EXPERIMENTAL STUDY TO DETERMINE THE
EFFECTIVENESS OF KUMON METHOD
IN COMPARISON WITH TRADITIONAL
LECTURE METHOD FOR TEACHING
OF MATHEMATICS
TO GRADE-5

JAMEELA ASHRAF
Ph.D (Education)
Reg. No. 203/FUI/Ph.D (Edu) - 2011

A thesis submitted in partial fulfillment of the requirement for the Degree of Ph.D (Education)

Department of Education
FOUNDATION UNIVERSITY ISLAMABAD
RAWALPINDI CAMPUS
2017
DEDICATION

This study is dedicated to

My Beloved Father

Raja Muhammad Ashraf, Mother Saleema (late)

And family.
FORWARDING SHEET

This thesis entitled “Experimental Study to Determine the Effectiveness of Kumon Method in Comparison with Traditional Lecture Method for Teaching of Mathematics to Grade-5” is forwarded for the purpose of evaluation.

(Prof. Dr. Muhammad Maqsood Alam Bukhari)
Supervisor

(Dr. Aisha Akbar)
Co. Supervisor
APPROVAL SHEET

This thesis entitled “Experimental Study to Determine the Effectiveness of Kumon Method in Comparison with Traditional Lecture Method for Teaching of Mathematics to Grade-5” submitted by Jameela Ashraf in partial fulfillment of requirement, for the degree of Doctor of Philosophy in Education, is hereby accepted.

Prof. Dr. Muhammad Maqsood Alam Bukhari
Supervisor

Dr. Aisha Akbar
Co. Supervisor

External Examiner 1
External Examiner 2

Head of Department (Edu.), FURC
Director, FURC
AUTHOR’S DECLARATION

I Jameela Ashraf hereby state that my Ph.D thesis titled “Experimental Study to Determine the Effectiveness of Kumon Method in Comparison with Traditional Lecture Method for Teaching of Mathematics to Grade-5” is my own work and has not been submitted previously by me for taking any degree from this university Foundation University Islamabad, Rawalpindi Campus or anywhere else in the country / world.

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Name: Jamila Begum
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(Jamila Begum)
ABSTRACT

The study was designed to investigate the effectiveness of Kumon method in comparison with traditional method in the teaching of Mathematics to grade-5. Kumon is a math and reading enrichment program, which provides practice and instruction to each individual. This helps the students to think and work independently. The hypothesis of this experimental study was that in Mathematics, Grade-5 students have no significant difference in their academic achievement treated by Kumon method and by traditional lecture method. The objectives of the study were to determine the effectiveness of Kumon teaching method for academic achievement of children in Mathematics, to find out the effectiveness of traditional teaching method for academic achievement of children in Mathematics, to make the comparison between the effectiveness of Kumon teaching method and traditional lecture method for academic achievement of the students and to compare the effectiveness of Kuman method on academic achievement of boys and girls in Mathematics. To achieve these objectives and to test the hypothesis, Kumon method was applied by Pre-test and Post-test equivalent group design. Two tests(pre-test and post-test) containing MCQs were developed. All grade-5 students of Fazaia inter colleges of Rawalpindi and Islamabad was the population. Cluster sampling technique was used. One of the three Fazaia colleges (junior section) was selected randomly. All grade-5 students of the selected cluster formed the sample of the study. The study was conducted in two phases at two different time periods applying the same procedure, the same teachers but the groups were different. Data was collected and analyzed by applying t-test and recommendations were given on the basis of findings of the study. This experimental research shows that Kumon method is more effective for teaching mathematics to Grade 5 students in comparison with traditional lecture method. It also shows that Kumon method is equally helpful in teaching mathematics effectively to boys and girls.
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CHAPTER 1

INTRODUCTION

Mathematics enjoys a vital position in school curriculum. It is offered as a compulsory subject in educational institutions up to class X. It encompasses various areas like Algebra, Arithmetic, Geometry, Trigonometry and Statistics. It has also attained a rank of special universal language through which one can express ideas about shape, quantity and relationships. Mathematics is considered as “key to success”. Traditional theories of Mathematics are undergoing change with the advent of Computer skills.

Mathematics is the subject which develops creative nature of students. A skillful teacher can promote the creativity by modeling creative behavior. Mayesky (1995) stated that students with more creative teachers produce more creative work than students working under less creative teachers. Methods or strategies provide guide lines to make his/ her teaching creative and to achieve the desired objectives. Having grip on different methods of teaching, teacher is able to make his teaching effective and creative.

Kumon is a method which develops computational skills and enables students to work within prescribed time and in more complex situation. It enables the students to make rich connections among different concepts of Mathematics. By doing such activities, without any conscious thought, students can perform basic functions and fundamentals of Mathematics.

(“Private tuition for children in core subjects of maths & English,” n.d.) believed that having learnt through Kumon method, the student can reduce his/ her anxiety in Mathematics, can improve his/her mathematical ability to solve problems and he/she can learn to know the reason which hindered performance.
In Kumon method of teaching, work-sheets are used in a systematic and sequential order through which students undergo the small steps of learning. After having complete grip and mastery at one level, students move to the next level. Mastery is determined by completion time and accuracy. Weischadle (2002) advocated that this method of learning Mathematics develops self-learning skill of each student when they work within the prescribed time. Lessons are based on every child’s requirements and needs of learning. Kumon method basically supplements school education. Our educational system is marks-oriented. Students are in the race of getting better grades, to be recognized socially and to get admission in the renowned institutions. Creative learning approaches are rarely seen in our educational set up.

1.1 STATEMENT OF THE PROBLEM

This study was planned to determine the difference between the academic achievement of Grade-5 students in Mathematics by teaching them through Kumon Method and through Traditional Lecture Method.

1.2 OBJECTIVES OF THE STUDY

Followings were the objectives:

(i) To determine the effectiveness of Kumon teaching method for academic achievement of children in Mathematics.

(ii) To find out the effectiveness of traditional lecture method of teaching for academic achievement of children in the subject of Mathematics.

(iii) To compare the effectiveness of Kumon method and traditional lecture method for academic achievement of children in Mathematics.

(iv) To compare the effectiveness of Kumon method on academic achievement of boys and girls in Mathematics.
1.3 SIGNIFICANCE OF THE STUDY

Kumon teaching method is a student-centered program which enhances the self-learning ability of each student, without concerning the age of student and his/ her grade in school. Each student can easily explore his/her abilities or talents to make progress without any fear of school and pressure of his/her academics.

In this dynamic world, students realize the importance of acquiring knowledge, so they cannot sit passively; they want to involve themselves in learning process interactively. When students start learning independently, they develop their ability to foster their learning and also nurture their motivation towards learning and develop passion for better understanding. With the help of Kumon method of teaching, the students i) get right and suitable point to start, ii) study with higher number of work sheets and iii) maintain standard completion time. The most important thing in the world is to open up new world for our children to explore.

Results of this research study are expected to help teachers, students, teacher training institutes, policy makers and curriculum designers in selecting Kumon method of teaching for school students in Pakistan. The study results might also lead to further research on method of teaching Mathematics at various levels of education.

1.4 DELIMITATIONS

The study was delimited to;

- The twin cities, Rawalpindi and Islamabad;
- Fazaia Schools and Colleges of Rawalpindi and Islamabad Pakistan;
- Students of Grade-5;
- Text book of Mathematics for Grade 5;
1.5 HYPOTHESES OF THE STUDY

The research hypotheses of the study were:

**H1**: There is significant difference in the mean achievement scores of Grade Five students if they are taught Mathematics through Kumon Method of Teaching and through Traditional Lecture Method of Teaching.

**H2**: There is significant difference in the mean achievement scores of grade 5 boys and grade 5 girls when taught through Kumon method.

The above research hypotheses were tested through the following null hypotheses;

**H₀₁**: There is no significant difference in the mean achievement scores of Grade Five students if they are taught Mathematics through Kumon Method of Teaching and through Traditional Lecture Method of Teaching.

**H₀₂**: There is no significant difference in the mean achievement scores of grade 5 boys and grade 5 girls when taught through Kumon method.

1.6 METHODOLOGY OF RESEARCH

1.6.1 Population and Sample

The population of the study consisted of 5<sup>th</sup> grade students of three Fazaia inter colleges in Rawalpindi and Islamabad, Pakistan.
One of the three Fazaia colleges was selected randomly through cluster sampling. All grade-5 students of the selected school, Fazaia Inter College Jinnah Camp Nur Khan Rawalpindi, formed the sample of the study.

1.6.2 Research Instrument

The only tool used for the collection of data was Mathematics achievement test developed by Teacher Training Institute, Islamabad. The test consisted of objective type questions from the units used in the study. There were 25 test items (MCQs) in Pre-test and Post-test. Moreover, end chapter tests were also developed from each chapter and these were conducted at the end of teaching each chapter.

1.6.3 Validity and Reliability

The instrument was improved in consultation with three Mathematics teachers. Reliability of the test was determined by test-re-test method. The test was administered to 25 students of the colleges not selected in the sample. Pearson Product Moment was used to determine the correlation in scores yielded by the students in their Pre-test and Post-test. The reliability figures of pre-test and post-test of academic achievement were 0.86 and 0.83 respectively, which were calculated through Spearman Brown formula using Statistical Package for Social Sciences (SPSS).

1.6.4 Topics Selected for Experiment

The researcher taught the topics and units from syllabus prescribed for teaching Mathematics for Grade-5 students by Air Headquarters. These topics were taken from Mathematics book for Grade 5 published by the Oxford Press. Thirty two lessons were selected for the purpose of teaching during the experiment. List of topics is appended (Appendix XII). Separate lesson plans were prepared for teaching through Kumon method and through Traditional Lecture method. Three model lesson plans on each method are appended (Appendices IV-V). All the lesson plans (32+32)
were prepared before the conduct of the experiment. This was the first phase of the experiment which was conducted during the period from October, 2014 to December, 2014. The second phase of the experiment was of six weeks duration with effect from April, 2015 to May, 2015. For this phase, ten lesson plans were prepared for each method of teaching. List of topics is appended (Appendix XII).

1.6.5 Experimental Design

For the purpose of data collection, the following design was used.

<table>
<thead>
<tr>
<th>Pre</th>
<th>ECT1</th>
<th>ECT2</th>
<th>ECT3</th>
<th>Post</th>
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<tbody>
<tr>
<td>E R</td>
<td>O1</td>
<td>treatment O3</td>
<td>t treatment O5</td>
<td>t treatment O7</td>
</tr>
<tr>
<td>C R</td>
<td>O2</td>
<td>O4</td>
<td>O6</td>
<td>O8</td>
</tr>
</tbody>
</table>

The two groups were equated in the light of results of students in their pre-test. One group was named as the experimental group, and other group was named as the control group. Kumon Teaching Method was selected to teach the students of the experimental group and lecture method was used to teach the students of the control group.

The study was carried out in two phases, one for twelve (12) weeks and other for six (6) weeks. In phase I, pre-test was conducted on 22-09-14. Teaching classes were conducted from October 1, 2014 to December 24, 2014. After completion of every chapter, students were given tests. Three ECTs (end chapter tests) were conducted during treatment. ECT1 was conducted on October 27, 2014, ECT2 was conducted on November 24, 2014 and ECT3 was conducted on December 28, 2014. Three days were given for revision. On December 31, 2014, after 12 weeks, both groups were given post test. t-test was applied to find out the difference in achievement. Significance level was 0.05.

In phase-2, the same procedure was applied. Pre-test was conducted on 30-03-15. Teaching was
conducted with effect from April 1, 2015 to May 15, 2015. After completion of every chapter students were given tests. Two ECTs (end chapter tests) were conducted during the treatment. ECT1 was conducted on April 20, 2015; ECT2 was conducted on May 12, 2015. Three days were given for revision. On May 15, 2015, after 6 weeks, both groups were given post test. t-test was applied to find the difference in achievement. Results of both the phases were compared. Second phase results supported phase -1 study.

1.7 DATA COLLECTION

Before beginning this experimental research, pre-test was taken and administered. The results of student’s academic achievement in pre-test were collected, and on the basis of these results two groups were formed. During treatment “end chapter tests” were given and the students were evaluated. At the end of research period, final test (post-test) for academic achievements was conducted.

1.8 ANALYSIS OF DATA

By using Independent and paired sample t-test, data of the study was tabulated and analyzed. Difference between the two mean scores was calculated at 0.05 level of significance. Statistical package for social science (SPSS) was applied for analysis. In Chapter Four, the results of this experimental research have been presented. Conclusions were made and findings were drawn on the basis of statistical analysis of data.

1.9 DEFINITIONS OF TERMS

In this experimental study, the following terms were used:

**Traditional Lecture method:** In this method of instruction is based on principles of “teaching being Teacher centered”.

Students are passive listeners.
Emphasis on memorization.

**Kumon Method:** Kumon teaching method is based on principles of:-

- Diagnostic Test
- Self-learning
- Easy beginning point
- More and more practice
- Mastery of concepts

In Kumon Method, the role of teacher is that of a facilitator. He/she gives knowledge and information to students to get better solution of problems.

**Achievement:** The ability to complete or to perform an activity in as skillful manner in any given educational setting.

**Effectiveness:** Capabilities of producing desired results.
CHAPTER- 2

RELATED LITERATURE AND RESEARCH STUDIES

This chapter consists of the followings topics.

Significance and Scope of Mathematics

New Trends in Mathematics

Importance of Math in Everyday Life

Methods of Teaching

Theories of Learning

Kumon Method of Learning

Spreading Globally

Summary of Literature Review

2.1 SIGNIFICANCE AND SCOPE OF MATHEMATICS

Mathematics education believes on mathematization of cognition of a child, clarity of concepts which leads towards systematic and logical inferences which is the actual soul of this subject. Mathematics gives way to think, how to deal with the abstract and how to solve the problems in an effective manner. It is studied as a compulsory subject at Secondary level, so child must be provided quality education in the subject of Mathematics. The requirement for Pakistan is to provide affordable and enjoyable mathematics education for every one. There is a need to help young children to face the challenges coming in their future life, at least upto elementary school level. This can be done with the help of mathematics education (“Mathematics,” n.d.) School mathematics should be such that; i) Students should take interest in learning mathematics and enjoy it. ii) Learn the importance of Mathematics. iii) Every child has certain experiences in his life and Mathematics is a part of it, which he/she can share it with others. iv) Mathematics
helps children to put and solve the problems. v) Students make relationships by using abstractions. vi) Teachers must have the ability to engage every student in the classroom. Followings are the core areas of concern; i) Majority of students have fear of Mathematics. ii) Existing curriculum is disappointing both for the talented and non-participating students. iii) Old strategies to assess a student which considers mathematical perception as mechanical computation. iv) Teachers lacking in preparation can’t help students in learning of Mathematics (Ahmed, Clark-Jeavons, & Oldknow, 2004).

Mathematics education also reflects social discrimination, especially in case of gender differences which states that boys are better in doing mathematics as compared to girls. This analysis helps us to suggest the followings; i) Math education should focus on achieving higher goals rather than narrow goals. ii) Engage every child to work hard and achieve success; also teach them conceptually to face the challenging situations of mathematics. iii) Use different assessment techniques to evaluate student’s mathematical skills instead of examining the factual knowledge. iv) Variety of resources should be used by math teacher to teach this subject effectively. (Zohrevand, Jafari, & Arshad, 2010)

Focus should be shifted from math contents towards the math learning process. These processes are formal problem-solving method, heuristic approach, estimation and approximation of things, optimizing the use of AV.aids, logical and analytical approach to proof, make connection and mathematical communication. Using these processes and giving them importance helps students to remove the fear of the subject of mathematics from their minds. This can be achieved by using combination of different approaches, methods, techniques and procedures. These learning environments encourage students to participate, engage them and also give them the sense of becoming successful in their lives. There is a need to restructure board exams to assess student’s
learning, and reduce the failure in mathematics. In other words, these exams must also be challenging to evaluate the concept understanding and their competencies. There is a need to prepare teachers to teach mathematics. There must be resource material bank, which gives easy approach or access to that material. To reduce the content delivery by lecture method, we can use the geometric A.V.aids which leaves ever lasting impact on students mind and they can retain the concepts for longer time because when vision is involved it helps to improve their understandings and learning. Motivation on earlier stage matters a lot and contributes towards effective learning in the subject of mathematics. Students need motivation and ability to apply concepts. All students have the right to learn mathematics and they can learn mathematics well. The only requirement is to give them quality education in the subject of mathematics (Ahmed et al., 2004)

2.1.1 Importance of Mathematics for Human Life

Mathematics is called as the gateway and key to all sciences. Kant, the famous philosopher, said that all sciences depend on Mathematics. If they do not relate to mathematics, they are called defective areas. To know what is happening in the world all around, one must have knowledge of mathematics. If we neglect the importance of mathematics and without its knowledge we are unable to get information about all things in the world. Kant also stressed that all natural sciences are taken as science only if they are mathematical, and mathematics has very vital place in the setting of civilization by updating all branches of science (“Mathematics,” n.d.)

In the Scientific and Technological world of modern era, main focus is laid on all branches of science such as Physics, Chemistry, Biology, Medicine and Engineering. Mathematics, which is the mother of all sciences, is effective and efficient and provides necessary tools to all branches of
science. It is a fact that all sciences can progress and can flourish only with the support of mathematics. It is not only considered as science of all sciences but also as art of all arts.

Mathematics is created by human mind and concerns mainly with ideas, procedures and logical reasoning. It is not only about Arithmetic, Algebra and Geometry but also much more about Trigonometry, Statistics, and Calculus. All these are included in Mathematics. Basically, mathematics is about how to think, and how to organize a logical proof by reasoning. It provides an insight to the power of minds of curious students, and it also gives value to the teaching-learning programs. (“Mathematics,” n.d.)

Two things in the study of mathematics are important. These are; the way to arrange the subject matter and the way to teach or present it to students.

Mathematics is basic requirement of daily life and necessity for successful dealing with matters of life.

It is one of the main tools of education required to fulfill the needs of human mind.

Aims and objectives of teaching mathematics have significant place in school curriculum. Mathematics is the back-bone of material civilization. The above discussion highlights the importance of Mathematics.

2.1.2 Relationship of Mathematics with other Sciences

2.1.2.1 Science

Mathematics has direct connection with science, especially in the fields such as chemistry, astronomy and physics. Students who are unable to get mastery on basic arithmetic skills, they struggle to read scientific charts and graphs. Students become able to solve problems of chemistry, get understanding about scientific reasons and their analysis with the help of geometry, algebra
and calculus. Math is also the need of practical sciences like engineering and computer science. It also enables the students to solve the equations (Ciftci & Karadag, 2016)

2.1.2.2 Literature and Writing

Literature and poetry understanding is also possible by getting mastery on basic arithmetic. With the help of Mathematics, one can count the words in a specific line of poetry which affects reader’s mind. Mathematics also helps students to plan assignments of literature, its reading estimated time and make them able to manage these tasks. Mathematical ability of logical thinking will also be helpful in writing something in clear and logical manner (Tarasenkova, 2014)

2.1.2.3 Social Studies

In the classes of social studies like history, where students require reading the charts and graphs which provide historical data or information about the ethnic groups. In geography, students require understanding about the elevation of an area which affects its population or reading charts which give information about the life spans of the population. Statistical analysis is possible only with help of the basic knowledge of mathematical terms and formulas.(De Lourdes Mata, Monteiro, & Peixoto, 2012)

2.1.2.4 The Arts

With the help of mathematical basics, students can benefit while in the selection of their favorite careers like theater, music, dance or art. In musical rhythm of dances which are used in ballet performances, students are benefitted from mathematical series.(Miendlarzewska & Trost, 2013)

2.2NEW TRENDS IN MATHEMATICS

In the last 50 years, a lot of changes were made in the fields of Mathematics such as research, applications, education, and exposition. Some of these changes, such as invention of computers,
are extensively used in mathematical education. These trends can influence primary, secondary and higher secondary levels. There are other, more subtle trends that may not be so obvious.

1. **New applications and rapid increase in their significance.**

   The subject of mathematics is used significantly in all branches of science and technology and the field of economics. Mathematics can help students not only in recognizing the problems but also helps in their solutions (Tarasenkova, 2014)

2. **New tools: CIT (computers & information tech).**

   There is enough work on introduction of computers in educational setup. But the influence of computers in the life of a person and fast changes in the field of research, Email, electronic encyclopedias and internet sources are visible to draw the illustrations, graphs and algorithms. (Gawron et al., 2016)

3. **New forms of mathematical activity.**

   Various new forms are introduced as mathematical activities, such as algorithms and programming, modeling, conjecturing, expository writing and lecturing which are quite significant.(Graeber, 1999)

### 2.3 IMPORTANCE OF MATHEMATICS IN EVERYDAY LIFE

Followings are some areas telling the importance of Mathematics;

**Animator** – In the field of animation, where linear algebra is used to describe the ways to rotate, to shift to make an object large and small.

**Computer Engineer** – Mathematics is involved in creating different applications and gadgets of next generation more than our thinking.

**Fashion Designer** – Mathematics is used to determine areas, perimeter using algorithms by fashion designers to design and to calculate the cost of material used.
**Astronaut** – In space-technology, mathematics is used to make precision of calculations from the point of leaving the earth till the end of the project.

