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Investigation Study to Decrease Failure Ratio of Mathematics Subject in S.S.C. Examination

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ABSTRACT

A survey into the tenth standard examination conducted by the Gujarat Secondary Education Board has revealed that only 49.10% students pass SSC examination. In mathematics alone the failure levels to 45.61 %.

The efforts have been made to find out the reasons for the deplorable result especially in Mathemetics. Researchers studied the answer sheets concentrating upon the errors students committed and/or for the difficulties they might have faced in answering the questions. The research project was taken over by Heads of Education Departments of four Universities from the State of Gujarat and was assisted by 45 teachers. On the basis of findings, various troubleshooters and solutions have been suggested. The findings and the solutions were circulated to all the schools through the monthly magazine published by the Board of Secondary Education.

Key words:

- **S.S.C.** (Secondary School Certificate): The certificate given to the Passing students for the examination conducted by the State Government for the age group of 15-17 years.
- **10th Std:** A benchmark year denoting the end of the School level. The Higher Secondary education starts after this level.

Introduction

There had been a number of attempts in the past to ascertain the reasons of poor performance in Mathemtaics by the SSC students. **Bokil (1956)** found that the school size was not so important a factor to affect the percentage of failures, but the size of school influenced the number of candidates scoring less than 20 per cent of the total marks. **DEPSE (1964)** found that teachers` qualifications, their background accompanied by the mode of teaching, methods employed and working conditions on one hand and on the other the location of the school, equipments/ facilities available, media of instruction etc, were the factors which affected the pass/fail ratio of the school. It was also found that the large number of students failed in at the S.S.C. level English and Mathematics. **Gujarat (1969),** compared the achievements of pupils in Mathematics with those in 12 other countries and found that the achievement of pupils from Gujarat is much lower than their counterparts in other countries. This emphasized the need for paying more attention to diagnostic testing in Mathematics and developing remedial programmes. **Sail (1978),** analyzed the answer books concentrating upon each question in Mathematics and English and found that transposition, forming equations, solving equations with coefficients and fractions, etc. were the areas of common mistakes in algebra. The common errors in geometry were centralised against drawing figures, using theorems involving perpendicular bisector of chord, applying Pythagoras theorem, properties regarding isosceles etc. **Gadgil (1978)** reveals in one of his analytical

studies that: Out of seventy five in algebra about 37 percent candidates secured less than ten marks and about 67 percent secured less than twenty one marks. In geometry about 27 percent secured less than ten marks and about 71 percent less than twenty-eight marks. **Sharma (1978)** while analyzing the UP board (another province in India) results found that, the average performance continued to increase every year in Hindi, Mathematics and Science subjects. **Jain and Burad (1988)** found that the causes responsible for low results in secondary mathematics in Rajasthan State have been timely unavailability of efficient and knowledgeable teachers for mathematics due to late appointments and frequent transfers, while other factors like lack of prompt correction of homework, lack of child-centered teaching were also responsible for low results. **Kasat (1991)** has made an in depth study of the causes of failures in the S.S.C. examination of Marathi medium high school students in Palghat Tehsil.The major findings were poor intelligence levels, poor numerical ability, poor comprehension and recall ability of students. Students have shown a constant disinterestedness in mathematics, multiplied by poor study habits, lack of help from parents and teachers, and difficulties in understanding certain topics.

Above efforts have primarily been individualistic in nature sans assistance from any Government body and they lack suggestions to overcome the problem of failures in general. Any such attempt has been made for the first time by Gujarat State Education Board to bring out an understanding of the problem of poor results with an intention to take up corrective measures.

In Gujarat State, Gujarat Secondary Education Board holds the SSC examination. The following table shows the number and result of the students who have appeared in SSC examination during last three years:

Table: 1

Examination Year	Total number of candidates	Passed	Result in Percent
March-2002	6,33,253	3,28,091	51.81
March-2003	6,42,110	2,75,927	42.97
March-2004	6,34,120	3,34,099	52.69

The above figures depict that during the last three years, an average of 6,36,494 students have taken the S.S.C. examination out of which 50.85% candidates have failed in the examination. It's a matter of concern that in a society every year 50% of its students fail in their public examinations.

The following table shows results of Mathematics in a particular year:

Table: 2

The result of Mathematic subject of S.S.C. examination held in March-2004

Subject	**Total number of candidates**	**Total Number of Students who Appeared in the Exam**	**Passed**	**Percentage**
Mathematics	534652	524879	285471	54.39

According to S.S.C.examination norms whoever secures less than 35% marks in considered fail. 45.61% students have failed in Mathematics S.S.C. examination held in March 2004.

