

Assessment of Mathematical Learning (High School)

Indian National Presentation

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Examinations carry very high stakes in India

- For most exam boards, entry to **12th** and choice of subject stream is decided on basis of **10th** exam (though RTE has brought about some changes and some relief)
- Entry to college decided on basis of **12th** exam / entrance exams
- Entrance exams *v* *highly* competitive, particularly for good colleges
- These have had an enormous influence on school education, with a trickle-down effect that reaches the primary level (thus, assessment styles are much the same at all levels)

Tutorial colleges ('coaching centres')

- Prepare students for entrance exams of sought-after colleges
- Their methods:
 - mastery of pattern recognition
 - cultivation of huge memory banks
- Private tutoring for the school board examinations too has become a common feature and a major 'cottage industry' in the country
- Their practices have gotten absorbed into the educational culture.

Sample questions from ICSE (10)

① Given: $x = \frac{\sqrt{a^2 + b^2} + \sqrt{a^2 - b^2}}{\sqrt{a^2 + b^2} - \sqrt{a^2 - b^2}}$. [4 marks]

Use componendo and dividendo to prove that $b^2 = \frac{2a^2x}{x^2 + 1}$.

② Without using trigonometric tables evaluate [3 marks]

$$\frac{\sin 35^\circ \cos 55^\circ + \cos 35^\circ \sin 55^\circ}{\csc^2 10^\circ - \tan^2 80^\circ}$$

3 marks \doteq $4\frac{1}{2}$ minutes, 4 marks \doteq 6 minutes

Sample questions from ISC (12)

- ① Show that the line $y = x + \sqrt{7}$ touches the hyperbola $9x^2 - 16y^2 = 144$. [3 marks]
- ② Evaluate: $\int \frac{2 \sin 2\theta - \cos \theta}{6 - \cos^2 \theta - 4 \sin \theta} d\theta$. [5 marks]
- ③ Find the equations of the two lines of regression for the following observations: $(3, 6)$, $(4, 5)$, $(5, 4)$, $(6, 3)$, $(7, 2)$. Find an estimate of y for $x = 2.5$. [5 marks]

3 marks \doteq 5 minutes, 5 marks \doteq 8 minutes

AIEEE

All India Engineering Entrance Examination (for entrance to B.E./B.Tech.)

- Duration of paper: **3** hours
- Structure of paper: **30** questions each in M, P, C (MCQ format)
- Total of **90** questions
- Time estimate: $2\frac{1}{2}$ to **3** minutes for each MCQ
- Taken by over a million students

Sample AIEEE question

1 Let

$$I = \int_0^1 \frac{\sin x}{\sqrt{x}} dx \quad J = \int_0^1 \frac{\cos x}{\sqrt{x}} dx.$$

Then:

A $I > \frac{2}{3}, J < 2$

C $I < \frac{2}{3}, J < 2$

B $I > \frac{2}{3}, J > 2$

D $I < \frac{2}{3}, J > 2$

Time available: $2\frac{1}{2}$ to 3 minutes

JEE-IIT

Joint Entrance Examination, for B. Tech. courses, Indian Institutes of Technology

- Taken by nearly half a million students
- Format of paper tends to change from year to year — to 'beat' the coaching centres
- Exam format (2011): Two **3** hour papers, with questions in M, P, C: MCQs with **1** correct answer, with > 1 correct choice; MCQs based on paragraph comprehension; matrix column matching; etc

Sample JEE-IIT question

① The value of $\lim_{x \rightarrow 0} \frac{1}{x^3} \int_0^x \frac{t \ln(1+t)}{t^4 + 4} dt$ is

Ⓐ 0

Ⓑ 1/12

Ⓒ 1/24

Ⓓ 1/64

Time available: $2\frac{1}{4}$ minutes

Is there anything 'wrong'? Yes: The context . . .

- The notion of *summative assessment*, with the future of the child hanging on the result
- The *purpose* (of the competitive exams): to filter and exclude rather than to include and nurture; girls in particular tend to get excluded.
- The fact that these examinations carry *enormously high stakes*: there are suicides associated with public examinations every single year, and also a vast amount of criminal activity.

Difficulties with content too . . .

- Emphasis on *procedure* and *manipulative skills* (algebra, trigonometry) rather than on *process* (not that the two are unconnected & disjoint; it is a question of emphasis, of balance);
- Heavy dependence on *memorization*, particularly at State Board level;
- Typical end-of-year exams in 8th and 9th are no different in style from board exams (though there is no real need for this . . .);
- Data Analysis: Focus is on *computation*, with no *interpretation*.

Difficulties of large systems . . .

- Even classroom assessment tends to be based on procedure and skills of manipulation rather than on process, and this is so at all levels (but this is perhaps typical of large educational systems . . .).
- The challenge: To address this through *teacher education* (especially at secondary and tertiary levels).

Continuous and Comprehensive Evaluation (CCE)

Purpose To decrease stress of board exams and workload and introduce a uniform and comprehensive pattern in education

Modality Curricular and extra-curricular evaluations along with academics, work experience skills, dexterity, innovation, steadiness, teamwork, public speaking, behaviour. Marks will be replaced by grades.

Comment. A CBSE initiative. Promising, but critically dependent on teachers' mindset. Without adequate teacher preparation it has no future.

Changes needed . . .

- Assessment has tended to be driven by **practical concerns rather than by educational priorities**. This must change.
- Research needed to explore how assessment can be facilitated using **technology** (e.g., self-assessment, where repetitive trials can be done).
- Work needed to strengthen the reach of **diagnostic and normative testing**, and of **investigative projects**.
- Work needed to build a strong **resource base** of assessment models and diagnostics (for teachers).