Chapter II

Review of Related Literature

2.0 Introduction

The review of the related study is nothing but a wide look into the past research work done in the specified fields. It provides information related to the type of study and type of design that may be eventually used in conducting research. Research works done in the past serve as solid foundation on which, any new investigation firmly rests. A careful consideration of ‘recommendation for further research’ in various research studies guides to investigator regarding the suitability of the problem and assists in delimiting his research problem. Therefore, the investigator has tried to review the literature of the past studies which correlates with achievement.

The review of the literature is divided into two parts:

(i) Research work done in India,
(ii) Research work done in other countries.

2.1 Research studies in India

2.1.1 “A study of the use of mathematics laboratory for teaching mathematics by developing a Strategy and testing its effectiveness.”[29]

Objectives:

1. To find out various method being used in teaching mathematic.
2. To find out teaching view about Mathematics laboratory set-up.
3. To develop a strategy to be used in mathematics laboratory set-up.
4. To test the effectiveness of the strategy developed for teaching mathematics laboratory set-up.
5. To suggest recommendation for the development of mathematics laboratory and training of Mathematics teachers.

Sample of the Study:

For this experimental study purpose, two different samples were chosen namely student’s sample and teacher’s sample. The students’ sample of the study consisted of a total 80 students of class X standard of Kendriya Vidhyalaya, Ojhar and while teacher’s
sample consisted of 100 teachers of mathematics working in schools in & around Ojhar Nasik District. Two equal groups were formed on basis of their marks obtain in class IX.

**Tools:**

Tools like Questionnaire, visits, observation and interview were used in the study.

**Research design:**

The research design of the study was “two groups posttest experimental design”. Two groups namely, control group and experimental group were taken with each of them having a total of 40 students. The research methodology was Quasi Experimental research.

**Strategy evolved for teaching mathematics in mathematics laboratory:**

A strategy consisting of three different methods namely; Expository method, cooperative learning method, and problem solving method coupled with modeling was evolved. These three methods were administered as one unit but in three stages while teaching mathematics in mathematics laboratory.

**Procedure of the study**

Investigator visited numbers of mathematics laboratories and collected suggestions and guidance before preparing the questionnaire and formulating the strategy for teaching mathematics. On the basis of observation, interviews and validated by two experts a questionnaire consisting 18 questions was prepared. Questionnaire was administered among 100 teachers. On the basis of responses, a statistical analysis and interpretation were drawn and then, a strategy consisting of three methods was developed. The strategy evolved was used for 10 weeks on the experimental group to teach mathematics in a mathematics laboratory atmosphere. The control group taught the same mathematics content using normal classroom teaching. The method of teaching control group was traditional method. At the end of 10 weeks; a posttest was administered to the both groups to evaluate and assess the performance of students.

**Findings:**

Teachers who were trained through behaviourist model were not aware of methods like cooperative Learning; guided-Expository and problem-solving method integrated with modeling. So, these methods were less preferred to teach mathematics as compared to traditional didactic methods like Lecture; Lecture-Demonstration methods. Mathematics laboratory is not an integral part of curriculum framework in Maharashtra. Mathematics laboratory cultivated research attitude among students, when it was integrated with strategy evolved. Mathematics Laboratory and its utility were given less
importance during teaching degree pursuit. Majority of in-service teachers lack the knowledge of the modus-operandi using mathematics laboratory for teaching mathematics at school level. Majority of teachers were not given in-service training in using computers and software to teach mathematics. Use of computer and mathematical software to teach and provide conceptual knowledge of mathematics in a Mathematics Laboratory yielded positive reinforcement among students. Use of computers and allied software was not in the curriculum of teaching degree pursuit. Hence teachers of mathematics were not aware of using computer and allied software to teach mathematics. Strategy evolved to teach mathematics helped in effective content management. Computer and mathematical software used in Mathematics Laboratory has provided hands-on experience of mathematical knowledge taught. The strategy evolved has also helped students to know the social relevance of knowledge learnt. 3rd stage of the strategy helped teacher to create learning problems and situations that will actively involve students and stimulate interest in how mathematics is applied in real life situations. There is significant difference between the mean scores of Experimental Group and Control group. The t-test revealed that the t-value statistically arrived was 5.59 for the degree of freedom 78. When t-value was compared with 0.05 level and 0.01 levels of significance for the same degree of freedom, the t-value arrived was significantly greater than both levels of significance. So, the strategy evolved for teaching mathematics in a mathematics laboratory was effective than didactic traditional methods.

2.1.2 “To study the effectiveness of different strategies of teaching on achievement in mathematics in relation to intelligence, sex and personality”[30]

Objectives:

The objectives of the study were to find out (i) whether achievement in mathematics was affected by different strategies of teaching, (ii) whether different strategies had differential effects on achievement of male and female students, (iii) whether levels of intelligence interacted with teaching strategies in terms of achievement, and (iv) whether personality acted as a potential factor in selection of teaching strategy.

