

# AN ANALYTICAL STUDY OF MATHEMATICS QUESTION PAPERS OF MADHYA PRADESH BOARD WITH RESPECT TO ITS PATTERNS/DESIGN, CONTENT COVERAGE, DIFFICULTY LEVEL, OBJECTIVITY IN MARKING AND ITS IMPACT ON ACHIEVEMENT OF STUDENTS

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**ABSTRACT:** The present study was done to analyse the Mathematics question paper with respect to its pattern/design, content coverage, difficulty level, objectivity in marking and its impact on achievement of students. Purposive sampling technique was followed for the selection of subjects, subject experts and subject specialists, selection of years (time span) for study. The cluster sampling technique was followed for selection of student sample from a cluster. Question paper of three different years (2006, 2007, 2010) was taken for study. Sample consisted of 1796 class-X students from Madhya Pradesh Board of Secondary Examination. Also views of 10 subject experts were taken regarding pattern/design of question paper, content coverage, difficulty level and objectivity in marking. Researcher developed tool for collection of views of subject experts. Findings of the study revealed that though there is no effect of different pattern/design of question paper or different sets of question paper used during particular year on students' achievement there is effect of content coverage, objectivity in marking and cognitive level of questions.

**KEYWORDS:** Content coverage, Difficulty level, Objectivity in marking, Design/Pattern of question paper, Cognitive Level

**1. INTRODUCTION:** Evaluation is a very comprehensive term, which includes evaluating any object, individual, institution, position of an office, event, trend, etc. However, in education system evaluation deals with students' evaluation, which includes the assessment of the performance of the students in the areas of their personality development in terms of intellectual, social and emotional development after they have been provided learning experiences through classroom process.

In education, evaluation is employed basically for two purposes: One is to improve teaching learning process and help improving the learning and the other is to ascertain the level of achievement of the learning. Both purposes are equally important in an educational programme.

Hence, any error in the process of evaluation is not acceptable as it affects the career and future life of thousands of students. Therefore the evaluation procedure should be very carefully design and conducted.

In general, functions of evaluation / examination can be defined the as follows -

- To evaluate the achievement is the primary function of Examinations. Periodic examinations judge the level of student's educational achievement.
- To measure the all-round development of the students.
- Examinations provide suitable criterion for assessing the efficiency of the teachers.
- Examinations enable one to find out the ability of the child to make a practical use of acquired knowledge.
- Examinations help in diagnosis of specific weakness of students and thus enable the teachers to adopt remedial measures.
- Examinations provide stimulations and incentives for both students and teachers to work hard.

- Examinations give an idea of student's capacity to work, power for retention of memory, his/her problems solving ability.
- The examination measures the fitness and suitability students for admission into various educational, vocational and professional courses.

This kind of check up of the school work is essential in the interests of all concerned pupils, teachers and parents.

The study report prepared for the International Educational Report Service, UNESCO, Paris, (1) mentioned that-

- An examination should become an instrument for promoting growth rather than simply measuring it. Its result should be used for diagnostic and prognostic purpose rather than merely for classification, grading and certification.
- An examination should not be considered as a multi-purpose tool. Special procedures and tools need to be developed for each specific purpose. Pupil evaluation and comparison of standards ought not to be attempted through a single examination. It is not desirable to make decisions regarding varied and dissimilar aspects of the personality on the basis of a single test.
- To be reliable, evaluation should become a continuous process occurring over a period of time.

There are various facts influencing the quality of written examination including administrative shortcomings. The most prominent shortcomings are emphasis on memorization, subjectivity, poor content coverage, difficulty level of question paper, test length, language of questions.

It is opined "Effective questions are clear, purposeful, brief, naturally sequenced and thought provoking."(2)

It is also opined "Questions properly planned, carefully worded, evenly distributed scientifically asked, honestly answered and intelligently followed up are very profitable and in fact indispensable in the effective teaching-learning process." (3)

It can be said that a good written examination (and question paper) should consider the following-

- 1 Matching with the purpose.
- 2 Good content coverage and proper weight age to each content.
- 3 Proper weight age to different learning objectives.
- 4 Sequence of questions.
- 5 Simple language and Clarity of instructions.
- 6 Internal options rather than overall options.
- 7 Use of multiple but parallel sets.
- 8 Appropriate difficulty level of questions.
- 9 Well-designed marking scheme.
- 10 Inclusion of variety of questions-more short answer question rather than few long descriptive ones.

