OBJECTIVES OF THE SECONDARY SCHOOL MATHEMATICS CURRICULUM OF ORISSA.
Objectives stated in clear and specific terms will control and guide the direction of research. Aimless behaviour seldom pays off and is untenable in research. It is absolutely essential, therefore, that teachers learn to set clear objectives for themselves and their pupils. Gronlund reiterating the importance of objectives in curriculum development states:

"Stating objectives in terms of learning outcomes rather than the learning process admittedly is easier said than done. Most of us are so concerned with the content of the course and the ongoing process in the classroom that we find it difficult to concentrate our attention on the changes in pupil behaviour which are really our reason for teaching. The very nature of teaching conditions us to focus our attention on the immediate learning process. We can successfully shift this focus, however, if we continually ask ourselves: What should the pupils be able to do at the end of the course that they could not do at the beginning? As we attempt to answer this question, always in terms of knowledge, understandings, skills, attitudes, and so on, we find that the pupils' end-of-course performance has almost automatically become the centre of focus. We are then in a much better position to define our instructional objectives in terms of learning outcomes".

The UNESCO publication "New Trends in Mathematics Teaching. Vol. IV" succinctly states the function of objectives in curriculum-development in these words:

"Objectives state what a person should be able to do. Objectives determine a precise endpoint whose attainment can be clearly assessed. It is a learning product that the teacher hopes will result from instruction, whether in a lesson, unit course, or, curriculum. It is the terminal behaviour expected from the pupils at the completion of a
period of learning. An objective, therefore, is defined precisely by such expressions as 'to know the theorem ........', 'to be able to solve the equation of the type ......' etc. It is indispensible as it helps in fixing the goals of education, selecting content and processes of the subject, determining the teaching strategies and assessing the pupils' growth."

Dubisch Roy has brought to light the on-going debate relating to the importance of various objectives and the inherent vagueness and lack of clarity of thought in this regard. He states:

"More important for our immediate purpose is the fact that the objectives for individual courses are often debated. Thus we find that some educators regard the primary objectives of each course as developing an ability to think, while others feel that the imparting of information is the primary task. Still others advocate such nebulous aim as the inculcation of moral and spiritual values or an appreciation for democracy. Personally I do not feel that the third class of objectives is attainable while I would seek to combine the other two. Thus I believe that teachers should not try directly to teach students how to think but rather should present information in such a way that the thinking involved in the subject stands out clearly, and the students can see the value of a thoughtful approach to the subject."

The objectives of Secondary School Mathematics Curriculum have been analysed with reference to the objectives as stated in the syllabus, taxonomy of educational objectives as developed by Bloom and others, the objectives enumerated by various educational commissions and committees; objectives outlined as desirable in standard pedagogic literatures. The
THE OBJECTIVES OF SECONDARY SCHOOL MATHEMATICS CURRICULUM FROM PEDAGOGIC LITERATURE.

In order to define the objectives of teaching mathematics, efforts have been made both at the National level and International level. Various committees and commissions have been set up for the purpose. It is practically impossible to review the entire pedagogical literature relating to mathematics teaching. Therefore, a selective approach has been adopted and certain important books on mathematics teaching have been consulted for the purpose. Although impetus has been provided by ready availability of some books in the area, limitations of this selection are due to the paucity of books in this area in the State of Orissa for ready reference. The author had to rely on the resources made available to him to consult as many books in the field as possible. All his endeavours are circumscribed by limitations of scarce literary facilities, limited finance and time.


The Third International Congress on Mathematical Education held in Karlsruhe, Federal Republic of Germany.
in August 1976 has stated the following aims and objectives of teaching mathematics at the secondary level:

"a) to develop mental activities and to intellectualise attitudes, by putting the pupils in contact, active contact, with the rudiments of a science which as a subject of study is particularly favourable to such a development,

b) to provide the pupils with knowledge and skills and with a conceptual tool and the ability to use it, all of which are necessary for active and intelligent participation in contemporary society,

c) to ensure that those who continue their studies have an essential basis as regards mathematical preparation on the one hand, and the ability to study mathematics on the other"4

The above objectives are the expressions in general of mathematics education.

