CHAPTER 2
CONCEPTUAL FRAMEWORKAND REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Review of related literature is systematic identification, location, analysis and report of documents containing information related to research topic. Conceptual and research based reviews provide the researcher valuable guidance and suggestion for conducting the research. They also serve as a solid foundation for the study. A review of related literature is a must in research. It helps the researcher in understanding and defining the problem accurately and systematically. This review help the researcher to proceed in one's study and also helps to prepare a proper design for the study.

Review of related literature is one of the significant aspects of research. It enables the researcher to get acquainted with the work done in the concerned area. It also helps to explore the needs of research in unknown and unexplored areas. It develops insights into the methodological aspects of the research.

2.2 CONCEPTUAL FRAMEWORK

Number games are a new focus in Mathematics. It is a new way of helping students to learn mathematics very interestingly and more effectively than traditional way of learning mathematics. Education should be for whole development of human being. Mathematics is one important part of Education. Without use of mathematics we cannot live. So Mathematics is very important for us. Mathematics learn through Number games are more effective and better than traditional way of learning.

2.2.1 Definitions of Education

The Concepts of Education as given by prominent Indian educationists are as follows.

Principles of Education and School Organization;

1. Upanishad: "Education is for liberation".

2. Bhagavad Gita: "Nothing is more purifying on earth than wisdom."

3. Vivekanand: “Education is the manifestation of the divine perfection, already existing in man."

4. Gandhi: "By education, I mean an all-round drawing out of the best in the Child and man body, mind and spirit."

5. Tagore: "The widest road leading to the solution of all our problems is education."

6. Sri Aurobindo: "Education which will offer the tools whereby one can live for the divine, for the country, for oneself and for others and this must be the ideal of every school which calls itself national".

2.2.2 Concepts of Education as defined by Western philosophers

1. Socrates: "Education means the bringing out of the ideas of universal validity which are latent in the mind of every man".

2. Plato: "Education is the capacity to feel pleasure and pain at the right moment. It develops in the body and in the soul of the pupil all the beauty and all the perfection which he is capable of."

3. Aristotle: "Education is the creation of a sound mind in a sound body. It develops man's faculty, especially his mind so that he may be able to enjoy the contemplation of supreme truth, goodness and beauty of which perfect happiness essentially consists.

2.2.3 Why Education is Important in Our Life

It is very easy to explain importance of education. No human beings are able to survive properly without education. By the means of education only one’s potential can be used to maximum extent. Education tells men how to think, how to work properly, how to make decision. Through education only one can make separate identity. It is most important in life like our basic need foods, cloth and shelter. With the beginning we learnt how to interact with others, how to make friends because of education only. As I remember when my parents had enrolled my name in school not only I learnt the alphabets and numbers but also I made friends, interacted with them with teachers. With further development you were faced with the sense of competition and desire and other such emotions and feelings, you also learnt to control these emotions and feelings. And also teaches how to act in different situations. Education is not just restricted to teaching a person the basic academics, say computers, mathematics, geography or history education is a much larger term.

If you want to find out the impact of education on any individuality, you better do an intense observation to the ways of well-educated people and then compare them with an illiterate man. You would get a clear picture of the education and its accurate concept. Education is one of the important factors which formulate the persona of a person. Education is a productive and beneficial factor in a person's life. It is everyone's right to get. The training of a human mind is not complete without education. Only because of education a man are able to receive information from the external humanity, to notify him with past and receive all essential information concerning the present.

When one travels around the world, one observes to what an extraordinary degree human nature is the same, whether in India or Australia, London, Europe or America. Conservative education makes independent thinking extremely complicated. If we are being educated merely to achieve distinction, to get a better job, to be more efficient, to have wider domination over others, then our lives will be shallow and empty. If we are being educated only to be scientists, to be scholars wedded to books, or specialists addicted to knowledge, then we shall be contributing to the destruction and misery of the world. We may be highly educated, but if we are without meaningful combination of thought and feeling, our lives are incomplete and clashing. Education develops a meaningful outlook of life. The individual are different but to accentuate the differences and to encourage the development of a definite type education is must.

Education is not just a matter of training the mind. Training makes for efficiency, but it does not bring about completeness. Knowledge and efficiency are necessary, which brings up by education. Education should help us to discover lasting values; unfortunately, the present system of education is making us submissive, emotionless and deeply thoughtless. Systems, whether educational or political, are not changed without explanation; they are transformed when there is a fundamental change in ourselves. The individual is of first importance, not the system; and as long as the individual does not understand the total process of himself, no system can bring order and peace to the world.