Gujarat Secondary Education Board has been constantly trying to improve the quality of education through various efforts. To create a proper atmosphere during examinations will not suffice till students start showing actual results.

A Description of the Problem

The present paper concentrates upon an 'Investigation Study to Decrease Failure Ratio of Mathematics Subject in S.S.C. Examination'.

The paper concerns with the poor results of SSC students and suggests remedial steps to overcome the problem of poor results year after year in Mathematics in SSC examination.

The Focus

The focus of this study is on

- Studying the answer books of the students who secured less than 30 % marks in Mathematic in the S.S.C. examination of March-2004.
- Identifying the errors in solving each problem/ sum as appeared in the answer sheets
- Relating questions asked with the answers produces by the students.
- Locating the trouble areas in the question paper that sounded difficult for the students.
- Formulating suitable suggestions for each chapter of the curriculam for future guidance based upon the students` errors.

Sample

At random among the answer books securing less than 30 % marks in Mathematic subject 500 answer books were selected for focused study based on the goals listed above.

Importance of Subject

This is the first ever exercise of this nature carried out by Gujarat State Board of Secondary Education. The intention was to find out the worrying areas and to undertake remedial steps to lessen the ratio of failures. The study extended its efforts to the factors responsible for this kind of result.

Method Of Study

The Secondary Education Board of Gujarat held a meeting on 24th October 2004 under the direction of Shri H.N.Hingu (Chairman of Secondary Education Board). It was well attended by the head of education departmants Dr. Ramesh Kothari from M. S. University, Baroda, Dr. Bhogayata from Bhavnagar University, Dr. Uchaat from the Sauarshtra University, Rajkot, Dr. R. D. Mulia from Gujarat University, Ahmedabad. It was resolved that a study should be undertaken to formulate the base of research.

The study of the answer books of the students who took the 10th standard examination

was undertaken by 45 teachers at Preksha-Bharti, Koba, in the district of Gandhinagar from 7th November 2004 to 9th November 2004. During this process the teachers were made familiar with the research subject and its importance. They were given the guidance as to how they should study/evaluate the answer books. They were asked to record their opinions that they formed through this process of study/evaluation. After that, according to the subject and question-paper, groups were formed with five teachers in every group. Each teacher was required to study only one question from the answer-books. Three answer-books were given to each group and thus the work started. After sometime the review meeting was held where the supervisors asked them about their experience, and discussed the difficulty of work that the groups might have faced in studying and evaluation the answer books. On this basis, necessary changes were made and then the answer-books were given to the teachers.

Analysis of Information

Table: 3

The measure of mistakes according to questions

Q.1 (A) Pythagoras **Theorem**		
• 27% have answered completely	• 58% have answered with mistakes	• 80% have not attempted given theorem
(B) (1) Factorize (Cyclic expressions)		
• 52% have not tried • 48% have tried with mistakes	• 62% could not simplify after solving brackets	• 10% did not know to attempt
(2) Simplify (Rational expressions)		
• 62% have not tried • 38% have tried with mistakes	▪ 52% did not know to take least common multiple	• 15% have made mistakes in division & multiplication
(C) (1) Factor (by finding Middle term)		
• 60% have not tried • 40% have tried with mistakes	• 75% did not know to find middle term	• 15% have made mistakes in arranging terms.
(2) Factor (Add & subtract the new supposed term)		
• 58% have not tried	• 42% have tried with mistakes	• 65% did not know to suppose
(3) Factor (Depending on remainder theorem)		
• 55% have not tried • 45% have tried with mistakes	• 65% had no concepts of remainder theorem	• 27% have made mistakes in adding & subtraction the co-efficient of even & odd

