CHAPTER II

REVIEW OF THE LITERATURE
Chapter-II

Review of the literature

The evidences of several studies associating the mathematics education could be consulted. These are discussed below.

2.1 Literature on Mathematics Education

A study by Raymond, (1997) investigates relationships between a beginning elementary school teacher’s beliefs and Mathematics teaching practices. Findings indicate that teacher’s beliefs and practice were not wholly consistent. Rather, his/her practice was more closely related to beliefs about mathematics content than to beliefs about mathematics pedagogy. Teachers’ beliefs about mathematics content were highly influenced by his/her own experiences as a student and beliefs about mathematics pedagogy were primarily influenced by own teaching practice.

Davis (1997) proposed an alternative way of framing mathematics teaching while studying methods of mathematics teaching. It was indicated that manner in which the teacher listens is offered as a metaphoric lens through which to reinterpret practice, as a practical basis for teaching action, and as a means of addressing some of the critics’ concerns. His study was around an extended collaborative research project with a middle school mathematics teacher.
Mathematics teachers and educational researches ordered arithmetic and algebra problems according to predicted problem-solving difficulty for students (Nathan and Keedinger, 2000). Predictions deviated systematically from algebra student’s performances but closely matched a view implicit in textbooks. Analysis of students’ problem-solving strategies indicates specific ways that students’ algebraic reasoning differs from that predicted by most teachers and researchers in the sample and portrayed in common textbooks. The symbol precedence model of development of algebraic reasoning, in which symbolic problems’ solving precedes verbal problem solving and arithmetic skills strictly precede algebraic skills, was contrasted with the verbal precedence model of development, which provided a better quantitative fit of students’ performance data.

Recent research in the area of motivation in mathematics education was examined by Middleton and Spanias (1999) in their study. Consistencies across research perspectives that suggest a set of generalized conclusions about the contextual factors, cognitive processes, and benefits of interventions that affect students’ and teachers’ motivational attitudes were noted. Criticisms are leveled concerning the lack of theoretical guidance driving the conduct and interpretation of the majority of studies in the field. Few researchers have attempted to extend current theories of motivation in ways that are consistent with the current research on learning and classroom discourse. In particular, researchers interested in studying motivation in the content domain of school mathematics need to examine the relationship that exists between mathematics as socially constructed field and students’ desire to achieve.
Verschaffel and Carte (1997) attempted to test the hypothesis that it is feasible to develop in pupils a disposition toward (more) realistic mathematical modeling. Elementary school children’s tendency to neglect real-world knowledge and realistic considerations during mathematical modeling of word problems in school arithmetic was noted.

Clarke (1997) investigated changing role of teacher. Two teachers using innovative mathematics materials in class VI were used for the study. Using daily participant observation and regular interviews with the teachers and the project staff member responsible for providing in-school support, a picture emerged of changing teacher roles and of those factors influencing the process of change. One teacher demonstrated little change in either espoused beliefs or observed practice over the course of the study. The second teacher demonstrated increasing comfort with posing non-routine problems to students and allowing them to struggle together toward a solution, without suggesting procedures by which the problems could be solved. He also increasingly provided structured opportunities for students’ reflection on activities and learning. Major influences on this teacher’s professional growth appeared to be the provision of the innovative materials and the daily opportunity to reflect on classroom events in conversations and interviews with the researcher.

Leino (2001) in his book “Knowledge and Learning in Mathematics” indicated that pupils, with their own experiences and constructs, try to come to know mathematical concepts, operations, structure, and ideas as tools for organizing their physical, social, and mental world. The book also pointed out that the only efficient way a pupil has of learning mathematics is to meaningfully
reconstruct the basic concepts of mathematics. Teachers can provide pupils with relevant contexts for mathematizing, act like a mathematician introduce names and other terms and help the pupils' learning processes, but they cannot give the pupils ready-made concepts of mathematics. There are also inefficient ways to learn mathematical information that seem to be easy, attractive and quick—just to remember the names and correct responses to formalized stimuli or to do the same operations that the teacher has shown. Very soon these mechanical accesses into mathematics usually become boring to teachers as well as pupils as commented in the book.