2.2.4 Importance of Education in Society

Education, if looked beyond its conventional boundaries, forms the very essence of all our actions. What we do is what we know and have learned, either through instructions or through observation and assimilation. When we are not making an effort to learn, our mind is always processing new information or trying to analyze the similarities as well as the tiny nuances within the context which makes the topic stand out or seem different. If that is the case then the mind definitely holds the potential to learn more, however, it is us who stop ourselves from expanding the horizons of our knowledge with self-doubt or other social, emotional, or economic constraints.

While most feel that education is a necessity, they tend to use it as a tool for reaching a specific target or personal mark, after which there is no further need to seek greater education. Nonetheless, the importance of education in society is indispensable and cohering, which is why society and knowledge cannot be ever separated into two distinct entities. Let us find out more about the role of education in society and how it affects our lives.

2.2.5 Purpose of Education in Society

2.2.5.1 Education is Self-Empowerment

Receiving a good education helps to empower making us strong enough to look after in any given situation. It keeps you aware of your given surrounding as well as the rules and regulations of the society you're living in. It's only through knowledge that you can be able to question authority for its negligence or discrepancies. It is only then that you can avail your rights as a citizen and seek improvement in the structural functioning of governance and economy. It's only when a citizen is aware about the policies of its government can he be able to support or protest the change. As a whole, people can bring about development only when they know where improvement is necessary for the greater good of mankind. Education helps you understand yourself better, it helps you realize your potential and qualities as a human being. It helps you to tap into latent talent, so that you may be able to sharpen your skills.

2.2.5.2 Financial Stability and Dignity of Life

Another importance of education is that it helps in gaining sufficient academic qualification so that the individual is able to get suitable employment at a later stage. A decent employment would be combined with hard-earned remuneration or salary through which you can look after your personal expenses. While the person earn for therself, he/she gradually begin to realize the true worth of money and how hard it is to earn it. The person realizes the significance of saving for a rainy day and for unforeseeable contingencies. He/She feel empowered because there is a new sense of worth that develops within the person, and he/she feel the need to be independent and free from any further financial support. The individual take pride in the fact that he/she is earning for therself, and are not obligated to anyone.

Mathematics is a one important part of education.

2.2.6 Mathematics

Aristotle defined mathematics as "the science of quantity", and this definition prevailed until the 18th century. Starting in the 19th century, when the study of mathematics increased in rigor and began to address abstract topics such as group theory and projective geometry, which have no clear-cut relation to quantity and measurement, mathematicians and philosophers began to propose a variety of new definitions. Some of these definitions emphasize the deductive character of much of mathematics, some emphasize its abstractness, some emphasize certain topics within mathematics. Today, no consensus on the definition of mathematics prevails, even among professionals there is not even consensus on whether mathematics is an art or a science A great many professional mathematicians take no interest in a definition of mathematics, or consider it undefinable. Some just say, "Mathematics is what mathematicians do."

Mathematics arises from many different kinds of problems. At first these were found in commerce, land measurement, architecture and later astronomy; today, all sciences suggest problems studied by mathematicians, and many problems arise within mathematics itself. For example, the physicist Richard Feynman invented the path integral formulation of quantum mechanics using a combination of mathematical reasoning and physical insight, and today's string theory, a still-developing scientific theory which attempts to unify the four fundamental forces of nature, continues to inspire new mathematics. Some mathematics is only relevant in the area that inspired it, and is applied to solve further problems in that area. But often mathematics inspired by one area proves useful in many areas, and joins the general stock of mathematical concepts. A distinction is often made between pure mathematics and applied mathematics. However pure mathematics topics often turn out to have applications, e.g. number theory in cryptography. This remarkable fact that even the "purest" mathematics often turns out to have practical applications is what Eugene Wigner has called "the unreasonable effectiveness of mathematics". As in most areas of study, the explosion of knowledge in the scientific age has led to specialization: there are now hundreds of specialized areas in mathematics and the latest Mathematics Subject Classification runs to 46 pages. Several areas of applied mathematics have merged with related traditions outside of mathematics and become disciplines in their own right, including statistics, operations research, and computer science.