Sample:

A sample of 300 students was randomly selected from grade IX students of four schools of Chandigarh.
Tools:

The sample subjects were administered (i) The Mathematics Achievement Test, (ii) The Jalota Group Test of Mental Ability (1972), (iii) The Eysenck Personality Inventory (1964).

Procedure:

In the study a pretest/post-test experimental design, was followed. A four-way factorial design (3 X 2 X 2 X 3) was employed. The independent variables in the study included strategies of teaching, sex, personality and intelligence and the criterion variable was achievement in mathematics. The strategies of teaching varied in three ways-(a) lecture-discussion, (b) inductive-drill and (c) auto-instruction group discussion. The personality varied in two ways- extraverts and introverts; the variable of intelligence had three levels-low, average and above average. The students were divided into three groups of 100 each. One group was taught mathematics through lecture-discussion, the second group was taught mathematics through inductive-drill and the third group was taught mathematics through auto-instruction group discussion. The data collected through pretest/post-test were analyzed through four way (3 X 2 X 2 X 3) analysis of variance.

Finding:

The findings of the study were: (1) All the three strategies, namely, (a) lecture-discussion, (b) inductive-drill, and (c) auto-instruction group discussion, were found to be equally effective in terms of achievement in mathematics disregarding levels of intelligence, sex and personality type. (2) Boys and girls of superior ability did not show any significant difference between their mean scores on achievement in mathematics. (3) Girls of average ability scored significantly higher in mathematics than boys of average ability. (4) Lecture discussion strategy found favour with average ability students as they scored significantly higher than above-average and below-average groups. (5) Strategy II and strategy III, namely inductive-drill and auto-instruction group discussion, was more suited to the students having above-average intelligence than average and below-average intelligence. (6) The strategy of lecture-discussion was found to be equally effective with above-average and below-average ability (intelligence) introverts as well as extraverts. (7) Extraverts of high ability, average ability and below-average ability scored equally well when taught through strategy I. (8) Under the strategy of inductive-drill, average-ability extraverts scored significantly higher than average-ability introverts. (9) Under the strategy of auto-instruction group discussion, high ability and low ability extraverts did not differ from the high ability and low ability introverts. But extraverts of average ability differed significantly in their achievement from average ability introverts. (10) Out of the three strategies, strategy I was more suited for below-average ability extraverts and
introverts, strategy II for high ability extraverts and strategy III was most suited for high ability introverts for achievement in mathematics.

2.1.3 “An Investigation into the Relative Effectiveness of Guided Discovery and Expository Approaches of Teaching Mathematics” [31]

Objectives:

The major objectives of the research were:(i) to study the relative effectiveness of guided discovery and expository approaches of teaching mathematical concepts, (ii) to study the relative effectiveness of guided discovery and expository approaches of teaching problem solving, (iii) to study the interaction of intelligence and achievement in mathematics vis-a-vis guided discovery and expository approaches, and (iv) to study the relative effectiveness of guided discovery and expository approaches in different types of pupils, namely boys, girls and rural pupils.

Sample:

The population selected for testing the above hypotheses was class IX pupils of Vizagapattanam. From this population, three samples, namely, boys, girls and rural pupils, were selected.

Tools:

Intelligence test, Achievement test

Procedure:

From the population, three samples, namely, boys, girls and rural pupils, were selected. On each sample an intelligence test was administered. Each sample was then divided into two equivalent groups on the basis of their means and SDs on this intelligence test. Thus the two groups were matched for intelligence. After dividing each sample into two equivalent groups, one group was allotted to the guided discovery approach and the other was allotted to the expository approach. Identical topics from arithmetic, algebra and geometry were taught to both the groups for one month. After this a test on these topics was administered to the two groups. The randomized blocks design was based upon the principle of grouping experimental units into blocks. Blocks were formed on the basis of intelligence which was related to achievement in mathematics.
Findings:

The major findings were: (1) There was no significant difference in achievement in mathematics when taught by the guided discovery and expository approaches. (2) There was no significant difference in achievement in mathematical concepts when taught by the guided discovery and expository approaches. There was no significant difference in problem solving when taught by the guided discovery and expository approaches, except in the case of girls here a significant difference was found. (3) There was no significant difference in variance in achievement when taught by the guided discovery and expository approaches. (4) Intelligence had no say in achievement when taught by the guided discovery and expository approaches, except in the case of urban boys.

2.1.4 “Development of Symbol Picture Logic Programme and to Study its Effect on Mathematics Achievement-A System Approach”[32]

Objectives:

The objectives of the study were (i) to develop a symbol picture logic programme (SPLP) on the basis of the fundamentals of symbolic logic, (ii) to study the effectiveness of the SPLP on the achievement in mathematics, (iii) to identify the effect of the SPLP in the context of variables like intelligence and syllogistic reasoning ability, and (iv) to find the effectiveness of the SPLP in the context of other variables like parent education, sex and the choice of mathematics course at the S.S.C. level.

Sample:

There were 160 students in the experimental group and 160 in the control group. Four schools were selected at random from 16 schools of Bayad taluka.