National Council of Educational Research and Training (N.C.E.R.T.)

The NCERT had appointed a project-staff with Dr. Shib K. Mitra as the Director to conduct an All-India Survey of Achievement in Mathematics at the school level in 1964. They had studied the syllabuses of different States of India. According to the Project Report:
"When these syllabi were studied, it was observed that most of them do not mention educational objectives at all. They mention only the topics. In cases where the statement of objectives were provided, there were in many cases rather vague like 'making a good citizen'. Some syllabi, however did describe objectives in more operational terms.

**State-A**

1. To develop the ability to solve common problems in arithmetic and geometry related to home and social life.

2. To develop interest for some vocation and to train in keeping correct account of different individual and group activities.

3. To train in clear, logical and critical thinking.

4. To develop the attitude to work correctly.

5. To develop problem-solving skills.

**State-B**

1. To inculcate habits of an objective search for truth.

2. To develop accuracy, logical thinking and reasoning.

3. To inculcate the habit of working systematically.

4. To promote the power of concentration in the students.

5. To help the students understand the practical utility of the subject and enable them to apply the power of the same in everyday life.
vi.** To create a sense of neatness and to promote abstract thinking.**

**State C**

i. **Skills in the four fundamental operations with numbers and letter numbers.**

ii. **Knowledge of the primary concepts, facts, relations, operation symbols, etc. of mathematics.**

iii. **Ability to make use of mathematical knowledge in the solution of the problem in the classroom and outside.**

iv. **Ability for estimation of measurements and approximation of answers to the problems.**

v. **Ability to check answers.**

vi. **Ability to represent verbal statements diagrams and symbols.**

vii. **Ability for logical thinking i.e. to analyse a problem to select relevant facts and reject others and to solve problems by using principles learnt.**

viii. **Ability to find out the principles involved in a procedure.**

ix. **To develop habits of accuracy, precision, speed and neatness.**

**State D**

i. **Knowledge of mathematical concepts, facts, procedures, symbols and principles.**

ii. **Ability to apply mathematical knowledge to problems in the classroom, in the world outside and in the study of the sciences.**
iii. Ability to represent verbal statements by graphs, symbols and diagrams.

iv. Ability to analyse a problem, select the relevant facts, reject the irrelevant ones, solve it by the application of principles already learnt and give a systematic proof wherever necessary.

v. Ability to interpret graphical, symbolic, diagrammatic representations.

vi. Ability to find out the principles involved in the steps of given procedures.

vii. Ability to verify results wherever possible.

viii. Capacity for estimation and approximation.

ix. Habits of precision, accuracy, speed and neatness.

x. Ability to appreciate the beauty, rhythm and symmetry of mathematics.\(^5\)

The project staff had classified the objectives of the above state syllabi. They were as follows:

"1. Knowledge and understanding of terms, concepts, principles, relationships, symbols. Recognising and defining of key words and phrases.

2. Skills

a) Computational processes of squaring, cubing, square-root, cube-root, factorising, solving equations.\)
b) Skills in reading the graphical data.

3. Application of knowledge and skill to new situations - novelty of situation.

a) Awareness of the interrelations among the branches of mathematics.

b) Solving problems by combining different branches of mathematics.

c) Verifying results.

d) Approximations.

4. Logical reasoning

a) Analysing "if - then" arguments in terms of basic assumptions and conclusions which logically follow.

b) Distinguishing between conclusions which do or which do not follow logically from a given set of assumptions.

c) Recognising unwarranted analogies.

d) Identifying necessary and sufficient conditions.

e) Detecting unstated assumptions.

f) Recognising inadequate data in generalisations.

g) Distinguishing between relevant and irrelevant data.

h) Interpretation of data
National Conference on School Mathematics

National Conference on School Mathematics organised by Mathematical Association of India with the assistance of N.C.E.R.T., National Council of Science Education (N.C.S.E.) and University Grants Commission (U.G.C.) had listed the following objectives of teaching school mathematics.

Objectives of teaching new mathematics.