For those who are mathematically inclined, there is often a definite aesthetic aspect to much of mathematics. Many mathematicians talk about the elegance of mathematics, its intrinsic aesthetics and inner beauty. Simplicity and generality are valued. There is beauty in a simple and elegant proof, such as Euclid's proof that there are infinitely many prime numbers, and in an elegant numerical method that speeds calculation, such as the fast Fourier transform. G.H. Hardy in A Mathematician's Apology expressed the belief that these aesthetic considerations are, in themselves, sufficient to justify the study of pure mathematics. He identified criteria such as significance, unexpectedness, inevitability, and economy as factors that contribute to a mathematical aesthetic. Mathematicians often strive to find proofs that are particularly elegant, proofs from "The Book" of God according to Paul Erdős. The popularity of recreational mathematics is another sign of the pleasure many find in solving mathematical questions.

Most of the mathematical notation in use today was not invented until the 16th century. Before that, mathematics was written out in words, a painstaking process that limited mathematical discovery. Euler (1707–1783) was responsible for many of the notations in use today. Modern notation makes mathematics much easier for the professional, but beginners often find it daunting. It is extremely compressed: a few symbols contain a great deal of information. Like musical notation, modern mathematical notation has a strict syntax (which to a limited extent varies from author to author and from discipline to discipline) and encodes information that would be difficult to write in any other way.

Mathematical language can be difficult to understand for beginners. Words such as or and only have more precise meanings than in everyday speech. Moreover, words such as open and field have been given specialized mathematical meanings. Technical terms such as homeomorphism and integrable have precise meanings in mathematics. Additionally, shorthand phrases such as if for "if and only if" belong to mathematical jargon. There is a reason for special notation and technical vocabulary: mathematics requires more precision than everyday speech. Mathematicians refer to this precision of language and logic as "rigor". Mathematical proof is fundamentally a matter of rigor. Mathematicians want their theorems to follow from axioms by means of systematic reasoning. This is to avoid mistaken "theorems", based on fallible intuitions, of which many instances have occurred in the history of the subject. The level of rigor expected in mathematics has varied over time: the Greeks expected detailed arguments, but at the time of Isaac Newton the methods employed were less rigorous.

2.2.7 Importance of Basic Mathematics

Mathematics is the study of numbers, and counting, and measuring, but that is only the beginning. Mathematics involves the study of number patterns and relationships, too. It is also a way to communicate ideas, and perhaps more than anything, it is a way of reasoning that is unique to human beings. Mathematics is divided into pure or theoretical mathematics, and applied mathematics. Applied mathematicians focus on how to apply mathematical principles to questions people have about the world around them and other practical problems (The New Book of Knowledge, 2006). It is the study of relationships between numbers, between spatial configurations, and abstract structures. Traditionally the subject is divided into ARITHMETIC, which studies numbers, GEOMETRY, which studies space, ALGEBRA, which studies structures, ANALYSIS, which studies infinite processes (in particular, CALCULUS),and PROBABILITY THEORY AND STATISTICS, which study random processes (Universal Encyclopedia, 1996).

One of the very useful branches of mathematics is Algebra. Originally, it was no more than generalized arithmetic. Arithmetic deals with numbers, which may be divided into real numbers and complex numbers. Real number includes integers, fractions and irrational numbers (numbers that cannot be expressed as a ratio of two integers), such as $\sqrt{2}$ and $\sqrt{5}$ (Encyclopedia Americana, 2006). Algebra has been identified as a societal gate keeper for further development of mathematical and scientific instruction, and for wide-ranging economic opportunities (Encyclopedia of Education, 2003). Mathematics plays a vital role in the modernization of this civilization. It is everywhere and affects the everyday lives of people. Although it is abstract and theoretical knowledge, it emerges from the real world. Mathematics is one of the essential and basic areas of the college curriculum which has a wide field of subject matter. In education, mathematics plays an important role. It is the study of numbers the relationship between these number and various operations performed on them. It is the science of quantity, size and shape. It is also a way to communicate and analyze ideas, a tool for organizing and interpreting data and above all, perhaps a method of logical reasoning unique to man. Mathematics is a necessary part of other sciences. In the words of Physicist Richard Feynan "Nature talks to us in the language of mathematics, that is numbers, mathematical rules and equations help us to make sense of the world around us (The Book of Popular Science, 2002).