		powers
(D) (1) Simplify (Rational – expressions)		
• 44% have not tried • 56% have tried with mistakes	▪ 62% have not concept of least common multiple	• 30% have not concept to cancel common factor from denominator.
(2) Ratio and proportion (find X)		
• 48% have not tried • 62% have tried with mistakes	• 50% did not have the concept of componendo and dividendo	• 24% made mistakes in addition and subtraction
(E) Fill in the blanks (by choosing appropriate option)		
• 92% have tried	• 60% have no concept of intervals	• 48 % have less understanding about graph
• **Q.2 (A) Theorem: - In the same circle congruent chords are equidistant from the center of the circle.**		
• 50% have answered with mistakes • 25% have not answered	• 50% had no concept of congruent chords • 40% had no concept of altitude & foot of the altitude	• 25% had no concept of congruence between triangles.
(B) (1) Ratio & Proportion (prove that)		
• 70% have written with mistakes & 20% have not written	• 90% didn't know the rules of proportion • 70% didn't try to simplify	• 90% had difficulty to solve negative power.
(2) Ratio & Proportion (Prove that)		
• 35% have attempted with mistakes • 60% have not written	• 80% didn't have concept to multiply each number of ratio by particular number	• 70% didn't know how to put value of each ratio • 50% have not compared the results.
(3) Variation (Problem Sum)		
• 95% have not attempted	• 90% didn't know about basic concept of direct variation & inverse variation	• 80% didn't know the laws of exponent • 70% didn't know to square the standard number.
(C) (1) Find Mean		
• 50% with correct answers • 40% have committed mistakes	• 40% didn't know to use formula for ungrouped data • 12% made mistakes in addition of decimal numbers	
(2) Find median and mode		
• 40% with correct answer	• 70% made mistakes in finding median	• 65% made mistakes in finding mode • 28% didn't arrange the data in ascending order
(3) Find mode		
• 70% have not answered	• 75% didn't know the formula for mode	• 60% have not put the correct value in formula
(D (1) Example of Function		
• 55% with correct answer. • 33% have not answered.	• 30% made mistakes in finding squares of negative & irrational numbers.	

<table>
<tr><td colspan="3">(2) Find Range of the Function</td></tr>
<tr><td>• 40% with correct answers
• 35% have committed mistakes
• 25% have not answered</td><td>• 35% had no idea about set of numbers</td><td>• 28% made mistakes in finding range of the function</td></tr>
<tr><td colspan="3">(E) Fill in the blanks</td></tr>
<tr><td colspan="3">True Blanks...
• 40% in variation
• 30% in Trigonometry
• 60% in rational expressions
• 30% in ratio and Proportion
.</td></tr>
<tr><td colspan="3">Q. 3 (A) Theorem: - Prove that an inscribed angle in a Semi-circle is right angle.</td></tr>
<tr><td colspan="2">• 40% have attempted correctly
30 % have not answered</td><td>• 20% had no idea to draw perpendicular from the center on a given chord.</td></tr>
<tr><td colspan="3">(B) (1) Example of height and distance - 100% Students have not written
(2) And (3) Area and Volume - 100% Students have not written</td></tr>
<tr><td colspan="3">(C) Prove that (Trigonometry)</td></tr>
<tr><td>• 60% have not tried
• 40% had wrong answer</td><td>• 26% Students had no idea of identities</td><td>• 34% had no idea of Trigonometric ratios with respect to θ</td></tr>
<tr><td colspan="3">(D) (1) Example of inverse variation</td></tr>
<tr><td colspan="2">• 80% have not attempted
• 20% have tried incorrectly</td><td>• 23% had shown relation of inverse variation but they had not found the value of non-zero constant ‘K’.</td></tr>
<tr><td colspan="3">(2) Find Value (Trigonometry) -- 100% students have not calculated the example</td></tr>
<tr><td colspan="3">(E) 1 & 2 Quadratic Equation:
These examples are not calculated correctly by anyone because they had no idea about Formula $\Delta = b^2-4ac$, Further; they had no idea about the standard form of Quadratic Equation & co- efficient a & b with constant C.
3 & 4 Give Definition: - 80% have written correct definition.</td></tr>
<tr><td colspan="3">Q. 4 (A) Rider: - Segment $\overline{AD}$ is median of ΔABC. G is the centroid of ΔABC. ΔPAD and ΔNGD are equilateral triangles, than prove that Area of ΔABC = 9*area of ΔNGD</td></tr>
<tr><td>• 50% have tried
• 80% with answered incorrect figure</td><td>• 30% with incorrect ‘given’ & to ‘prove’
• 100% had given incorrect proof</td><td>• 26% had no idea about equilateral triangle, centroid, ratio & area.</td></tr>
<tr><td colspan="3">(B) (1) Simplify</td></tr>
<tr><td colspan="2">• 70% have written incorrect factors
• 30% made mistakes in sign.</td><td>• 18% students did mistakes in taking common
• 22% students did mistake in factorizing trinomial
• 25% students did mistake in factors of difference of perfect squares.</td></tr>
<tr><td colspan="3">(2) Statistics: Find mean by Class- length and frequency</td></tr>
<tr><td colspan="2">• 80% have tried – 80 % made mistakes in calculation
• 70% have not written formula</td><td>• 40% have not found the mid-value
• 30% have not made a table
• 40% have not calculated the value of $\sum f_i u_i$</td></tr>
<tr><td colspan="3">(3) Statistics: Find mean and median by number of children & number of families.</td></tr>
<tr><td colspan="2">• 80% have tried
• 80% made mistake in calculation.
• 70% have not written formula</td><td>• 40% have not found value of cumulative Frequency
• 30% have not made table
• 40% have not found the value of ‘L’.</td></tr>
</table>