"They are -

i. to make the child feel that mathematics is a growing, dynamic, exciting, intellectual enterprise;

ii. to make the child aware of the patterns and structures in mathematics;

iii. to make the teaching of mathematics consistent with the nature of modern mathematics;

iv. to make the child think in the same way in which a mature mathematician thinks;

v. to make the child aware of both the powers and limitations of mathematics;

vi. to make the child feel that mathematics is indispensable to human civilization;

vii. to make the child aware of the recent applications of mathematics;

viii. to make the child aware that mathematics is indispensable for answering some of the intellectual problems of mankind."
ix. to prepare the child for a fast changing world with fast changing concepts in social relations, management problems, science and technology.

x. to make an effort to prove statements or atleast to make them pausible and avoid training him through mathematical drilling."7

The above objectives deal mainly with the attitudinal changes of the pupils for new mathematics in the schools.

In his book 'A Course in Teaching of Modern Mathematics, Aggarwal has outlined the objectives as follows -

"1. The pupil develops computational skill.

2. He understands and uses the mathematical concepts.

3. He develops the power of understanding and making use of the mathematical language, (symbols).

4. He develops the power of organising, interpreting and expressing statistical and graphical data.

5. He develops self-reliance through the habit of verification.

6. He develops the power of analysis and the ability to work accurately.

7. He develops quantitative thinking, (Precision in thinking).

8. He develops the power of generalisation.
9. He sees the relationship between mathematics and his environment.

10. He makes reasonable estimation and understands that measurement is refined estimation.  

Some other books on teaching of mathematics in India do not specifically mention the objectives of its teaching at the secondary stage. However, they deal with values and aims of teaching mathematics.

Watson, in his book, "Developments in Mathematics Teaching", has summarised the objectives of B.S. Bloom as follows:

"Knowledge would include simple factual recall of items such as formulae, definitions, notations etc.

Comprehension was concerned with the routine use of ideas, such as the ability to translate verbal mathematical material into symbolic statements and vice-versa, or to perform routine computations or mathematical processes. Application refers to the use of ideas and material in non-routine situations; 'analysis' to such abilities as those involved in recognising unstated assumptions, distinguishing facts from hypotheses, checking the consistency of hypotheses with given information; and 'synthesis' to the putting together of elements and parts so as to form a whole, organising and presenting ideas, proposing ways of testing a hypothesis; and making mathematical discoveries or generalisations."
The notion of specifying the objectives of a particular curriculum unit in precise terms came into prominence with the publication of the Taxonomy of Educational Objectives (Bloom and others 1956). The original Bloom classification describes five categories of educational objectives which are arranged in an ascending hierarchy, i.e. knowledge, comprehension, application, analysis, and synthesis. These can be used by the teachers in designing teaching-tasks and evaluating their success and in the success of their pupils' efforts.

The objectives can be effectively used in the following important ways in curriculum development:

1. It helps in analysing and classifying objectives.

2. It provides an idea as to how the all-round development of a child can be achieved.

3. It provides the basis for a precise comparison of two curricula, syllabi or courses.

4. The same topic of a subject may be taught in different standards with the help of taxonomies.

5. It also helps in evaluation process.

6. It helps to include all the three domains in the teaching-learning-process.

7. Taxonomy increases the validity and reliability of the testing procedure.
India became a free nation nearly after two hundred years of colonial rule, on the 15th August, 1947. From that day onwards, Government of India have been trying to educate people so as to bridge the gap between a developing country like ours, and the developed countries. Therefore, various commissions and committees have been set up for updating the curriculum almost at all levels of educational hierarchy.


The Commission was set up with a view to bringing about major changes in Secondary Education. The Commission has not specifically stated the objectives of teaching any subject. It has opined:

"But there is undoubtedly room for formulating these aims in more specific terms and with special reference to the needs and the ideas of our country in its actual situation. As political, social and economic conditions change and new problems arise, it becomes necessary to re-examine carefully and re-state clearly the objectives which education at each definite stage, should keep in view."

Therefore, the Commission had suggested the need for formulation of objectives in specific terms. However, some aims were suggested which were broad-based. They were:

"From this necessarily sketchy analysis of the dominant needs of the present situation, it is clear that we shall have to formulate our aims
with reference to these broad categories - the training of character to fit the students to participate creatively as citizens in the emerging democratic social order; the improvement of their practical and vocational efficiency so that they may play their part in building up the economic prosperity of their country; and the development of their literary, artistic and cultural interests, which are necessary for self-expression and for the full development of the human personality, without which a living national culture cannot come into being."