2.2.8 Modern views of Mathematics

This type of instruction is based on detailed knowledge of student's construction of mathematical knowledge and reasoning. That is this teaching is based on a deep understanding of:

(a.) the general stages that students pass through in acquiring the concepts and procedures for particular mathematical topics;

(b.) the strategies that students use to solve different problems at each stage; and

(c.) the mental processes and the nature of the knowledge that underlies these strategies (Almonia et. al.,2006)

Solutions in mathematical problems do not limit on a single pattern or method. Students has to choose their preference as to which they find easier to express their answers.

According to the National Research Council, much of the failure in school mathematics is due to a tradition of teaching that is inappropriate to the way most students learn. Yet, despite the fact that numerous scientific studies have shown that traditional methods of teaching mathematics are ineffective, and despite professional recommendations for fundamental changes in mathematics curricula and teaching, traditional methods of teaching continue (Encyclopedia of Education, 2003). As time evolves, knowledge evolves. In order for the students to grow knowledgeably, teachers also has to grow first. Learning don’t limit in the four walls of the classroom. Being resourceful is a big help to update what you have previously learned.

2.2.9 Importance of Mathematics

It is said that Mathematics is the gate and key of the Science. According to the famous Philosopher Kant, "A Science is exact only in so far as it employs Mathematics". So, all scientific education which does not commence with Mathematics is said to be defective at its foundation. Neglect of mathematics works injury to all knowledge.

One who is ignorant of mathematics cannot know other things of the World. Again, what is worse, who are thus ignorant are unable to perceive their own ignorance and do not seek any remedy. So Kant says, "A natural Science is a Science in so far as it is mathematical". And Mathematics has played a very important role in building up modern Civilization by perfecting all Science. In this modern age of Science and Technology, emphasis is given on Science such as Physics, Chemistry, Biology, Medicine and Engineering. Mathematics, which is a Science by any criterion, also is an efficient and necessary tool being employed by all these Sciences. As a matter of fact, all these Sciences progress only with the aid of Mathematics. So it is aptly remarked, "Mathematics is a Science of all Sciences and art of all arts." Mathematics is a creation of human mind concerned chiefly with ideas, processes and reasoning. It is much more than Arithmetic, more than Algebra more than Geometry. Also it is much more than Trigonometry, Statistics, and Calculus.

Mathematics includes all of them. Primarily mathematics is a way of thinking, a way of organizing a logical proof. As a way of reasoning, it gives an insight into the power of human mind, so this forms a very valuable discipline of teaching-learning programmes of school subjects everywhere in the world of curious children. So the pedagogy of Mathematics should very carefully be built in different levels of school education. In the pedagogical study of mathematics we mainly concern ourselves with two things; the manner in which the subject matter is arranged or the method the way in which it is presented to the pupils or the mode of presentation. Mathematics is intimately connected with everyday life and necessary to successful conduct of affairs. It is an instrument of education found to be in conformity with the needs of human mind. Teaching of mathematics has its aims and objectives to be incorporated in the school curricula. If and when Mathematics is removed, the back-bone of our material civilization would collapse. So is the importance of Mathematics and its pedagogic.

2.2.10 Branches of Mathematics

1. Arithmetic

2. Geometry

3. Algebra

2.2.10.1 Arithmetic

Arithmetic or arithmetic's is the oldest and most elementary branch of mathematics, used very popularly, for tasks ranging from simple day-to-day counting to advanced science and business calculations. It involves the study of quantity, especially as the result of operations that combine numbers. In common usage, it refers to the simpler properties when using the traditional operations of addition, subtraction, multiplication and division with smaller values of numbers. Professional mathematicians sometimes use the term (higher) arithmetic when referring to more advanced results related to number theory, but this should not be confused with elementary arithmetic.

History

The prehistory of arithmetic is limited to a small number of artifacts which may indicate conception of addition and subtraction, the best-known being the Ishango bone from central Africa, dating from somewhere between 20,000 and 18,000 BC although its interpretation is disputed.

The earliest written records indicate the Egyptians and Babylonians used all the elementary arithmetic operations as early as 2000 BC. These artifacts do not always reveal the specific process used for solving problems, but the characteristics of the particular numeral system strongly influence the complexity of the methods. The hieroglyphic system for Egyptian numerals, like the later Roman numerals, descended from tally marks used for counting. In both cases, this origin resulted in values that used a decimal base but did not include positional notation. Complex calculations with Roman numerals required the assistance of a counting board or the Roman abacus to obtain the results. Early number systems that included positional notation were not decimal, including the sexagesimal (base 60) system for Babylonian numerals and the vigesimal (base 20) system that defined Maya numerals. Because of this place-value concept, the ability to reuse the same digits for different values contributed to simpler and more efficient methods of calculation. The continuous historical development of modern arithmetic starts with the Hellenistic civilization of ancient Greece, although it originated much later than the Babylonian and Egyptian examples. Prior to the works of Euclid around 300 BC, Greek studies in mathematics overlapped with philosophical and mystical beliefs. For example, Nicomachus summarized the viewpoint of the earlier Pythagorean approach to numbers, and their relationships to each other, in his Introduction to Arithmetic.