Tools:


Procedure:

The symbol picture logic programme was developed keeping in mind the basic element of logic to be included in set programme and the basic connectives in logic. For selecting the basic connectives; in symbol picture logic, the concept of Linda Jestrom of the Centre for Research in Thinking and Language of Catholic University was kept in mind. The equivalent group technique was adopted. The 2 X 2 X 2 factorial design was
adopted for studying the SPLP in relation to achievement, parents' education and sex. Analysis of variance technique was used for analyzing the data. The experiment was carried out on students of class IX.

Finding:

Some of the findings were: (1) The students of the experimental group who were given a treatment of the SPLP showed better achievement in mathematics than the control group students. (2) The students with high intelligence benefited more by the SPLP by better achievement in mathematics than those who possessed low intelligence. (3) The student possessing high reasoning ability benefited more by the SPLP by better achievement in mathematics than those who possessed low reasoning ability. (4) There was no interaction between the programme (treatment) and intelligence. (5) There was no interaction between the programme and syllogistic reasoning ability. (6) There was no interaction effect of intelligence and syllogistic reasoning ability of the students. (7) There was no interaction among the programme, intelligence and syllogistic reasoning ability. This showed that the achievement in mathematics was independent of these three variables. (8) The students of the control group possessing low general ability

2.1.5 “Effect of Mastery Learning Strategy (MLS) on Pupil Achievement”[33]

Objectives:

The objectives of the enquiry were (i) to study the effectiveness of the Mastery Learning Strategy (MLS) method of teaching in relation to pupil achievement in mathematics, (ii) to study pupil achievement in mathematics, adjusted on intelligence, socio-economic status and pre-achievement in mathematics taught through the mastery learning strategy and the conventional method, (iii) to study the effect of MLS on self-concept of pupils, (iv) to study the change in attitude of pupils towards mathematics due to MLS, (v) to study the effect of MLS on different dimensions of non-verbal creativity of pupils, namely, fluency, flexibility, originality, elaboration and total score in non-verbal creativity, and (vi) to study the effect of MLS on different dimensions of verbal creativity of pupils, namely, fluency, flexibility, originality and composite creativity.

Sample:

Fifty pupils of two sections of class VI of a government boys' middle school formed the sample. They belonged to below average socioeconomic strata and varied in age from 11 to 13 years.
Tools:

The tools used were Cattell's Culture Fair Test for Intelligence, Kuppuswamy's Socio-economic Status Scale, a Test of Self-concept of Pupils prepared by Sherry and others, a Scale for Measuring Attitude of Pupils towards Mathematics, Torrance Test of Creative Thinking (Forms A and B), Test of Creativity by Passi for verbal creativity, and an achievement test in mathematics developed by the investigator.

Procedure:

The experiment was confined to eight units in mathematics. The experimental and control groups were in the same school and taught by the same teacher. The study consisted of three stages. The first stage involved testing of pupils' achievement in mathematics, their intelligence, socioeconomic status, self-concept, attitude towards mathematics and verbal and non-verbal creativity. The second stage comprised the experiment over a period of six months wherein the teaching of eight units selected from the syllabus was undertaken. The final stage comprised testing of both the groups on achievement in mathematics, their self-concept, attitude towards mathematics and verbal and non-verbal creativity.

Finding:

The major findings of the study were: (1) The students taught through the mastery learning technique showed higher gains in mathematics than those taught by the conventional method. (2) Even when statistically adjusted for initial differences in intelligence, socioeconomic status and pre-achievement, the treatment group performed significantly better. (3) The self-concept and attitude towards mathematics did not show a significant improvement over the period of treatment though the attitude towards mathematics of students taught through mastery learning showed higher gain scores. 4. The mastery learning strategy for teaching mathematics was more effective in increasing non-verbal and verbal creativity.

2.1.6 “An Investigation into Efficacy of Different Instructional Media in the Teaching of Mathematics to the Pupils of Class IX in Relation to Certain Variables” [34]

Objectives:

The objectives of the study were (i) to investigate the efficacy of instructional media I (visual projection) over instructional media II (activities and experiment) in terms of achievement, (ii) to investigate the efficacy of visual projection over programmed
learning material, (iii) to investigate the efficacy of activities and experiments over programmed learning material, (iv) to investigate the efficacy of visual projection over the traditional method of teaching, (v) to investigate the efficacy of activities and experiments over the traditional method of teaching, and (vi) to investigate the efficacy of programmed learning material over the traditional method of teaching in terms of achievement.

Sample:

The experiment was carried out in two schools. Four groups of class IX pupils having 30 pupils in each group were selected for implementing the instructional media while the other four groups were treated as control groups.

Tools:

The Junior Index of Motivation (JIM Scale) and Test of Reasoning Ability were used for collecting necessary information about the variables.

Procedure:

Factorization of the type $a^2 - b^2$ and expansion of $(a + b)^2$ were selected for preparing transparencies for projection through the overhead projector. The same topic was selected for the preparation of materials for activities and experiments as well as for preparing programmed learning material. The criterion tests on both units were prepared. The pretest post-test control group design was adopted for the purpose of studying the efficacy of different media. The analysis of covariance was used to draw conclusions.

