problem solving, general observation and day-to-day language use is not very good.

3. Instead of acquiring concepts, students seem to be learning to handle a limited number of question types. So when they come across a question similar to one they have ‘learnt’, they ‘jump’ to the most familiar answer they find!

4. Students are learning in ‘compartments’, i.e. they may be aware of two pieces of information, but often not know how they are related or how that relation works in a real life situation.

5. Apart from problems with learning strategies, a number of specific and clear ‘common errors’ exist in the different subjects. Since they are widespread, it should not be difficult for textbooks and teachers to specifically address these errors.

6. Some background information - like the average class size, the number of hours of instruction per week, the number of working days per week and whether the school has laboratories for English, Maths and Science - was sought from each participating school through a questionnaire developed for the purpose. Only a very weak negative correlation was observed with the class strength. No other factors correlated significantly with the average performance of the schools/classes.

### SUBJECT-WISE FINDINGS - MATHS

- Analysis shows that conceptual understanding tends to be weak in certain topics like decimal fractions, concepts like perimeter and general number sense. Students do not seem to have developed a conceptual understanding of decimal fractions. Similarly, a common misconception is that multiplication must always yield a greater number than division or other operations. Students seem shaky with the concepts of area and perimeter. Even among the two, perimeter seems to be less understood.
SUBJECT-WISE FINDINGS - ENGLISH

- A number of basic errors related to spellings and pronunciation were noticed in which students were asked to identify a word rhyming with ‘dawned’ in class 8. Similarly, students chose ‘hear’ (60%) rather than ‘pear’ (22%) when asked which word rhymes with ‘hair’. They also felt that ‘size’ rhymes with ‘seize’, not ‘flies’. It is clear that many students are choosing words that are spelt similarly, rather than rhyming words.

- Comprehension errors are common in cases where the answer does not appear explicitly in the text.

STUDENTS’ ENGLISH WRITING SKILLS

In addition to the objective type items used in the main and secondary studies, a writing task - writing a paragraph, describing a picture/incident or writing a story - was also given to each student. About 32,000 student writing samples were thus obtained. A random sample of these were selected and analysed.

The analysis shows that although students’ proficiency in English increases with class, even in class 8 about 80% of students are making mistakes in comprehension, grammar and syntax. It appears that for a large population of students language learning is mechanical, with students often failing to relate a writing task to its real life implications.

![Image of a chart showing common errors in English]

Some students wrote stories where they had to report a telephonic message.
In Science, misconceptions or common errors were found. Some of these are:

A. When asked the chemical formula for pure steam, 51% students answered that pure steam does not have a chemical formula, even though the 3 facts given below are known to the students by this stage:

1. The chemical formula of water is H₂O.
2. Water changing to steam is a physical change.
3. Chemical composition does not change in a physical change.

B. If one considers biologically, is Man an animal? A fly? The answer is yes, and it is discussed under classification of living things - an important topic. Yet 19% of class 8 students do not think that Man is an animal and 47% do not think flies are animals.

C. The height of the water collected (though not the volume) in any vessel of uniform cross-section in a rain will be the same - that is why rainfall is measured in cm. Yet, 74% of students in class 6 did not think so. This kind of question will be answered well if students are required to do simple experiments like collecting rain water and checking what the height of water collected depends on.
How are the students in the 'top' schools of our metros performing compared to their peers in other countries? To find this out, some questions from Trends in International Mathematics and Science Study (TIMSS), an international assessment in which over 40 countries participated were included in the paper used for the secondary study. Since the performance of students internationally on these questions was known, a comparative picture could be obtained.

The findings are, to say the least, quite worrying. Students from the 'top' schools of our metros are performing below average international levels. The performance of the class 4 students is significantly lower than the international average in each one of the 11 questions included from TIMSS. More strikingly, students of a higher class (class 6) performed only marginally better than the international average for class 4 students. As seen in the graph, the trend is similar in both Maths and Science. It is worth remembering that the data being compared is of Indian students in 'top' schools (by popular perception) and the average students of other countries.

73% of metro students in class 4 got this right, which is good, but internationally, 82% of class 3 and 85% of class 4 students answered correctly.

Overall Recommendations

This section contains some specific recommendations mostly at a systemic level. Some are easier to implement than others, but all of them, we believe, would help us move closer to the goal of improved student learning.