Greek numerals were used by Archimedes, Diophantus and others in a positional notation not very different from ours. Because the ancient Greeks lacked a symbol for zero (until the Helenistic period), they used three separate sets of symbols. One set for the unit's place, one for the ten's place, and one for the hundred's. Then for the thousand's place they would reuse the symbols for the unit's place, and so on. Their addition algorithm was identical to ours, and their multiplication algorithm was only very slightly different. Their long division algorithm was the same, and the square root algorithm that was once taught in school was known to Archimedes, who may have invented it. He preferred it to Hero's method of successive approximation because, once computed, a digit doesn't change, and the square roots of perfect squares, such as 7485696, terminate immediately as 2736. For numbers with a fractional part, such as 546.934, they used negative powers of 60 instead of negative powers of 10 for the fractional part 0.934. The ancient Chinese used a similar positional notation. Because they also lacked a symbol for zero, they had one set of symbols for the unit's place, and a second set for the ten's place. For the hundred's place they then reused the symbols for the unit's place, and so on. Their symbols were based on the ancient counting rods. It is a complicated question to determine exactly when the Chinese started calculating with positional representation, but it was definitely before 400 BC.

The gradual development of Hindu–Arabic numerals independently devised the place-value concept and positional notation, which combined the simpler methods for computations with a decimal base and the use of a digit representing 0. This allowed the system to consistently represent both large and small integers. This approach eventually replaced all other systems. In the early 6th century AD, the Indian mathematician Aryabhata incorporated an existing version of this system in his work, and experimented with different notations. In the 7th century, Brahmagupta established the use of 0 as a separate number and determined the results for multiplication, division, addition and subtraction of zero and all other numbers, except for the result of division by 0. His contemporary, the Syriac bishop Severus Sebokht described the excellence of this system as "... valuable methods of calculation which surpass description". The Arabs also learned this new method and called it hesab.

2.2.10.2 Arithmetic operations

The basic arithmetic operations are addition, subtraction, multiplication and division, although this subject also includes more advanced operations, such as manipulations of percentages, square roots, exponentiation, and logarithmic functions. Arithmetic is performed according to an order of operations. Any set of objects upon which all four arithmetic operations (except division by 0) can be performed, and where these four operations obey the usual laws, is called a field.

Addition (+)

Addition is the basic operation of arithmetic. In its simplest form, addition combines two numbers, the addends or terms, into a single number, the sum of the numbers. (Such as $2 + 2 = 4$ or $3 + 5 = 8$)

Subtraction (-)

Subtraction is the opposite of addition. Subtraction finds the difference between two numbers, the minuend minus the subtrahend. If the minuend is larger than the subtrahend, the difference is positive; if the minuend is smaller than the subtrahend, the difference is negative; if they are equal, the difference is 0.

Multiplication (× or · or *)

Multiplication is the second basic operation of arithmetic. Multiplication also combines two numbers into a single number, the product. The two original numbers are called the multiplier and the multiplicand, sometimes both simply called factors.

Division (÷ or /)

Division is essentially the opposite of multiplication. Division finds the quotient of two numbers, the dividend divided by the divisor. Any dividend divided by 0 is undefined. For positive numbers, if the dividend is larger than the divisor, the quotient is greater than 1, otherwise it is less than 1 (a similar rule applies for negative numbers). The quotient multiplied by the divisor always yields the dividend.

Decimal arithmetic

Decimal representation refers exclusively, in common use, to the written numeral system employing Arabic numerals as the digits for a radix 10 ("decimal") positional notation; however, any numeral system based on powers of 10, e.g., Greek, Cyrillic, Roman, or Chinese numerals may conceptually be described as "decimal notation" or "decimal representation".