While critically evaluating the quality of question papers used in different examinations, it was found that question papers lack in proper time and marks distribution management, poor content coverage, able to test only the knowledge, variation in the weight-ages to instructional objectives decided (given) by board to the actual weight-age found in both question papers, very less variation in difficulty level of questions across different subjects, internal options not comparable in terms of objective-wise, difficulty-wise and content-wise in some subjects etc. [(4), (5), (6)] In a comparative study on the question paper of different Boards, it was found that question papers of different boards are poor in terms of coverage of instructional objectives, content coverage (7).

A new trend of examination has been started by introducing multiple set of question paper scheme by CBSE (Central Board of Secondary Education), Delhi, in the year 1992, having four different sets of question papers in some selected subjects for Delhi school only. The purpose of this introduction was to avoid copying in the examination hall. In 1993 Board conducted examination with three sets of question papers in which about 70% of the questions were common but they are shuffled in their order. This pattern is now followed by most of the state boards in class X and XII level. Board of secondary education, MP is also following the same pattern. While analyzing different sets of question papers of chemistry of different states boards, it was found that language of question were defective and having variations in the difficulty level of different sets of same board in a year (8)

Since there is no separate passing marks in Essay and Objective type questions, majority of the faculty were of opinion that inclusion of Objective type questions helps students to perform better in the written examination. There were serious reservations regarding inclusion of objective type questions as an evaluation tool.

In this perspective, the study need to be conducted to determine the impact of design of question paper of same Board examination of different years of class X in the subject of Mathematics and Science of Madhya Pradesh.

## 2. RESEARCH QUESTIONS:-

1. Whether the question papers of Mathematics have different pattern/design in different years?
2. Whether the question paper is comparable in the terms of content coverage in different years as well as in different pattern/design of question paper?
3. Whether the question paper is comparable in the terms of difficulty level in different years as well as in different pattern/design of question paper?
4. Whether the question paper is comparable in the terms of Objectivity in marking in different years as well as in different pattern/design of question paper?
5. Whether the question paper is comparable in the terms of Cognitive level in different years as well as in different pattern/design of question paper?
6. If the question papers differ in the Pattern/design in different years, whether there is an effect of different pattern/design on students' achievements?
7. If the question papers differ in the content coverage in different years, whether there is an effect of different content coverage on students' Pass/Fail?
8. If the question papers differ in the difficulty level in different years, whether there is an effect of different difficulty level on students' Pass/Fail?
9. If the question papers differ in the objectivity in marking in different years, whether there is an effect of different objectivity in marking on students' Pass/Fail?
10. If the question papers differ in the cognitive level in different years, whether there is an effect of different cognitive level on students' Pass/Fail?

## 3. HYPOTHESES:-

1. There is no effect of pattern/design of Mathematics question papers in students' achievement.

**4. RESEARCH METHODOLOGY:** In the present study two types of sampling techniques was used. Purposive sampling technique was followed for the selection of subjects, subject experts and subject specialists, selection of years (time span) for study. The cluster sampling technique was followed for selection of student sample from a cluster. In order to include different pattern of question paper in research work the question paper of 2006, 2007 and 2010 were taken into consideration. Question paper of 2006 and 2007 are of same pattern while question paper of 2010 differs in pattern/design from 2006 and 2007. Also during 2006 and 2007 there was three sets of questions papers for each subjects while during 2010 it was four in number. For this study researcher had not taken the question paper of year 2008 and 2009 since the set system and pattern/design of question paper was as same as during 2006 and 2007. Selecting the sample of the student's population, to have proper representation of the population, stratified random sampling sample technique was used. Students were from both rural and urban schools from Mandla district.

In order to find the difficulty level, objectivity in marking, content coverage and cognitive level of questions, opinion of subject experts are required. For this a group of teachers was needed who might have good command on the subject matter as well as having the long teaching experience along with experience in setting question papers and examine the scripts of the students. But it is very difficult to identify the number of teachers who can fulfil these criteria. So numbers of experts were chosen irrespective of location of the study. Five subject experts of subject was selected for the collection of opinion regarding the expected cognitive level, difficulty level and objectivity in marking of the questions in the question paper used for making blue print since table of specification for the tests of the subjects were not available to researcher. Five expert teachers of the subject were selected to collect view/opinion regarding content coverage of topics of the content areas.