Findings:

Some of the major findings of the study were: (1) Visual projection and activities and experiment were equally effective for Unit I while visual projection was superior to the activities and experiment approach for Unit II. (2) Visual projection was superior to programmed learning material for Unit I, while they were equally effective for Unit II. (3) The approach of media activities and experiment was superior to programmed learning material for Unit I but they were equally effective for Unit II. (4) Visual projection was superior to the traditional method of teaching for Units I and II. (5) The activities and experiment approach and the traditional method were equally effective for both units. (6) Programmed learning material and the traditional method of teaching were equally effective for Units I and II. (7) The results clearly indicated that the instructional media I, namely visual projection, was comparatively more effective than any other media like activities and experiment or even programmed learning material. The low
achievers were comparatively more benefited by programmed learning material than the high and average achievers.

2.1.7 “An investigation into the impact of Divergent thinking Programme in mathematics on the creative levels of the children of classes VII and VIII” [35]

Objectives:

(i) To provide the reliable divergent thinking programme in mathematics.(ii) To study the effect of Divergent Thinking Programme in mathematics on the creativity of students of standard VII and VIII with respect to reinforcement. i.e. feed back. (iii) To study the effect of DTPM on the creativity components viz. Fluency, Flexibility and Originality. (iv) To investigate whether the grade difference in creativity is there or not. (v) To investigate whether the sex difference in the creativity exists or not.

Sample:

One school complex with co-education system in Gujarati medium was chosen for the experiment. Three classes of standard VII and VIII from a school in Ahmedabad city were selected. Then three equal groups of each standard were formed (a control group and two experiment groups) One experimental group was formed as a group with feedback and other experimental group called group without feedback. Thus, there were four experimental groups with 90 students in all.

Tools:

Main tools were used in this study were PTC and DTPM (i) Passi Test of Creativity (PTC). PTC contained six tests, four test were verbal and remaining non verbal. In this study the verbal tests were used. (ii) Divergent thinking Programme in mathematics. The DTPM tool was prepared and tested as an instrument for creativity. It contains three types of problems (a) Multi- response (b) Hidden shapes (c) Make-up problems.

Statistical methods:

Analysis of pre-test score posttest score was made for all the six groups. The ANCOVA method was applied.
Findings:

Various finding were considered together and discussed objectives were narrated with reference to the hypothesis, observation and conclusion. (1) Divergent Thinking Programme in mathematics was an essential tool to develop creativity of VII and VIII grade students. (2) The programme was equally useful to develop creativity in ether sex. (3) DTPM was an essential tool to increase in fluency a creativity component of the students of both the standard (4) DTPM was not useful to get change in flexibility scores. (5) DTPM was useful but the training was not effective for originality.

On the whole, the results derived from the analysis were very interesting and encouraging, and they showed that creativity can be develop through DTPM.

2.1.8 “A study of the effect of a Specially Designed Teaching Strategy and some socio-psychological factors on creativity among middle school children.” [36]

Objectives:

(i) To find out the effect of the specially designed teaching strategy on general creative abilities of urban and rural children. (ii) To investigate the effect of specially designed teaching strategy on mathematical creative abilities of urban and rural children. (iii) To compare the effect of specially designed teaching strategy on high, average and low levels of general creativity of urban and rural children. (iv) To compare the effect of specially designed teaching strategy on high, average and low levels of mathematical creativity of urban and rural children. (v) To identify the personality factors of high and low general creatives. (vi) To investigate the biographical factors of high and low general creatives. (vii) To identify the personality factors of high and low mathematical creatives. (viii) To investigate the biographical factors of high and low mathematical creatives. (ix) To find out whether there is any significant differences in the personality factors of urban and rural children who were found to be creative on the basis of their general creativity score. (x) To find out whether there is any significant differences in the personality factors of urban and rural children who were found to be creative on the basis of their mathematical creativity score. (xi) To study the relationship between general creativity in respect of fluency, flexibility, originality and elaboration on urban and rural samples.

Sample:

The sample of the study consisted of 277 (165 urban and 112 rural) VII and VIII class pupils purposely selected from two intermediate college of Sultanpur district in U.P. the sample used for the study was purposive.
Tools:

Tools used for collection of data were (i) General Creativity Test – verbal and nonverbal developed by Mehdi (1973) (ii) Mathematics Creativity Test developed by investigator (iii) Hindi adaptation of Thorndike Dimension of Temperament Test by Mehdi and investigator (iv) Biographical inventory developed by Mehdi.

Syntax or phasing:

The syntax or phasing of the teaching model involves a description of the teaching strategy in action. It tells us about the shape of the activities which typify the particular education environment belonging to each teaching-learning strategy.

First phase: The students were familiarized with the concepts, principles and formulae of mathematics.

Second phase: The problems were analyzed with help of students.

Third phase: Students were initiated to develop hypotheses in mathematics situation.