Number theory

The term arithmetic also refers to number theory. This includes the properties of integers related to primarily, divisibility, and the solution of equations in integers, as well as modern research that is an outgrowth of this study. It is in this context that one runs across the fundamental theorem of arithmetic and arithmetic functions. A Course in Arithmetic by Jean-Pierre Serre reflects this usage, as do such phrases such as first-order arithmetic or arithmetical algebraic geometry. Number theory is also referred to as the higher arithmetic, as in the title of Harold Davenport's book on the subject.

2.2.11 Arithmetic in Education

Primary education in mathematics often places a strong focus on algorithms for the arithmetic of natural numbers, integers, fractions, and decimals (using the decimal place-value system). This study is sometimes known as algorism.

The difficulty and unmotivated appearance of these algorithms has long led educators to question this curriculum, advocating the early teaching of more central and intuitive mathematical ideas. One notable movement in this direction was the New Math of the 1960s and 1970s, which attempted to teach arithmetic in the spirit of axiomatic development from set theory, an echo of the prevailing trend in higher mathematics.

Learning Arithmetic by using number games is more effective than traditional way

We all know that children enjoy playing games. Experience tells us that games can be very productive learning activities. But ... What should teachers say when asked to educationally justify the use of games in mathematics lessons?

Are some games better than others?

What educational benefits are there to be gained from games?

2.2.12 What is a Mathematical Game?

When considering the use of games for teaching mathematics, educators should distinguish between an 'activity' and a 'game'. Gough (1999) states that "A 'game' needs to have two or more players, who take turns, each competing to achieve a 'winning' situation of some kind, each able to exercise some choice about how to move at any time through the playing". The key idea in this statement is that of 'choice'. In this sense, something like Snakes and Ladders is NOT a game because winning relies totally on chance. The players make no decisions, nor do that have to think further than counting. There is also no interaction between players - nothing that one player does affect other players' turns in any way.

Oldfield (1991) says that mathematical games are 'activities' which:

Involve a challenge, usually against one or more opponents;

Are governed by a set of rules and have a clear underlying structure;

Normally have a distinct finishing point;

Have specific mathematical cognitive objectives.

2.2.13 Benefits of using Games

The advantages of using games in a mathematical programme have been summarized in an article by Davies (1995) who researched the literature available at the time.

Meaningful situations - for the application of mathematical skills are created by games

Motivation - children freely choose to participate and enjoy playing

Positive attitude - Games provide opportunities for building self-concept and developing positive attitudes towards mathematics, through reducing the fear of failure and error;

Increased learning - in comparison to more formal activities, greater learning can occur through games due to the increased interaction between children, opportunities to test intuitive ideas and problem solving strategies

Different levels - Games can allow children to operate at different levels of thinking and to learn from each other. In a group of children playing a game, one child might be encountering a concept for the first time, another may be developing his/her understanding of the concept, a third consolidating previously learned concepts

Assessment - children's thinking often becomes apparent through the actions and decisions they make during a game, so the teacher has the opportunity to carry out diagnosis and assessment of learning in a non-threatening situation

Home and school - Games provide 'hands-on' interactive tasks for both school and home

Independence - Children can work independently of the teacher. The rules of the game and the children's motivation usually keep them on task.

Few language barriers - an additional benefit becomes evident when children from non- English -speaking backgrounds are involved. The basic structures of some games are common to many cultures, and the procedures of simple games can be quickly learned through observation. Children who are reluctant to participate in other mathematical activities because of language barriers will often join in a game, and so gain access to the mathematical learning as well as engage in structured social interaction.

2.2.14 Using Games in Math Teaching

By Marilyn Burns

Over the forty years that I have been teaching mathematics to children in classrooms and to teachers in workshops, games have played an important role. I have found that both children and teachers are always delighted to learn a new game. But while children seldom question the value of games, teachers have often expressed to me that they do not feel entirely comfortable incorporating games in their math instruction. They are not sure that games are a good use of math time, and they worry that the parents of their students will raise concerns about games detracting from their children learning "real" math.

I have three goals for this article. One is to provide you with a sound rationale for how and why games enhance math learning. My second goal is to introduce some examples of games and describe how I have structured their use in the classroom. Finally, I will provide suggestions for additional games along with resources for additional ideas.

2.2.15 Supporting Math Learning

It is important as teachers that we justify the instructional choices that we make in the classroom. To that end, the researcher offer you their rational for using games to help teach math, not only to convince you of the worth of games but also to help you communicate with your students and their families about how games support math learning. I think that incorporating games into math teaching is beneficial for:

Providing students practice with skills;

Giving students ways to apply mathematical ideas to problem-solving situations and develop strategic thinking, important aspects of mathematical thinking;

Building students' interest in and appreciation for mathematics by engaging them in enjoyable activities and challenges;

Supporting the idea that learning can (and should) be as fun as possible;

Creating a class menu of choice activities that are educationally valuable and provide options for those students who complete assignments more quickly than others.