**Architect** – Mathematics is also used in the field of Architecting to calculate the areas, perimeters of buildings, dimensions; floor layout, parking areas etc (Barrett & Zhang, 2009)

Mathematical background is the main requirement of various appealing fields and careers. If some students want to become a math’s teacher, data analyst or want to choose the field of fashion designing, teacher and parents both must help them and provide them the necessary tools to make them successful members of society. Kumon program of Mathematics helps students by its problem solving technique even from basic to advance levels of Mathematics and also enhance their thinking and analytical reasoning ability; which are necessary for their future life success.

**2.3.1 Increasing students’ Motivation and Perseverance**

Albert Einstein said that he was not smart enough in doing mathematics but it was just that he stayed on problems for longer time. He also attributed his success to persistence and preserving in the fear of challenges. Grit is used to describe it; grit is perseverance and passion for achieving the goals in the long run by Duckworth Lab, the University of Pennsylvania. Nobody can deny the strong relationship of intellect and success. According to Einstein and other researchers; grit predicts more towards success as compared to the intellect. Now the question arises how perseverance can be developed among students. Right learning attitude and praise can create motivation and increase perseverance in the students which help them to achieve their goals in their class-rooms and meet our expectations as well.

There is need to cultivate more and more grit, because encouragement is the right of every individual without considering their grades or results, but must focus on their efforts and their progress ("How Teachers Can Motivate Students of Any Age | MindShift | KQED News," n.d.)
2.4 METHODS OF TEACHING

According to Kochhar (9999) teacher plans his/her lesson by using different strategies to deliver his/her lesson effectively by keeping this thing in his/her mind that all his/her approaches must be relevant to desired teaching learning process.

Every teacher should have characteristics to be persistent and have behavior relevant to the contents and methodologies which must be in accordance with teaching-learning process. A set of teacher’s behavior occurs simultaneously or sequentially in a valid way.

There are different ways of learning for individuals. Its pattern consists of pedagogy of lecture method, which covered the journey over centuries from early Greek to Dewey. According to the Philosophy of Progressivism, Athenian’s methods of teaching were used to enable little children for discussion publically. By doing so; they could have effective and efficient discourse. Socrates used successfully the combination of different approaches to encourage the young students to get the best. Dewey supported project based learning because in this method, learner involves himself actively in learning studio, and also be able to solve problems which he considers that are real to him. Discussion here shows that teaching process needs continuous revision to fulfill the need of students when they face and go through different learning environments. Although lecture method has countless advantages, is continuously reshaped and redesigned by curriculum experts. Curriculum developers are trying to make methods of delivering contents more purposeful and more effective. The stress has been shifted towards construction of knowledge instead of simply delivering the facts. Lecture method fails to teach advance and upcoming ideas in the scientific world which requires new trends and approaches (Kochhar, 9999)
2.4.1 Utility of Teaching Methods

Welty, (1989) describes the points which are essential for teachers to strengthen their instructional process and make it impressive. Awareness about learner’s thinking/cognitive level. Must know about their experiences, interests and goals. Participation of the teachers is essential to design and plan an effective teaching-learning process. Material which is not relevant should be avoided during teaching-learning process. Teachers should learn new teaching materials which strengthen teaching-learning process. An ample opportunity should be given to the students to participate in teaching-learning situations in class.

2.4.2 Lecturing

(Shinn, 1997) said that the traditional approach of teaching which is still used in present day classroom situations needs to be revised to fulfill the needs of advance concepts in the field of science. Teachers must play an active role throughout their lessons and disseminate the facts to students. Lecture method is very cheap and economical. That’s why it is commonly and frequently used in teaching process. It also a time saving method. Once a teacher prepares a lesson, he / she can repeat it more than one time. In very little time, a teacher can deliver a lot of knowledge. Teaching objectives are continuously changing; although this traditional method has a lot of advantages, it is now discontinued. It is not recommended to use this traditional method alone. It is quite difficult to achieve the new objectives of teaching by using lecture method. The goals of teaching can be achieved by maximum and active participation of children in the process of learning.
The role of a teacher should be like a facilitator, which makes learning easier to young kids and involves them in the process of learning. Teacher should make classrooms as student-centered instead of teacher-centered, and allow students to recognize their problems freely. The teachers should help the learners to build up their knowledge by using different and new instructional material and strategies. Lecture method needs to be revised because students get bored when they are passive listeners (Freeman et al., 2014)

In this method, teacher carefully plans his / her expository lesson and formally delivers it to his / her students. This method of teaching is also called as method of exposition. (James Michael Lee)

It can be used:

(i) **To motivate:** When a teacher is starting a new unit or a new topic, he or she can sometimes deliver the outstanding aspects of address effectively. A teacher can raise curiosity among students by giving some information about the significant persons, important events and problems.

(ii) **To clarify:** Sometimes, students feel difficulty and get troubled during their study, teacher should aim to clarify ambiguities by lecturing for few minutes, although the purpose of lecture is to save the time.

(iii) **To review:** By using lecture method, a teacher is able to summarize main points of the lesson and indicates the importance of that topic.

(iv) **To expand contents:** Lecture is considered as the best method to present lot of information regarding the lesson. Students always take interest to know more than the text book. They are interested in teacher’s readings, travels and in his/ her experiences (Johnson, 1989)

**Advantages of Lecture Method**

According to Johnson, (1989),
1. It vitalizes ideas which often appear cold and impersonal when printed on the book while the spoken words are frequently more effective than the printed material. During a lecture, a teacher can use games, gestures and facial expressions to convey. By impersonal characteristics, by modulating voice and by using simple devices, he/she can impress his/her message effectively. In fact, one can give life and colour to printed material.

2. Lecture gives an opportunity to come in immediate contact with students. Teacher can gauge the students, appreciation. He can change his approach to make his message clearer.

3. Lecture can be adapted to the abilities, interest, needs of students.

4. Lecture can give the students training in listening, taking rapid notes.

5. Lecture saves time.

6. Good lecture stimulate brighter students. They are prompted to put in more efforts.

**Limitations of Lecture Method**

1. It makes the students passive listeners. Learning is participating in a lecture. It needs the opportunity to talk, to ask, so that the best teaching can take place.

2. Lecture reduces the opportunity to learn by doing as readymade material is presented to the students.

3. Lecture is an inefficient teaching tool in the development of attitude and process outcomes. There is no teaching where there is no learning.

4. The lecture does not guarantee that the students will understand its contents. Being almost teacher-centered, it offers little opportunity to evaluate the students during the lesson.

5. The average high school students may not have sufficient attention span to attend forty minutes class.
6. A lecture can quickly develop a deadening monotony. It is the exceptional teacher who can stimulate and keep up the interest of the learners continuously.

7. Most of school teachers are not good lecturers (Johnson, 1989).

2.4.3 Demonstration method

According to Johnson (1989), the demonstration method is a special type of method in which a teacher explains the things practically while he/she is delivering a lecture; the teacher shows his/her students several things, or many areas of the lesson, a teacher is delivering to a group of students. It develops skills of the students. When the lecture method is not sufficient, demonstration method is quite helpful for the teacher to explain the concepts of distance, time, temperature, angle-measurement, volume, area, perimeter etc. It is very interesting and effective to get the learner’s attention and it helps in developing their skills including creative thinking. Demonstration takes a lot of time to manage the resources. It is valid when learners are only in the form of groups.

2.4.4 Discussion

According to Johnson (1989), in discussion method, students and teachers exchange their ideas with each other through discussion and communication. The teacher speaks directly to the students, gives them tasks, or asks them questions, or makes comments, then waits for their response. This helps auditory learners retain the learning material. In this method, students/learners either take a stand on an issue or they are assigned a position. The groups of learners can then discuss their views with each other. Students continue open conversation, which make them able to express themselves, and may provide new areas for learning. In the discussion method, students get confident.
2.4.5 Deductive- Inductive Method

Two very distinct and opposing instructional approaches are inductive and deductive. Both approaches can offer certain advantages, but the biggest difference is the role of the teacher. In a deductive classroom, the teacher conducts lessons by introducing and explaining concepts to students, and then expecting students to complete tasks, to practice the concepts; this approach is very teacher-centered. Conversely, inductive instruction is a much more student-centered approach and makes use of a strategy known as ‘noticing’ (Kochhar, 1992).

Deductive Method

According to Johnson (1989), a deductive approach to instruction means that the teacher gives the students a new concept, explains it, and then has the students practice using the concept. For example, when teaching a new mathematics concept, the teacher will introduce the concept, explain the rules related to its use, and finally the students will practice, using the concept in a variety of ways and situations. According to Bob Adamson, “The deductive method is often criticized because: i) it teaches mathematics in an isolated way; ii) little attention is paid to the formula; iii) practice is often mechanical.” This method can, however, be a viable option in certain situations; for example, when dealing with, highly motivated students, teaching a particularly difficult concept, or for preparing students for exams.

Inductive Method

In contrast with the deductive method, inductive method makes use of student “noticing”. Instead of explaining a given concept and following this explanation with examples, the teacher presents students with many examples showing how the concept is used. The intent is for students to
“notice”, by way of the examples, how the concept works. Using the mathematical concept, the teacher would present the students with a variety of examples for a given concept without giving any preamble about how the concept is used. As students see how the concept is used, it is hoped that they will notice how the concept is to be used and determine the mathematics formula. As a conclusion, to the activity, the teacher can ask the students to explain the formula as a final check to see whether they understand the concept.

2.4.6 Kumon Method

Toru Kumon was the founder of the Kumon program of learning about 50 years ago in Japan (KNA, 2008). Toru was working in a high-school as teacher of Mathematics and as a Father too (Izumi, 2001). Toru’s son was facing difficulties in Mathematics so Toru developed worksheet series for his son which he had to complete daily after his school (Izumi, 2001). Toru’s son started working with these worksheets in grade-2 and at the time when he was in the grade-6, he started to solve Calculus (KNA, 2008).

There are seven components which comprises the Kumon Method of Learning (Izumi, 2001):

1. Individualized learning–Kumon student works and moves to the next higher level at a pace which is dictated according to the abilities of a student and his initiative (KNA, 2008). The teacher’s primary goal is to pursue and help children attain the highest potential of each unique student (KNA, 2008).

2. Independent learning–the level of difficulty progresses so gradually that learner advances smoothly and independently. As a result, the learner develops self-motivation and self-reliance (KNA, 2008).

3. Comfortable starting point–each student’s starting point is determined by a Placement Test (KNA, 2008). The starting point is intentionally set low so that initial work is completed and
mastered easily (KNA, 2008). This initial success fosters student’s concentration, study habits, confidence, and proficiency with later steps (KNA, 2008).

4. Curriculum—the study materials are organized so that skills develop incrementally and in a logical progression. The levels of the Math programs are divided into smaller steps. For each step, students complete a 10 page worksheet booklet (or set).

5. Repeated practice—the Kumon Method ensures comprehension and retention by requiring daily practice (KNA, 2008). The amount of practice for each worksheet and each level is determined by the learner’s needs and performance.

6. Mastery—Kumon assesses speed and accuracy which measures the level of mastery. The learner is said to be have mastered in a level, when he/she gets cent percent accuracy in a task in a given time (KNA, 2008).

7. At higher study level—“Kumon’s goal for all learners is to attain advanced student status as soon as possible” (Izumi, 2001, p. 65). Students are promoted to higher level up to three or more levels from the time of their entry in one study year (Niikura, 2006b).

2.5 THEORIES OF LEARNING

2.5.1 Behavioral Psychology

Behaviorism was the most popular learning theory in the 1950s - 1960s (Woodward & Montague, 2002). From this perspective, learning is best characterized in terms of observable stimuli and responses as opposed to unobservable internal factors (Gray, 1999; Hetherington, Parke, &Schmuckler, 2005). There are two processes of learning: i) classical process and ii) operant process. According to Gray (1999), Classical process is a process of learning, where learners have to respond to unfamiliar stimulus in the same way as they respond in familiar one, if both are presented systematically. While in operant process, learners have their learning which depends on
the effects of that behavior; positive and negative reinforcement increases the likelihood when behavior occurs again whereas punishment decreases that.(Hetherington, 2005, p. 11). Operant conditioning is the most relevant process to learning Mathematics. There are many principles and constructs used in an operant conditioning framework to explain how people learn including reinforcement, punishment, shaping, and chaining (Gray, 1999).

2.5.2 Learning Hierarchy

According to a behavioral-analytic, operant conditioning model, knowledge and skills are developed and mastered following a hierarchy of learning: acquiring knowledge, being fluent to generalize and adapt skills (Daly & Martens, 1994; Haring, Lovitt, Eaton, & Hansen, 1978). Proficiency at each stage is necessary for success at later stages. In the phase of acquisition, learner is acquiring responses accurately (Haring et al., 1978). Acquisition is the first step to skill mastery (Poncy, Skinner, & Jaspers, 2007, p. 28). In other words, acquisition is the strong base, on which proficiency, generalization, and adaptation depends, which has an important impact on the development of skill (Poncy et al., 2007). Suggested strategies for improving accuracy include increasing the number of learning trials (Albers & Geer, 1991), modeling, demonstrating, and errorless learning (Daly, Witt, Martens, & Dool, 1997; Haring et al., 1978).

When someone is able to perform a skill with accuracy and speed it is called fluency.(Haring et al., 1978). The children get proficiency in solving fundamentals of Mathematic questions with quick and correct response. It does not require conscious evaluation (Goldman & Pellegrino, 1987). Fluent response not only requires less effort, but reinforcement rate also is higher (Codding, Eckert, Fanning, Shiiko, & Solomon, 2007). Also, students can reduce their anxiety and increase their motivation by responding automatically to complete their assignments (Billington, Skinner, & Cruchon, 2004; Skinner, 2002). And finally, opportunities to practice are allowed by fluency
which will be the source to increase accuracy and also improve fluency (Skinner, Pappas, & Davis, 2005). The basic strategy to improve fluency is practicing more and more (Skinner, McLaughlin, & Logan, 1997, p. 297). Time-tested drillings or exercises and achievement reports are also recommended techniques to improve fluency (Daly et al., 1997; Haring et al., 1978).

In the generalization stage, the learner can not only perform the skill both accurately and fluently, but is acquiring the ability to adapt the skill in different styles (Haring et al., 1978). Generalizations are necessary to have useful skill; that each student should be able in responding to people in different settings across the time with accuracy and fluency. (Stokes & Baer, 1977). These categories include training multiple stimuli and response exemplars, including common stimulus in programming, training in multiple contexts, incorporating salient and self-mediated stimuli, and using appropriate reinforcement techniques to reward generalization, when it occurs (Stokes & Baer, 1977; Stokes & Osnes, 1989).

Finally, the ability of modification of skill is called adaptation which can fit a novel situation (Haring et al., 1978). A skill is mastered, when the student is proficient in performing it in each stage of learning (Haring et al., 1978). Adaptation is particularly important when learning Mathematics because mathematical skills and concepts develop hierarchically (Fuchs & Fuchs, 2005). In order to acquire more advanced mathematical skills, the individual has to adapt previously mastered skills to novel problems/situations. In fact, solving novel problems is the suggested strategy for enhancing adaptation of skills (Daly & Martens, 1994).

Concepts and methods such as the learning hierarchy are frequently drawn from behavioral psychology for the purpose of educating students. Equally influential in the field of education, however, is cognitive psychology.
2.5.3 Cognitive Psychology

The cognitive perspective on learning began to gain popularity in the late 1960s and early 1970s (Woodward & Montague, 2002). This orientation emphasizes the influence of cognitive factors in learning and development (Hetherington et al., 2005) and describes learning in terms of stored information (Gray, 1999). Emerging from behaviorism, cognitivists also attribute learning to the processes of classical and operant conditioning (Gray, 1999). The difference between the two schools of thought is that the cognitivist also considers the mental activity that occurs between stimulus and response (Gray, 1999). The three major sub theories within cognitive developmental psychology (Piagetian theory, Vygotsky’s socio-cultural theory, and information-processing theory) continue to influence educational research and practice (Woodward & Montague, 2002). Piagetian theory is a theory of cognitive growth of a child which is actively involved in gathering new fact and figures and collecting information, and incorporating these with his previous knowledge already present through assimilation and accommodation processes (Hetherington et al, 2005, p. 15). Socio-cultural theory is defined as a theory of development, given by Lev Vygotsky, that is, development of children is evolved by the interactions with more skilled persons around them in their environment (Hetherington et al, 2005, p. 15). The information-processing approach, however, is the most useful for explaining cognitive changes such as the development of Mathematics skills because of its many relevant metaphors, models, and concepts (Hetherington et al., 2005).

2.5.4 Information-Processing

The information-processing approach uses the computer as a metaphor for how man learns and thinks (Bjorklund, 2005; Hetherington et al., 2005). A few followers of the information-processing theory believe that the mind functions exactly like a computer. Rather, the theory is used for its
concepts and language which are widely used to describe and understand learning processes (Bjorklund, 2005).

The information-processing approach comprises four tenets (Siegler, 1998; Siegler, 2001). First, thinking is information-processing and therefore, involves perception, encoding, representation, storage, and retrieval of information. Second, encoding, strategy construction, automatization, and generalization are the mechanisms which allow a child to learn and develop cognitively. For example, information about a Mathematical problem is encoded and then, in combination with prior knowledge, the student constructs a strategy to solve the problem. New strategies are slow and effortful but become automatic and more effective with practicing. Strategies must then be generalized to novel problems/situations. Third, the information-processing approach holds that development is driven by self-modification. In other words, the learner uses previously acquired knowledge and strategies to adapt his/her responses to more difficult problems. The fourth tenet of information-processing is that both the learner’s abilities and the nature of the task can influence the learner’s performance (Siegler, 1998; Siegler, 2001).

According to this theory, information moves through a system of cognitive structures (Bjorklund, 2005). Information from the environment, perceived through one or more than one of the five senses, enters the sensory register and is stored there temporarily (Hetherington et al., 2005). This information, if encoded, is then sent to short-term memory STM (Hetherington et al., 2005). STM has a limited capacity, so information must be rehearsed (to maintain the information) or transferred to long-term memory (LTM) before it dissipates (Hetherington et al., 2005). LTM holds knowledge and strategies permanently in most cases (Hetherington et al., 2005). When a particular response is required, the knowledge and strategies contained in the LTM, can be
transferred and temporarily held in STM, where responses can then, be executed (Hetherington et al., 2005).

The transfer of information between the aforementioned cognitive structures is aided by attention, memory, and inhibition in typically developing children. Attention is a complex process that is influenced by several variables (Hetherington et al, 2005). One such variable is maturation; as the child ages, mental resources and the ability to allocate said resources improves (Hetherington et al., 2005). To learn a complex skill, such as Mathematics, students must also be able to attend to the information at hand, but also ignore irrelevant information (Hetherington et al., 2005). Miller and Weiss (1981) determined that, selective attention improves over time. In sum, attention influences the processing of information, and improves as children develop; therefore, the ability to learn improves over time.

Memory develops and becomes more efficient over time, as a result of maturational changes in other cognitive processes (Hetherington et al., 2005). First, the STM’s information capacity increases and overall information-processing improve, when children’s processing speed improves. Speed of processing influences all aspects of information-processing and according to Kail (2000), has the most influence on developmental changes in cognitive ability. Processing speed typically increases with maturation, rather than as a result of practice (Miller & Vernon, 1999). Second, memory strategies, such as rehearsal, information organization, and elaboration, are increasingly observed in individuals as they develop (Hetherington et al., 2005). These strategies also make cognitive processing more efficient. Third, knowledge of the world influences how children understand information, and also, how they will recall that information at a later time (Hetherington et al., 2005). In other words, as children learn, and make more mental connections
between stored information, the cognitive processes become more efficient. As these three areas develop, so does the child’s memory.

Memory can also improve with practice. When a skill is practiced repeatedly, it can eventually be performed automatically (Hetherington et al., 2005). Automatic processes require none of the STM’s limited capacity, require no mental effort, are unconscious, and do not interfere with other processes (Bjorklund, 2005). Storage and retrieval of new, more complex information is enhanced, when lower-level information can be retrieved from LTM automatically.

Last, inhibition is required to ensure, that information flows smoothly from input to output in the information-processing model. With age, children become better at ignoring irrelevant information in the environment, and suppressing inappropriate responses (Bjorklund, 2005). When there is less irrelevant and/or inappropriate material in the child’s STM, there are more resources available for essential cognitive operations, which makes cognitive processes such as the transfer of information between STM and LTM and learning, more efficient (Bjorklund, 2005).

To conclude, the information-processing theory is, a useful model for studying and explaining children’s learning because it provides many useful terms and constructs. The concepts of this theory will be used throughout this literature review to explain the development of mathematic skills.

2.5.5 Typical Development of Mathematical Abilities

Mathematical ability is partly innate (Butterworth, 2005; Shalev, 2004). Infants as young as four months old demonstrate the ability to compare, understand, and respond to different quantities of items, for groups containing up to four items (Starkey & Cooper, 1980). This ability has also been observed in monkeys (Nieder, Freedman, & Miller, 2002), supporting the notion that, numeracy is a biologically based, innate ability. Using a habituation-dishabituation design, Wynn (1992)
demonstrated that 4- to 5-months old infants are sensitive to simple addition and subtraction scenarios. Wynn (1992) placed a doll on a stage, covered the doll with a curtain, and showed another doll instead of previous one. When the curtain was removed, babies looked for long time in case of one or three dolls, as compared to two (Wynn, 1992). Children, therefore, seem to have an innate ability to understand simple addition and subtraction problems.