<table>
<tr><td colspan="3">(C) (1) Find diameter if length of chord and perpendicular distance of the chord from the center is given.</td></tr>
<tr><td>• 50% have tried
• 30% have not tried</td><td>• 20% made figures
• 20% had no idea about hypotenuse</td><td>• 80% have not used the formula of Pythagoras.</td></tr>
<tr><td colspan="3">(2) Example of circum center.</td></tr>
<tr><td colspan="2">• 80% with incorrect attempt
• 20% made correct attempt
• 70% have not made figures</td><td>• 68% had no idea of circum center and center.
• 60% have not written the sum of three angles of triangles.</td></tr>
<tr><td colspan="3">(3) Example of Tangent</td></tr>
<tr><td>• 90% with incorrect Attempt</td><td>• 70% didn’t make figures.
• 68% have not made figures of tangent</td><td>• 60% didn’t use the formula Of Pythagoras.</td></tr>
<tr><td colspan="3">(D) (1) Definitions & Formula</td></tr>
<tr><td>• 90% have tried</td><td>• 90% haven’t found Δ
• 90% haven’t put formula</td><td>• 100% haven’t found the correct solution</td></tr>
<tr><td colspan="3">(2) Quadratic equation (Find solution by factorization)
100% students have not tried</td></tr>
<tr><td colspan="3">(E) Quadratic Equation (Find solution by factorization)
• Definition of Cyclic Quadrilateral and congruent circles
• Formula of curved surface area of sphere and volume of cylinder.
• 75% students have given incorrect answer.</td></tr>
<tr><td colspan="3">Q. 5 (A) Construction: - Construct a regular hexagon inscribed in a circle with radius 4 cm.</td></tr>
<tr><td colspan="2">• 28% have not drawn
• 72% attempted
• 12% could not draw a hexagon.</td><td>• 35% made construction but didn’t write the steps.
• 32% students could not divide the circle in six equal parts</td></tr>
<tr><td colspan="3">(B) (1) Example of Variation</td></tr>
<tr><td>• 45% have not tried
• 55% attempted</td><td>• 32% have not supposed ‘K’
• 28% have not put formula</td><td>• 65% have no clear concept of variation</td></tr>
<tr><td colspan="3">(2) Quadratic Equation</td></tr>
<tr><td>• 44% have not tried</td><td>• 40% have not assumed ‘m’</td><td>• 10% have not substituted the value of ‘m’</td></tr>
<tr><td colspan="3">(3) Problem sum</td></tr>
<tr><td>• 67% have not tried</td><td>• 25% have not made quadratic equation</td><td>• Problem in substitution
• Problem in making equation</td></tr>
<tr><td colspan="3">(C) Example of Geometry</td></tr>
<tr><td colspan="3">(1) The correspondence PQR ↔ EDF between Δ PQR and ΔDEF is a similarly PQ =8, QR = 5, DF =10 and EF=8 then find ED & PR.</td></tr>
<tr><td>• 48% have not tried
• 52% made incomplete attempt</td><td>• 40% have tried to get answer till ending
• 12% could not find the answer</td><td>• 36% students did mistakes in taking ratios of corresponding sides
• 23% students did mistakes in simplification</td></tr>
<tr><td colspan="3">(2) Δ ABC ~ Δ XYZ If area of ΔABC is 18 & area of ΔXYZ is 50 & if AC = 20 then find XY</td></tr>
<tr><td colspan="2">• 45% have not tried
• 55% made incomplete Attempt</td><td>• 40% students have no knowledge about the formula which denotes the relation between area & sides</td></tr>
</table>

