INTRODUCTION

Jayasree N. “Effect of direct instruction model on achievement in select mathematical skills of upper primary pupils of Kerala” Thesis. Department of Education, University of Calicut, 2004
CHAPTER 1

INTRODUCTION

- Need and Significance of the Study
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Mathematics has been recognised as a living and growing intellectual pursuit throughout centuries. It has its roots in everyday activities and forms the basic structure of highly advanced technological society. Therefore mathematics learning is necessary for all students; not only for those who have careers that demand advanced mathematics but also for all citizens. It is to be noted that proficiency in mathematics whether basic or advanced is not an innate characteristic: it is achieved through persistence, effort and practice on the part of learners and effective instruction on the part of teachers.

The study of mathematics has become indispensable in one's life because of its wide-ranging application in the present technological society. This society requires the use of skills such as estimating, measuring, interpreting, predicting and applying mathematics to life situations. The National Policy of Education (1986) has rightly visualised mathematics as a vehicle to train a child to think, reason, analyse, and articulate logically. Since qualitative treatment, measurement, analysis and synthesis, are being extensively used in many other academic subjects, the relevance of mathematics in child's environment and in the study of other subject areas has to be emphasized in the school curriculum. Mathematics is an important curriculum area at the school level. Everyone agrees that study of mathematics should be compulsory for all, as a part of general education at the school stage. It is also expected that all children should achieve some basic skills in mathematics at mastery level since mathematics is an important key element for students' general comprehension and analytic skills.

In the existing situation of the country, one can find that the achievement level of majority of children in mathematics is not upto the mark. Failure in mathematics is considered as one of the major factors for the overall failure rate in school, resulting in wastage and stagnation at different
levels. Therefore some corrective methods are necessary for improving the quality of teaching-learning process in mathematics in schools.

Students with learning difficulties spend a substantial portion of their academic working, on mathematics learning. Major deficits in mathematical skills are apparent and persistent in them. Secondary pupils with difficulties in learning will make only a slow progress in the learning of complex concepts and skills. Teachers complain that the lack of skills in basic computation and numeration are most common even among students at higher classes. By the time students complete schooling or drop-out of schools, they might have made only the most rudimentary achievements in mathematical skills. Only a few might have acquired the levels of application and problem-solving skills necessary to function independently. It is to be noted that the progress in the learning of mathematics depends on their receiving better instruction in mathematics while they are at primary level. Many studies show that students in primary graders fail to acquire sufficient skills in fundamental operations and their applications. These persistent skill deficit, combined with limited fluency in the recall of basic mathematical facts and concepts hinder the development of higher level learning. One of the reasons for the skill deficit can be attributed to unsatisfactory and inefficient techniques of teaching and learning.

1.1 NEED AND SIGNIFICANCE

The teaching and learning of mathematics have always been a major concern in education. There is a general feeling of dissatisfaction among public and educationists about the teaching-learning strategies of mathematics currently adopted in many of the schools. Students' failure occurs mainly as a result of inadequate and inappropriate learning experiences in mathematics class. Ineffective instruction leads not only to poor performance but also a negative estimate to self-efficiency.
In the case of primary teaching many people consider that the content is very easy to learn and anybody can teach. Mathematics is a subject, which is built on certain basic concepts. Higher concepts are impossible without the correct knowledge of the previous concept. Proper understanding of basic concepts and the ability to apply them in different situations are extremely important for the achievement in mathematics.

Teaching methods associated with outdated views of teaching and learning theories are still prevalent in many classrooms. Such practices include extensive whole-group instruction and intensive drill and practice on isolated skills for groups or individuals. These practices are not particularly effective for all primary-grade children. This challenge necessitates a pedagogical shift from transmitting a body of expected knowledge that is largely memorised to one that is largely process oriented. Helping them to develop the skills necessary to become life long learners requires a different approach to teaching and learning. Hence the major aim of teaching is to create powerful learners. Children enrolled in educational programmes, which have well-defined academic objectives will enjoy greater achievement in basic skills.