The more advanced Mathematics skills are acquired through learning, or nurture. These mathematical abilities develop hierarchically (Ardila & Rosselli, 2002); each stage (enumeration, counting, Arithmetic, and understanding arithmetical concepts) builds upon the skills acquired in the previous stage (Ardila & Rosselli, 2002; Butterworth, 2005; Klein & Starkey, 1987). Enumeration is the ability to sequence and distinguishes between items in a group of objects (Ardila & Rosselli, 2002; Klein & Starkey, 1987). Infants show evidence of enumeration, as young as, six months old, although their number representations are often imprecise (Wood & Spelke, 2005). Enumeration continues to improve, as the child develops (Wood & Spelke, 2005).

Counting is an even more complex type of enumeration, as it requires many sub skills (Butterworth, 2005). Children must first learn the counting words; a skill that begins to emerge at about the age of two (Butterworth, 2005). Also, in their second year, children acquire the one-to-one principle and the stable order principle (Ardila & Rosselli, 2002). The one-to-one principle is the understanding, which each number word is linked with one and only one object (Gelman & Gallistel, 1978). The stable order principle embodies the concept which each number name is assigned to a permanent position in the list of numbers, and that the sequence of numbers in that list never changes (Ardila & Rosselli, 2002; Gelman & Gallistel, 1978). At around age three, children will demonstrate the third principle required to be able to count: the cardinal principle (Butterworth, 2005; Gelman & Meck, 1983). The cardinal principle is the understanding that, a
collection of items contains the number of objects corresponding to the last counting word used (Ardila & Rosselli, 2002; Gelman & Gallistel, 1978). Children continue to refine these counting skills until about the age of six (Butterworth, 2005).

Counting is considered as the basics of Arithmetic for most children (Butterworth, 2005, p. 8). Addition, therefore, is commonly taught by building on the child’s counting skills. There are three addition strategies, which make use of counting skills: counting all, counting on from first, and counting on from larger (Butterworth, 1999; Carpenter & Moser, 1982). Counting all develops first (Butterworth, 1999; Carpenter & Moser, 1982). Children in this stage, represent both numbers in the addition problem using physical objects (their fingers, for example), and will then count all the objects (Carpenter & Moser, 1982; Butterworth, 1999). In the next stage, counting on from first, children will no longer record the first added and will instead begin with that number and use an external aid (such as their fingers), to add on the second number (Carpenter & Moser, 1982; Butterworth, 1999). Final or last stage (starting on from bigger) is the most effective (Butterworth, 1999; Carpenter & Moser, 1982). Children select, from the equation the largest number and then use an external aid (such as fingers) to count on, the smaller addend (Butterworth, 1999; Carpenter & Moser, 1982). Subtraction develops similarly. Acquisition of addition and subtraction continues into the second grade.

The next stage of development is fluency with Arithmetic facts. At this stage, children, no longer needs to mentally add or subtract the numbers in an equation. Instead, the solution is quickly and accurately retrieved from memory (Butterworth, 2005). Siegler and Shrager (1984) suggest that over time, children learn to associate specific answers with specific equations.

At around the age of eight or nine, children begin to learn multiplication and division (Ardila & Rosselli, 2002). These new skills are also built upon previously mastered skills;
Multiplication and division are frequently explained in terms of repeated addition and subtraction (Butterworth, 2005).

Mathematical reasoning is a distinct domain of mathematical ability (Fuchs et al., 2008). It is defined as axiomatic reasoning, logical deduction, formal inference, and problem-solving (Arthur Steen, 1999). Relatively, little is known about how mathematical reasoning develops (Arthur Steen, 1999). There is evidence, however, that suggests that logical and mathematical thinking can develop naturally through social interaction, games, commercial transactions, and discussions with others (Schliemann & Carraher, 2002). This is not to say that mathematical reasoning cannot be further developed via formal instruction. Rather, Arthur Steen (1999) suggests that, active classroom tasks: such as discussion, projects and teamwork will be more effective than passive strategies such as memorization, drill, and templates in helping children develop mathematical reasoning.

In both research and practice, mathematical reasoning is often secondary to computation. Mathematics teachers often focus on teaching students how to do Mathematics with little focus on ensuring that their students understand how to reason mathematically (National Center for Educational Excellence, 1996). It is not surprising then that Zhou, Peverly, and Lin (2005) found that, first grade Chinese and American children’s numerical operation skills were better developed than their mathematical reasoning skills. The imbalance in knowledge and emphasis between computation and mathematical reasoning is not due to differences in their importance. Mathematical reasoning is necessary for solving word problems, finding patterns, and verbalizing logical explanations (Zhou et al., 2005).
2.5.5.1 Gender Differences in Mathematical Ability

There is a widespread mainstream belief that males have a greater aptitude for Mathematics than females. This belief can be traced as far back as 1894 when Havelock Ellis wrote about males’ cognitive superiority in a variety of domains including Mathematics. Since then, gender differences in mathematical ability have been the focus of many research studies and the source of great debate.

Many early studies reported significant gender differences in mathematical ability with the results favoring males. Research in this area continues to this day and the results are often, conflicting. Some researchers report no gender differences others find gender differences, sometimes in favor of males, other times the gender differences favor females. For example, Demie (2001), Gorard, Rees, and Salisbury (2001), and Penner (2003) have found gender differences in mathematical ability. The later researcher found that gender differences favored males in all areas measured. The conclusion of the two other studies was that females outperformed males in basic arithmetic. In contrast, Ding, Song, and Richardson (2007), Georgiou, Stavrinides, and Kalavana (2007), and Leahey and Guo (2001) have observed that, there are no significant differences in boys and girls in mathematical ability up to elementary level. Main reason for paradoxical findings can likely be attributed to various research methods (Aunio, Aubrey, Godfrey, Pan, & Liu, 2008). Researchers may have come to different conclusions because of sample differences (for example, cultural differences or age range), and/or type of Math skill investigated.

Meta-analysis has revealed that the magnitude of gender differences varies with age. These differences among male and female students become pronounced after their SSC level (Georgiou et al., 2007; Hyde, Fennema, &Lamon, 1990; Leahey&Guo, 2001).
Gender differences may also vary, depending on the specific Mathematics skill evaluated. Some research shows that females perform better on computation tasks, males do better on problem-solving tasks, and there is no difference in male and female students in comprehension of mathematical ideas or basic mathematical knowledge (Anastasi, 1958; Demie, 2001; Gorard et al., 2001; Hyde et al., 1990; Stage, Kreinberg, Eccles, & Becker, 1985). Females demonstrate superiority regarding computation as early as during elementary classes while superiority favoring males in problem solving do not emerge until SSC level and HSSC level (Hyde et al., 1990). Research in this area may have advanced and led to new conclusions in recent years. Unfortunately, recent research could not be located in a PsychInfo search.

Although, gender differences are relatively small among the majority of elementary school aged children, it is still important to determine the origin of slight differences. Some researchers attribute gender differences to gender socialization. There is some evidence to support this hypothesis. Teachers and parents think negatively about females acquiring advanced Math skills (Fox, 1976), which results in less encouragement for females to pursue advanced Mathematics. Some research has also shown that, there are gender differences in interest in Mathematics. One possible cause for this disinterest is popular media; the message in popular media often discourages females from taking interest in Mathematics (Bjorklund, 2005). Last, some researchers have demonstrated that females tend to have lower self-confidence in Mathematics and higher Math anxiety than males (Felson & Trudeau, 1991). In sum, the gender socialization hypothesis is that females are conditioned by society to believe that they have a lower aptitude for Mathematics, that society expects males to demonstrate better performance in Mathematics than females, and that females will not need advanced Mathematics skills (Felson & Trudeau, 1991; PerssonBenbow & Stanley, 1983).
Some researchers’ results have challenged the socialization hypothesis. Felson and Trudeau (1991) found no gender differences in parental encouragement in Mathematics and they found that although females have greater anxiety about Mathematics, they have greater general test anxiety, rather than a specific fear of Mathematics (Felson& Trudeau, 1991).

An alternate explanation for gender differences in Mathematics is biologically-based. Some researchers have proposed that gender differences in brain lateralization are the cause of gender differences in mathematical ability (Halpern, 1986). In addition, several reports have shown that males demonstrate different brain activation patterns than females when solving Mathematics problems, suggesting hard wired differences between the sexes (Hyde, 2007). This hypothesis has also been challenged. It could be that, there are differences between experiences of boys and girls in Mathematics with their growing age. (Hyde, 2007). Further evidence against a biologically-based hypothesis comes from meta-analyses. Analysis shows that, the ratio of gender differences in mathematical skills has decreasesd in the last few decades (Bjorklund, 2005). It is highly unlikely that drastic evolutionary changes in neuroanatomical could have occurred over such a short time span.

There is another alternative explanation for the gender differences in mathematical ability. It may be that differences in background knowledge and cognitive strategies lead to differences in mathematical ability (Bjorklund, 2005). Byrnes and Takahira (1993) found that males scored higher on tests of mathematical strategies, background knowledge, and aptitude [Scholastic Aptitude Test (SAT)]. Knowledge of strategies and background knowledge accounted for 50% of the variance in the SAT scores, and when these two factors were controlled for statistically, gender differences in SAT scores were no longer significant (Byrnes &Takahira, 1993). Questions still remain, however, such as why there are differences in background knowledge and strategies in the
first place, since grade-point average and numbers of Mathematics courses completed were comparable for males and females in Byrnes and Takahira’s (1993) study. The researchers proposed that, the source of gender differences in Mathematics is likely multi factorial, including socialization, physiological and cognitive factors (Bjorklund, 2005, p. 420).

Gender differences, in mathematical achievement are greatest among individuals, who score in the top fifth percentile with the gender difference favoring males (Bjorklund, 2005; Preckel et al., 2008). This differential representation of males, at the upper extreme is likely due to the fact, that males demonstrate significantly more variance in test scores than females (Feingold, 1992; Hedges &Nowell, 1995). As a result, males may be more likely, to enter and excel in mathematically-based occupations (Hedges &Nowell, 1995).

In conclusion, for most of the population, the difference between males and females in mathematical ability is small. The gap widens slightly with age across different types of Mathematics skills, and at the upper extreme of ability levels. It is important to understand the pattern, sources and implications of gender differences in mathematical ability because misinformation and stereotypes can negatively influence people’s self-image, self-esteem, achievement, occupational status and earnings (Hedges &Nowell, 1995).

2.5.5.2 Giftedness in Mathematics

Giftedness is often defined as extraordinary cognitive ability paired with extraordinary specific knowledge, and achievement in a particular domain (Lohman, 2005; Threlfall & Hargreaves, 2008). Still, the criterion for identifying giftedness often only consists of a score above a certain cutoff, on a measure of intellectual ability. Many school districts and researchers have selected an IQ of 130 as a cutoff score on a measure such as the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV) in order to be formally identified as gifted (Mills et al., 1994; Montague
& van Garderen, 2003; Tsui&Mazzocco, 2007; van Garderen& Montague, 2003). Other researchers use domain specific achievement scores to group children as, “gifted” (Ma, 2005; Mills, Ablard, &Gustin, 1994; Niederer, Irwin, Irwin, & Reilly, 2003; Swanson, 2006; Threlfall& Hargreaves, 2008). This method allows researchers to group students who may be gifted. Without a measure of, cognitive ability, children cannot be formally classified as gifted. As such, researchers who use achievement scores to group children into ability categories typically label the highest scoring group as, “precocious” or “talented” to highlight the fact that these students are not formally identified as gifted.

2.5.6 Gender Differences

Among the mathematically gifted, there are more males than females (Preckel et al., 2008). Benbow and Stanley (1983) compared the number of males and females who scored above 700 on the SAT-Mathematics and found a male-to-female ratio of 13:1. Gender differences in mathematical ability within the general population have been decreasing since the 1960s and the disparity continues to get smaller except among the gifted, where males continue to be disproportionately represented (Bjorklund, 2005).

2.5.6.1 Qualitative versus Quantitative

Same-age comparative studies have shown that gifted children are different from their fellows in many ways (Shore &Kanevsky, 1993; Steiner & Carr, 2003). Threlfall and Hargreaves (2008) stated that gifted learners:

- They have broader/wider knowledge and be able to make connection between the concepts
- They spend little more time on planning but they solve problems quickly.
- They represent and categorize problems more efficiently.
- They can elaborate knowledge well.
- They have variety of approaches with them and able to use those strategies more flexibly.
- They invite challenging and complex problems.
- They use their meta-cognition with sophistication and self-regulation.

Reichel (1997) noted several signs of mathematical giftedness, specifically. When new words, symbols, and sketches are created by students and they have deep insight of problems then they are able to reduce complexity, formalize, and generalize the concepts and apply formulas, and want to discuss Mathematics, they are demonstrating signs of mathematical giftedness (Reichel, 1997).

There has been debate and conflicting evidence as to whether these differences and the superior ability/achievement of gifted children are due to qualitative (life-long, fundamental differences in thinking processes, and strategies) or quantitative differences (precocity) between them and typically developing children (Shore & Kanevsky, 1993; Winner, 2000a). Many researchers purport that, mathematically gifted children are qualitatively different from average-ability children because the gifted take more time to orient to a problem, to utilize a wider range of problem-solving strategies, and to evaluate their progress both, during and after completing a problem (Niederer et al., 2003, p. 72).

However, it is unclear whether these differences remain over time and therefore whether they are truly qualitative differences. The majority of evidence support the theory that gifted children develop and process information in a qualitatively different way from typical children is anecdotal (Winner, 2000a). Systematic research is needed to determine whether extraordinary mathematical ability is always accompanied by qualitative cognitive differences throughout gifted individuals’ lives (Winner, 2000b).
In contrast, Threlfall and Hargreaves (2008) propose that the gifted and non-gifted difference between children is quantitative. Threlfall and Hargreaves (2008) compared how gifted students of nine-year old and average-achieving students of 13-year old solve Mathematics problems. The results of this study suggest that in at least some respects young, gifted children solve mathematical problems with a similar approach to that of older children of average ability (Threlfall & Hargreaves, 2008). This research supports the position that the difference between gifted and average ability children is a matter of precocity (a quantitative difference) (Threlfall & Hargreaves, 2008).

There are other researchers, still, who say that gifted children are both quantitatively and qualitatively different from average-achieving children (Winner, 2000a). There is clearly, a strong need for further systematic research to solve this debate.

**2.5.6.2 Nature versus Nurture**

It is a dominant cultural belief that giftedness is a product of the individual’s genetic makeup and that; it is innate (Winner, 2000b). Although there is some evidence to support this position, research has not supported the nature perspective unequivocally (Threlfall & Hargreaves, 2008).

A contrasting view, the “expert performance” approach, proposes that there is a clear link between giftedness and deliberate practice (Ericsson, Roring, & Nandagopal, 2007). There is scientific evidence supporting this position. Researchers have shown that, extraordinary achievement in a variety of domains (Science, Arts, Mathematics, athletics, piano, violin, chess, etc.) is predicted by the amount of time the individual spends on practicing (Ericsson, Krampe, & Tesch-Romer, 1993). Despite this and other evidence of the importance of nurturing giftedness, no evidence is contributed to genes as the main reason of difference among individuals which make them able to
develop their expertise. (Sternberg, 2001). In other words, it is most likely that both nature and nurture contribute to giftedness.

2.5.6.3 Educating the Mathematically Gifted

Giftedness is often overlooked as an area in need of research and interventions as giftedness is often viewed as something to be admired or envied, rather than, something that needs to be addressed with an intervention (Winner, 2000b). Also, advocates of the nature perspective believe that giftedness is an innate attribute that cannot be developed through training and intervention (Winner, 2000b). In reality, much is to be gained by, providing gifted children with interventions and/or enrichment programs that are tailored to their needs.

If the special education needs of gifted children are not met, these children are likely to be underserved (Mills et al., 1994; Silverman, 1989). Less stimulating curriculum in the subject of Mathematics is the source of less motivation, less achievement which also affects the value of education in the mind of gifted and talented students. (Ma, 2005). Gifted children need an appropriate level of challenge to ensure their happiness, mental health, and social integration (Winner, 2000b). Also, gifted children will become our future leaders and innovators; it is in all of our best interest to provide them with an education that will maximize their potential (Winner, 2000b). The best way to ensure that gifted students’ special needs are met and that they will reach their full potential is to provide them with individualized education (Lubinski & Persson Benbow, 2006; Mills et al., 1994).

Research suggests that acceleration is the most appropriate and impressive method for gifted children which supports them facing the challenges and also provides the appropriate speed or pace for their learning. (Mills et al., 1994). This is a process of advancing the student by providing him/ her with material that is at an appropriately challenging level (Feldhusen, 1989). Hundreds
of studies have shown that this is an effective method for enhancing the achievement of gifted students (Lubinski & Persson Benbow, 2006). What’s more, the positive effects of acceleration are long term. Participants in a fast-paced, intellectually rigorous Mathematics programs were two times more likely to have Mathematics- or Science-based careers than non-participants 10-20 years after completion of the program (Swiatek & Benbow, 1991). In sum, an effective gifted program will include acceleration.

Research also supports the use of flexible pacing for the mathematically gifted (Stanley, 1991; Winner, 2000a). Mills and colleagues (1994) evaluated the effect of a Mathematics program that incorporated flexible pacing. More specifically, the program integrated four strategies: (i) the curriculum was linear (students did not advance until they demonstrated mastery), (ii) the curriculum was flexibly paced (the pace was determined by each individual’s unique rate of achievement), (iii) no age or grade restrictions were placed on students, and (iv) instructional placement was determined by the student’s achievement level at the time of entry in the program (Mills et al., 1994). Third, fourth, fifth, and sixth grade mathematically gifted students demonstrated greater achievement gains over a 3-6 months period than controls (Mills et al., 1994). These gains were maintained after a period of five months (Mills et al., 1994).

Another major benefit of Mills and colleagues’ (1994) Mathematics program was that it provided a venue for like-minded children to meet and interact. Although gifted children tend to be more introverted and enjoy solitude more than average-achieving children, they still desire peer contact and friendships (Winner, 2000b). Gifted children especially desire interaction with like-minded peers (Winner, 2000b). Enrichment programs that bring gifted students together address this need.

In practice, the most common intervention for gifted children is placement in an enrichment or advanced class within the child’s school. Advanced classes are common at the secondary level but
rare at the elementary level (Winner, 2000b). This is unfortunate because enrichment classes are needed at all school levels as giftedness occurs at all ages.

Enrichment classes are most often headed by a special education teacher. This is an important component of the program as gifted students still need support despite their advanced knowledge. For gifted children, enrichment of topics which are irrelevant has less effective individual achievement. (Diezmann & English, 2001). The teacher is required to design an enrichment program that is appropriately challenging. The quality of this program, therefore, will depend on the teacher’s training, theoretical orientation, skill, and personality, etc. There is much variability in these teacher variables and thus there is much variability in the quality of enrichment programs. Despite this disadvantage, informal enrichment programs are commonly used interventions for gifted students.

Formal programs are employed much less frequently as interventions for gifted students although are many advantages to using formal programs. Formal programs provide the consistency that is lacking in informal programs as instruction and evaluation are standardized. Also, programs are periodically reviewed and revised by multiple professionals who often lead to a superior product. Third, formal programs are more likely, to be designed based on theory, and research. The disadvantages of formal programs are that they often cost money and that they can be too rigid and not individualized to the unique client’s needs. A formal program that also allows for individualization may be the optimal intervention for gifted children. Unfortunately, there is currently no research on programs of this nature.

Giftedness is defined as extraordinary performance or ability in one or more domains. Further research is needed to resolve the debate regarding whether, the differences between gifted and non-gifted children are quantitative, qualitative, or both. Similarly, there is a nature-nurture debate
as to the origins of giftedness; likely, both nature and nurture contribute. Last, research on interventions for gifted children has largely been ignored. The effectiveness of formal programs as interventions for gifted students is in particular need of research.

2.6 KUMON METHOD OF LEARNING

According to Izumi (2001), Kumon method of learning is the most favorite and successful program after school academics all over the world. Kumon has Centers in 46 countries and has over 40,000 students in Canada alone (Izumi, 2001; L. Kaul, personal communication, June 26, 2008). Kumon’s Mathematics and Reading programs are used by children with varying abilities, from individuals with disabilities (Autism, MR, LDs, etc.), typically developing individuals, to gifted students. The programs are also used by children in varying grades (from preschool to postsecondary education) (KTRIE, 2002; McKenna et al., 2005).

The Kumon programs were designed to supplement public education (McKenna et al., 2005). Most school boards take a spiral approach to Mathematics and Reading instruction; teachers introduce many skills and then spiral back at a later time to further develop each skill (KNA, 2008). Kumon’s approach is linear (KNA, 2008). Kumon teachers introduce one topic at a time and will not advance a student until he/she demonstrates mastery of the lower level skill (KNA, 2008). Still, Kumon is meant to complement, not replace, general education received at school (KNA, 2008).