Fourth phase: Students were motivated to collect data for verification of hypotheses.

Fifth phase: Hypotheses were verified in terms of logical validity.

Sixth phase: generalizations were drawn about the solutions of the problem.

Findings:

(1) The effect of specially designed teaching strategy on different dimensions of general creativity, viz. fluency, flexibility, originality, elaboration and also on general creativity as a whole among urban and rural children were found to be significant.(2) The effect of specially designed teaching strategy on originality (verbal) and elaboration (nonverbal) dimensions of mathematical creativity was not found significant in the short duration of experiment. (3) The specially designed teaching strategy for the development of creative thinking abilities among children was found to be more effective with the high creatives than with the average and low creatives. (4) The SDTS was found more effective with the high mathematical creatives than with the average and was not found at all effective with the low creatives. (5) Rural high and low general creativities were found to differ significantly from one another only with respect to three personality factors, viz. impulsive, active and responsible. Rural high creatives are playful, active and responsible. (6) Rural high and low general creatives were found to differ significantly from one another with respect to socio-cultural and education background, interest
patterns and level of aspiration. (7) Urban high and low mathematics creatives were found to differ significantly from one another only with respect to three personality factors, viz., cheerful, placid and impulsive.

2.1.9 “The effect of a creative teaching model in mathematics on the achievement and the attitude of ninth class students.” [37]

Objective:

(i) To develop a programme in mathematics which promotes both cognitive and affective growth in pupils. (ii) To evaluate the programme by study its effect on pupil’s achievement and attitude. (iii) To study the effect of factors like sex, parental education, student’s motivation on the achievement and attitude of the pupils.

Sample:

A total of 112 students were selected from IX class of Shri M.G.H. School, Gantur.

Tools:

The following tools were used for measuring the four independent variables and two dependent variables. (i) Achievement – score from school records. (ii) Attitude test developed by H.G.Desai (iii) Motivation – JIM scale develop by the extension unit of M.B.Patel college of Education, Vallabh vidyanagar. (iv) Parental Education - a bio data sheet develop by investigator.

Procedure:

The programme was developed to meet the needs of ninth class pupils of Andhra Pradesh. The programme is meant for telugu speaking students. The creative teaching model was developed by investigator on the basis of the William’s three dimensional model for implementing cognitive and affective behaviours in the classroom. Treatment was the given to experimental group. The design chosen was a $2^4$ factorial design. The data collected was subjected to analysis of variance. The F test was used to test the significance of the effects of various factors.

Findings:

(1) The CTM had significant effect on both achievement and attitude of the students. The achievement and attitude towards mathematics of experimental group
showed considerable improvement. (2) Though boys and girls differed in achievement, their attitude did not differ significantly. (3) The first order interactive effect of sex and motivation was significant for both achievement and attitude.

2.1.10 “Teaching of mathematics: Effectiveness of Computer Assisted Instruction (CAI) & Conventional Method of Instruction.” [38]

Objectives:

(i) To study the difference in mathematics achievement which occurs as a result of the different in instructional strategy among boys and girls separately and as a group.
(ii) To study the direction of change in attitude of male and female students separately and as a group towards mathematics as result of two different instruction strategy.

Sample:

The sample of the study is consisted 220 students from four selected higher secondary schools, covering the good, average and poor students of the Bhilai Steel plant, Bhilai (M.P).

Findings:

(1) The students who used the computer score significantly higher than those taught mathematics through the convention method. (2) The students who used the computer showed significantly highly favorable attitude towards mathematics than those who did not use the computer. (3) Achievement in mathematics and change in attitude towards mathematics were found to be independent of the sex factor.

2.1.11 “An Investigation into Efficacy of Different Instructional Media in the Teaching of Science to the Pupils of Class VIII in Relation to Certain Variables” [39]

Objectives:

The objectives of the study were (i) to compare the achievement of pupils in science learning through different instructional media and the traditional way of teaching, (ii) to compare the achievement of pupils in science learning through the programmed learning approach and the traditional way of teaching, (iii) to compare the achievement of pupils in science learning through slides with discussion approach and the traditional way of teaching, (iv) to compare the achievement of pupils in science learning through the experimental approach and the traditional way of teaching, (v) to compare the
achievement of pupils in science learning through the programmed learning approach and slides with discussion approach, (vi) to compare the achievement of pupils in science learning through the programmed learning approach and the experimental approach, and (vii) to compare the achievement of pupils in science learning through slides with discussion approach and the experimental approach

Sample:

The experiment was carried out in two schools of Anand city. Four equivalent groups with respect to motivation towards schools and reasoning ability were prepared. In each group there were 25 students.

Tools:

The programmed learning material, slides and laboratory experiments were designed. The criterion test was prepared on the units selected for experimentation. The Junior Index of Motivation Scale and the Reasoning Ability Test were used for measuring motivation towards schools and reasoning ability of pupils.