Mathematics appears to be a tough subject for many students. They often need a challenge or a boost to stimulate a real interest in it. Studies show that many students are not motivated enough by their school work and are in need of special attention to help for development of their full potential. Getting students excited about mathematics is a challenge. Some students have a natural love to work with numbers, while others struggle through every problem with aversion.

Miserable failure in schools in the final certification examination consequent to failure in mathematics is often reported, even though subjects are taught by teachers specialised themselves in mathematics. These teachers
are masters of the subject but they fail to help the students to boost them and master the content. This imbalance is conspicuous in the Secondary School Leaving Certificate Examination results. The quantum of mathematics syllabus in the general curriculum has been attributed as one of the reasons for this imbalance. As a result, in the performance of mathematics there is a wide gap between the anticipated outcome and actual outcomes. There seem to be a gap between the theory and practice in teaching resulting in the discrepancies between curriculum formulated and implemented. It is reported that marks in mathematics has the lowest state average in the Secondary School Leaving Certificate Examination.

The recent findings reported in the literature by cognitive and instructional psychologists Rosenshine (1997) suggest that the role played by the individual student's information processing capabilities may be a critical factor for improving learning and retention of skills. The search for the secret of effective teaching is not a new one. The development of teaching models has successfully brought together a unique combination of theory construction and empirical testing.

Several psychologists have identified one such teaching approach that enables to improve student learning that is 'Direct Instruction Model'. Direct Instruction Model emerged as an outgrowth of attempts to synthesis principles of effective teaching into a practical pedagogical model. Pioneered by Engelmann in the 1960's Direct Instruction is a teacher-directed, school reform model, which maximises learning. This model of teaching breaks skills into teachable sub skills and then shows students how to bring these together in a larger strategy. This is a powerful research-based basal programme that not only teaches essential skills but also fosters natural fluency in mathematics, allowing smart decisions in all aspects of life. The
goal of Direct Instruction is to (i) help students attain mastery as quickly as possible and (ii) to increase student achievement.

The important objective of mathematics instruction is that, the three components of mathematics, namely basic skills, mental arithmetic and mathematical extension are to be taught to a mastery level and to be continuously revised to retain them. The suitability of Direct Instruction Model to attain the above three basic components caught the attention of the investigator as it is a systematic method of presenting the materials in small steps, pausing to check student understanding and eliciting active and successful participation from all students.

The basic theory of Direct Instruction Model of teaching and results of the research on the practical application of this model was studied carefully by the investigator to know whether this can be adopted to get better results in the mastery of basic essential concepts in mathematics in an ordinary school in Kerala. The essential features of Direct Instruction Model are detailed in Chapter II.

From the studies surveyed it was found that Direct Instruction is worth experimenting in the primary stage for mastering basic skills in a conventional educational context. Most of the studies were conducted in the western countries concentrating more on language and other skill oriented subjects including mathematics. Investigator failed to identify any study in Indian conditions. The investigator felt that the rigid classroom organisation of our schools may be disturbed only to a minimum and at the same time the attainment of instructional objectives in mathematics be maximised. The investigator is also interested in finding out not the attainment of knowledge in the content alone but how best the mastery can be attained if Direct Instruction is adopted in a conventional class.
If Direct Instruction Model is suitable for mastering tasks in one unit, it is hoped that it will be successful for other topics in the same subject and at different levels too. Considering the above factors, it seems worthwhile to examine how good Direct Instruction Model can be implemented on experimental basis in learning of basic concepts in mathematics. One of the delimitations of Direct Instruction Model of teaching anticipated by the authors is that this method cannot be applied for all pupils for all the time and for all the educational objectives. This fact will be kept in mind during the selection of the topics for experimentation, in the selection of instructional objectives, and for drawing the sample for experimentations.

1.2 STATEMENT OF THE PROBLEM

The present study is entitled "EFFECT OF DIRECT INSTRUCTION MODEL ON ACHIEVEMENT IN SELECT MATHEMATICAL SKILLS OF UPPER PRIMARY PUPILS OF KERALA".