The following tools and instruments are required for the study:-

- **Question papers of different subjects of Madhya Pradesh Board Examination for different years:** In the present study question paper of Science and Mathematics subject of class- X Madhya Pradesh Board Examination required. Since the set system implemented in the state thus all sets of question paper was required during study. Three sets were used during 2006 and 2007 for both subjects and four sets during 2010.
- **Achievement scores of students in Board Examination roll number wise:** Achievement scores of students in the Science and Mathematics subject during mentioned year required. The Scores was collected in from the schools for the sample students from their respective schools along with students' examination roll numbers.
- **List of allotted sets of question paper corresponding to roll numbers:** Corresponding to roll number of the selected students list of sets of question paper allotted to them in different subject during different years was required for present study. The list was collected from the examination centres from where students appeared in the examination.
- **Questionnaire to analyze different parameters of Question paper:** For the present study different Questionnaires were developed as per requirement for the analysis of question paper.

**5. ANALYSIS OF DATA & RESULT:-**

**5.1. Whether the question papers of Mathematics have different pattern/design in different years?**

Years	2006						2007						2010							
Set	A		B		C		A		B		C		A		B		C		D	
Marks	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions	Word limits	Type of questions
1	Not included																			
2	-	VSA	-	VSA	-	VSA	-	VSA	-	VSA	-	VSA	-	VSA	Not included					
3	-	SA	-	SA	-	SA	-	SA	-	SA	-	SA	-	SA	-	VSA	-	VSA	-	VSA
4	-	SA	-	SA	-	SA	-	SA	-	SA	-	SA	-	SA	-	VSA	-	VSA	-	VSA
5	-	LA	-	LA	-	LA	-	LA	-	LA	-	LA	-	LA	-	SA	-	SA	-	SA
6	-	LA	-	LA	-	LA	-	LA	-	LA	-	LA	-	LA	-	SA	-	SA	-	SA

Table I:- Comparison of marks distribution for different form of questions in the question papers in different years for Mathematics and Science subject.

From the above table it can be said that the pattern/design of Mathematics question papers used during 2006 and 2007 was same. Also, the pattern of question paper of Mathematics subject used during 2006/2007 differs from the pattern/design of question paper used during 2010.

**5.2. Whether the question paper is comparable in the terms of content coverage in different years as well as in different pattern/design of question paper?**

S. No.	Topics	Year									Pattern					
		2006			2007			2010			2006/2007			2010		
		weightage given in question paper (in%)	Weightage given in specification table (in%)	Difference in weightage (in%)	weightage given in question paper (in%)	Weightage given in specification table (in%)	Difference in weightage (in%)	weightage given in question paper (in%)	Weightage given in specification table (in%)	Difference in weightage (in%)	weightage given in question paper (in%)	Weightage given in specification table (in%)	Difference in weightage (in%)	weightage given in question paper (in%)	Weightage given in specification table (in%)	Difference in weightage (in%)
1	Linear Equation in Two Variable	9.5	10	-0.5	10	10	0	10	10	0	9.67	10	-0.33	10	10	0
2	Polynomial and Rational number	5	7	-2	5	7	-2	7	7	0	5	7	-2	7	7	0
3	Ratio and Fraction	7	5	2	7	5	2	5	5	0	7	5	2	5	5	0
4	Quadratic Equation	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0
5	Commercial Mathematics	0	8	-8	0	8	-8	8	8	0	0	8	-8	8	8	0

Table II: weightage of marks given to different content coverage in different years as well as in different pattern of question paper.

Above table shows that during 2006 in Mathematics question paper the weightage given to content coverage differ from the standard specification table by 12.5 percentages and during 2007 it differs by 12.0 percentages. During 2010 the weightage given to content coverage in question paper differ from the standard specification table by zero percentage. Thus it can be said Mathematics question differ in content coverage in different years.

### 5.3. Whether the question paper is comparable in the terms of difficulty level in different years as well as in different pattern/design of question paper?

Years	Difficulty Level (in %)		
	Easy	Average	Difficult
2006	19.61	53.14	26.27
2007	21.91	49.61	28.48
2010	30.51	46.40	23.09
2006/2007	20.94	51.47	27.57
2010	30.51	46.40	23.09

Table III: Comparison of weightage given to different difficulty level in different years as well as in different pattern/design of Mathematics question papers as per teachers perceptions.

It can be said from above table that Mathematics question papers of different Patter/design used during different years are not comparable in terms of difficulty level.

### 5.4. Whether the question paper is comparable in the terms of Objectivity in marking in different years as well as in different pattern/design of question paper?