When a student first enrolls in Kumon, he/she must write a placement test, based on his previous learning which decides the exact place or starting point of that child. It is also known as placement test, where student is assigned a starting level; there are 26 levels in the Math program and 24 levels in the Reading program. Following placement, students are to complete daily worksheets that are completed in about 20 minutes. Twice a week, Kumon students must go to a Kumon Centre where they have to complete their daily worksheets and pick up more worksheets for the rest of
the week. Immediately after completion of their worksheets, they should be graded by either a parent (if at home) or the teacher (if at the Centre). Students then correct their mistakes. After completing all the required worksheets for a given level with adequate accuracy and speed, students are given an Achievement Test to ensure that the level is in fact mastered. If the student is able to complete the Achievement Test with accuracy and speed, the student is promoted to the next level (KNA, 2008).

Anecdotal report tells that Kumon is the method which includes easy and comfortable starting point, in self learning, more and more practice which makes students perfect and they get mastery of that level and be able to move to the next level. Despite Kumon’s popularity and personal testimonials, only one empirical study of its effectiveness surfaced in a recent Psych Info search (McKenna et al., 2005). McKenna and colleagues (2005) measured the effectiveness of the Kumon Mathematics program for economically disadvantaged children in grades two through five. Results showed that children receiving Kumon Mathematics instruction had greater improvements in Mathematics skills than a control group after getting 3-4 months of instruction and that those gains were maintained 2 years later (McKenna et al., 2005). However, this study has several limitations. First, children’s achievements in Math are highly variable in grades one and two (APA, DSM-IV-TR, 2000) and thus including grade two students in the sample, may have skewed the results. Second, 98% of the participants in this study were African American so the study’s results may not be generalizable to the general population. Far more troublesome than the limitations of McKenna and colleagues’ (2005) study is the fact that this is the only published empirical study investigating Kumon’s effectiveness. A Math program used by millions of students (gifted, average, learning disabled, and otherwise) should have more evidence-based support.
2.6.1 Kumon and Gifted Students

Kumon method of teaching mathematics and reading is extensively used by gifted children. Due to its flexibility, Kumon meets all the educational needs of gifted group of children, because it deals every individual in a sequence (McKenna et al., 2005). McKenna, 2005 also said that gifted students can work and learn mathematics without waiting for others similar to their general classroom.

McKenna and fellows (2005) made a comparison between Kumon students and non-Kumon students and they found that Kumon students are much better in gaining Math’s skills in all levels as compared to non-Kumon students, but it did not show level of participation and also lacking in discussion phase. To determine the effectiveness of Kumon method for gifted students is at very early stage.

2.6.2 Kumon and Students with Disabilities

Kumon Mathematics and Reading programs are primarily used by average-achieving and gifted children; however, there are a significant number of students with disabilities who make use of these programs. KTRIE (2002) reported that there are approximately 4,700 children with disabilities enrolled in Kumon Centers in Japan. Kumon believes that every child has a right to grow and need to be guided to get his/ her maximum potential. (KNA, 2008; KTRIE, 2002). KTRIE (2002) reported that ‘expanding and developing one’s strong point … is important when teaching normal children, however, it is more important when teaching disabled children’ (p. 2). Although Kumon is not being used to treat the disabilities of children, but it helps in developing the ability and skills of children and develops their capacity to do or learn which can improve the disability of learning (KTRIE, 2002).
The Kumon Method also includes the tenet that learners should learn at their own pace (KTRIE, 2002). This flexibility is important for students, with disabilities as they often learn at a much slower pace than typically developing children (KTRIE, 2002). Even within groups of students with the same diagnosis, there will be variability in the rate at which each child learns. In sum, although Kumon was originally and mainly designed for average-achieving children, the Kumon Method of Learning also addresses the special needs of students with disabilities.

Effectiveness of Kumon method of teaching for students with disabilities has not been investigated empirically. However, there is an anecdotal report of the effectiveness of the Kumon Mathematics program for an 18-year-old with Down syndrome published in a journal (Haslam, 2007). Haslam (2007), the teenager’s Mother, suggested Kumon program due to its small steps and practice which made him to be successful in Mathematics. Parent reports of the benefits of Kumon add valuable information and support for further use of the program. Nevertheless, objective, quantitative support is needed.

2.6.3 About Kumon Method

Kumon method is time-framed method of learning with emphasis on building ability of independent learning among students. Kumon lectures or lessons are planed according to needs of every student, which encourages each student to get more and more. It is supplementary program which help in achieving goals of an institution (“Private tuition for children in core subjects of maths & English,” n.d.)

2.6.3.1 Success from the Beginning

In Kumon method of teaching, every child goes through a diagnostic test of his/ her previous learning which decides the exact starting point, which is comfortable to each individual and that
starting point is kept one level below their present status in school. This starting point which is
determined by Kumon instructors is most beneficial to them in developing their independent
learning ability, in building self confidence and to set a proper routine with program.

2.6.3.2 Promoting the Level -Just Right to children

In Kumon program, students are allowed to work on their own comfortable pace and flourish
neither keeping ages nor grades in mind, so Kumon provides just right level to them. After having
ability to comprehend the concepts, students move to the next or advance level.

2.6.3.3 Comprehending Concepts

Students become able to comprehend and understand truly after completing their work correctly
within allotted time-frame. Completion of assignments not only correctly but also in recommended
time will enable them to get strong grip of each concept and have ability to comprehend it.

2.6.3.4 Practice and practice makes man perfect

When students work daily under Kumon for 30-minute, that practice develops skills and they fully
and deeply concentrate on each topic. Regular work practice makes them able to understand
mathematics (“Private tuition for children in core subjects of maths & English,” n.d.)

2.6.3.5 Believing in Each Child’s Talent

Instructors have strong belief in every student’s potential and ability to do well by
Kumon. Teachers play a role of facilitators at Kumon who guide them to perform
their activities at their level best. Teachers plan their lesson-notes to achieve desired learning objectives of every child in the long-term.

### 2.6.3.6 Self-Learning

Kumon Curriculum has 26 levels in Mathematics and 24 levels in reading. Every next coming level is follows the previous one, with teacher’s effective lesson planning, by which students are able to learn their lesson independently which inculcates creative ability and analytical approach among them.

- Students get confidence and success in their academics.
- Kumon builds basic skills of students, key to overall success.
- Kumon helps students become able to get mastery on Math’s basics.
- Kumon helps students in improving their study habits.
- Kumon builds confidence and discipline
- Kumon helps in developing logical thinking and problem solving skills.

### 2.6.3.7 Kumon program is good for everyone.

Kumon program is carefully planned and has complete curriculum for all students from pre-school to high-school even up to college. Kumon facilitates students of all ages and at all stages in their schooling, which enables them to face the challenges of higher classes ("Private tuition for children in core subjects of maths & English,” n.d.)

### 2.6.4 Kumon Centre Work-Pattern.

Mostly students go to Kumon Center twice in a week. Each Kumon Centre deals with students in a friendly manner and gives them comfortable environment, where they can concentrate on work
with enough space. Students receive their tasks or class assignments which they have to complete independently. After completion, their works is checked and marked and also corrected if students have made any mistake, before leaving the centers. This practice make them realize what are the expectations and how they can remain comfortable and focused on their work during center-time which enables them to realize the actual benefits of learning on their own (“Kumon India opens new Centres in Mumbai and Pune,” n.d.)

Kumon teachers are trained and also certified according to Kumon’s requirements which is, each learner’s need based lesson plans. In Kumon lesson plans, ability of each student is kept in mind and makes material understandable to each child. Students work at their own pace under the kind supervision of instructors, which ensures that each child gets mastery before promotion to the next level. Kumon method of teaching enables each child to do his/ her work independently, above his/ her present level and this is the main aim of Kumon program.

2.6.4.1 Kumon Program helps children to grow academically and personally

Kumon method helps students to get mastery over basic skills which are key to their academic success as well as to groom their personality. Kumon enables the students to do the following:

- Mastery on fundamentals of mathematics and reading.
- Improvement of study habits.
- Enables students to concentrate deeply.
- Build confidence and discipline.
- Enables the students to learn independently.
- Develop their skills to think critically & analytically.
2.6.4.2 Kumon method is aligned with standards of a state

Kumon is world wide accepted curriculum which is organized in logical and systematic concepts and levels which help the students to achieve success in their organizations.

2.6.4.3 Kumon program has no conflict with classroom lesson plans

Kumon program is a supplement to school curriculum. Classroom experiences are much important to every child, and Kumon does not replace that and has no conflict with classroom activities. It reinforces which helps students to get proficiency and mastery in Mathematics and reading.

2.6.4.4D Kumon program is for all kind of children having learning disabilities

Kumon flourishes every child even from pre-school to high-school. Kumon program is highly flexible according to the needs of every individual. It can adjust or accommodate every child.

2.6.4.5 Data supports the efficacy of Kumon method

Many research studies have been conducted to show the performance of Kumon students in standardized tests. Data from the Trends in International Mathematics and Science Study show that 4th and 8th grade Kumon children scored above national and international averages in mathematics. In the United States, more than 50 percent math students are above their grade level, and one-fourth of them are 2 to 3 years above their grade in school (“Kumon India opens new Centres in Mumbai and Pune,” n.d.)

2.6.5 The Advantages of the Kumon Math Program

2.6.5.1 Reasons which make Kumon method of teaching different and great

There are many advantages of Kumon, which are as follows:
Students in Kumon have to work with their own speed or pace, which gives them opportunity to work without the fear of getting late or left behind as compared to other fellow beings. They can avail as much time as they require to get mastery on that particular unit or lesson.

There is a lot of repetition of work in Kumon method which makes understanding easy to every child. They can repeat their task again and again until they get complete grip on that topic.

In Kumon method, every child is given his/ her work in the form of a test, which is marked daily to see the accuracy and also the test is time-based. The booklets which are given to each child has its fixed time-frame to complete that task. If a child completes his/ her work within given standard time, he/ she will move on to the next level. It also shows the proficiency of every child in a subject, or need to get it.

The workbooks are not too long; they are short, but done and checked daily which gives the opportunity to focus without boredom. Every Kumon workbook takes maximum 20 minutes per day.

2.6.5.2 Disadvantages of the Kumon Math Program

Kumon Math Program has some disadvantages that are:

- Lot of repetition.
- Costly, unaffordable to all.
- Availability of same tutor every day is not possible sometimes.
- Answer books are given to the parents by Kumon centres and parents or guardians have to check the answers ("Kumon India opens new Centres in Mumbai and Pune," n.d.)
2.7 SPREADING GLOBALLY

2.7.1 More than 50 countries, Kumon is offering opportunities to students to learn

Kumon has its basic aim nurturing the students to meet the challenges of 21st century and gives support to societies globally. All over the world Kumon method of teaching provides activities to help students to explore their talent and develops maximum competencies to learn.

Total World Enrollment:

4,289,000  (total number of subject enrollments as of July, 2015) researcher’s personal visit to Dehiwala Colombo 6, Srilanka

2.7.2 Kumon Method develops student’s basic learning & academic abilities globally accepted

Kumon method is basically a Japanese technique, but it is accepted all over the world. Question arises why it is accepted by various countries different to one another in their cultures, values, and in their systems of education? The main reason, Kumon works with the mission to develop high academic abilities, over which foundation of whole education is laid. Students of all age groups are benefited by Kumon because Kumon method is an independent study program which is ideal for all.

2.7.3 Kumon aspiration is to help children grow along with people of world

Kumon method of teaching is spreading all over the world very quickly because it is a very simple method which requires only pen and paper. People all around the world are now realizing the need to explore their talent and to develop their skills up to maximum, this is the reason which gives the aspiration to people and that aspiration is the reason of spreading Kumon.
Kumon believes in the hidden talent of each child. Children flourish without considering their age or grade level. Every time a child has to face unknown and inexperienced challenge independently, he/she undergoes a procedure where his/her skill development is brought to maximum level having strong achievement sense.

Kumon workbooks carried small steps, where each child is allowed to progress gradually, which enable them to flourish smoothly from easy to difficult problems and finally towards advance level by their own.

In 1954, Toru Kumon was the founder of worksheets. These worksheets are continuously updated by considering reactions of students towards worksheets and feedback of Instructors. By getting the information from students and instructors, the worksheets are made more effective for self-learning. These worksheets are made to allow students to higher level of learning by their own. If students face some difficulties in solving the problems which are not understandable to them by their own, then kumon teachers are there to guide them. They never spoon-feed them with the solution of those problems. Instructors check the level of their understanding before facilitating them with hints. Instructors also help them by showing some examples/problems already studied, to enable them to solve difficult problems by themselves. In doing so, students feel satisfaction with a sense of achievement and become able to get mastery of new tasks independently ("Learn Japanese at Kumon! Class and Correspondence Course | KUMON Japanese Language Program," n.d.)

Kumon instructor plays an important and key role to explore the hidden potential in each student. Instructors pay attention on each and every child personally to see their academic ability, their personality and how they solve the worksheets. Instructors are there to provide effective support to them to make sure their learning at a “just-right” level them. The academic growth of each
student is acknowledged by Kumon instructors without comparing with others, while praising and encouraging them. At the same time, they also meet regularly with parents to evaluate and monitor the academic development of every child. Students are benefited fruitfully by Kumon through true dedication of teachers, who sincerely wish to achieve the desires of Kumon program.

2.8 SUMMARY OF LITERATURE REVIEW

Learning theory is used to guide understanding of the development of mathematical ability. Behavioral Psychology’s learning hierarchy model and Cognitive Psychology’s information-processing model are especially useful in studying typical and atypical development in Mathematics. These models are useful in interpreting whether the differences between children with Mathematics Disorder, average achieving children, and gifted children are quantitative, qualitative, or both. Another important area within the literature on Mathematics is the issue of whether differences exist between the gender in terms of mathematical ability.

The knowledge base of effective remedial and enrichment Mathematics programs is insufficient. Kumon is an afterschool Math program that claims to be effective for children of varying abilities. There is only one empirical study that has investigated Kumon’s effectiveness in a scientific manner. This is unacceptable considering that the program is used by hundreds of thousands of children across the World.

In sum, the current state of knowledge demands systematic, quantitative research of Mathematics programs for children of varying abilities. Since Kumon seems to be a promising intervention (based on a previous related available literature and anecdotal report) and its use is so ubiquitous, the current study will begin to add to the current literature by investigating the effectiveness of Kumon as a remedial and enrichment Mathematics program.
Mathematics requires accumulating gained knowledge by practice. Students enhance the ability to calculate, to develop skill of analysis and logical thinking in an easy way to grip the mathematics of senior classes (differential and integral calculus). Kumon method of teaching helps them to cultivate problem solving skill they may face in coming years of life. Workbooks emphasis to develop strong skills of calculation which make the students able to apply those skills to other concepts of mathematics. Kumon program of Mathematics releases the sense of fear and failure of subject and realises them that they can do it. Kumon program has two very significant questions. 1st, everyone has to decide his own mission, and 2nd, there is a core value of working hard and being regular to achieve that mission. Kumon is a new method of learning where every one has to seek knowledge by self-learning, only assistance by teacher, when it is required to them. 

kumon;

i) gives clear and precise instruction practice and practice to every individual of all levels.

ii) provides for automaticity.

iii) to begin to think and to work independently.

To discourage rote-learning and to keep all students away from it, teacher should prepare him/herself to provide an opportunity to young kids to get meaning or to know the purpose of their learning and experiences.

In view of facts that acquired knowledge may become obsolete very soon, she or he has to teach the students how to learn, how to make a distinction between important and unimportant facts, reasons and views, and how to make a sensible use of present knowledge for gaining further knowledge and better understanding.
CHAPTER- 3

METHOD OF RESEARCH

This experimental research was conducted to determine the effectiveness of Kumon method with comparison to traditional method for teaching of Mathematics to Grade-5 students. The research study has the following steps:-

Population and sample

Time-schedule of the research study;

Research experimental design;

Instrument of the study;

Collection and Analysis of Data.

3.1 POPULATION

The population of the study consisted of 5th grade students studying in three Fazaia Inter Colleges in Rawalpindi and Islamabad. The population consisted of 97 boys and 118 girls. The population size was thus 215 students.

3.2 SAMPLE

One of the three Fazaia colleges was selected as cluster sampling randomly. All grade-5 students of the selected college formed the sample of the study.

3.3 TIME-TABLE

Phase-1

The study was carried out in two phases, one for twelve (12) weeks (October, 2014 to December 2014) and other for six (6) weeks (April 2015 to May 2015) for teaching Mathematics to Grade 5 students of the Fazaia Inter College Jinnah Camp Nur Khan Rawalpindi.
Experiment No. 1 was conducted for 12 weeks in F.I.C J/C Nur Khan Rawalpindi.

The researcher took 60 sessions in F.I.C J/C Nur Khans. The control group was taught by another mathematics teacher of the same qualification and experience as that of the researcher, the experimental group was taught by the researcher.

The time-table of study was as under:-

September, 2014 Pre test (academics) was conducted on Grade-5 students of F.I.C J/C Nur Khan 22-09-2014 at 9:00 A.M.

Weekly Time-Table from October to December (Three months)

Daily 3rd period from 9:10A.M to 9:50 A.M for both the groups (Experimental and Control).

Three End Chapter Tests were also conducted after completion of every chapter.

December, 2014 Post-test (academics) was conducted on 31-12-2014 at 9:00A.M.

Time-Table of phase-1 is appended (Appendix VII).

**Phase-2**

Experiment No. 2 was conducted for six weeks in F.I.C J/C Nur Khan Rawalpindi.

The researcher took 30 sessions in F.I.C J/C Nur Khan. The control group was taught by same the mathematics teacher (phase-1) of same qualification and experience as that of the researcher, the experimental group was taught by the researcher.

The time-table of study scheduled was as under:-

On March 30, 2015 Pre test (academics) was conducted on Grade-5 students of F.I.C J/C Nur Khan at 9:00 A.M.

Weekly Time-Table from April to May (six weeks)

Daily 3rd period from 9:10A.M to 9:50 A.M for both the groups (Experimental and Control).
Two End Chapter Tests were also conducted after completion of each of the two chapters. (Chapter 1 and 2)

Post-test (academics) was conducted on 15-05-2015 at 9:00A.M.

Time-Table of phase-2 is appended (Appendix XXIII).

### 3.4 RESEARCH DESIGN

In comparison to other experimental designs, Pre-test Post test time series equivalent group design was decided to be more effective for Mathematics because it easily excludes irrelevant materials. (Bukhari, M.A, 1999).

The two groups were equated in the light of results of students in their pre-test. One group was named as the experimental group, and other group was named as the control group. Experimental group was treated by Kumon method and traditional lecture method was used to treat control group.

For the purpose of data collection, the following design was used.

<table>
<thead>
<tr>
<th>Pre</th>
<th>ECT1</th>
<th>ECT2</th>
<th>ECT3</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>E R</td>
<td>O1</td>
<td>treatment O3</td>
<td>treatment O5</td>
<td>treatment O7</td>
</tr>
<tr>
<td>C R</td>
<td>O2</td>
<td>O4</td>
<td>O6</td>
<td>O8</td>
</tr>
</tbody>
</table>

The two groups were equated in the light of results of students in their pre-test. One group was called the experimental group, and other group was named as the control group. Kumon Teaching Method was used for teaching the students of experimental group. Lecture method was used to teach the students of control group.

The study was carried out in two phases, one for 12 weeks and other for six weeks. In phase I, pre-test was conducted on 22-09-14. Teaching was conducted from October 1, 2014 to December 24,
2014. After completion of every chapter, students were given tests. Three ECTs were conducted during treatment. ECT₁ was conducted on October 27, 2014, ECT₂ was conducted on November 24, 2014 and ECT₃ was conducted on December 28, 2014. Three days were given for revision. On December 31, 2014, after 12 weeks, both groups were given the posttest. t-test was applied to find out the significant difference in their achievement. Significance level was 0.05. In phase-2, same procedure was applied. Pre-test was conducted on 30-03-15. Teaching was conducted from April 1, 2015 to May 15, 2015. After completion of every chapter students were given tests. Two ECTs (end chapter tests) were conducted during treatment. ECT₁ was conducted on April 20, 2015; ECT₂ was conducted on May 12, 2015. Three days were given for revision. On May 15, 2015, after 6 weeks, both groups were given the posttest. t-test was applied to find the difference in their achievement. Results of both the phases were compared.

3.4.1 Independent Variables


2. Traditional lecture method of teaching.

3.4.2 Dependent Variables

1. Achievement of students.

The researcher also controlled other extraneous variables by keeping the same time-table, qualifications and teaching experience of teachers for experimental and control groups.

No extra coaching was provided during the research period.

3.5 RESEARCH INSTRUMENT

The basic tool for collection of data was ‘‘Mathematics Achievement Test’’ developed by Teacher’s Training Institute Islamabad. The test consisted of objective type questions from the
units used in the study. There were 25 test items (MCQs) in the Pre-test and the Post-test, with 10 items in each chapter test. (Appendices I, XIII, XVII phase-I) and (Appendices XX, XXVIII, XXXI phase-II)

3.5.1 Preparation of Pre-test of academic achievement, end chapter tests, post-test of academic achievement.

Researcher used Pre-test of academic achievement, end chapter tests and post-test of academic achievements developed by Teachers Training Institute Islamabad based on Blooms Taxonomy.

