

REFORMING BOARD EXAMS FOR LEARNING WITH UNDERSTANDING

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Board exams results in India are crucial in deciding what the students will do further in their career – whether choosing Science / Commerce / Arts (10th) or the colleges that they get into (12th). As a result, teachers start preparing students for such exams from lower classes, by giving them similar pattern tests, question types and make them proficient in the procedure through repetition or memorization. This paper talks about a research study project to reform 10th Gujarat board exams by using best practices from other national and international board exams. The paper talks about the steps taken to understand the school leaving exams in different countries and the type of questions that are asked. The study recommended a five year plan to reform the board exam, with an eventual goal of students learning with understanding and developing critical thinking skills rather than a drill based approach.

INTRODUCTION

The Board Exam at the end of class 10 and class 12 represents a high stakes goal for students, parents and school system. The ultimate objective of these exams at the end of secondary level may be either for obtaining a secondary school certificate, determining criteria for post secondary placements, i.e. admissions to a college or for both. In countries Like Singapore, UK, US and to some extent in India, these examinations serve as the sole purpose of getting certified as “high school graduate” whereas in countries like Finland, Russia, Brazil etc. high school exit examinations serve dual purpose of certification and admission to universities. In a few countries, students have to sit for other critical “university entrance exams” for securing admissions in specific courses. South Korean and Chinese students sit for such high stakes test. While for certification and admission to further courses, these examinations are pivotal, the whole perspective of seeing it as a constructive tool to ensure learning has to be internalized.

For this a multi-pronged approach would be required which will not only orient teachers to focus on understanding based question making, but will also modify the existing mindsets of students and families to consider education independent of the degree label.

The teaching methods in schools and coaching classes geared towards achieving success in the Board Exams are usually by way of making students practice a certain type of problem over and over– sometimes the procedure is emphasized far more than the understanding of the problem. Students are also encouraged to memorize passages or diagrams. There is a need to recognize this across the country that school-leaving exams need to become much less rote-based, thereby increasing the rigor and quality and creating a systemic change in the way concepts are taught by teachers and learned by students.

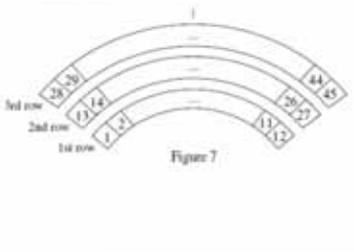
Sample Maths Questions from Gujarat	Sample Maths questions from Hong Kong (similar questions are also found in other international Boards)	
Find the n th term of an Arithmetic Progression 3, 8, 13, 18.....	The seats in a theatre are numbered in numerical order from the first row to the last row, and from left to right as should in Figure 7. The front row has 12 seats. Each succeeding row has 3 more seats than the previous one. If the theatre cannot accommodate more than 930 seats, what is the greatest number of rows of seats in the theatre?	
The formulae to find the total surface area of a closed cylinder are.....		
Find the simple interest of Rs. 8000 at 10% for 3 years		
<p>Fig. 1: We emphasise so much on only textbook-based and procedural questions (all the examples of the left) that our children struggle with questions that they may be in an unfamiliar form. The question on the right represents a real-life application of Arithmetic Progressions. Can we introduce many such questions in the Gujarat Board 10 paper - today there are almost none?</p>		

Figure 1: Sample maths questions from Gujarat and Hong Kong

Educational Initiatives has been conducted assessments that have questions that focus on conceptual understanding and learning. Our experience and longitudinal data in certain impact assessments strongly suggest that asking right kind of questions can stimulate higher order thinking in students and teachers both. Questions indicating weak skills or concepts, when shared and discussed with teachers, they tend to modify their teaching methods which in turn can help students learn concepts clearly.

The National Curriculum Framework 2005 (NCERT, 2005) and the Report of the Committee on Exam Reform, Gujarat, have emphasized the need to move away from rote-based to understanding-based questions. Doing so would require changes in the pattern and types of questions asked in the Board Exam. The ultimate purpose is not simply to change the questions in our exams papers but to actually build capacity within the relevant government bodies in the State to be able to build the right type of questions.

After all a bank of questions can be obtained simply from international assessment papers However, important challenges lie elsewhere, like:

1. The Board Exams are a high-stake, multi-stakeholder process: Every student aspires to write and perform well in the Board Exam; further, for every individual the performance in the exam has important consequences for him or her and the immediate family.

The Board itself is a stakeholder as it is responsible to the government, politicians and the public and interacts with paper setters and correctors (drawn from teachers). Many of them are in turn answerable to the media and the public.