One of the best ways the researcher know to help parents understand the benefits of games is to introduce them through homework assignments. The researchers often ask students to teach someone at home how to play a game they have learned in math class. This both gives students the opportunity to show others at home what they have learned and gives parents a way to learn, firsthand, what their child is experiencing in math class.

Games we play can be categorized into games of chance, games of strategy, and games that rely on both chance and strategy. While the researcher has used games in all three categories, the researcher has had most success with games that both involve elements of luck and also call for strategic thinking. That is because the element of luck adds excitement to games and also gives students who do not think as quickly or strategically as others the chance to win.

A note about competition in the classroom: while the researcher works hard to make cooperation and collaboration part of the culture of the classroom, the researcher think that there is a place for games in which one player or team will be a winner. The researcher thinks that it is important for children to learn to win and lose gracefully. However, the researchers also try to avoid games that divide students into haves and have-nots. Games should promote good will as well as competition, and offer support and fun to all. To that end, the researcher often has pairs of students play games as opponents so that the responsibility for decisions does not fall on one student. And, of course, the researcher remind students regularly that the reason the researcher having them play a particular game is for the learning that the researcher is promoting, and the researcher is explicit about what the learning is.

Examples from the classroom

This section presents excerpts from two books in the Teaching Arithmetic series. (There are currently eleven books in this Math Solutions Publications series.) Each excerpt presents a lesson that is built on using a game to support student's basic number understanding. Along with describing the rules for the games, the excerpts provide detailed information about how the games were introduced in the classroom and how students responded. I hope that these lessons provide models that will be helpful to you as you consider other games to try with your students.

2.3 REVIEWS OF RELATED LITERATURE

This chapter present a clear idea of the related literature reviewed for this study which includes the following materials.

Gurusamy, S. 1990. A diagnostic study of the errors committed by students of Standards IX in solving problems in geometry. M.Phil., Edu. Alagappa Univ. Objective of the study: - 1. To identify and categories the errors committed by the students of standard IX in solving problems in geometry, 2. To design some suitable remedial teaching programmes for the students of standard IX in solving problems in geometry. Major Findings of the study:- 1. It was found that the students' mean achievement scores were increased and the errors were considerably reduced in the post-test. 2. The level of performance of the students in the post-test was found to be high after the implementation of the remedial programme.

Hariharan, D. 1992. Attitudes of high school students towards homework and their achievement in mathematics. M. Phil., Edu. Madurai Kamaraj Univ. Objectives of the study:- (1)To measure the attitudes of high school students towards Homework in mathematics (2) to measure their academic achievement In mathematics and (3) to find out the relationship between the attitudes Of high school students towards homework and their achievement in mathematics Major Findings of the study:- 1. Girls were higher than boys in their attitude towards homework. 2. Urban students were higher than rural students in their attitude towards homework. 3.

Private school students were higher than the government school students towards homework.

Jain.S.L. and Burad.G.L.1988.Low results in mathematics at secondary examinations in Rajasthan. Independent study, Udaipur. State Institute of Educational Research and Training. Objective of the study:- To find out the causes related to low results and give suggestion to remove them. Major Findings of the study:- (1) Non-availability of mathematics teachers due to late appointment and frequent transfers, lack of appropriate classroom blackboards and other physical facilities, irregular attendance of students, teachers' habit of leaving the headquarters daily, and lack of residential facilities in some difficult areas were the administrative causes, (2) A low standard in the lower classes, non-availability of textbooks, lack of timely correction of homework an overburdened and uninteresting curriculum, lack of child- centered teaching, overcrowded classrooms

Mishra, R. 1991. Development of teaching steps for handling arithmetic-disabled children, M. Phil., Psy. Utkal Univ. Objective of the study: - To develop an approach and specific steps in teaching subtraction and addition to the arithmetic-disabled children.. Major Findings of the study:- (1) with training and following the teaching steps, the disabled subject, could perform in a better way.(2) With repetition, the subjects' performance improved. Thus, the defect did not lie with the teaching procedures as the subjects' performance was increased, though the improved performance remained for a shorter period. (3)With repetitive training and more assessment, the subjects could improve and retain in the memory for a longer period.