3.6 PILOT TESTING

Before conducting the study, the instruments were tested in two schools (F.G.H.S No: 1 for boys Chaklala, and F.G.H.S for girls Chaklala) on 20 male and 20 female students. After getting feedback and after consultation with the supervisor, the tests were improved.

3.6.1 Validity and Reliability

The instrument was improved in consultation with three working Mathematics teachers. Reliability of the test was determined by test-retest method. The test was administered to the students of the colleges, not selected in the sample. Pearson Product Moment was used to determine the correlation in scores yielded by two administrations. The reliability figures of pre-test and posttest of academic achievement were 0.86 and 0.83 respectively which were calculated through Spearman Brown formula using Statistical Package for Social Sciences (SPSS).

3.7 PROCEDURAL STEPS OF THE STUDY

For the formation of the experimental and control groups of Grade-5 students, pre-test was administered on the sample. The test was of 90 minutes duration. After conducting the test, results were prepared to form both the groups.
3.7.1 Students Group Formation

Two equal groups of students were formed in the light of pre-test results. There was equal number of students in both the groups, 35 students (male & female) in each group. Two groups were formed on the basis of their mean values in academics. One group which was treated by Kumon method was named as experimental group and other group was taught by traditional lecture method and it was named as control group. Achievement scores are given in Appendix III phase-I and appendix XXII phase-II).

3.7.2 Lesson plans for experimental and control groups

Text book was consulted to prepare lesson plans. For this study, Mathematics Book-5 was used in consultation with the experts and subject specialists of Mathematics. Several teaching aids were used as teaching materials to teach Mathematics through kumon method and lecture method and these aids are as under:-

- Lesson plans on kumon teaching method(Appendix IV);
- Lesson plans on traditional lecture method of teaching (Appendix V);
- Chalk, Duster, Textbook, black-board /white-board and marker;
- Teaching material required for teaching like multi-media, charts, flash cards etc.
- Work sheets of experimental group (Appendix VI)

3.7.3 Procedural steps of experimental and control groups

Grade-5 children were divided into two groups (experimental & control). Experimental group was taught by Kumon method whereas lecture method was used for teaching the students of control group. This practice was carried out for twelve weeks for phase-1. Sixty periods were taken, and then Post test of academic achievement was conducted. Moreover ECTs (during treatment) were
conducted, to find out the continuous difference in students’ performance. In phase-2 the same practice was carried out for six weeks. Thirty periods were conducted, and then Posttest of academic achievement and ECTs (during treatment) were conducted to find out the difference in student’s performance. During the period of research, cooperation was extended by the principal, teaching staff and administration. The results of Grade-5 students in all tests (pre, post and ECTs) are appended in Appendices III, XVII, XIX phase-I and appendices XXII, XXX, XXXIII phase-II).

3.8 DATA COLLECTION

By evaluating all tests, Pre-test (before treatment), ECTs (during treatment) and Post-test (after treatment) were conducted. To determine the effectiveness of teaching Mathematics through kumon method, in comparison with traditional lecture method, ECTs and Post-test of academic achievements were conducted on male and female students. To determine the difference between effectiveness of two methods of teaching Mathematics, results of all tests, (pre, post & ECTs) were considered as data for this study.

3.9 ANALYSIS OF DATA

Academic achievement of the two groups was analyzed by applying t-test. Using version16 of Statistical Package for Social Sciences (SPSS), the data was analyzed.

The conclusions were drawn and recommendations were made on the basis of analysis of the data.
CHAPTER- 4

PRESENTATION AND ANALYSIS OF DATA

This chapter deals with the presentation and analysis of data and the discussion has been made in two phases.

Phase-1: Experiment No 1

Phase-2: Experiment No 2

PHASE-1

Phase-1 deals with the experiment conducted for 12 weeks during the period from October, 2014 to December, 2014. The following data have been presented in the appendices given against each.

Pre-Test objective type test of phase-1(appendix I);

Key for pre-test of phase-1(appendix II);

Pre-test of academic achievements of phase-1(appendix III);

Model lesson plans of experimental group taught by Kumon Method (appendix IV);

Model lesson plans of control group taught by traditional lecture method (appendix V);

Work sheets of experimental group (appendix VI);

Time-table for teaching the groups (appendix VII);

List of boys in experimental group (appendix VIII);

List of girls in experimental group (appendix IX);

List of boys in control group (appendix X);

List of girls in control group (appendix XI);

Name / Topics of 32 lessons taught (appendix XII);

Post-Test objective type test of phase-1(appendix XIII);
Key for post test (appendix XIV);

Post-test academic achievements of phase-1(appendix XV);

4.1: Pre-test and Post-test (Phase-I)

Award lists of pre-test and post-test (Phase-I) have been appended (appendices III and XVII) and the data shown in these award lists were used to calculate Mean value, Standard deviation value and t-values and these values have been presented in table 1, and figure 1.

Table-1: Data of Pre-test and Post-test (Phase-I)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Experimental (n=35)</th>
<th>Control (n=35)</th>
<th>95% Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D</td>
<td>Mean</td>
</tr>
<tr>
<td>Pre-test</td>
<td>17.23</td>
<td>3.14</td>
<td>17.54</td>
</tr>
<tr>
<td>Post-test</td>
<td>22.37</td>
<td>1.82</td>
<td>18.74</td>
</tr>
</tbody>
</table>
It is clear from the data of Table 1 and Figure 1, that:

1. Mean value of pre-test on experimental group is 17.23 and mean value of control group is 17.54. Difference between the Mean values of pre test on experimental and control groups is 0.31 and it is not significant and the groups are approximately equivalent at pre test level.

2. Mean value of post-test on experimental group is 22.37 and mean value of control group is 18.74. Difference between the Mean values of post test on experimental and control groups is 3.63 and it is highly significant even at $p < .001$.

4.2: End Chapter Tests (Phase-I)

End chapter tests were also conducted as per requirements of experimental design, and the data collected in these tests have been placed as under:

End Chapter Tests of phase-1(appendix XVI);
Key of End Chapter Tests (appendix XVII);
List of Topics within the chapters (appendix XVIII);
End Chapter Test Academic Achievement of phase-1 (appendix XIX);

Award lists of End Chapter Tests on experimental and control groups (Phase-I) have been appended (appendix XIX) and the data shown in these award lists were used to calculate Mean values, Standard deviation values and t-values and these values have been placed in Table 2 and figure 2.

**Table-2: Data of End Chapter Tests (Phase-I)**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Experimental (n = 35)</th>
<th>Control (n = 35)</th>
<th>p</th>
<th>95% Conf.Int</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D</td>
<td>Mean</td>
<td>S.D</td>
</tr>
<tr>
<td>ECT1</td>
<td>7.83</td>
<td>1.5</td>
<td>5.74</td>
<td>1.58</td>
</tr>
<tr>
<td>ECT2</td>
<td>8.14</td>
<td>.94</td>
<td>6.71</td>
<td>1.43</td>
</tr>
<tr>
<td>ECT3</td>
<td>8.89</td>
<td>.77</td>
<td>7.0</td>
<td>1.52</td>
</tr>
</tbody>
</table>

*Note.* ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2; ECT3 = End Chapter Test-3;

**Figure 2**

![End Chapter Tests (ECT) achievement score](image)

It is clear from the data of Table 2 and Figure 2, that:-
1. Mean values of experimental group in ECT₁, ECT₂ and ECT₃ are (7.83), (8.14) and (8.89) respectively. Mean values of control group in ECT₁, ECT₂ and ECT₃ are ((5.74), (6.71) and 7.0) respectively.

2. Differences between the Mean values of ECT₁, ECT₂ and ECT₃ on experimental and control groups are 2.09, 1.43 and 1.89 respectively which are highly significant at p < .001.

4.3: Pre-test and Post-test for boys and girls of experimental group (Phase-I)

Award lists for boys and girls were separately prepared in case of both the Experimental and Control groups. Their Means and Standard deviations were separately calculated in the data and given in tables. Award lists of pre-test and post-test for boys and girls of experimental group have been appended.(appendices VIII and IX)

The data shown in these award lists were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in table 3 and figure 3.

### Table-3: Data of Pre-test and Post-test for boys and girls of experimental group (Phase-I)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys</th>
<th>Girls</th>
<th>p</th>
<th>95% Conf.Int</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D</td>
<td>Mean</td>
<td>S.D</td>
</tr>
<tr>
<td>Pre-test</td>
<td>17.47</td>
<td>3.18</td>
<td>17.00</td>
<td>3.18</td>
</tr>
<tr>
<td>Post-test</td>
<td>22.59</td>
<td>1.77</td>
<td>22.17</td>
<td>1.88</td>
</tr>
</tbody>
</table>

*Note. ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2; ECT3 = End Chapter Test-3;*
It is clear from the data of Table 3 and Figure 3, that:

1. Mean values of pre-test for boys and for girls are (17.47) and (17.00) respectively. Difference between the Mean values of pre-test of boys and girls on experimental group is (0.47) and it is not significant at p > .05.

2. Mean values of post-test for boys and for girls are (22.59) and (22.17) respectively. Difference between the Mean values of boy and girls on post-test of experimental group is (0.42) and it is not significant at p > .05.

4.4: End Chapter Tests for boys and girls on Experimental group (Phase-I)

Award lists of End Chapter Tests for boys and girls of experimental group (Phase-I) have been appended (appendices VIII and IX) and the data in these award lists of End Chapter Tests were
used to calculate Mean values, Standard deviation values and t-values and these values have been presented in Table 4 and figure 4.

Table-4 Data of End Chapter Tests for boys and girls on Experimental group (Phase-I)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys ( (n =17) )</th>
<th>Girls ( (n =18) )</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>S.D</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>S.D</td>
<td>M</td>
</tr>
<tr>
<td>ECT1</td>
<td>7.59</td>
<td>1.23</td>
<td>8.06</td>
</tr>
<tr>
<td>ECT2</td>
<td>8.12</td>
<td>.93</td>
<td>8.17</td>
</tr>
<tr>
<td>ECT3</td>
<td>8.88</td>
<td>.67</td>
<td>8.83</td>
</tr>
</tbody>
</table>

*Note:* ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2; ECT3 = End Chapter Test-3;

Figure 4

*End Chapter Tests (ECT) achievement scores of experimental group*

It is clear from the data of Table 4 and Figure 4, that:-
1. Mean values of boys in ECT 1, ECT 2 and ECT 3 are (7.59), (8.12) and (8.88) respectively and mean values of girls in ECT 1, ECT 2 and ECT 3 are (8.06), (8.17) and (8.83) respectively.

2. Difference between the Mean values of ECT 1, ECT 2 and ECT 3 of boys and girls of experimental group are 0.47, 0.05, and 0.05 respectively and these differences are insignificant at $p > .05$.

4.5: Pre-test and Post-test for boys and girls of Control group (Phase-I)

Award lists of pre-test and post-test for boys and girls of control group (Phase-I) have been appended (appendices X and XI) and the data in these award lists were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in Table 5 and figure 5.

Table 5: Data of Pre-test and Post test for boys and girls on Control Group (Phase-I)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys $(n=16)$</th>
<th>Girls $(n=19)$</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>S.D</td>
<td>M</td>
</tr>
<tr>
<td>Pre-test</td>
<td>17.69</td>
<td>3.01</td>
<td>17.42</td>
</tr>
<tr>
<td>Post-test</td>
<td>18.75</td>
<td>2.78</td>
<td>18.74</td>
</tr>
</tbody>
</table>

Note. ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2; ECT3 = End Chapter Test-3;
It is clear from the data of Table 5 and Figure 5, that:-

1. Mean value of pre-test for boys and for girls are (17.69) and (17.42) respectively. Difference between the Mean values of pre-test for boys and girls on control group is 0.27 and it is not significant at \( p > .05 \).

2. Mean value of post-test for boys and for girls are (18.75) and (18.74) respectively. Difference between the Mean values of post-test of boys and girls of control group is 0.01 and it is not significant at \( p > .05 \).

4.6: End Chapter Tests scores for boys and girls of Control group (Phase-I)

Award lists of End Chapter Tests for boys and girls of control group (Phase-I) have been appended (appendices X and XI) and the data in these award lists of End Chapter Tests were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in Table 6 and figure 6.
Table-6: Data of End Chapter Tests for boys and girls of control group (Phase-I)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys (n=16)</th>
<th></th>
<th></th>
<th>Girls (n=19)</th>
<th>P</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
<td>LL</td>
</tr>
<tr>
<td>ECT1</td>
<td>5.75</td>
<td>1.39</td>
<td>5.74</td>
<td>1.759</td>
<td>.024</td>
<td>.98</td>
</tr>
<tr>
<td>ECT2</td>
<td>6.50</td>
<td>1.71</td>
<td>6.89</td>
<td>1.15</td>
<td>-0.81</td>
<td>.42</td>
</tr>
<tr>
<td>ECT3</td>
<td>6.69</td>
<td>1.54</td>
<td>7.26</td>
<td>1.49</td>
<td>-1.12</td>
<td>.26</td>
</tr>
</tbody>
</table>

*Note:* ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2; ECT3 = End Chapter Test-3;

Figure 6

End Chapter Tests (ECT) achievement score

It is clear from the data of Table 6 and Figure 6, that:

1. Mean values of boys in ECT 1, ECT 2 and ECT 3 are (5.75), (6.5) and (6.69) respectively and mean values of girls in ECT 1, ECT 2 and ECT 3 are (5.74), (6.89) and (7.26) respectively.
2. Difference between the Mean values of boys and girls on control group in ECT₁, ECT₂ and ECT₃ are 0.01, 0.39, and 0.57 respectively and these differences are nonsignificant at p > .05.

4.7: Descriptive Statistics and paired sample t-test for experimental group (Phase-I)

The data shown in award lists of Pre-test and Post-test of experimental group were used to calculate paired sample t-test and these values have been presented in table 7 and figure 7.

Table-7: Descriptive Statistics and paired sample t-test for the experimental group (Phase-I)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pretest</th>
<th>Posttest</th>
<th>95% CI for Mean Difference</th>
<th>r</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement Score</td>
<td>17.23</td>
<td>22.37</td>
<td>-5.8, -4.49</td>
<td>.83**</td>
<td>15.91**</td>
</tr>
</tbody>
</table>

**p< .001.

Figure 7
It is clear from the data of Table 7 and Figure 7, that:-

Mean value of pre-test of experimental group is 17.23 and mean value of post-test of experimental group is 22.37. These figures show significant difference in pretest and posttest scores at .001 level.

4.8: Descriptive Statistics and paired sample t-test for the Control group (Phase-I)

The data in award lists of pre-test and post-test on control group were used to calculate paired sample t-test and these values have been presented in table 8 and figure 8.

Table-8: Descriptive Statistics and paired sample t-test for the Control group (Phase-I)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pretest</th>
<th>Posttest</th>
<th>95% CI for Mean Difference</th>
<th>r</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement</td>
<td>M 17.54</td>
<td>M 18.74</td>
<td>-1.88, -0.52</td>
<td>.74**</td>
<td>3.58*</td>
</tr>
<tr>
<td>Score</td>
<td>SD 2.86</td>
<td>SD 2.51</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<.01; **p< .001.

Figure 8
It is clear from the data of Table 8 and Figure 8, that:-

Mean value of pre-test on control group is 17.54 and mean value of post-test on control group is 18.74. These figures show significant difference in pre-test and post-test scores at the .01 significant level.

**PHASE-2**

Phase-2 deals with the experiment conducted for six weeks during the period April, 2015 to May, 2015. The following data is presented in the appendices given against each.

Pre-Test objective type test of phase-2(appendix XX);

Key for pre-test of phase-2(appendix XXI);

Pre-test of academic achievements of phase-2(appendix XXII);

Time-table for teaching the groups (appendix XXIII);

List of Boys in experimental group (appendix XXIV);

List of Girls in experimental group (appendix XXV);
List of Boys in control group (appendix XXVI);

List of Girls in control group (appendix XXVII);

Post-Test objective type test of phase-2(appendix XXVIII);

Key for post test (appendix XXIX);

Post-test academic achievements of phase-2(appendix XXX);

**4.1: Pre-test and Post-test (Phase-II)**

Award lists of pre-test and post-test (Phase-II) have been appended (appendices XXII and XXX) and the data shown in these award lists were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in table 1 and figure 1.

**Table 9: Data of Pre-test and Post-test (Phase-II)**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Exp. Group $(n = 35)$</th>
<th>Cont. Group $(n = 35)$</th>
<th>P</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Pre-test</td>
<td>16.77</td>
<td>4.01</td>
<td>16.97</td>
<td>4.25</td>
</tr>
<tr>
<td>Post-test</td>
<td>20.89</td>
<td>2.41</td>
<td>17.40</td>
<td>3.81</td>
</tr>
</tbody>
</table>
It is clear from the data of Table 9 and Figure 1 of experiment 2, that:

1. Mean value of pre-test on experimental group is 16.77 and mean value on control group is 16.97. Difference between the Mean values of pre test on experimental and control group is (0.20) and it is not significant, and the groups are approximately equivalent at pre-test level.

2. Mean value of post-test on experimental group is 20.89 and mean value on control group is 17.40. Difference between the Mean values of post test of experimental and control group is (3.49) and it is significant at 0.05 levels.

3. This mean difference of pre-test and post-test on experimental group is 4.12 and it is highly significant even at p < .001.

4.2: End Chapter Tests (Phase-II)

End chapter tests were also conducted as per requirements of experimental design, and the data collected in these tests have been presented in tables.
End Chapter Tests of phase-2 (appendix XXXI);

Key of End Chapter Tests (appendix XXXII);

End Chapter Test Academic Achievement of phase-2 (appendix XXXIII);

Award lists of End Chapter Tests on experimental and control groups (Phase-II) have been appended (appendix XXXIII) and the data shown in these award lists were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in Table 2 and figure 2.

**Table 10: Data of End Chapter Tests (Phase-II)**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Exp. Group ((n = 35))</th>
<th>Cont. Group ((n = 35))</th>
<th>P</th>
<th>95% CI Lower Limit</th>
<th>95% CI Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>S.D</td>
<td>M</td>
<td>S.D</td>
<td></td>
</tr>
<tr>
<td>ECT1</td>
<td>7.86</td>
<td>1.47</td>
<td>6.31</td>
<td>1.34</td>
<td>.000</td>
</tr>
<tr>
<td>ECT2</td>
<td>8.43</td>
<td>.97</td>
<td>7.03</td>
<td>1.12</td>
<td>.000</td>
</tr>
</tbody>
</table>

*Note. ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2;*

**Figure 2**

It is clear from the data of Table 10 and Figure 2, that:-
1. Mean values of experimental group in ECT₁ and in ECT₂ are 7.86 and 8.43 respectively. And mean values of control group in ECT₁ and in ECT₂ are 6.31 and 7.03 respectively.

2. The differences on means of ECT₁ and ECT₂ on Experimental and control groups are 1.55 and 1.4 respectively and these differences are highly significant at \( p < .001 \).

### 4.3: Pre-test and Post-test for boys and girls of experimental group (Phase-II)

Award lists for boys and girls were separately prepared in case of both the Experimental and Control groups. Their Means and Standard deviations were separately calculated in the data and given in tables. Award lists of pre-test and post-test for boys and girls of experimental group have been appended. (appendices XXIV and XXV)

The data shown in these award lists were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in table 3 and figure 3.

#### Table 11: Data of Pre-test and Post-test for boys and girls of experimental group (Phase-II)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys ((n = 19))</th>
<th>Girls ((n = 16))</th>
<th>( p )</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Pre-test</td>
<td>17.05</td>
<td>3.96</td>
<td>16.44</td>
<td>4.17</td>
</tr>
</tbody>
</table>

*Note. ECT₁ = End Chapter Test-1; ECT₂ = End Chapter Test-2;*

**Figure 3**
It is clear from the data of Table 11 and Figure 3, that:

1. Mean value of pre-test for boys is (17.05) and mean value of pre-test for girls is (16.44).
   Difference between the Mean values of pre-test of boys and girls on experimental group is (0.61) and it is not significant at p > .05.

2. Mean value of post-test for boys is (21.11) and mean value of post-test for girls is (20.63).
   Difference between the Mean values of boy and girls on post-test of experimental group is (0.48) and it is not significant at p > .05.

4.4: End Chapter Tests for boys and girls on Experimental group (Phase-II)

Award lists of End Chapter Tests for boys and girls of experimental group (Phase-II) have been appended (appendices XXIV and XXV) and the data in these award lists of End Chapter Tests were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in Table 4 and figure 4.
Table 12 Data of End Chapter Tests for boys and girls on Experimental group (Phase-II)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys $(n = 19)$</th>
<th>Girls $(n = 16)$</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>ECT1</td>
<td>8.00</td>
<td>1.63</td>
<td>7.69</td>
<td>1.30</td>
</tr>
<tr>
<td>ECT2</td>
<td>8.53</td>
<td>.905</td>
<td>8.31</td>
<td>1.07</td>
</tr>
</tbody>
</table>

Note. ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2;

Figure 4

It is clear from the data of Table 12 and Figure 4, that:-

1. Mean values of boys on experimental group in ECT 1 and ECT 2 are (8.00) and (8.53) respectively and mean values of girls on experimental group in ECT 1 and ECT 2 are (7.69) and (8.31) respectively.