The aims can be summarised as under:

1. Development of democratic citizenship;
2. Improvement of practical and vocational efficiency;
3. Development of personality;
4. Development of the quality of leadership; and
5. Development of interest in literature, art and culture.

*Education Commission, 1964-66.*

The Commission, although, very exhaustive in dealing with the various aspects of educational system of India, fails to describe educational objectives in precise terms. According to the Commission:

"Set language may be used in defining the basic terms in geometry and operations with numbers. It is only through the use of set language that a proper integration of arithmetic, algebra and geometry is possible. The use of the School Mathematics Study Group notations for line, segment, ray and so on, which provide for more precision in language, may be adopted."
The Commission further said in describing the methods of teaching:

"Emphasis should be more on the understanding of basic principles than on the mechanical teaching of mathematical computations."

From the above statements, it can be derived that the objectives of teaching mathematics at the secondary school stage should be to develop:

1. Knowledge of basic terms and notations;
2. Ability in operations with numbers;
3. Ability to integrate different branches of mathematics in solving problems;
4. Habit of precision;
5. Understanding of basic principles;
6. Ability in mathematical computations.

Iswarbhai Patel Committee Report (1977): Government of India, Ministry of Education and Social Welfare appointed a Review Committee headed by Sri Iswarbhai Patel, Vice-Chancellor of Gujrat University for ten year school i.e., from class-I to Class-X. The Committee spelt out the detailed curriculum for the 10 Year-School system replacing 11 year-school system. This document is important with respect to
curricular provisions of different subjects including mathematics for each of the classes.

The Review Committee enumerated some objectives, specifically, meant for secondary education keeping in view the constitutional obligation under Article 45.

Objectives of Secondary Education (VIII/IX-X)

1. acquisition of the skills and habits of self-learning;
2. acquisition of a broad-based general education consisting of science, mathematics, social sciences, languages, and socially useful productive labour;
3. acquisition of habits of helpful living and participation in games, sports, and athletics for the maintenance of physical fitness;
4. developing aesthetic appreciation and creativity through participation in artistic activities;
5. exploring the world of work and understanding the realities of life in order to prepare for a confident entry into the world outside the school;
6. participation in and promotion of social activities in the school and the community in such a way as to imbibe democratic values and to work towards the achievement of quality through service to the weak and the deprived."
The list of general and broad-based objectives for secondary education reveals that the Committee laid stress on the development of democratic values, service attitudes, creativity, appreciation, habits of helpful living, love for hard work, and confidence in himself. However, more stress has been given to manual work and social activities. A broad-based general education in Mathematics was considered an indispensable and integral part of the secondary education.

**National Policy on Education (1986).**

The National Policy of 1986 marked a significant step in the history of education in post-Independent India. It aimed to promote national progress, a sense of common citizenship and culture, and to strengthen national integration. It laid stress on the need for a radical reconstruction of the education system, to improve its quality at all stages, and paid much greater attention to science and technology, the cultivation of moral values and a closer relation between education and the life of the people. Perhaps the most notable development has been the acceptance of a common structure of education throughout the country and the introduction of the 10+2+3 system by most States. In the school curricula, in addition to laying down a common scheme of studies for boys and girls, science and mathematics were incorporated as compulsory subjects and work experience assigned a place of importance.
The Policy laid stress on mathematics teaching

"Mathematics should be visualised as the vehicle to train a child to think, reason, analyse and to articulate logically. Apart from being a specific subject, it should be treated as a concomitant to any subject involving analysis and reasoning.

With the recent introduction of computers in schools, educational computing and the emergence of learning through the understanding of cause-effect relationships and the interplay of variables, the teaching of mathematics will be suitably redesigned to bring it in line with modern technological devices."15

The Policy was based on a Framework in which objectives of teaching mathematics were enumerated.