1.3 DEFINITION OF KEY TERMS

1.3.1 Direct Instruction Model

"Direct Instruction Model is a systematic method of presenting materials in small steps, pausing to check for student understanding and eliciting active and successful participation from all students" (Rosenshine, 1986).
1.3.2 Achievement in Select Mathematical Skills

Achievement is defined as tangible accomplishment or performance in mathematical skills. The investigator proposed to confined only to intellectual mathematical skills included in 'fractions' and 'decimals'. These intellectual skills were measured by a test comprising of fundamental operations, place value and changing from one form to another form.

1.3.3 Upper Primary Pupils

Pupils who are studying in the upper primary classes namely V, VI, and VII in the schools managed directly/aided by Director of Public Instructions' Government of Kerala.

1.4 VARIABLES OF THE STUDY

Variables included in the present study are the following.

1.4.1 Independent Variables

Two sets of variables based on methods of teaching were selected as independent variables.

1.4.1.1 Direct Instruction Model

Direct Instruction Model of teaching by Siegfried Engelmann (2001) was selected for treatment.

1.4.1.2 Objective Based Instruction

Objective Based Method of teaching adopted and followed in the upper primary schools of Kerala was considered as conventional method of teaching.
1.4.2 Dependent Variable

Achievement in Mathematical skills was considered as the dependent variable. Test to measure this variable comprise of items like Knowledge, Comprehension and Application category. Achievement in Mathematical Skills Post-Test I and Post-Test II were considered as Dependent Variables.

1.4.3 Control Variables

The control variables in the experimentation were the following.

- Previous knowledge of the subject matter
- Non-verbal Intelligence
- Numerical Ability

1.5 DESIGN

The Pre-test-Post-test Quasi-Experimental design was used for the study. Three groups were selected for treatment. Experimental Group I was taught through Direct Instruction Model, Experimental Group II was taught through Direct Instruction Model and Objective Based Instruction alternately and Control Group was taught through Objective Based Instruction only.

1.6 OBJECTIVES

The specific objectives formulated for the experimentation were given as follows:

1.6.1 To compare the mean scores of Achievement in Mathematical skills Post-Test I (tested immediately after the treatment) of Control Group and Experimental Group I and between Control Group and Experimental Group II.
1.6.2 To compare the mean Gain scores of Achievement in Mathematical skills (Post-Test I minus Pre-Test) of Control Group and Experimental Group I and between Control Group and Experimental Group II.

1.6.3 To compare the mean Retention scores of Achievement in Mathematical skills Post-Test II (tested two months after the treatment) of Control Group and Experimental Group I and between Control Group and Experimental Group II.

1.6.4 To compare the mean Gain scores of Achievement in Mathematical skills (Post-Test II minus Pre-Test) of Control Group and Experimental Group I and between Control Group and Experimental Group II.

1.6.5 To study the main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Previous Knowledge of Subject Matter on Achievement in Mathematical Skills Post-Test I for Total sample, Boys and Girls.

1.6.6 To study the main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Non-verbal Intelligence on Achievement in Mathematical Skills Post-Test I for Total Sample, Boys and Girls.

1.6.7 To study the main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Numerical Ability on Achievement in Mathematical Skills Post-Test I for Total sample, Boys and Girls.

1.6.8 To study the main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Previous Knowledge of Subject Matter on Achievement in Mathematical Skills Post-Test II for Total sample, Boys and Girls.
1.6.9 To study the main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Non-verbal Intelligence on Achievement in Mathematical Skills Post-Test II for Total sample, Boys and Girls.

1.6.10 To study the main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Numerical Ability on Achievement in Mathematical Skills Post-Test II for Total sample, Boys and Girls.

1.6.11 To study the relative effectiveness of Direct Instruction Model on Achievement in Mathematical Skills when initial difference in select variables namely 'Previous Knowledge of Subject Matter', 'Non-verbal Intelligence' and 'Numerical Ability of subjects are controlled one by one.

1.7 HYPOTHESES

To find out the relative effectiveness of Direct Instruction Model over Objective Based Instruction of Upper Primary pupils, the following hypotheses were formulated.