2. Board Exam paper setting and question types: Another interesting characteristic about Board Exams (and school assessments in general) is that they are extensively experienced by a large number of people. In the context of Board Exam reforms, the question paper is set for students with a varied ability to answer questions. Board exam papers are prepared in a secure environment as multiple question paper setters work on sections of the test paper. With this secure process, to get the questions rigorously set and without error is a challenge and leads to error.
3. The challenge of capacity needs to be addressed: Probably the most common response we got when we showed the question types from tests like Programme for

International Student Assessment, the International Board or the other countries was “Our children will not be able to answer these questions”. Usually, this was quickly elaborated further, “*Actually our students are very capable but are not taught in this way*”. “*Our teachers today are not able to teach in the way required for students to be able to answer such questions*”.

A detailed, carefully thought through and well-planned capacity building programme would need to be designed to provide continuous and on-demand hand-holding to teachers (and answers to parents, students and others).

This capacity building is necessary not because our teachers or question setters lack any capability or are second to anyone. Rather it is needed because the expectations from their roles for decades now have been different, and to prepare children for the globalized knowledge economy that is already upon us, many existing skills would need to be polished and some new ones developed.

Educational Initiatives developed a research-based transformation of the class-10 Board Exam paper into one that has an appropriate mix of questions to test knowledge, understanding, application and higher-order thinking skills. And, since the intended change involves several stakeholders, a concrete action plan to achieve the change over 5 years was prepared. It is important to note that Andhra Pradesh SCERT (2013) has released guidelines for SSC Examination Reforms. Andhra Pradesh SCERT has also mentions reforming the pedagogy and textbooks by making new textbooks and training teachers on how to use them in the class.

This research had two major objectives:

- Recommending an alternative Board Exam pattern that is based on the same curriculum, but purports to test/ understanding and higher-order thinking skills, not just recall.
- Coming up with a concrete action plan that will address capacity building issues as well as the concerns of the various stakeholders (parents, teachers, schools, etc.) to facilitate the transition.

METHODOLOGY

The trigger of this project was a vision that the Gujarat Class 10 Board Exam question papers would be in line with those from the best school leaving exams in the world and would focus on testing students’ understanding, application and other higher order skills and not merely rote or recall. To do this Boards/ countries were selected to be studied for the board exam pattern they follow.

Choosing the Countries/Boards of Study

The countries which we have studied were chosen through a scrutiny of economic and performance indicators. Two indicators which were deemed appropriate to select the countries for study are i. Gross domestic product (GDP) derived from purchasing power parity (PPP) and ii. Overall ranks of the participant countries in Programme of International Student Achievement (PISA) test in 2009 and 2009+ cycles (OECD, 2009).

PISA is an international student achievement test which assesses the students on acquisition of literacy, measures “real-life” skills pertaining to reading, mathematics and science, as well as cross disciplinary competencies (OECD 2003). More than 70 countries participated in PISA 2009 round of study.

The overall performance of some of the countries chosen for the study in PISA test and their corresponding GDP is tabulated below:

Country/Territory	PISA 2009 Rank	GDP(PPP) International Dollar
Shanghai	1	11,134
South Korea	2	31,753
Finland	3	36,723
Hong Kong	4	49,342
Singapore	5	59,936
Canada	6	40,457
New Zealand	7	27,966
US	17	48,147
UK	23	35,974
Russia	44	16,687
Brazil	54	11,845
Indonesia	58	4,668
India (HP and TN)	73	3,703
World Average		\$10,700

Table 1: List of countries on two indicators

The table shows a fair degree of correlation between the rank achieved in PISA and the GDP of nations. An overview of educational performance of different countries reveals that Finland, Singapore, Canada and New Zealand are often the top performers in International achievement tests.

A comparative analysis of school leaving examinations was done for these 10 countries with the help of the following:

1. Exploring Secondary Education Systems and Assessment Practices.
2. Comparing and Contrasting Different School Leaving Examinations.
3. Understanding the Shortcomings of Gujarat Secondary Examinations Question Papers.
4. Bringing out the “Quality of Assessments” in Four Different Secondary Examinations.

In addition to this, the researchers also developed understanding of the existing Gujarat Board Examination process, meeting with different stakeholder namely students, teachers, school heads, board officials and researchers were done to understand what is now and want kind of reform they want to see in board exams in Gujarat.

DATA ANALYSIS

As part of data analysis the following were done:

1. Desk research was conducted to understand the Secondary Education Systems of Selected Countries and the key features of some the assessments at the end of the secondary school were compared and contrasted.
2. The board exam papers were collected from different countries and studied for the types of questions asked. The essence of “comparative study of the different examination boards” was
 - To identify the key qualitative issues in the question papers of Gujarat board and to bring out some qualitative features of question papers of other boards. This was done with item-wise analysis for English, Science, Social Science and Mathematics.