2. Difference between the Mean values of ECT 1 and ECT 2 of boys and girls on experimental group are 0.31 and 0.22 respectively and these differences are non significant at $p > .05$.
4.5: Pre-test and Post-test for boys and girls of control group (Phase-II)

Award lists of pre-test and post-test for boys and girls of experimental group have been appended. (Appendices XXVI and XXVII)

The data shown in these award lists were used to calculate Mean value, Standard deviation and t-values and these values have been presented in table 5 and figure 5.

Table 13: Data of Pre-test and Post test for boys and girls on control group (Phase-II)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys (n =19)</th>
<th>Girls (n =16)</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
<td></td>
<td>LL</td>
</tr>
<tr>
<td>Pre-test</td>
<td>16.37 4.13</td>
<td>17.69 4.40</td>
<td>-.912</td>
<td>.368</td>
</tr>
<tr>
<td>Post-test</td>
<td>17.05 4.22</td>
<td>17.81 3.31</td>
<td>-.582</td>
<td>.565</td>
</tr>
</tbody>
</table>

*Note. ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2;*

Figure 5
It is clear from the data of Table 13 and Figure 5, that:-

1. Mean value of pre-test for boys on control group is (16.37) and mean value for girls on control group is (17.69). Difference between the Mean values of pre-test of boys and girls on control group is (1.32) and it is not significant at $p > .05$.

2. Mean value of post-test for boys on control group is (17.05) and mean value for girls is (17.81). Difference between the Mean values of boy and girls on post-test of control group is (0.76) and it is not significant at $p > .05$.

**4.6: End Chapter Tests for boys and girls on control group (Phase-II)**

Award lists of End Chapter Tests for boys and girls of control group (Phase-II) have been appended (appendices XXVI and XXVII) and the data in these award lists of End Chapter Tests were used to calculate Mean values, Standard deviation values and t-values and these values have been presented in Table 6 and figure 6.
Table 14 Data of End Chapter Tests for boys and girls on control group (Phase-II)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Boys (n =19)</th>
<th>Girls (n =16)</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>ECT1</td>
<td>6.53</td>
<td>1.17</td>
<td>6.06</td>
<td>1.52</td>
</tr>
<tr>
<td>ECT2</td>
<td>6.58</td>
<td>.961</td>
<td>7.56</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Note. ECT1 = End Chapter Test-1; ECT2 = End Chapter Test-2;

Figure 6

It is clear from the data of Table 14 and Figure 6, that:-

1. Mean values of boys in ECT 1 and ECT 2 are (6.53) and (6.58) respectively, and mean values of girls in ECT 1 and ECT 2 are (6.06) and (7.56) respectively.

2. Difference between the Mean values of ECT 1 and ECT 2 of boys and girls of control group are 0.47 and 0.98 respectively and are non significant at p > .05.
4.7: Descriptive Statistics and paired sample t-test for experimental group (Phase-II)

The data shown in award lists of Pre-test and Post-test of experimental group were used to calculate paired sample t-test and these values have been presented in table 7 and figure 7.

Table 15: Descriptive Statistics and paired sample t-test for experimental group (Phase-II)

<table>
<thead>
<tr>
<th>Results</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>95% CI for Mean Difference</th>
<th>r</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>S.D</td>
<td>M</td>
<td>S.D</td>
<td>r</td>
</tr>
<tr>
<td>Achievement Score</td>
<td>16.77</td>
<td>4.05</td>
<td>20.89</td>
<td>2.41</td>
<td>.866**</td>
</tr>
</tbody>
</table>

**p< .001.

Figure 7
It is clear from the data of Table 15 and Figure 7, that:

Mean value of pre-test on experimental group is 16.77 and mean value of post-test on experimental group is 20.89. These figures show significance difference in pretest and posttest scores at .001 significant level.

4.8: Descriptive Statistics and paired sample t-test for Control group (Phase-II)

The data shown in award lists of pre-test and post-test on control group were used to calculate paired sample t-test and these values have been presented in table 8 and figure 8.

Table 16: Descriptive Statistics and paired sample t-test for Control group (Phase-II)

<table>
<thead>
<tr>
<th>Results</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>95% CI for Mean Difference</th>
<th>r</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement Score</td>
<td>M 16.97</td>
<td>S.D 4.25</td>
<td>M 17.40, S.D 3.81</td>
<td>-0.95, .100</td>
<td>.93**</td>
</tr>
</tbody>
</table>

*p<.01; **p< .001.

Figure 8
It is clear from the data of Table 16 and Figure 8, that:

Mean value of pre-test on experimental group is 16.97 and mean value on post-test for experimental group is 17.40. These figures show significant difference in pretest and posttest scores at .001 significant levels.
CHAPTER -5

SUMMARY, FINDINGS, CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

This chapter deals with summary, findings, conclusions and recommendations of the study to determine the effectiveness of Kumon Method in comparison with traditional lecture method for the teaching of Mathematics to Grade-5 children.

5.1 SUMMARY

In our education system, for teaching of mathematics at primary school level, a number of methods are available, but lecture method of teaching is still in use to teach Mathematics to junior classes. Teaching Mathematics by Kumon method is a new and an innovated approach. Seventy students of Grade 5 were picked from Fazaia Inter College Jinnah Camp Nur Khan Rawalpindi for research purpose. From the 5th Grade Mathematics book, an academic achievement test was designed. The test comprised of twenty five multiple choice questions. In the light of results obtained after having Pre-test, two groups were equated. One was named as experimental group treated by Kumon method and the other was named as control group. Kumon teaching method was used to teach the students in experimental group whereas lecture method was used to teach the students in control group. In Experiment No.1, these groups were taught for a periods of twelve weeks. The Post-test was conducted at the end of treatment and three ECTs (End Chapter Test), were conducted during the treatment. t-test was applied to explain and interpret the results achieved in Experiment No-1. In Experiment No-2, both the groups were taught for six weeks. Two ECTs and one Post-test were conducted and student’s achievement was analyzed. Graphic representations of results were presented in chapter 4 which made the findings clearer.
5.2 FINDINGS

The following are the detailed findings of Experiment No-1:

PHASE-I

1. Mean value of the pre-test on experimental group was 17.23 and mean value of control group was 17.54. Difference between the Mean values of pre-test on experimental and control groups was 0.31 which was not significant so the groups were approximately equivalent at pre test level. (Table No.1)

2. Mean value of the post-test on experimental group is 22.37 and mean value of control group was 18.74. Difference between the Mean values of post test on experimental and control groups was 3.63 which was highly significant even at p < .001. (Table No.1)

3. Mean values of experimental group in ECT1, ECT2 and ECT3 were (7.83), (8.14) and (8.89) respectively. Mean values of control group in ECT1, ECT2 and ECT3 were ((5.74), (6.71) and 7.0) respectively. (Table No.2)

4. Differences between the Mean values of ECT1, ECT2 and ECT3 on experimental and control groups were 2.09, 1.43 and 1.89 respectively and are highly significant at p < .001. (Table No.2)

5. Mean values of the pre-test for boys and for girls were (17.47) and (17.00) respectively. Difference between the Mean values of pre-test of boys and girls on experimental group was (0.47) and which was not significant at p > .05. (Table No.3)

6. Mean values of the post-test for boys and for girls were (22.59) and (22.17) respectively. Difference between the Mean values of boy and girls on post-test of experimental group
was (0.42) which was not significant at \( p > .05 \).  

7. Mean values of boys in ECT\( _1 \), ECT\( _2 \) and ECT\( _3 \) were (7.59), (8.12) and (8.88) respectively and mean values of girls in ECT\( _1 \), ECT\( _2 \) and ECT\( _3 \) were (8.06), (8.17) and (8.83) respectively.  

8. Difference between the Mean values of ECT\( _1 \), ECT\( _2 \) and ECT\( _3 \) of boys and girls of experimental group were 0.47, 0.05, and 0.05 respectively and these differences were insignificant at \( p > .05 \).  

9. Mean value of the pre-test for boys and for girls were (17.69) and (17.42) respectively. Difference between the Mean values of pre-test for boys and girls on control group was 0.27 which was not significant at \( p > .05 \).  

10. Mean value of the post-test for boys and for girls were (18.75) and (18.74) respectively. Difference between the Mean values of post-test of boys and girls of control group was 0.01 which was not significant at \( p > .05 \).  

11. Mean values of boys in ECT\( _1 \), ECT\( _2 \) and ECT\( _3 \) were (5.75), (6.5) and (6.69) respectively and mean values of girls in ECT\( _1 \), ECT\( _2 \) and ECT\( _3 \) were (5.74), (6.89) and (7.26) respectively.  

12. Difference between the Mean values of boys and girls on control group in ECT\( _1 \), ECT\( _2 \) and ECT\( _3 \) were 0.01, 0.39, and 0.57 respectively and these differences were insignificant at \( p > .05 \).
13. Mean value of the pre-test on experimental group was 17.23 and mean value of post-test on experimental group is 22.37. These figures show significant difference in pretest to posttest scores at .001 levels.

(Table No.7)

14. Mean value of the pre-test on control group was 17.54 and mean value of post-test on control group was 18.74. These figures show significant difference in pre-test to post-test scores at the .01 significant levels. (Table No.8)

PHASE-II

15. Mean value of the pre-test on experimental group was 16.77 and mean value on control group was 16.97. Difference between the Mean values of pre test on experimental and control group was (0.20) which was not significant, and the groups were approximately equivalent at pre-test level. (Table No.9)

16. Mean value of post-test on experimental group was 20.89 and mean value on control group was 17.40. Difference between the Mean values of post test on experimental and control group was (3.49) which was significant at 0.05 levels. (Table No.9)

17. This mean difference of pre-test and post-test on experimental group was 4.12 which were highly significant even at p < .001. (Table No.9)

18. Mean values of experimental group in ECT$_1$ and in ECT$_2$ were 7.86 and 8.43 respectively. And mean values of control group in ECT$_1$ and in ECT$_2$ were 6.31 and 7.03 respectively.
The differences on means of ECT₁ and ECT₂ on Experimental and control groups were 1.55 and 1.4 respectively and these differences were highly significant at p < .001.

(Table No.10)

19. Mean value of pre-test for boys on experimental group was (17.05) and mean value for girls on experimental group was (16.44). Difference between the Mean values of pre-test of boys and girls on experimental group was (0.61) which was not significant at p > .05.

(Table No.11)

20. Mean value of post-test for boys on experimental group was (21.11) and mean value for girls was (20.63). Difference between the Mean values of post-test of experimental group was (0.48) which was not significant at p > .05.

(Table No.11)

21. Mean values of boys on experimental group in ECT₁ and ECT₂ are (8.00) and (8.53) respectively and mean values of girls on experimental group in ECT₁ and ECT₂ are (7.69) and (8.31) respectively.

(Table No.12)

22. Difference between the Mean values of ECT₁ and ECT₂ of boys and girls on experimental group were 0.31 and 0.22 respectively and these differences were insignificant at p > .05.

(Table No.12)

23. Mean value of pre-test for boys on control group was (16.37) and mean value for girls on control group was (17.69). Difference between the Mean values of pre-test of boys and girls on control group was (1.32) which was not significant at p > .05.

(Table No.13)
24. Mean value of post-test for boys on control group was (17.05) and mean value for girls was (17.81). Difference between the Mean values of boy and girls on post-test of control group was (0.76) which was not significant at p > .05. (Table No.13)

25. Mean values of boys in ECT₁ and ECT₂ were (6.53) and (6.58) respectively, and mean values of girls in ECT₁ and ECT₂ were (6.06) and (7.56) respectively. (Table No.14)

26. Difference between the Mean values of ECT₁ and ECT₂ of boys and girls of control group were 0.47 and 0.98 respectively and were insignificant at p > .05. (Table No.14)

27. Mean value of pre-test on experimental group was 16.77 and mean value of post-test on experimental group was 20.89. These figures show significance difference in pretest to posttest scores at .001 significant levels. (Table No.15)

28. Mean value of pre-test on experimental group was 16.97 and mean value of post-test on experimental group was 17.40. These figures show significance difference in pretest to posttest scores at .001 significant levels. (Table No.16)

5.3 CONCLUSIONS

It is clear from the findings, that there was no significant difference between the experimental and control group values at pre-test level which means that the experimental and control groups were approximately equivalent. The results show that in both the experiments the differences between mean values of post-tests of both comparison groups were significant. It was therefore concluded
that the Kumon method of teaching mathematics to 5th grade students was more effective than the traditional method.

Differences between the mean values of ECTs in both the experiments were significant, which further supported the result that Kumon method was effective in teaching mathematics.

A comparison of the performance of boys and girls in the groups shows that there were no gender differences in learning mathematics through the Kumon method.

5.4 DISCUSSION

This study was conducted to determine the effectiveness of Kumon method of teaching. This study was one of six studies conducted to determine the effectiveness. The WWC (What Works Clearing House) identified only five research studies conducted on Kumon method during the period of 1985 to 2008. No studies about the effectiveness of Kumon were conducted after 2008.

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Only two studies were within the scope but did not meet WWC standards, because only there was only one phase conducted and it was difficult to attribute the observed effects to Kumon method. The WWC also reported that one study was out of scope because it did not include student’s outcome.

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The current study was conducted in two phases on two different groups of students and comparison of both groups of student was made. The result of second phase supported the first phase. And it was clear from both phases that the Kumon method was more effective as compared to traditional
lecture method. Student performance were included in this study and with the help of scores achieved in series of tests.

Second study was also out of scope according to WWC, because it did not use sample within the grade specified whereas this study was conducted on grade 5 students.

According to WWC, the third study was also out of scope because it did not examine the effectiveness of Kumon method, only descriptive information was obtained from a source publically available. The current study was conducted experimentally to see the effectiveness of Kumon method.

Mekenna, M. A (2005) also conducted study on Kumon method but it was not published because it was lacking in specific grade sample. It was conducted on group of students from grade 2 to 5. According to UKai (1994), no experimental study was conducted to compare Kumon method with other ways of teaching mathematics.

This study was conducted to determine the effectiveness of Kumon method in comparison with traditional lecture method. It was also grade specific, conducted on grade 5 students in two phases in different periods of time.

5.5 RECOMMENDATIONS

The following are the recommendations of this study;
1. First recommendation for 5\textsuperscript{th} class math teachers for teaching this subject be given by explaining to them very clearly, in simple language, how to use this method practically in the classroom.

2. Rote learning may be discouraged by using Kumon Method of Teaching which may be used for Mathematics in the subject of Mathematics at grade 5 level.

3. Kumon Method may be referred for Mathematics teachers training institutes. Practical teaching of Mathematics be conducted during the teaching practice.

4. Kumon Method be encouraged among working Math teachers. The departments of education may conduct refresher courses, training programs and workshops in order to introduce Kumon Teaching Method to the working teachers.

5. The text books of Mathematics for grade 5 be revised by curriculum planners under the shade of Kumon Teaching Method.

6. In public and private schools of Pakistan, Kumon Teaching Method be used at 5\textsuperscript{th} grade level.

7. Research studies be conducted to validate effectiveness of Kumon method in the subject of Maths at other grade levels and by taking separate groups of boys and girls at different stages of school. This study be replicated on the subject of English at different levels of education.
BIBLIOGRAPHY


Agenda for action for the 80's, National Council of Teachers of Mathematics, 1980.


APPENDIX I

PRE-TEST OF PHASE-1

Subject: Mathematics for Grade 5 Total marks: 25 Time: 1hr and 30 min (1 ½ hours)
Name of Student: _________________ Signature’s student: _________________
Name of school: _________________ Marks obtained: __________

Instructions:

- Cutting or erasing the questions is not allowed.
- Paper will be finished within specified time and no extra time will be given.

Choose the correct one

1. Nineteen Lac is
   i. 19,000,000 ii. 19,00,000 iii. 19,00,00,000

2. Place your comma in Pakistani period 2905384
   i. 290,53,84 ii. 2,905,384 iii. 290,05,384

3. 3, 18, 72,499 ------------------ 3,187, 24, 99
   i. < ii. > iii. =

4. Arrange in ascending order (18, 06, 295 18, 60, 995 18, 06, 259)
   i. 18, 06, 259 18, 06, 295 18, 06, 995
   ii. 18, 06, 259 18, 06, 295 18, 60, 995
   iii. 18, 60, 995 18, 06, 295 18, 06, 259

5. Write symbols <, > or =
   18, 50, 119 18, 51, 119

6. Round off 9 years 4 months to the nearest year
   i. 9% years ii. 9 years iii. 10 years
7. Work out approximate answers to these sums by rounding off to the nearest 10
   \[62 + 99 + 48 =\]
   i. 210    ii. 200    iii. 300

8. DMAS rule Means
   i) \(\div, +, \times, -\)   ii) \(+, \times, -, \div\)   iii) \(\div, \times, +, -\)

9. \((3 \times 7) + 12 =\)
   I. 33    II. 29    III. 13

10. Perimeter of a square = __________
    i) \((\ell \times \beta)\)   ii) \((\ell + \beta) \times 2\)   iii) \((\alpha \times \beta \div 2)\)

11. Volume of a cube = __________
    i) \((\alpha \times \beta) \times 2\)   ii) \((\alpha + \beta) \div 2\)   iii) \((\ell \times \beta \times h)\)

12. If the area of a carpet is 32 sq cm and its breadth is 4m, its length will be ____ cm
    i) 7 sq cm    ii) 10 sq cm    iii) 8 cm

13. If the brick is 21 cm long, 8 cm wide and 6 cm height, its volume will be _____ cm³
    i) 108 cm³    ii) 1008 cm³    iii) 35 cm³

14. Any number with 5 or 0 in the ____ column is divisible by 5
    i) Hundred    ii) Tenths iii) Unit

15. Any ____ number must be divisible by 2
    i) odd    ii) Prime iii) Even

16. 5,481 is divisible by ______
    i) 2    ii) 5    iii) 9
17. $2 \times 2 \times 3$ are the prime factors of ______
   i) 6  ii) 12  iii) 7

18. $379 + n = 400$ $n =$ ?
   i) 779  ii) 21  iii) none of these

19. $-4 \underline{} -5$
   i) $<$  ii) $>$  iii) $=$

20. $(-17) \times 10 (-1) =$ _____.
   i) $-170$  ii) 170  iii) 7

21. The number is divisible by _____ if the digit in the unit’s place is zero.
   i) 3  ii) 5  iii) 6

22. The cost of one book is _______ if 6 books cost Rs 36.60
   i) 6.01  ii) 6.10  iii) 6.00

23. We use a ___________ to separate the thousands from the HTU.
   i) Full stop  ii) Comma  iii) Round bracket

24. Five hundred + 4 tens + 9 units = ________________
   i) 500+49  ii) 549  iii) 5409

25. $\frac{3}{4}$ hour = _____ minutes.
   i) 15 minutes  ii) 45 minutes  iii) 30 minutes
APPENDIX II

KEY FOR PRE-TEST OF PHASE-1

Choose the correct one

1. Nineteen Lac is
   i) 19,00,000

2. Place your comma in Pakistani period 2905384
   i) 2,905,384

3. 3, 18, 72,499
   =
   3,187, 24, 99
   iii) =

4. Arrange in ascending order (18,06,295 18,60,995 18,06,259)
   i) 18,06,259 18,06,295 18,60,995
   ii) 18,06,259 18,06,295 18,60,995

5. Write symbols <, > or =
   18, 50, 119 < 18,51,119

6. Round off 9 years 4 months to the nearest year
   i) 9 years
   ii) 9 years

7. Work out approximate answers to these sums by rounding off to the nearest 10
   62 + 99 + 48 =
   i) 210
8. DMAS rule Means
   iii) ÷, x, +, -

9. \((3 \times 7) + 12 =\)
   i) 
   \[
   33
   \]

10. Perimeter of a square = 
    ii) \((\ell + \beta) \times 2\)

11. Volume of a cube = 
    iii) \((\ell \times \beta \times \ell)\)

12. If the area of a carpet is 32 sq cm and its breadth is 4m, its length will be ____ cm
    iii) 8 cm

13. If the brick is 21 cm long, 8 cm wide and 6 cm height its volume will be ____ cm³
    ii) 1008 cm³

14. Any number with 5 or 0 in the ____ column is divisible by 5
    iii) Unit

15. Any ____ number must be divisible by 2
    iii) Even

16. 5,481 is divisible by ____
    iii) 9

17. \(2 \times 2 \times 3\) are the prime factors of ____
    ii) 12
18. \[ 379 + n = 400 \quad n = ? \]
   ii) 21

19. \( -4 \quad \_\_\_\_ \quad -5 \)
   ii) >

20. \[ (-17) \times 10 (-1) = \_\_\_\_ \].
   ii) 170

21. The number is divisible by _____ if the digit in the unit’s place is zero.
   ii) 5

22. The cost of one book is _________ if 6 books cost PRs 36.60
   ii) 6.10

23. We use a __________ to separate the thousands from the HTU.
   ii) Comma

24. Five hundred + 4 tens + 9 units = ________________
   ii) 549

25. \( 3/4 \) hour = _____ minutes.
   ii) 45 minutes   iii) 30 minutes
## APPENDIX III