"At the secondary stage the learner should acquire knowledge and understanding of concepts, symbols, and processes related to algebra, geometry, elementary trigonometry and statistics. He should develop the ability to solve problems through algebraic method and apply his knowledge of trigonometry and statistics to solve/interpret simple problems. He should also acquire knowledge and understanding of such concepts as are required to study mathematics as discipline. He should further develop facility with the use of ready reckoners, tables and calculators etc."16

National Council of Educational Research and Training, India.

The N.C.E.R.T. is the apex body at the central level of India. It is entrusted with the work to advice the Central as well as the State Governments in the matters relating to School education, undertaking research activities, training of teachers, extending expert opinion and advice to the State
Departments of Education, and finally devising basic principles and guidelines for framing the syllabi.

The objectives accepted by the NCERT at the national level for teaching mathematics were:

"The students should be able to:

i. understand and use number system;

ii. acquire necessary computational skills, including use of logarithms;

iii. understand mathematical concepts in use in trade and commerce and be able to apply them;

iv. become acquainted with spatial forms and develop ability to apply the knowledge to measure areas and volumes;

v. develop deductive reasoning;

vi. understand quantitative data, and use elementary statistics to represent them in different forms and be able to interpret the data for better understanding of situations and for application in life."

Interstate Board for Anglo-Indian Education

The booklet published in March, 1988 on behalf of the Council For the Indian Certificate of School Examination has enumerated the following objectives of mathematics teaching.
"Objectives: The main aims of the syllabus are to develop in candidates:

i. the need and value of numbers as applied to everyday life;

ii. confidence and skill involving Mathematical procedures;

iii. an understanding of Mathematical concepts and their application to further studies in mathematics and science." 18

Board of Secondary Education, Orissa.

The Board of Secondary Education, Orissa in its Regulations and Syllabus for High School Certificate Examination, published in the year 1986 had put down an exhaustive description of the objectives of teaching mathematics. The objectives were stated in terms of pupil behaviour.

Detailed Specifications

"1. To acquire the knowledge of terms, concepts, symbols, definitions, principles, processes, and formulae of Mathematics at the Secondary Stage.

Specification:

The objective is achieved if the pupil -

1.1 Recalls or reproduces

1.2 Recognises
2. To develop the understanding of terms, concepts, symbols, definitions, principles, processes and formulae of Mathematics at the Secondary Stage.

Specifications:

The objective is achieved if the pupil-

2.1 gives illustration
2.2 detects error and corrects them
2.3 Compares
2.4 discriminates between closely related concepts
2.5 Classifies as per criteria
2.6 identifies relationships among the given data
2.7 translates verbal statements into symbolical statements and vice versa
2.8 estimates the results
2.9 interpretes
2.10 verifies

3. To apply the knowledge and understanding of Mathematics to familiar situations or new problems.

Specifications:

The objective is achieved if the pupil -

3.1 analyses and finds out what is required
3.2 finds out the adequacy, superfluity or relevance of data
3.3 establishes relationship among the data
3.4 selects the appropriate method for solution of problems
3.5 suggests alternative method
3.6 generalises (i.e., reasons inductively)
3.7 infers (reasons deductively)

4. To acquire skill in
   a) computation
   b) drawing geometrical figures and graphs
   c) reading tables, charts and graphs etc.

Specifications:

The objective is achieved if the pupil—

4.1 carries out oral calculations with ease and speed
4.2 carries out written calculations with ease and speed
4.3 handles geometrical instruments with ease and proficiency
4.4 measures accuracy
4.5 draws freehand figures with ease
4.6 draws figures to specifications or to scale
4.7 draws figures accurately
4.8 reads tables with speed and accuracy
4.9 interpretes graphs
5. To appreciate the role of Mathematics in day to day life.

Specifications:

The objective is achieved if the pupil-

5.1 appreciates the role of Mathematics in solving problems of other branches of science

5.2 appreciates the symmetry of figures and designs

5.3 appreciates the development in qualities like brevity and exactness through the study of Mathematics

6. To develop interest in Mathematics

Specifications:

The objective is achieved if the pupil-

6.1 reads literature in Mathematics

6.2 writes popular articles on mathematical topics for the school journal

6.3 solves mathematical puzzles

6.4 participates in the activities of mathematics club

6.5 gives short cuts for solving problems

6.6 does additional study in Mathematics

6.7 brings to the teacher additional problems not related to syllabus
7. To develop scientific attitude through the study of Mathematics.