1. Stereotypical misconceptions / mistakes in comprehension exist among students – many of which are highlighted in this report. When updating textbooks and during teacher training programmes, such findings should be taken into account so that the incidence of such misconceptions may reduce.
2. A debate needs to be initiated on the importance and role of learning with understanding and the problems with rote learning.
3. The nature of questions in the Board Exams should change with more questions that test learning with understanding and fewer rote / recall questions. This will have a downstream effect on the nature of school test questions and classroom questions.
4. Teacher training that impacts the teaching methodology to make it more understanding rather than rote-focused will be a critical enabler.
5. The practice of Boards to give students very high marks - close to 100% in most subjects - has many negative effects. Apart from creating pressure (because a single mark matters so much more in a high scoring situation), inflated scores are often taken as indicators of thorough learning. Boards should start awarding students a percentile score in every paper. This is neither difficult to do, nor is it objectionable in any way.
6. India should participate in international benchmarking assessments like the TIMSS which test students on how well they can apply the learnt competencies/concepts. This will help the country benchmark student performance with the rest of the world and become the basis for improvement. Benchmarking studies like the TIMSS can be conducted within India also.
DISCUSSION – ARE STUDENTS TAUGHT THE CONCEPTS THAT WERE TESTED

This study shows surprising results that even in the ‘top’ schools, a significant fraction of middle school students have not mastered primary school competencies; and that significant differences exist in the learning levels in various Indian cities. We would like to emphasize that the purpose of this study is not to sensationalise these gaps or even to identify the so-called ‘top cities’ or ‘top schools’ - in fact, these aspects have been consciously downplayed in the report. The question of interest is how can we discover underlying, non-apparent patterns and use that learning to improve the system? That is the purpose of this study.

We would like to believe that studies like this help us identify problems and thus give us a chance to move onto the cycle of problem discovery, cause identification, solution implementation and feedback (which may lead to a deeper level of problem identification) and thus create a positive spiral towards improvement.

BIBLIOGRAPHY AND REFERENCES

We are an educational research organization that focuses on learning research through assessments. EI has been started by a group of IIM Ahmedabad alumni with first-hand experience of setting up and running educational institutions. It has been formed with a mission to work towards qualitative improvement in India's educational system and our vision is “A world where children everywhere are ‘Learning with Understanding’.

PROJECTS OF EI:

Andhra Pradesh Randomised Evaluation Study (2004 onwards): Done in partnership with Harvard University, Azim Premji Foundation, World Bank and the Government of Andhra Pradesh, this is a longitudinal study across 8-9 years and covers currently 100,000 elementary school kids and measures the impact of various inputs (eg., block grants, additional teachers) with outcome-based teacher incentives.

Assessment of Student Learning in Sarva Shiksha Abhiyan – RGSM, Chhattisgarh (2008 onwards): The test was developed in Hindi and administered to approximately 3 lakh students in about 1900 schools in 16 districts in Chhattisgarh states. The tests have already been conducted for students of class 3 to 8 for Language and Maths and the report is in final stages.

Municipal School Benchmarking Study (2004-2007): Supported by ICICI Bank, this study assessed learning in 35,000 municipal school students from class 2, 4 and 6 across the 6 biggest towns in each of the states - Gujarat, Andhra Pradesh, Rajasthan, Chhattisgarh and Uttar Pradesh.

UNICEF Learning Assessment Study for Quality Education (2005-2006): assessed mathematics and language acquisition among primary school children in the UNICEF quality package schools in 13 states of India. The tests were standardised across 9 languages and involved very intricate development cycle involving language experts from all over India.

Teacher Needs Assessment (2008 onwards): is a census study that has been initiated by the Royal Education Council, Government of Bhutan. In this project all teachers of Bhutan are assessed for their general ability, competence in subject knowledge and pedagogical practices.

Student Learning Study (2008-2009): Supported by Google Inc., this study is currently ongoing and assesses student learning in 21 states of India. Nearly 190000 students in classes 4, 6 and 8 are tested for learning in Language and Maths in rural and urban govt. schools.

EI’S PRODUCTS AND LEARNING SOLUTIONS:

ASSET: is an objective-type, multiple-choice test for students of Classes 3 to 12. It is a scientifically designed, skill based assessment developed in India for Indian schools. It assesses students’ level of proficiency in the skills and concepts underlying the school syllabus and provides them feedback about their strengths and weaknesses. Know more about ASSET at www.ei-india.com

Mindspark: is a computer based self-learning programme that helps the child improve his/her skills. It allows each student to follow a learning path that is based on his need. Mindspark is currently available for Maths for classes 2-10 in English version. Mindspark can be accessed at www.mindspark.in

Rural Mindspark: Hindi version is currently available on demand for some Maths modules. Contact EI to know more about other language versions and modules.

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