Stacey & Macgregor (1999) conducted a study in Australia covering curriculum policy and algebra learning. Information about pertaining to programs offered was obtained from teachers, by textbook analysis and by some lesson observation and teaching interventions were collected from approximately 3000 students in 34 secondary schools. Results indicated that performance varied considerably between schools and classes. Some differences are attributable to teaching methods, the content taught and the arrangement of the curriculum. The study indicated that subtle reductions in goals and the isolation of topics in the curriculum were disturbing trends.

A TIMSS (Third International Mathematics and Science Study) study relating to mathematics learning conducted in Japan, Daniel (2003) observed that there has been considerable attention given to the design of instructional activities and materials to promote student learning and achievement in mathematics. Daniel discussed about an instructional design approach for mathematics learning (realistic mathematics education) that uses context problems to facilitate students'
development of applied problem solving strategies. It has been pointed out that such strategy provides experiences intended to help students become able to reinvent formal mathematics. It has also been reported that the use of both discovery learning features and direct instruction strategies in computer-based instructions resulted in improved mathematics achievement.

The effects of cooperative learning on student achievement and attitudes in a secondary mathematics classroom were investigated by Whicker et. al. (1997). In their quasi-experimental design two pre-calculus courses were compared. Students in one class studied the material in co-operative learning groups; students in the 2nd class studied the material independently. Three chapter tests were used to measure student achievement and a questionnaire was administered to the treatment group members after the study was completed to assess their attitudes toward the cooperative learning procedure. The results obtained from a repeated-measures multivariate analysis of variance (with pretest scores as the covariate) showed a significant Group and Time interaction. Students in the cooperative learning group had increasingly higher test scores than students in the comparison group and significantly outscored the comparison group on the 3rd chapter test. Survey results revealed primarily favorable responses toward the cooperative learning procedure. Most students indicated that they liked working in groups and appreciated getting help from other students, especially for learning difficult concepts. Some students disliked having groups pre-assigned and permanent, and they suggested alternating group membership. Considerable evidence exists to support the claim that cooperative learning promotes achievement as well as other positive affective outcomes at the elementary and middle grade levels.
Cawley et al. (2001) studied the Arithmetic performance of students in the USA and suggested some reforms in the mathematics education to suit the present time requirements.

Similar was the comment of Anku (1997) while citing the claim of NCTM (National Council of Teachers of Mathematics) in its reforms documents (NCTM, 1989, 1991) that a comprehensive mathematics education of every child is the most compelling goal of the current reform in mathematics education. Also, throughout the documents, emphasis is placed on providing opportunities for all children to become mathematically literate.

The review of some school level mathematics curriculum/standards of international repute (Anonymous 1997, 2000, 2002) has also been done for the present study. The curriculums are designed keeping in view that students require consistent, challenging curriculums that will capture their interest and prepare them for a lifetime of learning. They require knowledge and skills that will help them to compete in a global economy and allow them to lead lives of integrity and satisfaction, both as citizens and as individuals. The expectations and achievements are clearly defined. The mathematics expectations are organized into five groups, which are the five major areas of knowledge and skills in the mathematics curriculum. The five groups are (i) number sense and numeration, (ii) measurement, (iii) geometry and spatial sense, (iv) patterning and algebra, and (v) data management and probability. Knowledge & skills expected from students are clearly outlined in the curriculum. The curriculum in all classes is designed to ensure that students build a solid foundation in mathematics; they should for example, understand a range of mathematical concepts, memorize necessary
mathematical facts (e.g., multiplication tables), learn and practice standard mathematical procedures, and apply mathematics in complex real-world situations. It has also been kept in mind that mathematics is a key element of the curriculum, parents, students and teachers need to understand why mathematics is important. Knowledge of mathematical language, structures, and operations will help students to reason, to justify their conclusions, and to express ideas clearly. Students also need to be able to use mathematics in connection with technology and in their daily lives, and eventually, in the workplace. The role of teachers has also been clearly outlined in these documents. Teachers are expected to provide activities and assignments that encourage students to search for patterns, engage in logical inquiries, and use technology to pursue mathematical investigations. Teachers will design lessons that help students understand the basic concepts underlying mathematical formulas, and students apply formulas and mathematical procedures in a variety of circumstances suited to the grade level. It is particularly important that young children explore mathematical concepts using a variety of materials and concrete objects. It has been viewed in the literatures that, mathematics has many real-life applications. Teachers should help students to examine a wide variety of ways in which mathematics plays a role in everyday situations. The curriculum/standards also emphasized that teachers should plan programs in which connections are made between mathematics and other subjects to enable students to broaden their knowledge in other subject areas.