In order to do an Item-Wise Analysis of question papers we collected different set of question paper from different boards. The set of question papers we analyzed are tabulated below:

Board	English	Science	Social Science	Math
Gujarat Board	1-2008	1-2008	1-2008	1-2008
IB	1-HL,SL(A)	6-P,C,B (HL,SL)		4- HL ,SL
CBSE	1-2010 SA	1-Science (Theory)	1-2008, 1-2010	1-2008, 2- 2010
Hong Kong	1-Four sample papers P1,P2, P3,P4	1-Integrated Science P1,P2	History P1 History P2 Geo P1, Geo P2	Math P1,P2,E1,E2
P – Paper E- Extended Paper HL- Higher Level SL- Standard Level A- A Course SA- Summative Assessment				

Table 2: List of question papers analyzed

The question papers were looked for the type of questions, difficulty level, are the questions direct, formula based or encourage students to apply the knowledge in solving questions.

FINDINGS

The tables below describe the analysis of math and science papers across boards. The questions in Gujarat board were mostly procedural, formula based, recall of definition with lack of quality of questions and more of general knowledge. While CBSE board exam papers had some good quality questions, it also had procedural, repeats from previous years, basic questions with low level of difficulty. The Hong Kong and IB diploma papers were of higher quality in comparison to Gujarat and CBSE Board.

Gujarat Board (2008-11) Mathematics	CBSE (2008-11) Mathematics	Hong Kong (Sample Paper) Mathematics	IB diploma (2006-11) Higher Level Papers
Majority of questions are procedural. Many questions require mere substitution in a	A number of procedural questions. Year 08 question paper contains some	An assortment of different difficulty questions Encourages students to	Procedural questions Mix of application and recall of knowledge Students need to use

<p>known formula.</p> <p>Few of the questions just need a recall of a formulae or definitions.</p> <p>Some of the questions are inappropriately framed.</p> <p>Lower difficulty level than it should be</p> <p>Lack of quality questions</p>	<p>good quality questions.</p> <p>A number of repeats from the previous years.</p> <p>Requires some basic knowledge</p> <p>Lower difficulty level questions</p> <p>Lack of quality questions</p>	<p>apply mathematics to solve scientific problems.</p> <p>Tests application of Mathematics to real life situations.</p> <p>Some of the questions are highly differentiating.</p> <p>Higher difficulty Level</p> <p>Higher order thinking</p>	<p>Mathematical tools</p> <p>Need to explain cause, effect and reason</p> <p>Higher difficulty level questions</p> <p>Avg. quality questions</p>
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Table 3: Comparison of mathematics question papers

Gujarat Board (2008-11) Science & Technology	CBSE (2008-11) Science (Theory)	Hong Kong (Sample Paper) Integrated Science	IB diploma (2006-11) Phy, Chem, Bio
<p>Procedural questions on conventional topics</p> <p>Recall based questions</p> <p>Non-essential information</p> <p>Seems to test General Knowledge</p> <p>Lower difficulty level than it should be</p> <p>Lack of quality questions</p>	<p>Short answer and Essay type questions</p> <p>Simple recall of facts</p> <p>A number of repeats from the previous years.</p> <p>Requires some basic knowledge</p> <p>Avg. Difficulty level questions</p> <p>Low quality questions</p>	<p>Analysis and Synthesis of contemporary topics</p> <p>Encourage objective scientific thinking</p> <p>Applying Knowledge of scientific process and phenomena</p> <p>Tests extensive scientific aptitude</p> <p>Satisfactory difficulty Level</p> <p>Higher order thinking</p>	<p>Procedural questions on conventional topics</p> <p>Mix of application and recall of Knowledge</p> <p>Students need to use Mathematical tools</p> <p>Need to explain cause, effect and reason</p> <p>Avg. difficulty level questions</p> <p>Good quality questions</p>

Table 4: Comparison of science question papers

Detailed Item Wise for Science and Technology Paper for Gujarat Board

1. A majority of questions **are procedural** (~60%). Require students to write about a phenomenon, a process, and state known facts, and explain functions and structures etc.
2. A second group of questions (~33%) are those which require students **to provide numerical data or define a term.**
3. A few questions (~7%) are based **on application of few basic concepts** ex. Finding numerical values by following one or two steps, or balancing a chemical equation, which may require student to think.

4. Some of the questions do **not seem to assess ‘skills of science’**, though important; these questions assess ‘general awareness’ of the students more than their understanding of science topics. For example, Q No. 15. In which country was the disease Minamata first seen? (MCQ); Q No. 16. Write full form Of G.S.L.V (1)
5. A few questions seem to check **awareness of non-essential information** e.g. the question which requires students to state the number of stars in the universe.
6. It appears that **the difficulty level of the questions** is lower than it should be. Two facts which contribute to this are: Some question loaded with hint while some others are repeats from previous year(s).
7. **Two good quality questions** we observed were: First - Which device converts solar energy directly to electrical energy? These questions certainly requires the student to think and answer, however it must be noted that if such questions are already provided in the text books, than they would no more be as effective.