<table>
<tr><td colspan="3">(3) In ΔXYZ, ∠Y is right angle. $\overline{YM}$ Is altitude of a triangle? If YM = 12 and XM = 9 then find XZ And MZ.</td></tr>
<tr><td colspan="2">• 44% have not tried
• 42% have tried to make figure</td><td>• 14% have written formula & have put value.
• 20% didn't give simplification</td></tr>
<tr><td colspan="3">(D) (1) In ΔABC, P∈ $\overline{AB}$, N∈ $\overline{AC}$ & segment $\overline{PN}$ || $\overline{BC}$, If AB = 7.5, AP = 5 & BC = 10.5 then find PN</td></tr>
<tr><td colspan="2">• 67% have not tried
33% have made incomplete attempt</td><td>• 26 % have no knowledge about line segments cut on the sides.</td></tr>
<tr><td colspan="3">(2) The curved surface area & volume of the Sphere are same then find the radius of the Sphere.</td></tr>
<tr><td colspan="2">• 48% have not tried
• 30% could not write the formula of area & volume</td><td>• 15% students did mistake in cancelling denominator
• 12% could not compare the formulas.</td></tr>
<tr><td colspan="3">(E) Rider: - $\overline{PN}$ is diameter of the circle. $\overline{PR}$ Is a chord other than diameter? The tangents at P & R intersect in a point 'S' outside the circle then prove that m∠PRS = 2m∠NPR
• 92% could not write the above rider
• 8% have tried to write to given and to prove</td></tr>
<tr><td colspan="3">• OR Answer the following (circle),</td></tr>
<tr><td>• 44% have not tried
• 56% with incorrect attempt</td><td>• 20% didn't know formula
• 28% could not calculate the answer by putting the value in formula</td><td>36% didn't have-understanding about the distance between two centers if they intersect each other internally or externally</td></tr>
</table>

Generalization of finding

Students assumed geometry to be easier to algebra because students were able to secure more marks in geometry. Among the topics allotted students found statistics to be the easiest one. Many students did not draw Figures with accuracy. They lack knowledge of formula and they failed in writing theorems. Some students failed to put correct value inspite of knowing the correct formula.

Chapter wise suggestions to decrease the measure of mistakes

While teaching, the teacher should describe the number, its square, cube, square root, and cube root with the help of suitable charts. Also proper arrangement and necessary explanation and observation for formulas of factors should be provided. Proper guidance of arrangement of terms according to descending exponent should be provided. The teacher should give proper knowledge of various rules regarding factors viz. 1.By taking common factors 2. Perfect squares 3. Find middle term 4.Cubic Method 5.Use of Remainder Theorem. All the steps of

every method should be presented on the blackboard and the teacher must take care that the students follow those steps properly.

In the chapter of Functions, the teacher should teach the various types of intervals and also give an understanding about representation of interval form into the set form. Necessary and sufficient practice to find value of the function should be provided along with examples to find out the values of functions. Also respective charts of function should be made.

In chapter of rational expressions, students should be instructed to do practice of processes in denominator, simplification of brackets, various examples of rational expressions and factors.

In chapter of cyclic expressions, give concept of cyclic order and different methods of cyclic expressions. Teacher should explain how to arrange the terms by pairs and simplify them after opening the brackets. Give knowledge about the signs and take care about the necessary practice that is to be given.

In the chapter, Ratio and Proportion give proper knowledge and clarify basic concepts of ratio and different types of ratio. Take illustrations related to experience and fields and take more illustrations for examples with proof. Give knowledge of direct variation, inverse variation and compound variation and clarify the concepts of two constants in partial variation. Teach the supposition method for problems regarding the sums and clarify the elimination method.

In chapter, Quadratic Equation, clarify the Quadratic equation $ax^2 + bx + c = 0$ and the discriminate $\Delta = b^2-4ac$. Clarify the method of factorization and also the formula to find solutions and teach to find value of Δ (Delta). After that, clarify the form of roots by using the value of Δ.

In chapter, Trigonometry and Heights & Distance, examine concept of factors, simplification of irrational numbers and understand elevation and depression angle. Clarify

the Concept of inverse trigonometric ratios and alternative angles and try to make the problems in an easier manner.

In the chapter, Similarity of triangles and Pythagoras, clarify the ratio of corresponding sides, the definitions of right angle; perpendicular line-segment, foot and altitude also describe the similarity & congruence by different illustrations. Clarify the AAA and ASA theorems.

In chapter, Circle, Circle and arc, Circle and tangent, give understanding of circle and its parts with necessary charts and pictures. Clarify the definitions & then students are to be spoken to regarding those to verify the doubts. The statements of all theorems are to be remembered by which students can calculate the examples more easily.

In chapter, Construction, **g**ive more practice exercises to draw figure of circle according to given measure of radius and others. Describe the different denotions for the center, measure of radius of a circle. Give exercise of dividing the circle in to 6 to 8 parts and to draw construction & to write steps of construction together. Clarify inscribed & circumscribed figures by various methods and line and bisectors of angles & then make these concepts clear in exercises.

In chapter, Area and Volume, clarify the concepts of area and volume by different methods. The models of cylinder, cone and sphere should to be prepared. Make charts of formula by students.

Revision and exercises are a must in all the chapters.

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