2.2 Literature on Education system

A study by Heyneman and Loxley (1982, 1983) about the impact of family background and school characteristics on pupil achievement in developing and
developed countries concluded that, in developing countries, family background has less influence on pupil achievement than school and teacher quality. Again Coleman et al. (1966) studied about the teaching learning factors that contributed to differences in mathematics achievement of pupils and viewed that school factors had little effect on academic achievement. Moreover too much television viewing among children has been linked with inadequate study patterns (Nair M K et al. 2003).

Numbers of investigations aiming improvement of school education have been reported from different corners of the globe. Some of the recent educational issues addressed by researchers are (i) methodology of mathematics teaching and role of teacher (Tsamir et al, 2009; Desoetea et al, 2009; Hackenberg and Tillema, 2009); (ii) justification of imparting special reasoning skill to students (Kuhn, 2009); (iii) performance and impact of school improvement programme specific to some schools (Lockheed et al, 2010; Gross et al, 2009); (iv) effect of student-teacher ratio on cost effectiveness vis-à-vis students achievements (Yeh, 2009; Desai, 1999); (v) effect of several academic and socio-economic factors on pupil achievements (Riddell, 2008; Hungi and Thuku, 2010); (vi) choices between private and state funded education. Many useful outcomes could be obtained from these works, particularly to the areas and issues relevant to these studies. The delineation of the factors prevailing in the environment of the learners in order to assess performances of learners has been found as an effective technique. Though some of the factors concerning parents, teachers and learners are interlinked, investigation could pin-point delineated responsibilities.
Njora Hung & Florence W Thuku (2010) studied differences in pupil achievement in Kenya with reference to domestic status of pupil and viewed that pupils from homes with better quality houses, many possessions (wealthy) and more educated parents were estimated to achieve better in mathematics than pupils from homes with low quality houses, few or no possessions (poor) and less educated parents.

Learning is a process of growth, progress and improvement during which an individual acquires knowledge, habit, skills and attitudes which further changes his behaviors. Therefore it is a process of modification of behavior through the various experiences gained by inter-action with the people and the objects in the environment. According to Kulkarni (1986) learning means relatively permanent change in behavior, which occurs as a result of experience or practice. The main aim of education is to effect desired changes in the behavior of students. Teaching and Learning are two aspects of the same process. Teaching is transmission of some facts, figures, values and attitudes to a group of students. It is a mutual sharing of experience and a continual feedback process. Recently, learning has assumed more importance than teaching. Candlin and Edelhoff (1982) viewed that “learners learn most when they are quite precisely aware of how their efforts are to be judged and evaluated”. Evolution plays a central role in determining what learners learns as well as what teachers teach and how they teach. Reardon et al (1994) viewed that “Changes in assessment policies can be used as a powerful lever for reforming schools.” Evolution is being employed in many countries in the belief that it will be a catalyst for curriculum change (Barnes et al (2000).
2.3 Literature on application of Fuzzy logic

Fuzzy logic is an application area of fuzzy set theory and its broad applicability in many areas of human affairs has been rapidly growing. It utilizes concepts, principles and methods developed within fuzzy set theory for formulating various forms of sound approximate reasoning (Klir. George J, Clair Ute. H. St., Yuan Bo, 1997). The application areas of fuzzy logic are also increased day-by-day. Efforts are also made to use fuzzy logic in problems of social sciences. Fuzzy mathematical programming has been developed significantly in recent years to solve a class of multi-objective optimization problems with ambiguous or fuzzy constraints as well as objectives (Chow. M.Y., Luh. P. Lin. S, Zhu. Joo, 2000). Fuzzy logic technology has achieved impressive success in diverse engineering applications ranging from mass market consumer products to sophisticated decision and control problems. (Chow. M.Y., 1996). The development of fuzzy logic was motivated in large measure by the need for a conceptual framework that can address the issues of uncertainty and lexical imprecision.