Specifications:

The objective is achieved if the pupil-

7.1 accepts proposition only when logically proved
7.2 examines all the aspects of the problem
7.3 points out errors boldly if convinced
7.4 accepts errors boldly
7.5 respects the opinions of others
7.6 keeps an open mind and does not regard any argument as final
7.7 develops habits of logical thinking.19

In so far as the objectives of teaching Mathematics as stated in the reports of various Commissions and Committees were concerned, none of the reports did describe categorically the objectives of teaching mathematics. The objectives were more general, broad-based and applicable to all the subjects i.e., education as a whole.

The Secondary Education Commission was keenly interested in the development of personality of the pupils with the quality of citizenship, practical and vocational efficiency, leadership, and interest in literature, art and culture.
The Education Commission (1966), however, tried to formulate objectives of teaching mathematics. The emphasis was on the ability of the pupils to integrate different branches of mathematics. The knowledge and understanding of basic terms, concepts and symbols were given due importance along with precision and mathematical operation.

The Iswarbhai Patel Committee emphasised objectives of Secondary education in general. It did not specifically mention the objectives of teaching mathematics.

The National Policy on Education and its Framework described the objectives of teaching mathematics more or less similar to that of the Education Commission. The emphasis was on knowledge and understanding of concepts, symbols and processes in all the branches of mathematics. The objectives, 'application' and 'interpretation' were included. The ability of the pupils to use ready reckoners, tables and calculators was also emphasised.

Curricula:

An attempt was made to analyse the objectives of teaching mathematics in the curricula of NCERT, CBSE, ICSE and BSE, Orissa. It was found that the objectives of NCERT and CBSE were the same. In the syllabi of NCERT and CBSE, the major objectives of knowledge, understanding, application and skill were emphasised. The ability to interpret was also included. On the basis of these four major objectives, six types of behavioural changes of the pupils were desired.
Knowledge was less emphasised than understanding, application and skill. Understanding of number system, concepts, quantitative data was given more importance than knowledge of concepts, statistical forms, quantitative data etc. Due weightage was given to computational skills and the skill to measure areas and volumes. The development of reasoning powers of the pupils was an addition to the objectives of teaching mathematics. However, the objectives mentioned in both the syllabi were precise, clear and distinctive.

The Council of Indian Certificate of School Examination (ICSE) stated only three objectives with respect to the teaching of mathematics. The objectives were inadequate to explain in definite terms, the behavioural changes to be produced in the pupils in learning mathematics. The objectives were understanding, application and skill. These three objectives were meant for further studies and mathematical procedures ignoring their application to the life situations. The need and value of mathematics were included as an objective; but they had their own explanation.

The syllabus of the Board of Secondary Education, Orissa in mathematics had spelt out the objectives of teaching mathematics in detail. There were seven major objectives to be achieved by the pupils. They were knowledge, understanding, application, skill, appreciation, interest and scientific attitude. The Syllabus Committee had made an attempt to describe
each of the seven major objectives in term of pupil behaviour. But in some cases, it did not mention the exact nature of the desired behavioural changes of the pupils in mathematics. For example, in objective No.1, what are to be recalled and reproduced and what are to be recognised were not mentioned. The same was the case with objectives No.2 and No.3. Of course, a close observation would indicate the behavioural changes as per the main headings of each of the objectives. But it would have been more meaningful if the behavioural changes had been spelt in clear terms.

In practice, the behavioural changes of the pupils as detailed under each objective, seem to be hard to achieve unless sufficient care is taken by the teacher. The objectives seem to have been lifted from Bloom's Taxonomy without any understanding of their implication. The objectives hang loosely and were not organically linked to the preparation of the text-book. It was a fine ornamental decoration of pedagogical theory to the otherwise traditional approach.

OPINION OF TEACHERS AND PUPILS OF ORISSA ON THE OBJECTIVES OF TEACHING MATHEMATICS.

From different perspectives, an attempt had been made to analyse the objectives of mathematics curriculum at the secondary school level. The objectives play significant role in designing the 'syllabus', 'course of study', 'course outline', or 'the intended curriculum'.