Procedure:

The density, specific density of a solid, and the cell and its structure were selected for the preparation of the material for instructional media. The programmed learning material, slides and laboratory experiments were designed. The criterion test was prepared on the units selected for experimentation. The Junior Index of Motivation Scale and the Reasoning Ability Test were used for measuring motivation towards schools and reasoning ability of pupils. The experiment was carried out in two schools of Anand city. Four equivalent groups with respect to motivation towards schools and reasoning ability were prepared. In each group there were 25 students. One group was taught through programmed learning, the second group was taught through slides with discussion approach, the third group was taught through the experimental approach and the fourth group was taught through the traditional approach. The analysis of covariance was used to test the various hypotheses.

Findings:

The major findings of the study were: 1. The programmed learning approach was more effective than the traditional way of teaching science. 2. The slide with discussion approach was more effective than the traditional way of teaching science. 3. The experimental approach was more effective than the traditional way of teaching science. 4. In the teaching of science, the experimental approach was the most effective of all approaches. 5. The programmed learning approach and slides with discussion approach were equally effective. 6. The use of instructional media indicated the possibility of improvement in the methodology of science teaching, raising the standard of science
education in secondary schools and development of taste and interest in the younger generation for the subject of science.

The major educational implication of the study is that there is not one method of teaching science. The teacher should be experimental-minded and should use different approaches in the light of different objectives. Media are effective in science education.

2.2 Research studies in other countries:

2.2.1 “Effect of using mathematics laboratory in teaching mathematics on the achievement of mathematics students” [40]

Objectives:

The purpose of this study is to investigate the effects of using mathematics laboratory in teaching JSS students in mathematics. Specifically, the study sought the following (i) To investigate the extent to which the use of mathematics laboratory will enhance the achievement of mathematics students. (ii) To compare the achievement of male and female mathematics students taught with mathematics laboratory.

Sample:

The population was made up of all the JSS III mathematics students in the secondary schools in Ekwusigo Local Government Area of Anambra State. Sample and sampling technique A total of one hundred (100) students were used for the study. Ekwusigo Local Government Area has only two co-educational schools and these were purposively selected. One arm of 50 JSS III students was randomly selected from each of the co-educational school. One class was assigned to treatment group A, fifty in number (23 boys and 27 girls) and the other class was assigned to control group B, fifty in number (17 boys and 33 girls).

Instrument and validation:

The researchers used the Mathematics Achievement Test (MAT) as an instrument. Also, Designed Mathematics Laboratory (DML) and the lesson plan were used as instructional tools for the study. MAT: This is a ten-item achievement test constructed by the researchers based on the JSIII mathematics syllabus in the area of plane geometry and algebraic expressions. The test was in essay form written to cover the areas of knowledge, comprehension and application levels. The same MAT was used for pretest and posttest treatment but the colour of the paper for posttest was changed from white to yellow. The validity of the items was assessed by three mathematics education experts and two experienced
secondary school mathematics teachers. The instrument was trial tested with 40 students in a school not participating in the study but within the same area of study. The Kuder Richardson formula was used to establish the coefficient of internal consistency for the instrument (MAT) and the value is 0.75.

**DML:** The Laboratory was designed to have a typical laboratory building with necessary fittings and equipment which include Geoboard, graph board, Pythagoras triple triangle, Skeletal globe, Abacus, close and open cylinders, cone, conic sections, rectangular and triangular pyramid, cube, cuboids, graphic calculator, computer system etc. This was looked into by three mathematics education experts to ensure its suitability and representation of a true mathematics laboratory. **Lesson plan:** The plan was written in two forms (i) Plan that used the DML as a teaching material for teaching the treatment group A.(ii) Ordinary lesson plan used in conventional classroom for group B.

**Procedure:**

Group A \((n = 50)\) were taught plane geometry and algebraic expressions using DML as a teaching material while group B \((n = 50)\) were taught the same topics without mathematics laboratory but with lecture method using ordinary lesson plan. The teaching in both schools which took four weeks was done by the researchers. This was concurrently done for both groups. One taught the students in both groups and examined them while the other marked their scripts compiled results and this helped in controlling teacher variable. To solve the problem of interclass discussion among the students, one intact class in each school was used only. More so, the experiment lasted for four weeks and it was expected that this period was long enough as not to permit the pre-test to affect the post-test scores and the items were rearranged before administering the post-test. The data collected were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA).

**Discussion of results**

Results of research question one showed that students taught mathematics with mathematics laboratory achieved more than those taught without mathematics laboratory. This was tested in hypothesis one which revealed that a significant difference exist between the achievement of students taught mathematics with mathematics laboratory and those taught with lecture method. This was in favour of mathematics laboratory group. This finding is supported by Srinivasa (1978), Agwagah (1997) and Ogunkunle (2000) where they highlighted the advantages of using mathematics laboratory in teaching to include providing opportunity for student to understand and internalize the basic mathematical concepts. In this way the students achieved better than otherwise. The results from research question two showed that boys had a mean gain of 26.8 while girls had a mean gain of 28.9. This was tested in hypothesis two. Results from this hypothesis showed that there was no significant difference in achievement of male and female mathematics students taught with mathematics laboratory. This finding is in line with the
findings of Okonkwo (1997) who reported that students’ gender has no significant effect on their achievement when taught with tangram puzzle game. However, the finding disagrees with the findings of Obioma (1985), Obodo (1993) and Okereke (2006). They reported gender as a significant factor in achievement when mathematics is taught with certain strategies/techniques. Onwioduokit and Akinbobola (2005) also reported gender as significant factor in physics achievement when taught physics with pictorial and written advance organizers.