In the last three decades, significant progress has been made in the development of fuzzy sets, fuzzy logic theory in engineering applications. Some of the notable applications of fuzzy logic have been (i) to study the relationship
between visual and linguistic information; (ii) to make easier automatic driving, automatic parking, diagnosis and prevention of failures (Mizumoto, and Tanaka, 1976; Sugeno and Nishida, 1985); (iii) medical diagnosis (Albin, 1975; Saitta and Torasso, 1981; Buisson et al, 1985) (iv) understanding economic theory (Pomsard and Fustier, 1986; Billot, 1992); (v) expert systems (Gaines and Shaw, 1985).

Application of fuzzy set and fuzzy logic is also seen in educational evaluation. Over the decades, educational tests are conducted to assess learners, performances in order to make decisions about what the learners learn and what the teachers teach in schools. Different methods have been applied to assess learners’ performances. But evaluation process should be most accurate for accurate estimation of any test. Chiu-Keung Law (1996) used fuzzy set theory in educational grading system and viewed that educational grading system is the most common form of educational evaluation. Law also formulated a structure model for a fuzzy educational grading system that provides an accurate indication of the learners’ academic performance.

Application of fuzzy logic has been increasing in investigation of research problems in almost all branches of study covering science, engineering, social science, economics, medicine etc. In fact, fuzzy logic is an application area of fuzzy set theory and its broad applicability in many areas of human affairs has been rapidly growing since the early 1990S. Extensive research works on fuzzy set theory are not in recent part. Similarly, the application areas of fuzzy logic are also increased day-by-day. Efforts are also made to use fuzzy logic in problems of social sciences. The author Wolf (1977) had prepared a survey of more recent developments in fuzzy logic area. Various aspects of the relationships between

Fuzzy mathematical programming has been developed significantly in recent years to solve a class of multi-objective optimization problems with ambiguous or fuzzy constraints as well as objectives. Fuzzy logic technology has achieved impressive success in diverse engineering applications ranging from mass-market consumer products to sophisticated decision and control problems. The development of fuzzy logic was motivated in large measure by the need for a conceptual framework that can address the issues of uncertainty and lexical imprecision.

Fuzzy set theory and fuzzy logic play important role in varieties problem area involving natural language such as to communicate with home computers or robots in natural language, to upgrade current systems of machine translators to the level of experienced human translators between natural languages and to develop the capability of machines to understand images, which is necessary to study the relationship between visual and linguistic information. Fuzzy logic and the associated technology are also used to make easier automatic driving, automatic parking, diagnosis and prevention of failures etc. Most frequently uncertainty has been seen in the diagnosis of disease. Fuzzy technology plays very important role in medical diagnosis. The utility of fuzzy set theory in medical diagnosis was first demonstrated by Albin (1975). Medical diagnosis and treatment planning have been done through application of fuzzy logic and approximate reasoning. Within the area of medicine some applications include the
linguistic variables for questionnaires investigating the relation between social stresses, psychological factors, and the incidence of coronary disease (Saitta and Torasso, 1981), the incorporation of fuzziness in an expert system dealing with the treatment of diabetes (Buisson et al, 1985), the use of linguistic descriptions of symptoms for the purpose of evaluating different treatment procedures (Oguntade and Beaumont, 1982), the use of fuzzy inference for evaluating orthodomatic treatment (Yashikawa et al, 1994), and clinical monitoring with fuzzy automata (Steimann and Adlassing, 1994). Verities medical applications are found in books edited by Kohout and Bandler (1986) and Gupta and Sanchez (1982). A special journal namely Biomedical Fuzzy Systems Bulletin, has been published by the Biomedical Fuzzy Systems Association in Japan since 1990.