From different perspectives, an attempt had been made to analyse the objectives of mathematics curriculum at the secondary school level. The objectives play significant role in designing the 'syllabus', 'course of study', 'course outline', or 'the intended curriculum'.
In the present study, the objectives of mathematics curriculum had been identified and suggested both by the teachers and the pupils in order of importance. Question No.5 of Teachers' Questionnaire and question no.1 of Pupils' Questionnaire elicited the opinion of teachers and students relating to the objectives of mathematics.

**Teachers' Opinion**

The Secondary School Teachers of Orissa teaching mathematics had been requested to rank the objectives of teaching Mathematics. A list of fifteen objectives were provided in the teachers' questionnaire for ranking them, in order of their preference. Teachers had been given the freedom to include three additional objectives, if they so desired. So, the researcher assumed the total number of objectives to be 18. Inverse weightage was accorded to the responses of the teachers. 18 points were given to the objective having the rank 1, 17 to rank 2 and so on.

It was found from the responses of the teachers that some teachers did not rank all the 15 objectives included in the questionnaire. So points were awarded to those objectives which were ranked by the teachers and the other objectives were left out of consideration.

Though the list of objectives had been provided with a request to rank them, the teachers had also been requested to suggest additional objectives on the basis of their long
experience. Only a very small number of teachers added one or two objectives. These opinions were taken cognizance of. However, the lack of originality and divergent thinking was evident. Teachers seem to be ossified by the school system. New ideas and exploratory methods were almost non-existent.

None of the teachers could add three additional objectives.

The objectives were arranged in ascending order on the basis of total scores obtained and were presented in Table 3.1.

The Secondary School Teachers of Orissa teaching mathematics have ranked the objectives in the following way. The objectives were ranked on the basis of cumulative inverse weightage method.

**TABLE 3.1**

RANKING OF OBJECTIVES BY TEACHERS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Objectives</th>
<th>Comparative Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>To acquire knowledge of fundamental operations and apply them in new situations.</td>
<td>3288</td>
</tr>
<tr>
<td>2.</td>
<td>To enable the child to be familiar with mathematical terms, concepts, symbols, formulae, ideas, relationships, procedures, principles, facts, developments etc.</td>
<td>2820</td>
</tr>
</tbody>
</table>
3. To develop mathematical skills, understanding and attitudes necessary to solve problems of life.

4. To apply the knowledge of mathematics in practical life.

5. To improve speed, accuracy, neatness and precision.

6. To develop the power of logical and critical thinking, objective reasoning and spirit of enquiry.

7. To develop skill to use mathematical instruments, prepare models, charts, draw figures, read graphs etc.

8. To develop the power of original thinking, concentration and inductive judgement.

9. To develop the power of generalisation from concrete data.

10. To develop work habits

11. To enable pupils to understand, express and interpret symbolic representation precisely, exactly and systematically.

12. To develop skill in collecting information from original sources.

13. To learn the technique of Problem solving.
14. To develop the ability to understand and appreciate interrelationship of different branches of mathematics.

15. To develop the sense of proportion with time factor.

16. To develop the will for determination.

17. To develop the habit of discipline.

Critical Commentary on the Opinions of the Teachers:

Ranking objectives is a difficult job. All objectives have importance. Allocating appropriate importance depends on a variety of factors such as the knowledge, competence and maturity of the teachers; the ability and aptitude of students; and the facilities that are available for teaching the subject.

Knowledge of the fundamental operations of mathematics, familiarity with mathematical terms, concepts etc.; and development of mathematical skills were the three most important objectives. However, such objectives as the development of discipline, determination and a sense of proportion ranked the lowest.
A close examination of the ranking, constrains the researcher to conclude that the teachers of secondary school mathematics were conservative in their outlook and belonged to the genre of teachers prior to the introduction of New Mathematics in Indian Schools. The winds of change are yet to blow; and the conservative attitude may take a long time to change.