**Conclusion:**

Based on the findings in this study, the following conclusions were drawn: (i) Students taught with mathematics laboratory achieved better than those taught without it. (ii) There exists no significant difference in achievement of male and female mathematics students taught with mathematics laboratory.

**Recommendations:**

The following recommendations were made based on the finding of the study: (i) Mathematics teachers should use mathematics laboratory in teaching mathematics. (ii) Government should establish mathematics laboratory in all schools like other science subjects laboratories (iii) Seminars/worships should be organized for mathematics teachers in secondary school on the use of mathematics laboratory. (iv) Mathematics student teachers should be trained on the use of mathematics laboratory in the mathematics methodology class.

**2.2.2 “The effect of Graphing Calculators use on student’s understanding of the derivative at a point.”[41]**

**Objective:**

The purpose of this study was to investigate whether or not the use of Graphing Calculator in teaching calculus would help students to develop appropriate concept images of concept of derivative at point. Two main questions of this study have been formulated as follows: (i) Is there difference between the concepts images that are held by students who are using Graphing Calculator and students whose not using the Graphing Calculator? (ii) To what extent can students make connections between the graphical, symbolic and numerical representations of the derivative at a point?
Sample:

The participants in this study were 71 undergraduate students enrolled in two different semester calculus classes at two state universities in USA (47 in the traditional class and 24 in experimental class). Moreover six student from traditional class and six students from experimental class agree to be interviewed.

Tools:

The pretest, the posttest and interview was used as tools in this study.

Procedure:

The present study was a two group study that used both qualitative and quantitative methodology where data were collected in a university freshman calculus course. The first group used a Graphing Calculator as an aid in learning of the derivative concept. The second group received traditional instruction of the derivative concept. (Graphing Calculator was not allowed). No attempt was made to balance the two groups equally according to age, sex or any other factor. The pretest was conducted at the beginning of the semester; the posttest and the interview were carried out at the end of research period. To analyze the quantitative data a t-test was used to determine if there was a significant difference between the two classes on the pretest at the beginning of the study, since it was not possible to randomly assign student to the two groups. Moreover, an analysis of covariance (ANCOVA) was performed. Pretest score were entered as the covariate; and the posttest entered as the dependent variable. For the qualitative data, colour coding scheme was used to analyze the interview transcripts.

Findings:

The finding of the study suggested that the use of the Graphing Calculator and the emphasis on the visual and numerical representation of derivative concept help students to develop a concept of image that includes different representations of the derivative with better connections among these representations. Understanding the derivative as a three layers (the ratio, the limit and the function) is important. More emphasis should be given on this while teaching the derivative concept.
2.2.3 “The effect of using The Geometer’s Sketchpad (GSP) on Jordanians student’s understanding some geometrical concepts” [42]

Objective:

This study tried to answer the following question (i) Are there any different between the mean of the pretest and posttest for the experimental group? (ii) Are there any different between the mean of the pretest and posttest for the control group? (iii) Are any different in the mean of the pretest for control group and experimental group? (iv) Are any different in the mean of the posttest for control group and experimental group?

Sample:

The population of the study was the Jordanian student in 9th grade boys. The sample of study consisted of 52 students in 9th grade at Model School of Yarmouk University. Irbid, Jordan.

Tools:

The Geometer’s Sketchpad (GSP), Achievement test( developed by researcher)

Procedure:

The sample of 52 students divided into two groups. There were 26 student in experimental group and 26 students in the control group. Both group were taught by same teacher. The experimental group studied the geometrical part of the curriculum by using book and the Geometer’s Sketchpad (GSP) software, while the control group studied the same part using book. The students in experimental group used the GSP once a week during the first semester of academic year 1999/2000. At the end of the experiment, all students in the sample took a test measuring their understanding of the some of the geometric concepts focusing on the relationship between the area and perimeter of polygons such rectangles and triangles. The instrument (achievement test) used in this study was designed by researcher. The validity of the items of the instrument was approved by some of the maths educators in Jordan. In the order to study hypotheses, the researcher found the means of the student’s results in the both groups on the pretest and the posttest, and used the ANCOVA test to compare and analyze the results.
Findings:

(1) this study had the sample from students in the 9th grade. This means that there is a need for further studies in other grades and levels. (2) the sample of the study consisted only males. It recommended to conduct other studies in the same area with samples from males and females. (3) since this study as well as other previous studies concluded that there was a significant effect of using GSP software, researcher recommends more emphasize on the use of computer and its programmes in mathematics and in education. (4) The GSP is one of the latest computer programmes in the mathematics area. It is recommended to evaluate its features and capabilities.