Pal, Asutosh. 1989. A critical study of some affective outcomes of the students as predictors of their mathematical ability. Ph.D., Edu. Univ. of kalyani. Objectives of the study:-1. To construct and standardize four tests on self-concept,anxity,attitude to mathematics and a questionnaire on academic motivation , 2. To find out their relation to students' achievement in mathematics, sex-wise, stratum-wise. Major Findings of the study: - (1)Boys shoed higher self-concept than girls.(2) There existed significant correlation between mathematics and self-concept, between mathematics and anxiety, between mathematics and attitude, between mathematics and academic motivation.

Pandhari, A.S. 1988. A study of language, memory and process as factor affecting students ' learning of mathematics in standard XII. Ph.D., Edu. Pune: Indian Institute of Education. Objectives of the study:-1. To study the effect of language, memory and processes as factor affecting student's performance in mathematics in standard XII. 2. To study the effect of these factors in the following g situation (a)urban, semi-urban, rural institutions, (b)'school attached' and 'college attached' junior colleges. Major Finding of the study:-1. The three factors under consideration, via, lack of language, memory and process affected students' learning in mathematics either separately or in combination. 2. All the three factors under study affected students' learning in mathematics adversely. 3. The learning outcomes of children belonging to urban, non-technical institution attached to colleges was superior to urban technical institution attached to high schools.

Samuel, Francis. 1989. Has conducted study on "Conceptual powers of children: An approach through mathematics." The objectives of the study:- 1.To find out whether the children's conceptual ability is according to their age,2. To find out whether there is any relation between intelligence and their ability to conceptualize as well as their ability to use concreto -logical forms of reasoning. Major finding of the study:- 1. Children at a younger age (7 years 5 months)did not display the ability to use the concreto-logical forms of reasoning, but on the other hand, more children at the age of ten did display this ability. 2. There was little difference in the degree of difficulty of understanding between the three topics-area, weight and volume .3. piaget's main thesis that the conceptual process follow stages of development is confirmed.

Sensarma, Aloke. 1989. Has conducted a study on "The evaluation method:A new teaching strategy for secondary school mathematics." Objectives of the study:- 1. To compare the relative effectiveness of the evaluation method and the traditional methods in respect of students achievements test and a High Mental Ability Test (HMAT) of mathematics. Major findings of the study: - 1. The adjusted GAT mean of group A was significantly greater than that of Group B and Group C. 2. The mean score on HMAT of experimental Group A was significantly greater than the mean scores of the control Groups B and C on HMAT.

Sensarma,Aloke.1989. The evaluation method: A new teaching strategy for secondary school mathematics. Indian Educational Review, Vol. 24(1):170-76. Objectives of the study:-To compare the relative effectiveness of the evaluation method and the traditional method.in respect of students achievements test and a High Mental Ability Test of mathematics. Major Findings of the study:- 1. The adjusted GAT mean of group A was significantly greater than that of group B and Group C. 2. The mean score on HMAT of experimental group A was significantly greater than the mean scores of the control Groups B and C on HMAT. 3.the evaluation method of instruction in mathematics was significantly better than the traditional method.

Sen Gupta, Debjani. 1989. "A child's conception of the fundamentals of Euclidean geometry." Objectives of the study:- 1. To develop the efficacy of piaget's methods of investigating epistemological problems in learning problems of any branch of knowledge of the curriculum of formal education, which is usually based on some self-evident truths. Major findings of the study:- 1. the "F" ratio of children's acquisition of five groups of axioms was significant. 2. The "F" ratio of the three age-groups of children was significant.3. Understanding of axioms as self-evident truths occurs in the course of growth between ages 5 and 7.

Sarala, S.1990. has conducted a study on "Conceptual errors of secondry school pupils in learning select areas in modern mathematics" The objectives of the study:- 1. To study the general nature of the error scores of secondary school pupils in modern mathematics, 2. to compare the error scores of pupils in the sub-samples classified on the basis of sex, location, school management, school standards, intelligence, interests. Major findings of the study:- 1. The number of conceptual errors committed by secondary school pupils in the areas selected for study was very high. 2. The relationship between errors in mathematics and intelligence, and study habits was seen to be negative and significant.3. Interest in mathematics was seen to have no influence on errors.

2.4 CONCLUSION

This chapter included conceptual frame work and reviews of related literature. The next chapter includes methodology of researcher.