1.7.1 There will be significant difference in the mean scores of Achievement in Mathematical Skills Post-Test I (tested immediately after the treatment) between Control Group and Experimental Group I and between Control Group and Experimental Group II.

1.7.2 There will be significant difference in the mean Gain scores of Achievement in Mathematical Skills (Post-Test I minus Pre-Test) between Control Group and Experimental Group I and between Control Group and Experimental Group II.

1.7.3 There will be significant difference in the mean Retention scores of Achievement in Mathematical Skills Post -Test II (tested two months after the
treatment) between Control Group and Experimental Group I and between Control Group and Experimental Group II.

1.7.4 There will be significant difference in the mean Gain scores of Achievement in Mathematical Skills (Post-Test II minus Pre-Test) between Control Group and Experimental Group I and between Control Group and Experimental Group II.

1.7.5 There will be significant main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Previous Knowledge of Subject Matter on Achievement in Mathematical Skills Post-Test I for Total sample, Boys and Girls.

1.7.6 There will be significant main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Non-verbal Intelligence on Achievement in Mathematical Skills Post-Test I for Total sample, Boys and Girls.

1.7.7 There will be significant main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Numerical Ability on Achievement in Mathematical Skills Post-Test I for Total sample, Boys and Girls.

1.7.8 There will be significant main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Previous Knowledge of Subject Matter on Achievement in Mathematical Skills Post-Test II for Total sample, Boys and Girls.

1.7.9 There will be significant main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Non-verbal Intelligence on Achievement in Mathematical Skills Post-Test II for Total sample, Boys and Girls.
1.7.10 There will be significant main effect and interaction effect of Methods of Teaching (Direct Instruction Model and Objective Based Instruction) and Numerical Ability on Achievement in Mathematical Skills Post-Test II for Total sample, Boys and Girls.

1.7.11 Pupils taught through Direct Instruction Model will have high mean Achievement in Mathematical Skills in Post-Test I and Post-Test II than pupil taught through Objective Based Instruction when the initial difference in Previous Knowledge of Subject Matter of subjects were controlled.

1.7.12 Pupils taught through Direct Instruction Model will have high mean Achievement in Mathematical Skills in Post-Test I and Post-Test II than pupils taught through Objective Based Instruction when the initial difference in Non-vertical Intelligence of subjects were controlled.

1.7.13 Pupils taught through Direct Instruction Model will have high mean Achievement in Mathematical Skills in Post-Test I and Post-Test II than pupils taught through Objective Based Instruction when the initial difference in Numerical Ability of subjects were controlled.

1.8  PROCEDURE

The various steps in the procedure for executing the study are summarised as given below.

1.8.1 Sample for the Study

Intact groups of students from standard VII were selected as sample and the subjects were from three different districts of Kerala. The groups were matched on the basis of Previous Knowledge of Subject Matter, Non-verbal Intelligence and Numerical Ability. Experimental Group I taught through Direct Instruction Model, Experimental Group II taught through Direct Instruction Model and Objective Based Instruction alternately and
Control Group taught through Objective Based Instruction, each consisted of sixty students.

1.8.2 Selection of the Topic for Treatment

A thorough analysis of the syllabus of mathematics at Upper Primary level was done. Investigator made discussions with experts in the field of mathematics, teachers who are handling the classes at upper primary level and students those who are studying at this level. Also the evaluation of studies conducted on achievement in mathematics, especially the studies conducted by Kouba (1988) and Bhattia (1998) as reported by Gupta (1991) enforced the investigator to select the topics 'fractions' and 'decimals' for treatment. It was also felt that these are the most difficult area among the students at any level. These are the topics which have a wide application in other subject areas and day-to-day situations. The mastery of these topics is very crucial for general comprehension and analytical thinking.

1.8.3 Instructional Materials and Tools Used for the Study

1.8.3.1 Lesson Plans Based on Direct Instruction Model

Twenty four lessons were prepared for teaching through Direct Instruction Model - fifteen were from fractions and nine from decimals. Lesson plans were prepared by adapting the lesson plan format of Direct Instruction Model proposed by Engelmann (2001).