**Pre-test scores of Academic Achievement of phase-1**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Names</th>
<th>Experimental (25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Muhammad</td>
<td>23</td>
</tr>
<tr>
<td>2.</td>
<td>Rabia Sana</td>
<td>23</td>
</tr>
<tr>
<td>3.</td>
<td>Mahnoor</td>
<td>22</td>
</tr>
<tr>
<td>4.</td>
<td>M. Umer</td>
<td>21</td>
</tr>
<tr>
<td>5.</td>
<td>Saad Zaman</td>
<td>21</td>
</tr>
<tr>
<td>6.</td>
<td>Adil Sherazi</td>
<td>20</td>
</tr>
<tr>
<td>7.</td>
<td>Minahil Rashid</td>
<td>20</td>
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<tr>
<td>8.</td>
<td>Fatima Atif</td>
<td>20</td>
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<tr>
<td>9.</td>
<td>Noor ulIman</td>
<td>20</td>
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<tr>
<td>10.</td>
<td>Hamza Asad</td>
<td>19</td>
</tr>
<tr>
<td>11.</td>
<td>Ajwad Waseem</td>
<td>19</td>
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<tr>
<td>12.</td>
<td>Danyal Kiyani</td>
<td>19</td>
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<tr>
<td>13.</td>
<td>Abdul Basit</td>
<td>18</td>
</tr>
<tr>
<td>14.</td>
<td>Fahad Amin</td>
<td>18</td>
</tr>
<tr>
<td>15.</td>
<td>Usama Khan</td>
<td>18</td>
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<tr>
<td>16.</td>
<td>Armish Qayyum</td>
<td>18</td>
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<tr>
<td>17.</td>
<td>Hamayil Qamar</td>
<td>18</td>
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<td>18.</td>
<td>Amir Shahzad</td>
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</tr>
<tr>
<td>19.</td>
<td>Hurain Zamir</td>
<td>17</td>
</tr>
<tr>
<td>S. No.</td>
<td>Names</td>
<td>Control (25)</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>--------------</td>
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<tr>
<td>1.</td>
<td>Haris Ejaz</td>
<td>23</td>
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<tr>
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<td>Husnain Arshad</td>
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</tr>
<tr>
<td>3.</td>
<td>Barira Sardar</td>
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<td>4.</td>
<td>Maryam Sheilkh</td>
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<td>5.</td>
<td>Aqsa Shahbaz</td>
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</tr>
<tr>
<td></td>
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<tr>
<td>---</td>
<td>-----------------------</td>
<td>-----</td>
</tr>
<tr>
<td>6</td>
<td>Awais Khalid</td>
<td>21</td>
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<tr>
<td>7</td>
<td>Junaid Javed</td>
<td>20</td>
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<tr>
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<td>10</td>
<td>Abieha Sami</td>
<td>19</td>
</tr>
<tr>
<td>11</td>
<td>Musna Nadir</td>
<td>19</td>
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<tr>
<td>12</td>
<td>Muhammad Ahmed</td>
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<td>Sana Ullah</td>
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<td>14</td>
<td>Zeeshan Haider</td>
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<td>15</td>
<td>Usman Jamil</td>
<td>18</td>
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<td>16</td>
<td>Ayesha Arshad</td>
<td>18</td>
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<tr>
<td>17</td>
<td>Anum Waqas</td>
<td>18</td>
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<td>18</td>
<td>Farwa Malik</td>
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<td>18</td>
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<td>20</td>
<td>Asad Bin Umer</td>
<td>17</td>
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<tr>
<td>21</td>
<td>Shoaib Asghar</td>
<td>17</td>
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<td>22</td>
<td>Abdul Moez</td>
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<td>M. Mustafa</td>
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<td>25</td>
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<td>27</td>
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<td>28</td>
<td>Shahana Ajmal</td>
<td>15</td>
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<td>Score</td>
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<td>-------</td>
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<td>29.</td>
<td>BismaZameer</td>
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<td>15</td>
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<tr>
<td>31.</td>
<td>Hassan Syed</td>
<td>15</td>
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<td>32.</td>
<td>Abdul Samad</td>
<td>13</td>
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<td>33.</td>
<td>Saba Andleeb</td>
<td>13</td>
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<td>34.</td>
<td>HamzaSaad</td>
<td>12</td>
</tr>
<tr>
<td>35.</td>
<td>Shanzay Khan</td>
<td>12</td>
</tr>
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APPENDIX IV

Model Lesson Plan for Experimental Group taught by Kumon Method

STAGES LESSON PLAN-1

Subject Mathematics
Topic Line Graph
Class V- Experimental Group
Time 40 min
Teaching Method Kumon Method
Apparatus
  - Graph Paper
  - Long Ruler
  - Colored Charts
  - Marker & Board
  - Multimedia
  - Worksheets
Aims of Lesson
  - To provide an introduction to the graph
To make the students able to understand graph, its types and axis of graphs

Students will be able to understand the line-graph

To make the students able to draw or plot the line-graph

P.K. Testing

In order to test the previous knowledge of the students and see KumonMethod the level where they stand or competency level of students, following questions will be asked after having a worksheet and by the use of multimedia.

Q: Define the word “graph”? Knowledge

Exp.Ans: Graph is a figure by which difference can be seen quickly and easily.

Q: What do you know about a graph paper? Comprehension

Exp.Ans: A paper which has square boxes on it.

Q: Why we use graph paper? Analysis

Exp.Ans: Graph paper is used to graph accurately.

Students have already know about the concepts of horizontal & vertical lines, column/ bar graph, pie chart/ graph. Worksheets are given.

Students are allowed to answer the questions on their worksheets and then teacher will correct the mistakes and check the minimum competency level in this concept.

Diagnostic Test & Corrective Teaching

After having worksheets on column/ bar graph and pie chart, teacher will link it up to the new topic, line graph.

Q: How can we plot a line graph?

Statement of Aim
The students will not be able to answer the last question, and the teacher will

Announce, “Today we shall study about line graph and procedure to plot the Line graph.”

**Topic will be written on board**

**Presentation**

Using Kumon method, after having minimum competency levels of students, teacher will present his/her lesson making link of previous knowledge of students, with the help of multimedia, teach about graph, drawing graph and then line graph.

**Multimedia is used**

Followings are the core concepts and DLOs (Desired Learning Objectives)

**Core- Concept I:** Graph

**DLO:** Students will be able to understand the definition of graph.

**Graph:** Graph is a figure through which we can observe the differences quickly and easily.

**Showing different types of graphs on multimedia.**

By drawing horizontal & vertical lines on board called x-axis & y-axis respectively.

Dear students, we can show relationship between two things “one” on x-axis and “second” on y-axis, by taking scale we can show these on graph.

**Individualized Learning**

For example; if marks of four students are given as,

<table>
<thead>
<tr>
<th>Marks</th>
<th>80</th>
<th>50</th>
<th>100</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Ali</td>
<td>Zara</td>
<td>Umar</td>
<td>Awais</td>
</tr>
</tbody>
</table>
Core Concept II: Drawing Graph.

DLO: Students will be able to draw a graph by using tables.

Information given in the table, by using them, names will be written on x-axis and marks will be on y-axis, but before that scale must be prepared.

Through Q/answers, graph will be drawn on board.

Q: How can we make a scale?

Involvement of students

Exp. Ans: Yes, along x-axis ----------------names & along y-axis-------------marks

And along y-axis 1 big square = 50 marks

By calling four students one by one and asking them draw marks of all students (one by each) on board using the set scale in the form of bars.

Students Participation

Encouragement which builds the confidence among students.

Dear students, if we take or draw only points on graph according to their marks instead of bars, the new shape of graph will be formed, by joining all the points,

Q: What will happen? Exp. Ans: yes, a line is drawn. This is called line graph, another form of graph.
Core-Concept III:  Line Graph

DLO: Students will be able to learn about and be able to draw line graph.

Line graph is another form of graph which shows gradual change. It is useful when we want to measure something which is gradually changing.

Few more examples will be solved on board with the help of students through Q/answers. Some more activity sheets are given to understand the line graph, and to see the achievement level of each student.

**Maximum drill makes the concept clearer.**

Generalization: Students will be able after practicing to answer the following questions.

Q: What is the similarity in Bar graph & Line graph?  Evaluation

(Both need axis)

Q: What is the difference between Bar & Line graph?

(Line graph shows gradual change while bar does not)

Students will be able to apply the concept in different situations.  Application

**Application:** the teacher will give the following problems for plotting line graph and answer the following questions.

Example:
<table>
<thead>
<tr>
<th>No.of Bars</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wt.of Chocolate</td>
<td>100 gm</td>
<td>200 gm</td>
<td>300 gm</td>
<td>400 gm</td>
<td>500 gm</td>
<td>600 gm</td>
</tr>
</tbody>
</table>

Q: Draw line graph of above example? (Use of graph paper & ruler)

Q: What will be the weight of 9 bars? (900 gm) Individual Learning

Q: What will be the weight of 10 bars? (1000 gm)

1000 gm = 1 kilogram

Recapitulation: Go over the main points of the lesson.

Home-work: Your home-work assignment is a worksheet about line graph.

Conclusion: In next class, we will study about other forms of graph or more about graph.

APPENDIX V

Model Lesson Plan for Control Group taught by Traditional Lecture Method

STAGES LESSON PLAN-1
Subject: Mathematics

Topic: Line Graph

Class: V- Control Group

Time: 40 min

Teaching Method: Traditional Lecture Method

Apparatus

- Ordinary Class Room
- Marker & Board

Aims of Lesson

After studying this lecture, students will be able to understand the line-graph.

Q: What is line-graph? Understanding

Q: What are the main types of graph?

Q: How a line graph can be plotted? Application

P.K. Testing

In order to test the previous knowledge of the students and motivate them towards lessons. I shall ask following question:

Q: What is graph?

Exp.Ans: Graph is a figure by which difference can be seen quickly and easily.

Q: What are the main types of graph?

Exp.Ans: Bar graph, Pie graph, Line graph

Q: What is the difference between Bar graph and Pie graph?

Exp.Ans: Bar Graph is in the form of column and Pie graph is circular in shape.
Q: How can we plot line graph?

Statement of Aim

The students will not be able to answer the last question, and the teacher will

Announce, “Today we shall study about line graph and procedure to plot the

Line graph.”

Presentation

Using walk, talk & chalk method (Lecture Method), teacher will present his/her lesson and during which, he also make use of board. Lecture Method

We already know that graphs are extremely useful in helping us to observe differences quickly and easily. We have already studied about Bar and Pie graph. Another very useful graph is the line graph.

Line graph is particularly useful when we want to measure something which is gradually changing Deductive method

it is a line joining the different observation points on graph along x-axis and y-axis. It shows continuous change in reading. For example, this line graph is showing the growth of a plant from a seed over a period of 5 days.

Board is used to draw line graph.

Look carefully the line graph at the bottom of previous example, then answer.

Q: What type of graph is shown?

Exp. Ans: Yes it is a line graph.

In this figure, you can see that on first day, plants’ height is 2cm. On second day 3cm similarly on third day 6cm and gradually increasing up to 10cm at the end of 5 days.

Consider an other example. Board is used
Q: What is the cost of 3 pizzas?
Exp. Ans: Yes, it is Rs. 45.

Q: If Sid has Rs. 60, how many pizzas can be buy.
Exp Ans: 4 pizzas.

Q: What do you think will be the cost of 7 pizzas?
Exp Ans: 105

**Generalization:**

Q: What is the similarity in Bar graph & Line graph?

(Both need axis)

Q: What is the difference between Bar & Line graph?

(Line graph shows gradual change while bar does not)

**Application:** the teacher will give the following problems for plotting line graph and answer the following questions.

**Example:**

<table>
<thead>
<tr>
<th>No.of Bars</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wt.of</td>
<td>100 gm</td>
<td>200 gm</td>
<td>300 gm</td>
<td>400 gm</td>
<td>500 gm</td>
<td>600 gm</td>
</tr>
<tr>
<td>Chocolate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q: Draw line graph of above example? (Use of graph paper & ruler)

Q: What will be the weight of 9 bars? (900 gm)

Q: What will be the weight of 10 bars? (1000 gm)

1000 gm = 1 kilogram

**Recapitulation:** Go over the main points of the lesson.
**Home-work:** Your home-work assignment is 1 to 5 questions of relevant exercise.

**Conclusion:** In next class, we will study about other forms of graph or more about graph.

### APPENDIX VI

**Work Sheets for Experimental Group**

**WORK SHEET-1**

<table>
<thead>
<tr>
<th>Name: --------------------------</th>
<th>Class: --------------</th>
</tr>
</thead>
</table>

Kids were asked if they play a musical instrument, and their responses are shown in the line plot.

Each X represents one kid. **LOOK** at the line plot, and **ANSWER** the questions.

**Kids who play instruments**

<table>
<thead>
<tr>
<th>Guitar</th>
<th>Trumpet</th>
<th>Drums</th>
<th>Piano</th>
<th>Violin</th>
<th>Flute</th>
<th>Bass</th>
<th>Saxophone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 1. How many kids play violin? -------------------------- |
| 2. How many kids play drums? -------------------------- |
3. Exactly four kids play what instrument? 

4. What two instruments do the same number of kids play? 

5. How many more kids play piano than flute? 

6. How many more kids play violin than bass? 

7. How many kids play trumpet and saxophone combined? 

8. If each kid plays only one instrument, how many kinds are shown in this graph? 

WORKSHEET-II

Name------------------------ Class-------------------
This graph shows the number of points scored in the 1st six games of the season by the two local soccer teams, the Blazers & the Demons. **LOOK** at the graph and **ANSWER** the questions.

**Points Scored in Soccer Game**

1. How many points did the Blazers score in game 3? --------------
2. How many points did the Demons score in game 6? --------------
3. In which game Blazers scored only one point? ------------------
4. What is the range of scores in this graph? ---------------------
5. In which game Blazers did their best? -------------------------

**WORKSHEET-III**

**Name**----------------------------- **Class**-------------------

A graph shows no. of sports played by girls. **LOOK** at the graph and **ANSWER** the questions.
1. What type of graph is given? -------------------

2. Which game girls played the most? ---------------

3. Which game they choose the least? ---------------

4. Which two sports have nearly an equal number of girls? ---------------

WORKSHEET-IV

This graph shows the popularity of a name as it changed over time. The names are ranked in popularity from 1 to 100. **LOOK** at the graph and **ANSWER** the questions. **Home Assignment**
Q: What name was ranked as 35? "
Q: Which name was ranked the highest? "
Q: Which name is ranked the lowest: "

APPENDIX VII

Time-Table for Teaching the Groups OF PHASE-I

Fazaia Inter College Jinnah Camp, Nur Khan

Junior School Section

Time-Table for both experimental group and control group

<table>
<thead>
<tr>
<th>Days</th>
<th>1st Period</th>
<th>2nd Period</th>
<th>3rd Period</th>
<th>4th Period</th>
<th>Break</th>
<th>5th Period</th>
<th>6th Period</th>
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APPENDIX VIII

LIST OF BOYS IN EXPERIMENTAL GROUP OF PHASE-I

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<th>S. No.</th>
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<td>1</td>
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<td>23</td>
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<tr>
<td>2</td>
<td>M. Umer</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>SaadZaman</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>AdilSherazi</td>
<td>20</td>
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<tr>
<td>5</td>
<td>HamzaAsad</td>
<td>19</td>
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</table>
APPENDIX IX

LIST OF GIRLS IN EXPERIMENTAL GROUP OF PHASE-I

<table>
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<th>S. No.</th>
<th>Names</th>
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<tbody>
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<td>Rabia Sana</td>
<td>23</td>
</tr>
<tr>
<td>2.</td>
<td>Mahnoor</td>
<td>22</td>
</tr>
<tr>
<td>3.</td>
<td>Minahil Rashid</td>
<td>20</td>
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**APPENDIX X**

**LIST OF BOYS IN CONTROL GROUP OF PHASE-I**
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APPENDIX XI
LIST OF GIRLS IN CONTROL GROUP OF PHASE-I

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APPENDIX XII

LIST OF TOPICS TAUGHT

1. Least Common Multiple
2. Highest Common Factor
3. Place Value Chart
4. Graphs
5. Fraction Form
6. Decimal Fraction
7. Construction of Angles
8. Construction of Triangle
9. Area of Triangle
10. Area of Quadrilateral
11. Perimeter
12. Volume
13. Rounding off
14. Simplification of Fractions
15. Brackets
16. Percentage
17. Profit and Loss
18. Average
19. Ratio reciprocals
20. Divisibility Chart and Test
APPENDIX XIII

POST TEST OF PHASE-I

Subject: Mathematics for Grade 5 Total marks: 25 Time: 1hr and 30 min (1 ½ hours)
Name of Student: _________________ Signature’s student: _____________
Name of school: _________________ Marks obtained: __________

Instructions:
 Cutting or erasing the questions is not allowed.
 Paper will be finished within specified time and no extra time will be given.

Choose the correct one

1. The HCF of 12, 16 and 20 is ______
   i) 12   ii) 16   iii) 4

2. The HCF of 2 × 5 and 2 × 2 5 is _____
   i) 30   ii) 20   iii) 10

3. The LCM of 2 × 3 × 5 and 2× 2 × 3 × 5 is _____
   i) 60   ii) 90   iii) 30

4. The LCM is the abbreviation of _____
   i) Lowest Common Multiple
   ii) Lowest Cost Material
   iii) Lowest common Material

5. If the cost price of Rs.13.250 and sale price is 15,800, we have _____
   i) loss    ii) profit    iii) None

6. \[ \frac{2}{8} = \] its lowest term is
7. \( \frac{1}{5} \) of \( \frac{1}{2} \) means
i) \( \frac{1}{5} \times \frac{1}{2} \) ii) \( \frac{1}{5} \div \frac{1}{2} \) iii) \( \frac{3}{4} = \frac{2}{3} \)

8. Two thirds of \( \frac{3}{4} \) means_____
   i) \( \frac{3}{4} \times \frac{2}{3} \) ii) \( \frac{3}{4} \div \frac{2}{3} \) iii) \( \frac{3}{4} = \frac{2}{3} \)

9. \( \frac{1}{2} \times \frac{1}{4} \times \frac{1}{5} = \) _______
   i) \( \frac{3}{40} \) ii) \( \frac{2}{40} \) iii) \( \frac{1}{40} \)

10. The product of any fractional number and zero is always _________
   i) One   ii) Zero   iii) Fractional number

11. In multiplication mixed of fraction we always change mixed number into _____ fraction
   i) Proper ii) Improper iii) We do not change

12. \( 81 \div 9 \) word we say _________
   i) How many 8s is make 9?   ii) How many 9s make 81?   iii) How many 8s make 9?

13. \( 2 \div \frac{1}{4} \) in word we say _________
   i) How many make 4 whole?
   ii) How many 2s make \( \frac{1}{4} \) ?
   iii) How many quarters make 2 whole
14. How many fifths make 3 whole?
   i) \( \frac{1}{4} \)  ii) \( \frac{1}{5} \)  iii) 15.

15. If cost price is Rs 14,500 and sale price is 16,500 the profit will be _________
   i) Rs 31,000  ii) Rs 2000  iii) 14,500

16. \( \frac{87}{100} \) as a percentage is ________
   i) \( \frac{87}{100} \% \) ii) 87\% iii) \( \frac{4}{100} \% \)

17. The reciprocal of \( \frac{3}{2} \) is ________
   i) \( \frac{3}{2} \) ii) \( \frac{2}{3} \) iii) \( \frac{2}{7} \)

18. The fractional form of 302 is ________
   i) \( \frac{1}{320} \) ii) \( \frac{1}{302} \) iii) \( \frac{302}{1} \)

19. \( \frac{12}{2} + \frac{1}{2} = \) ________
   i) \( \frac{12}{3} \) ii) 6 iii) 24

20. The Lowest term of \( \frac{1}{3} + \frac{1}{4} = \) ________
   i) \( \frac{4}{3} \) ii) \( \frac{1}{3} \) iii) \( \frac{12}{3} \)

21. Each fractional number has only _____ reciprocal
   i) 1  ii) 2  iii) 3
22. The product of a fractional number and its reciprocal is always _____
   i) The same fractional Number  ii) Zero  iii) One

23. When we divide any fractional number by 1 the quotient is _________
   i) The same fractional Number  ii) Zero  iii) One

24. \( \frac{3}{25} \) of \( \frac{3}{25} \) = _____
   i) 1  ii) 0  iii) \( \frac{3}{25} \)

25. The average of 1, 2 and 3 is ____________-
   i) 1  ii) 2  iii) 3
APPENDIX XIV

KEY FOR POST-TEST PHASE-1

Choose the correct one

1. The HCF of 12, 16 and 20 is ______
   iii) 4

2. The HCF of $2 \times 5$ and $2 \times 25$ is ______
   iii) 10

3. The LCM of $2 \times 3 \times 5$ and $2 \times 2 \times 3 \times 5$ is _____
   i) 60

4. The LCM is the abbreviation of ______
   i) Lowest Common Multiple

5. If the cost price of Rs.13, 250 and sale price is 15,800, we have _____
   ii) Profit

6. $\frac{2}{8} \times 4 = _____$ its lowest term is
   ii) 1

7. $\frac{1}{5}$ of $\frac{1}{2}$ means
   i) $\frac{1}{5} \times \frac{1}{2}$

8. Two thirds of $\frac{3}{4}$ means______
9. \( \frac{1}{2} \times \frac{1}{4} \times \frac{1}{5} = \) ________
   
   iii) \( \frac{1}{40} \)

10. The product of any fractional number and zero is always ________
    
    ii) Zero

11. In multiplication mixed of fraction we always change mixed number into ____ fraction
    
    ii) Improper

12. \( 81 \div 9 \) word we say ________
    
    ii) How many 9s make 81?