2.2.4 “The effectiveness of Multimedia Courseware as an alternative for tutoring Application of Integration.” [43]

Objective:

The objective of this paper was to evaluate the effectiveness of developed multimedia courseware as an alternative tool in tutoring the Application of Integration.

Sample:

Two groups of the students; the control and experimental (a total of 50) were involved in the study.

Tools:

(i) Multimedia Courseware (ii) pretest and posttest with 10 item multiple choices question in the application of integration

Procedure:

The sample was divided in two groups group A (experimental) and group B (control). Pretest was given to students from group A and B. after the four hour sessions on area and volume, the students from both groups were given the posttest.

Findings:

(1) the study indicated that students had understood the application of integration better after the tutorial session. This also implied that tutorial sessions are helpful and beneficial to student regardless of the tutoring method employed. (2) The result of this study implies that students in the experimental group perform as well as those in the control group. This indicates that the interactive multimedia courseware is as effective as the traditional chalk and board method in tutoring the students on this topic. This also
suggests that the students can do independent study using the multimedia courseware during tutorial session. (3) The study further highlighted that the multimedia courseware could be considered as an alternative method for tutoring the topic thus helping to ease the workload of the instructors and the use of graduate assistant.

2.2.5 “The Effect of Math and Chess Integrated Instruction on Math Scores.” [44]

Objective:

The objective study is to examine the effect on pupils’ math scores when a truly integrated math and chess workbook was used as an instructional practice workbook.

Sample:

One hundred and nineteen pupils, in grade 1 to grade 8, from five public elementary schools in Chicago, Illinois, USA.

Tools:

Tests of TONF (The Compass Learning Explorer Online Diagnostic Tool was used for both the pre-test and post-test. The Compass Learning Explorer Assessment meets the requirements as a true valid and reliable criterion-referenced assessment tool.) were given to all pupils for both tests. Each lesson consisted of lecturing, practice on math and chess integrated worksheets and chess playing.

Procedure:

The students of sample were participated in the after-school programme for 120 minutes, twice a week, for a total of 60 hours of instruction. None of the students has possessed any substantial knowledge in chess. The study began by administering pre-tests in the first week of this study at the beginning of the program on 10/23/06 and a post-test was conducted at the end of the program on 3/28/07. Paired t test was used to analyze the data.

Findings:

(1) The results of this study demonstrate that a truly integrated math and chess workbook can help significantly improve pupil’s math scores. Our observations show that the effect of using a truly integrated math and chess workbook also provides mental entertainment and thought by pupils as more fun than traditional computation practices. Pupils were able to sit longer when working on math and chess integrated workbook than
working on traditional computation worksheets. (2) The result of this research is particularly interesting for children who do not have a high interest in playing chess since the math and chess integrated workbook involves visualization, analyzing, spatial relation and data processing, these types of problems provide high order cognitive skills. Without spending substantial time on playing chess, we believe that children can get the similar benefits of playing chess on cognitive effects by working on math and chess integrated workbooks. This may require further study.

2.3 Significance of the study:

The present study is related to development of laboratory teaching programme and its implementation. Also, study is related to check effect of LTP on achievement of students. Since people believe that mathematics is one of the most difficult subject, there are so many reasons of this but the abstract nature of subject and a lack of proper teaching methodology are main. Laboratory teaching method helps to reduce these difficulties. It provides great scope for independent work and individual development. It helps in the growth of self-reliance. A successful experiment is a source of joy and encouragement to the learner. So the present study is very needful.

Due to the less research work in this area, we decided to review experimental researches on different strategies in teaching methodology of mathematics. This helped investigator in development of LTP, in planning of implementation, in construction of hypothesis also in selection of proper statistics.

All studies which are reviewed are related to experimental research in mathematics. So selection of tools depends upon variables. In these entire studies sample was divided into two equal groups. Some researcher considered previous year result of students as criteria for equal groups. In the present study I.Q. score is considered as criteria for making equal groups. In some studies pretest, posttest and ANCOVA were used for analysis. But in present study ANOVA and t test were used for same. In the abroad studies variables are few but in present study four independent variables and one dependent variable were taken to check its effects. Also main and interaction effects of these variables were tested. In present the study graphical analysis also considered as part of analysis.

In the field of laboratory approach people are using computers, mathematical software and some expensive kits which are available in few self financed schools. But in the present study, investigator prepared low cost kit which is easy to make from a material available in normal stationary shop. Also individual kit was provided to each student so that they can fell real experience of practical and 100% involvement of student was observed in the class.
In addition, the significance and outstanding of the present study lies in its content covered, work sheets, reading materials and kits. In the other studies of laboratory approach, researcher used mathematics laboratory as a class room. But in this study the programme is developed in such a way that it can be implemented in normal classroom. In the present study laboratory teaching method is totally student centric and teacher plays role of facilitator.

The review of the related literature helped investigator to select variable and a research method pertaining to the problem in hand.