The according to the teachers' perceptions the weightage of marks given to objectivity in marking in different years and in two different pattern/design of question papers is given in the following table:

Year	Objectivity/subjectivity	
	Objectivity (in%)	Subjectivity (in%)
2006	87.25	12.75
2007	97.04	2.96
2010	85.60	14.40
2006/2007	92.05	7.94
2010	85.60	14.40

Table IV. Comparison of weightage given to Objectivity in marking in different years as well as in different pattern/design of Mathematics question papers as per teachers' perceptions.

From the above table it also appears that the weightage given to Objectivity in marking is more for the pattern of question paper used during 2010 as compare to the pattern of question paper used during 2006/2007.

### 5.5. Whether the question paper is comparable in the terms of Cognitive level in different years as well as in different pattern/design of question paper?

According to teachers' perceptions the weightage of marks given to different cognitive levels in different years question paper and for two different pattern/designs of question papers is given in the following table-

Year	Cognitive level		
	Knowledge (in%)	Understanding (in%)	Application (in%)
2006	21.62	47.60	32.45
2007	23.87	39.95	36.17
2010	26.74	36.11	37.14
2006/2007	22.50	43.44	34.06
2010	26.74	36.11	37.14

Table V: Comparison of weightage of marks given to different cognitive level in different years as well as in different pattern/design of Mathematics question papers as per teachers' perceptions.

From the above table it appears that according to teachers' view during 2010 more weightage was given to "Easy" questions as compare to the weightage given during 2006 and 2007. During 2006 least weightage was given to "Easy" questions as compare to the weightage given during 2007 and 2010. During 2006 more weightage was given to "Average" questions as compared to the weightage given during 2007 and 2010. Thus it can be said that that Mathematics question papers used in different years are not comparable in terms of difficulty level.

### 5.6. If the question papers differ in the Pattern/design in different years, whether there is an effect of different pattern/design on students' achievements?

Hypothesis-1: There is no effect of pattern/design of Mathematics question papers on students' achievement.

From the above discussion it can be said that during 2006/2007 and 2010 different patterns of question paper was used for Mathematics. In order to find the effect of different pattern/design of question paper on students' achievement students' marks was collected. The average, SD and t-value for two subjects for two different pattern/design is given in following table-

Year	No. of Students	Mean	SD	t-test	Remark
2006/2007	1481	35.73	25.35	1.21	Not significant At 0.05 level For df=1765
2010	315	38.21	17.95		

Table VI:- Comparison of achievement of students for two different patters/designs of question papers of Mathematics.

The above table also shows that the obtained 't'-value is 1.21 is less than the theoretical 't' value 1.96 indicate that the mean values of two groups doesn't differ significantly at 0.05 level of significance.

Hence the null hypothesis "There is no effect of different patter/design of question papers on students' achievements in different years" is accepted. Thus, it may conclude that the use of different pattern/design of question paper doesn't have any effect on the students' achievement in Mathematics subject.

### 5.7. If the question papers differ in the content coverage in different years, whether there is an effect of different content coverage on students' Pass/Fail?

Year	Difference in weightage given to content coverage (in%)	Number of Passed students (in%)
2006	12.5	52.47
2007	12.0	56.29
2010	0.0	68.13

Table VII: Number of Passed students in Mathematics subject in different years.

From the above table it appears that in the Mathematics subject during 2010 the difference of weightage given to content coverage with standard specification table is zero percentage which is minimum as compare to other year differences and the number of passed students is 68.13% which is more than other years number of successful students. Thus it can be said that in Mathematics and Science subject there is effect of different content coverage on students' achievement.

### 5.8. If the question papers differ in the difficulty level in different years, whether there is an effect of different difficulty level on students' Pass/Fail?

Years	Weightage given to difficulty level (in %)			Number of Passed students (in%)
	Easy	Average	Difficult	
2006	19.61	53.14	26.27	52.47
2007	21.91	49.61	28.48	56.29
2010	30.51	46.40	23.09	68.13

Table VIII. Weightage given to Easy question in question paper and students' pass/ fail during different years in Mathematics.

From the above table it appears the number of passed students was more during 2010 when more weightage is given to "Easy" questions and less weightage was given to "Difficult" questions in compare to other years. The number of passed students is less during 2006 as compare to number of passed students during 2007 and 2010 when more weightage is give to "Average" questions in different years. Thus it can be said that there is effect of different difficulty level on students' pass/fail during different years.