The role of fuzzy set theory has been recognized in economic theories also. Many applications of fuzzy set theory relevant to economics have been described in the literature such as applications of fuzzy set theory in economics in a book edited by Pomsard and Fustier (1986), use of fuzzy set theory in economics in a book written by French economist A. Billot (1992) and several papers about fuzzy set theory in economics are published in Fuzzy Economic Review (Commenced in 1995) and Fuzzy sets and Systems (Vol. 49, No-1, 1992).

Human reasoning and decision making in natural language, which plays an essential role in economic phenomena, is based on genuine uncertainty embedded in natural language. British economist Shackle has argued that probability theory, which for expressing uncertainty, is not meaningful for capturing the nature of uncertainty in economics. To develop a meaningful framework for uncertainty in economics Shackle has also argued that uncertainty associated with imagined
actions whose outcomes are to some extent unknown should be expressed in terms of degrees of possibility rather than by probabilities.

A great deal of research has taken place on the applications of approximate reasoning and fuzzy logic in the inference process. Computer hardware has been recognized to implement various operations involved in fuzzy logic and approximate reasoning. Fuzzy computer hardware allows all inference rules of a complex fuzzy inference engine to be processed in parallel. This increases efficiency tremendously and, as a consequence, extends the scope of applicability of fuzzy controllers and, potentially, other fuzzy export systems. Electrical engineering has been affected by fuzzy set theory primarily through fuzzy controllers and fuzzy computer hardware. Fuzzy controllers have been produced for applications of different complexities such as for the control of a model car (Sugeno and Nishida, 1985), the control of automatic speed (Murakami, 1984), traffic junctions (Mamdani and Pappis, 1977; Nakat-sayama, Nagahashi and Nishizuka, 1984), robot control (Uragami, Mizumoto, and Tanaka, 1976). The interest in fuzzy controllers increased very rapidly in Japan and this increased interest was likely an outcome of the first implementation of fuzzy control in a significant project, an automatic-drive fuzzy control system for subway trains in Sendai city. Fuzzy controllers have been installed with great success in a broad variety of consumer products, including washing machines, refrigerators, video cameras, vacuum cleaners, automobiles, T.V. sets and many others.

It has increasingly been recognized that the areas of fuzzy systems and neural networks are strongly interconnected. Fuzzy systems provide a powerful
framework for knowledge representation, while neural networks provide learning capabilities and exceptional suitability for computationally efficient hardware implementations. Various fuzzifications of neural networks have been suggested, which attempt to extend their capabilities or make them more attuned to fuzzy systems for the purpose of hardware implementations. Strong emphasis has been given on the connection between fuzzy logic and neural networks by Harris et al (1993). The role of fuzzy logic and neural networks in intelligent control are discussed in a handbook edited by White and Sofge (1992).

Applications of different methods of approximate reasoning for expert systems have been discussed by Dutta, 1985; Baldwin, 1985; Bandler and Kohout, 1985; Freska, 1982; Hajek, 1985. An overview of the history and implications of fuzzy logic in expert systems is presented by Gaines and Shaw (1985). A large number of papers dealing with applications of fuzzy logic and the theory of evidence to expert systems have been collected by Gupta, Kandel, Bandler and Kiszka (1985). This collection contains papers discussing theoretical issues in approximate reasoning, their application to expert system design, and some actual expert systems that have been implemented using these methods of managing uncertainty.

In the last three decades, significant progress has been made in the development of fuzzy sets, fuzzy logic theory, and there are in engineering applications. The successful application of fuzzy sets and fuzzy logic can be attributed to the fact that fuzzy theory reflects the true situation in the real world,
where human thinking is dominated by approximate reasoning logic. The year 1990 may be viewed as the beginning of a new trend in the design of household appliances, consumer electronics, cameras and other types of widely used consumer products.