**Students' Opinion**

The researcher wanted to assess the students' perception of objectives of learning mathematics. So the opinions of the pupils reading in classes VIII, IX and X were collected and analysed. They were asked to rank the objectives (like the teachers) and the objectives were accorded inverse weightage. The students were asked to rank nine objectives. Freedom was given to add two additional objectives. None of the students could add a single objective. Some of the students ranked a few objectives and these were taken into consideration.

The ranking of objectives has been presented in table 3.2.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Objectives</th>
<th>Comparative Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>There is necessity of mathematics in everyday life.</td>
<td>2498</td>
</tr>
</tbody>
</table>
2. Knowledge of mathematics is essential for technical education.

3. One who is good at mathematics is also good at other subjects.

4. Mathematics develops the habit of punctuality, hard labour, and economical living.

5. Mathematics is a job-oriented subject.

6. Mathematics is an intellectuals' subject.

7. Pupils reading mathematics are well accepted by the teachers.

8. Living becomes difficult without the knowledge of mathematics.

9. Study mathematics under compulsion.

10. Mathematics helps logical thinking.

Critical Comments:

It is really disturbing to note that the students could not understand the organic linkage between mathematics
and logical thinking. "Mathematics helps logical thinking" was accorded the highest importance and was the objective with the lowest ranking. Lack of mathematical knowledge was considered to be a handicap by a few students; and it was considered as a subject studied due to compulsion.

By and large, most of the students had a pragmatic view of mathematics. Majority of them considered it to be useful in day to day life; and unlike some of their counterparts, did not dismiss it as of lesser importance.

As most of the secondary school students have an aspiration to become engineers or computer scientists, they considered mathematics to be a valuable subject. However, none of them stressed the importance of developing such objectives as precision, accuracy and the sheer joy of mathematics. The students, like their teachers, are caught in the mechanics of mathematics; and have not begun appreciating myriad colours of the mathematical prism.

**Topics according to Objectives:**

Theoretical postulates are like ineffectual angels fluttering in the void. The clouds may be beautiful, but it is the rain that sustains humanity. The theoretical objectives need to be concretised. This process of concretization is best reflected in the treatment accorded in the textbooks; and the conscious and unconscious methodologies adopted by the teachers.
About 54.27% of the teachers agreed that the way in which the topics were developed, helped in achieving the objectives mentioned in the syllabus. 33 teachers did not agree to this view. Only 72 teachers i.e., 32.72% mathematics teachers of Orissa at the secondary school stage agreed that the topics helped in achieving the objectives of the syllabus to some extent.

REFERENCES

1. N.E.Gronlund, Measurement and Evaluation in Teaching

2. New Trends in Mathematics Teaching,
   International Commission on Mathematical Instruction, Volume IV, Unesco, 1972 p.37

3. Dubisch Roy, The Teaching of Mathematics
   John Wiley and Sons, Inc.
   New York and London 1963, P.2

4. International Commission on Mathematical Instruction, op cit. P.36

5. All-India Survey of Achievement in Mathematics
   NCERT, NIE Campus, New Delhi 1970 pp. 16-17

6. Ibid, p.18

7. J. N. Kapur, Proceedings of the National Conference on School Mathematics
   Mathematical Association of India, I.I.T. Kanpur 1969, pp 59-60

   Dhanpat Rai and Sons, Delhi 1979, p.55
9. F.R. Watson, *Developments in Mathematics Teaching*
   Open Books, London 1976, p. 45

    Ministry of Education and Social Welfare,
    Govt. of India, New Delhi 1972, p. 22

11. Ibid, p. 23


13. Ibid, p. 348

    for Ten-Year-School,
    Extract Printed by S.C.E.R.T., Orissa,
    Bhubaneswar, 1984, p. 5
15. **National Policy on Education.**
   Govt. of India, New Delhi 1986, P.23

16. **National Curriculum For Primary and Secondary Education - Frame Work.**
   N.C.E.R.T., 1985, P.16

17. **Syllabi and Courses**
   Central Board of Secondary Education,
   New Delhi 1987, P.26

18. **Syllabus of Council for the Indian Certificate of School Examination.**
   Pragati House, New Delhi 1986, P.35

19. **Syllabus for the High School Certificate Examination, 1986.**
   Board of Secondary Education, Orissa, Cuttack. pp. 76-79.