### 5.9. If the question papers differ in the objectivity in marking in different years, whether there is an effect of different objectivity in marking on students' Pass/Fail?

Year	Weightage given to objectivity in marking in question paper (in %)	Number of passed students (in %)
2006	87.25	52.47
2007	97.04	56.29
2010	85.60	68.13

Table IX. Weightage given to objectivity in marking and students' pass/fail during different years in Mathematics.

From the above table it appears that the number of passed students is more during 2010 when more weightage is given to "Easy" questions and less weightage is given to "Difficult" questions in compare to other years. While the number of passed students is less during 2006 as compare to number of passed students during 2007 and 2010 when more weightage is give to "Average" questions in different years. Thus it cannot be said that there is effect of objectivity in marking on students' achievement in different years in Mathematics subject.

### 5.10. If the question papers differ in the cognitive level in different years, whether there is an effect of different cognitive level on students' Pass/Fail?

Year	Cognitive levels			Number of passed students (in %)
	Knowledge	Understanding	Application	
2006	21.62	47.60	32.45	52.47
2007	23.87	39.95	36.17	56.29
2010	26.74	36.11	37.14	68.13

Table X. Weightage given to cognitive level of questions and number of students passed during different years in Mathematics.

From the above table it appears that the number of passed students is more during 2010 and also the weightage given to Knowledge level is more compare to 2006 and 2007. The weightage given to Understanding level is more and number of passed students is less during 2006 as compare to 2007 and 2010.

Thus it can be said that there is effect of difference in cognitive level in different years on students' pass/fail. Further it can be said the more the weightage to "Knowledge" level and less the weightage to "Understanding" level more the number of passed students in Mathematics subject.

**4. CONCLUSION:** The study was undertaken with the question paper of class-X Mathematics and Science of three different years with different pattern/design. From the above finding following it can be concluded that-

1. There is effect of content coverage in the question paper of Mathematics on students' achievement. More the content coverage more the students' achievement.
2. There is effect of difficulty level of question paper of Mathematics and Science on student's achievement. More the "Easy" questions more the students' achievement.
3. There is effect of cognitive level of question papers of students' achievement. More the weightage to "Knowledge" level and less the weightage to "Understanding" level in Mathematics subject and in Science subject more the weightage to "Knowledge" level more the students' achievement.

**5. DISCUSSION:** Setting a balanced and good question paper is one of the critical activities to assess students learning in cognitive domain. There are varieties of issues involved. The present study establishes the need of improving the quality of question paper in examinations. There should be a balanced question paper as far as weightage to different content and levels of cognitive level objectives are concerned. If possible, measures like specification table, structure of question paper, difficulty level of questions etc. should be provided to paper setters along with past question paper of the course. Paper setters should also be instructed to provide key points / model answers of the questions in a sealed cover separately. Special instructions, if any, should also be appended along with the request letter to the paper setter.

#### REFERENCES:

1. Srivastava, H.S., 1979, *Examination Reforms in India*, Experiments and Innovations in Education, International Bureau of Education, UNESCO, Paris.
2. Kumar, A. and Gupta, S.K., 1993, *Enhancing Validity and Reliability of Question Papers*, NITTR, Bhopal
3. Agrawal, M., 2002, *A Critical analysis of Class XII English question papers of four boards of school education* Indian Educational Review, 38(1), NCERT, New Delhi, pp 102-114.
4. Lele, T.P. et.al., 1962 *Empirical studies in Examinations*, M.S. University, Baroda (Quoted in book on Preparing Objective Examinations by Harper, A and Harper E, Prentice Hall of India Ltd.)
5. Chourasia, K., 2012, *An Analysis of the Quality of Question Papers of an Engineering Examination*, M.Tech. Ed., Dissertation submitted to Barkatullah University.
6. Chandrasekhar, K., 2007, *A Critical Analysis of Class X English and Social Science Question Papers*, Indian Educational Review, Vol. 43, No. 2 pp 36-46.
7. Sreekanth, Y., 2007, *An Analysis of question papers of different Boards of Examinations in Social Science*, Indian Educational Review, Vol.43, No.2. NCERT, New Delhi. pp 18-35
8. Gupta, V.P., 2000, *Analysis of Chemistry Question Paper of M.P., Maharashtra, Gujarat and CBSE*, Department of Training Package on Paper Setting in Chemistry at Senior Secondary Level. PAC: 20. Bhopal. RIE.