1.8.3.2 Lesson Plans Based on Objective Based Instruction

Twenty four lesson plans were prepared for Objective Based Instruction. The objectives of both type of lesson plans (Direct Instruction Model and Objective Based Instruction) were same. Lesson plan format adopted by Department of General Education, Government of Kerala was the guidelines for preparing these lessons.
1.8.3.3 Unit Tests

Nine unit tests were prepared for experimental treatment—five from *fractions* and four from *decimals*. After Direct Instruction treatment unit tests were given to subjects.

The other tools used for the study are as follows:

1.8.3.4 Achievement Test in Mathematical skills (Pillai and Jayasree, 2001)

Achievement Test in Mathematics based on fractions and decimals were prepared and standardised by Pillai and Jayasree (2001) were used for treatment. Two parallel tests were developed, one was treated as Pre-Test and the other was used as Post-Test I and Post-Test II.

1.8.3.5 Standard Progressive Matrices Test (Raven, 1958)

1.8.3.6 Numerical Ability Test (Pillai and Jayasree, 2001)

A Numerical Ability Test was prepared and standardised by Pillai and Jayasree (2001) to measure the numerical ability of upper primary pupils of Kerala.

1.8.4 Procedure for Data Collection

Procedure adopted for collecting the required data as follows:

1.8.4.1 Administration of Pre-Test

Pre-Test was administered to Experimental Group I, Experimental Group II and Control Group before the treatment was given.
1.8.4.2 Administration of other Tools

Data based on other Independent variables namely Non-verbal Intelligence and Numerical Ability were collected from each group using appropriate tools.

1.8.4.3 Treatment

Experimental Group I was taught through Direct Instruction Model. Experimental Group II was taught through Direct Instruction Model and Objective Based Instruction alternately and only Objective Based Instruction was given to Control Group.

1.8.4.4 Administration of Post-Test I

Immediately after the treatment, Post-Test I was administered to each group.

1.8.4.5 Administration of Post-Test II

Post-Test II was administered to every group two months after the treatment.

1.8.5 Analysis of Data

The statistical techniques used to process the collected data are the following.

1.8.5.1 Test of Significance of difference between means

1.8.5.2 Two-way ANOVA with 2 x 2 Factorial Design

1.8.5.3 Two-way ANCOVA in 2 x 2 Factorial Design.
1.9 SCOPE AND LIMITATIONS

The aim of the study was to find out the effect of Direct Instruction Model on Achievement on select Mathematical Skills of upper primary pupils. The investigator tried to find out how far the learned materials are retained in pupils after each treatment. The study also examined whether changes could occur if the effect of Previous Knowledge in Subject Matter, Non-Verbal Intelligence and Numerical Ability were controlled.

Precautions were made to get valid and reliable results from the experimental study. It is hoped that the learning materials prepared for this study will be beneficial to other group of students in successive years.

Even though maximum care and precautions were made, the following limitations are anticipated.

- The study was conducted in one class - Class VII, the terminal stage of upper primary level.
- The selection of topics was confined to two topics namely 'fractions' and 'decimals' only.
- Achievement Test was intended to measure three instructional objectives in cognitive domain only.
- The items in Achievement in Select Mathematical Skills were confined to objective type items only, for easy scoring and objective measurement.
- Selection of the sample schools was not state wide, but was confined to only three revenue districts of Kerala.
- Same teacher taught both the control group and experimental groups. Therefore effect of teacher variation was not studied.
1.10 ORGANISATION OF THE REPORT

Report of the present investigation was organised in the following pattern to get precision and clarity. Each chapter is explained using relevant sections and subsections.

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Need and Significance of the study
Statement of Problem
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CHAPTER 2 REVIEW OF RELATED LITERATURE
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CHAPTER 3 METHODOLOGY
Selection of Variables
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CHAPTER 4 ANALYSIS
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- Equivalence of Groups
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   - Mean Difference Analysis
   - Analysis of Variance
   - Covariance Analysis

CHAPTER 5 SUMMARY FINDINGS AND SUGGESTIONS

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Major Findings

Tenability of Hypothesis

Suggestions for Improving

Educational Practice

Suggestions for Further Research