Detailed Item Wise for Math Paper for Gujarat Board

1. A Majority of Questions **are procedural** (~60%). For example - Q No. 4. The roots of the equation $x^2 - x - 30 = 0$ are.....
2. Section E with highest weightage (25%) has all the questions falling into the procedural category.
3. 20% of the questions **encourage thinking and application** of a learned concept.
4. Around 12 % of the questions **require students to ‘substitute’ in a known formula**. Students need not know the logic or reasoning behind the formulae. For Example, Q No. 14. The formulae to find the total surface area of a closed cylinder are.....
5. Another 5 % of the questions just **need a recall of formulae or definition of term**.
6. **Few questions are ill framed**, especially the problems in trigonometry, it is assumed that all trigonometric functions are defined for all values. Q No. 11 $1 / (\sin^2 \theta) - 1 = \dots$. It has been assumed that the given function is valid for all values of theta (θ), which is fundamentally an incorrect assumption

RECOMMENDATION TO GUJARAT SECONDARY AND HIGHER SECONDARY EDUCATION BOARD

To achieve this vision the following were recommended:

1. **Revamp the Board Exam Structure:** Develop an advisory council consisting of educationists from different domain. A transition cell, looking after the transition. A task force of teachers, principal and domain expert to support transition cell to communicate between schools and external stakeholders. A technical support group to provide expertise on developing and researching on assessments.
2. **Introduction of non-text bookish questions in the board exam papers:** Over a period of 5 years, such questions can be increased in a stepwise manner from 0 to 65% in the paper. The table below suggests the same. This gradual increase will help the students to change accordingly over a period of 5 years, as students now in class 5 will face the maximum number of such question and will have the maximum time to get

prepared in this process. This change will also help the way exam preparation is done in the current education system to move from rote to learning with understanding.

Year of Transition	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Percentage of ‘unfamiliar’ questions	0%	5%	15%	25%	45%	65%
Students are currently in class	10	9	8	7	6	5

Table 5: Proposed increase in percentage of unfamiliar questions

3. **Multipronged support to students and teachers** – Participate in international assessments like TIMSS, providing learning with understanding tests from class 3 and conduct talent search exams for promoting merit. This will motivate students and teachers to change the learning and teaching process in the classrooms.
4. **Capacity Building of Teachers** - Designing courses, creating a bank of video materials and courses in Gujarati, Creating a bank of quality material in Gujarati through an on-going translation programme, organizing regular activities including competitions and exchange programmes for teachers, rolling out the trainings – both in face to face and ICT formats.
5. **Development of advocacy plan** to create buy-in and advocacy in stakeholders.

RESULT

A detailed research report was submitted to Gujarat Board with the analysis and recommendations. Had the following 2 impacts:

1. Based on these the board chose to conduct the capacity building workshops for teachers who are responsible for setting board exam papers. The workshop covered how to create good questions, understanding concepts from understanding by design, creating question paper blueprint and sample questions. The workshops were held 12 days covering teachers mainly from math, science and social science. These workshops were held with the following objectives:
 - To improve the quality of questions in science and mathematics stream for Gujarat Board Exams
 - To develop understanding among teachers about important aspects of developing a balanced paper, development and understanding of good quality questions, and developing subject level understanding.
 - To be able to develop good quality of test papers to assess student learning with understanding.
2. Change in the types of questions asked in Board Exam Papers: As an initial step, in the year 2013 few of unfamiliar questions were asked in board exams, which were provided by Educational Initiatives from its question bank. A question used in math class 10, year 2013 is given as a sample here. More questions were used in science paper as well.

In Math class 10 in the year 2013, the following questions were asked in Gujarat Board exams. The data shown below is from ASSET, a diagnostic test developed by Educational Initiatives. This test is taken by more than 3 lac students every year.

<p>In a Maths test taken by 35 students, the average score of 15 girls is 10 and that of 20 boys is also 10. Which of the following can be calculated based on the data we have?</p> <p>A. The highest score in the class. B. The lowest score among the boys in the class. C. The sum of the scores of the 35 students of the whole class. D. All of the above can be calculated</p>		
	Option	Performance %
	A	9.7
	B	7.6
	C	54.0 ✓
D	27.2	
<p>This question was designed to test if students understand the concept of average and apply it in the given context to check what can be found out and what cannot be found out. 54% of class 8 private English medium school students were able to answer it correctly. However, 27% students selected D as the answer. They have not understood that given only the average, the highest or the lowest value in the range cannot be found out.</p>		

Table 6: Unfamiliar question asked in 2013 Gujarat board exam

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