13. \( \frac{2}{4} \) in word we say ________
    
    iii) How many quarters make 2 whole

14. How many fifths make 3 whole?
    
    iii) 15.

15. If cost price is Rs 14,500 and sale price is 16,500 the profit will be ________
    
    ii) Rs 2000

16. \( \frac{87}{100} \) as a percentage is ________
    
    ii) 87%

17. The reciprocal of \( \frac{3}{2} \) is ________
18. The fractional form of 302 is ________
   iii) \( \frac{302}{1} \)

19. \( \frac{12 + \frac{1}{2}}{2} = \) ___________
   iii) 24

20. The Lowest term of \( \frac{1}{3} + \frac{1}{4} = \) ___________
   i) \( \frac{4}{3} \)

21. Each fractional number has only _____ reciprocal
   i) 1

22. The product of a fractional number and its reciprocal is always _____
   iii) One

23. When we divide any fractional number by 1 the quotient is _________
   i) The same fractional Number

24. \( \frac{3}{25} \) of \( \frac{3}{25} = \) _______
   i) 1

25. The average of 1, 2 and 3 is ____________-
   ii) 2
APPENDIX XV

POST TEST SCORES OF ACADEMIC ACHIEVEMENT OF PHASE-I

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APPENDIX XVI

END CHAPTER TESTs OF PHASE-1

ECT 1
Subject: Mathematics for Grade 5 Total marks: 10 Time: 30 min
Name of Student: __________________ Signature’s student: _____________
Name of school: _________________ Marks obtained: __________

Instructions:
- Cutting or erasing the questions is not allowed.
- Paper will be finished within specified time and no extra time will be given.

Choose the correct one

1. 16 + 8 ÷ 2 =
   i) 12    ii) 20    iii) 16

2. 11 + 2 x 8 =
   i) 90'    ii) 114    iii) 27

3. 10 - 3 + 3 =
   i) 9    ii) 10    iii) 7
4. \[ \frac{84}{7} \times 10 = \]
   i) 120 ii) 1 iii) 100

5. \[ 3 \times 5 \times 7 \text{ are the prime factors of } \]
   i) 15 ii) 35 iii) 105

6. The HCF of 12, 16 and 24 is ______
   i) 12 ii) 16 iii) 4

7. The product of any fractional and 1 is ______
   i) One ii) Zero iii) Fractional number

8. In multiplication mixed of fraction we always change mixed number into ____ fraction
   i) Proper ii) Improper iii) We do not change

9. Turn \( \frac{29}{50} \) into equivalent fraction with denominator 100 is ______
   i) \( \frac{29}{100} \) ii) \( \frac{58}{100} \) iii) \( \frac{29}{100} \)

10. Round off 11.328 to 2 d.p is ___________
    i) 11.32 ii) 11.33 iii) 11.30

ECT 11

Subject: Mathematics for Grade 5 Total marks: 10 Time: 30 min

Name of Student: _______________ Signature’s student: _____________
Name of school: _______________ Marks obtained: ___________

Instructions:
- Cutting or erasing the questions is not allowed.
- Paper will be finished within specified time and no extra time will be given.
Choose the correct one

1. 99% as a fraction is __________
   i) \( \frac{99}{100} \)  ii) 99/1000  iii) \( \frac{9}{100} \%

2. If cost price is Rs 34,500 and sale price is 16,500 the loss will be ________
   i) Rs 31,000  ii) Rs 18000  iii) Rs 14,500

3. If cost price is Rs 4,700 and profit is Rs 500, sale price will be__________
   i) Rs 4200  ii) Rs 5200  iii) Rs 47, 700

4. The money we deposit in the bank is called
   i) Principal  ii) Interest  iii) Profit

5. Bank pays extra money for keeping money in the bank for a specific time is called _____
   i) Principal  ii) Interest  iii) Amount

6. H.C.F. of 27 and 36 is _____.
   i) 9  ii) 3  iii) 18

7. L.C.M of 12 and 18 is _____.
   i) 36  ii) 12  iii) 18

8. The ratio of 42 and 63 is _____.
   i) 7:9  ii) 2:3  iii) 6:7

9. When a number is multiplied by itself, the product is known as the_____ of the number,
   i) square  ii) factor  iii) ratio

10. Percent means___________________
ECT 111

Subject: Mathematics for Grade 5 Total marks: 10 Time: 30 min
Name of Student: _________________ Signature’s student: _____________
Name of school: _________________ Marks obtained: __________

Instructions:
▪ Cutting or erasing the questions is not allowed.
▪ Paper will be finished within specified time and no extra time will be given.

Choose the correct one

1. Area of a square= __________
   i) L+B    ii) L × B × H    iii) L× B

2. Area of a triangle= __________
   i) 2×b×h    ii) ½ b + h    iii) ½ b× h

3. Perimeter of a square = __________
   i) (ℓ × β)    ii) (ℓ + β) × 2    iii) (α×β ÷ 2

5. Volume of a cube = __________
   i) (α×β)×2    ii) (α + β) + 2    iii) (ℓ × β × h)

6. Volume of a cuboid = __________
   i) (α×β)×H    ii) (α + β) + 2    iii) (ℓ + β) × 2

7. If the area of a carpet is 36 sq cm and its breadth is 4cm, its length will be ____ cm
   i) 40 cm    ii) 32 sq cm    iii) 9 cm
8. If the length of a park is 50 m and breadth is 20 m its area will be _____ sq cm
i) 70   ii) 1000   iii) 30

9. If the area of a rectangle is 15 cm$^2$ its length is 5 cm then its breadth will be _____ cm
i) 3 cm   ii) 10 cm   iii) 20 cm

10. If the length of a rectangle is 16 cm and breadth is 10 cm its perimeter will be _____ cm
i) 12   ii) 52   iii) 32
APPENDIX XVII

KEY FOR END CHAPTER TESTs OF PHASE-1

ECT 1
Choose the correct one

1. $16 + 8 ÷ 2 =$
   ii) 20

2. $11 + 2 \times 8 =$
   iii) 27

3. $10 - 3 + 3 =$
   ii) 10

4. $84 ÷ 7 \times 10 =$
   i) 120

5. $3 \times 5 \times 7$ are the prime factors of ______
   iii) 105

6. The HCF of 12, 16 and 24 is ______
   iii) 4

7. The product of any fractional and 1 is ______
   iii) Fractional number

8. In multiplication mixed of fraction we always change mixed number into _____ fraction
   ii) Improper

9. Turn $\frac{29}{50}$ into equivalent fraction with denominator 100 is ______
   i) $\frac{58}{100}$
10. Round off 11.328 to 2 d.p is __________
   ii) 11.33

Key for ECT II

Choose the correct one

1. 99% as a fraction is __________
   i) \(\frac{99}{100}\)

2. If cost price is Rs 34,500 and sale price is 16,500 the loss will be _________
   ii) Rs 18000

3. If cost price is Rs 4,700 and profit is Rs 500, sale price will be___________
   ii) Rs 5200

4. The money we deposit in the bank is called
   i) Principal

5. Bank pays extra money for keeping money in the bank for a specific time is called _____
   ii) Interest

6. H.C.F. of 27 and 36 is _____.
   i) 9

7. L.C.M of 12 and 18 is _____.
   i) 36
8. The ratio of 42 and 63 is _____.
   ii) 2:3

9. When a number is multiplied by itself, the product is known as the_____ of the number,
   i) Square

10. Percent means____________________
    i) per 100

Key for ECT III

Choose the correct one

1. Area of a square= ___________
   iii) L× B

2. 2) Area of a triangle= ___________
   iii) ½ b× h

3. Perimeter of a square = ___________
   ii) (ℓ + β) × 2

5. Volume of a cube = ___________
   iii) (ℓ × β × h)

6. Volume of a cuboid = ___________
   i) (α × β) × β

7. If the area of a carpet is 36 sq cm and its breadth is 4cm, its length will be ____ cm
   iii) 9 cm
8. If the length of a park is 50 m and breadth is 20 m its area will be _____ sq cm
   ii) 1000

9. If the area of a rectangle is 15 cm$^2$ its length is 5 cm then its breadth will be ____ cm
   i) 3 cm

10. If the length of a rectangle is 16 cm and breadth is 10 cm its perimeter will be ____ cm
    ii) 52
APPENDIX XVIII

LIST OF TOPICS WITHIN THE CHAPTERS

1. Line graph

2. Least Common Multiple

3. Highest Common Factor

4. Fraction Form ________Addition, Subtraction, Multiplication and Division

5. Decimal Fraction________ Addition, Subtraction, Multiplication and Division

6. Construction of angles

7. Construction of triangles

8. Area of triangle

9. Area of Quadrilateral ________Rectangle and Square

10. Volume ________Cube and Cuboid

11. Perimeter ________Rectangle and Square

12. Rounding off

13. Simplification of fraction ________Common fraction and Decimal fraction

14. Brackets ________Simplification of brackets

15. Percentage
16. Profit and Loss
17. Average
18. Ratio
19. Reciprocals
20. Divisibility Chart
APPENDIX -XIX

END CHAPTER TEST SCORES OF ACADEMIC ACHIEVEMENT OF

PHASE-I

<table>
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<tr>
<th>S. No.</th>
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APPENDIX- XX

PRE-TEST OF PHASE-2

Subject: Mathematics for Grade 5 Total marks: 25 Time: 1hr and 30 min (1 ½ hours)
Name of Student: _________________ Signature’s student: _________________
Name of school: _________________ Marks obtained: __________

Instructions:
 Cutting or erasing the questions is not allowed.
 Paper will be finished within specified time and no extra time will be given.

Choose the correct one

1. 50332- 1521= ____________
   a) 59701                b) 51211                           c) 48811

2. 53061× 100 =____________
   a) 530710             b) 5306100                     c) 53061000

3. 2x(3-2) = _________________
   a) 1                 b) 2               c) 4

4. If Ali spends Rs.39526 and saves Rs.11074 out of his salary then his salary is------
a) Rs.28452     b) Rs.28552     c) Rs.50600

5. \( \frac{5}{8} \times \frac{5}{6} = \frac{25}{48} \) 
   a) 2/7     b) 6/7     c) 25/48

6. The L.C.M of 12 and 30 is 
   a) 6     b) 42     c) 60

7. \( \frac{16}{15} \div \frac{8}{5} = \frac{2}{3} \) 
   a) 2/3     b) 1/3     c) 3/4

8. \( 5.6 \times 1000 = 5600 \) 
   a) 56     b) 560     c) 5600

9. 4 hours = 
   a) 120 minutes     b) 180 minutes     c) 240 minutes

10. If price of one chocolate is Rs.20 then the price of 5 such chocolates is 
    a) Rs.15     b) Rs.25     c) Rs.100

11. An angle of measure 60\(^0\) is 
    a) acute angle     b) obtuse angle     c) right angle

12. In the given figures, the square is 
    a) \( \bigcirc \)     b) \( \boxed{} \)     c) \( \boxed{} \)

13. The given triangle is 
    a) Equilateral triangle 
    b) Isosceles triangle 
    c) Scalene triangle
14. If length of each side of a square is 1 cm then its area is
a) $1 \text{ cm}^2$  b) $2 \text{ cm}^2$  c) $3 \text{ cm}^2$

15. Area of given figure is
a) $5 \text{ cm}^2$  b) $6 \text{ cm}^2$  c) $12 \text{ cm}^2$

16. In the given triangle, the hypotenuse is
a) AB  b) AC  c) BC

17. $\frac{4}{9} - \frac{2}{5} = $

18. Without using protractor, find the missing angle
a) 80  b) 70  c) 90

19. A graph in the shape of a circle is called
a) Bar  b) Pie  c) Line

20. Lines which are perpendicular to one another have an angle between them.

21. Square each side is 15 m, then perimeter is
a) 225 m  b) 60 m  c) 30 m

22. 3985 paisa is equal to Rs
a) 39.85  b) 398.5  c) 3.985

23. $A= \{2, 3, 5, 7, 11, \ldots\}$ is a set.
a) odd     b) even     c) prime

24. $\frac{1}{8}$ of 488 is ---------
   a) 60     b) 61     c) 6.1

25. Sum of all angles of a quadrilateral is ---------
   a) $180^0$   b) $90^0$   c) $360^0$

APPENDIX- XXI

KEY OF PRE-TEST PHASE-II

Choose the correct one

1. $50332 - 1521 =$ ---------------
   c) 48811

2. $53061 \times 100 =$--------------
   b) 5306100

3. $2 \times (3 - 2) =$ ---------------
   b) 2

4. If Ali spends Rs.39526 and saves Rs.11074 out of his salary then his salary is------
   c) Rs.50600

5. $\frac{5}{8} \times \frac{5}{6} =$ ---------------
   c) $25/48$

6. The L.C.M of 12 and 30 is ---------------
   c) 60

191
7. \( \frac{16}{15} \div \frac{8}{5} = \frac{2}{3} \)
   a) 2/3

8. \( 5.6 \times 1000 = 5600 \)
   c) 5600

9. 4 hours = 240 minutes
   c) 240 minutes

10. If price of one chocolate is Rs.20 then the price of 5 such chocolates is
    c) Rs.100

11. An angle of measure 60\(^0\) is
    a) acute angle

12. In the given figures, the square is
    b) 

13. The given triangle is
    c) Scalene triangle

14. If length of each side of a square is 1cm then its area is
    a) 1 cm\(^2\)

15. Area of given figure is
    c) 12cm\(^2\)
16. In the given triangle, the hypotenuse is ---------------
   b) AC
   B                       C

17. \(\frac{4}{9} - \frac{2}{5} = \) ---------------
   c) \(\frac{2}{45}\)

18. Without using protractor, find the missing angle ---------------

   c) 90
   x

19. A graph in the shape of a circle is called ---------------
   b) Pie

20. Lines which are perpendicular to one another have a --------angle between them.
   c) 90°

21. Square each side is 15m, then perimeter is ---------------
   b) 60m

22. 3985 paisa is equal to Rs--------------
   a) 39.85

23. \(A = \{ 2, 3, 5, 7, 11, \ldots \}\) is ---------------set.
   c) prime

24. 1/8 of 488 is ---------------
   b) 61
25. Sum of all angles of a quadrilateral is -----------

   c) $360^0$

---

**APPENDIX-XXII**

**PRE-TEST SCORES OF ACADEMIC ACHIEVEMENT OF PHASE-II**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Names</th>
<th>Experimental (25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hussan Ilyas</td>
<td>24</td>
</tr>
<tr>
<td>2.</td>
<td>Kashan Khalid</td>
<td>23</td>
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<td>3.</td>
<td>Ifra Noureen</td>
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<td>Malaika Arzoo</td>
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<td>S. No.</td>
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<tr>
<td></td>
<td>Name</td>
<td>Age</td>
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<td>---</td>
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<td>35. Wafa Fatima</td>
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**APPENDIX-XXIII**

Time-Table for Teaching the Groups

Fazaia Inter College Jinnah Camp, Nur Khan

Junior School Section

Time-Table for both experimental group and control group

<table>
<thead>
<tr>
<th>Days</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Period</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Period</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Period</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; Period</th>
<th>Break</th>
<th>5&lt;sup&gt;th&lt;/sup&gt; Period</th>
<th>6&lt;sup&gt;th&lt;/sup&gt; Period</th>
<th>7&lt;sup&gt;th&lt;/sup&gt; Period</th>
<th>8&lt;sup&gt;th&lt;/sup&gt; Period</th>
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197
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**APPENDIX-XXIV**

**LIST OF BOYS IN EXPERIMENTAL GROUP OF PHASE-II**

<table>
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<tr>
<th>S. No.</th>
<th>Names</th>
<th>Experimental (25)</th>
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<td>1.</td>
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<tr>
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<td>18.</td>
<td>Abdullah Jan</td>
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APPENDIX-XXV

LIST OF GIRLS IN EXPERIMENTAL GROUP OF PHASE-II

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<td>Sundas Ajmal</td>
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<td>4.</td>
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<td>Noor-ul-Huda</td>
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## APPENDIX-XXVI

**LIST OF BOYS IN CONTROL GROUP OF PHASE-II**

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<td>Usama Mazhar</td>
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**APPENDIX-XXVII**

**LIST OF GIRLS IN CONTROL GROUP OF PHASE-II**
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<td>Aleezay Khurram</td>
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<td>Wania Shakeel</td>
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<td>Maham Akhtar</td>
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</table>
Subject: Mathematics for Grade 5  Total marks: 25  Time: 90 min

Name of Student: __________________ Signature’s student: ________

Name of school: __________________ Marks obtained: __________

Instructions:
- Cutting or erasing the questions is not allowed.
- Paper will be finished within specified time and no extra time will be given.

Choose the correct one

1. I am a multiple of 7, not a multiple of 2, but factor of 490 and the greatest common factor of 35 and 70. Who am I? ----------
   a) 35  b) 14  c) 63

2. Volume of given figure is -------------
   a) 20cm$^3$  b) 250cm$^3$  c) 100cm$^3$

3. Number of faces of a cube is -------------
   a) 4  b) 8  c) 6

4. If the length of a rectangle is “L” and breadth is “B” then formula to find its perimeter is --------------
   a) 4(L+B)  b) 2(L+B)  c) 1/2(L+B)
5. Ali obtained total 312 marks in 4 subjects. His average obtained marks in each subject is

a) 78  

b) 87  

c) 316

6. Who am I?

a) Ray  

b) Line  

c) Line segment

7. The simplest form of 16/40 is

a) 8/20  

b) 4/10  

c) 2/5

8. Area of this triangle is

a) 120 

b) 210 

c) 105

9. Measure of an angle 75° is

a) obtuse  

b) acute  

c) right

10. How many 1/2 hours are in 24 hours?

a) 12  

b) 8  

c) 48

11. 5/6 - 5/18 =

a) 10/18  

b) 10/24  

c) 5/18

12. Base area of a cube is 144 sq.cm. What will be length of its side?

a) 12cm  

b) 36cm  

c) 72cm
13. Sum of all angles of a parallelogram is ------------
   a) \(90^0\)    b) \(180^0\)    c) \(360^0\)

14. Scalene triangle has ----------- equal sides.
   a) 2    b) 3    c) no

15. \(2+2\times2=\) ------------
   a) 8    b) 6    c) both “a”, “b”

16. The H.C.F of 10 and 15 is -----------
   a) 5    b) 10    c) 15

17. A worker earned Rs.972 in 4 days. The daily income is -----------
   a) Rs.243    b) Rs.488    c) Rs.968

18. If the length of each side of a square is \(S\) then its perimeter will be----
   a) \(S+S\)    b) \(S\times S\)    c) \(4\times S\)

19. The number that match this expanded form is -----------
   \(2,000,000 + 88,000 + 400 + 2\)
   a) 208842  b) 2088402  c) 28842

20. 40, 84, 620 ----------- 4,084,260
   a) <    b) =    c) >

21. Area of this shape is -----------
   a) \(3 \times \text{side}\)    b) \(1/2 \times b\)    c) \(\text{side}^2\)
22. Average of 10, 15, 20, 25 and 30 is -------
   a) 15                     b) 20                     c) 25

23. $\frac{7}{8} \div 7$ is -------
   a) $\frac{49}{8}$           b) 7                     c) $\frac{1}{8}$

24. -------- Graph shows gradual change.
   a) pie                     b) line                   c) bar

25. Side x Side is the formula of area of -------
   a) triangle                b) square                 c) rectangle
Choose the correct one
1. I am a multiple of 7, not a multiple of 2, but factor of 490 and the greatest common factor of 35 and 70. Who am I?  
   a) 35

2. Volume of given figure is

![Diagram of a rectangular prism with dimensions 10cm x 5cm x 2cm]

   c) 100cm³

3. Number of faces of a cube is

   c) 6

4. If the length of a rectangle is “L” and breadth is “B” then formula to find its perimeter is

   b) 2(L+B)

5. Ali obtained total 312 marks in 4 subjects. His average obtained marks in each subject is

   ----------------
6. Who am I? 

b) Line

7. The simplest form of $\frac{16}{40}$ is 

c) $\frac{2}{5}$

8. Area of this triangle is $\text{cm}^2$ 

c) 105

9. Measure of an angle $75^0$ is $\text{angle}$. 

b) acute

10. How many $\frac{1}{2}$ hours are in 24 hours? 

a) 12

11. $\frac{5}{6} - \frac{5}{18} = $ 

a) $\frac{10}{18}$

12. Base area of a cube is 144 sq.cm. What will be length of its side? 

a) 12 cm

13. Sum of all angles of a parallelogram is 

c) $360^0$
14. Scalene triangle has equal sides.
   c) no

15. 2+2×2=
   b) 6

16. The H.C.F of 10 and 15 is
   a) 5

17. A worker earned Rs.972 in 4 days. The daily income is
   a) Rs.243

18. If the length of each side of a square is S then its perimeter will be
   c) 4×S

19. The number that match this expanded form is
   2,000,000 + 88,000 + 400 + 2
   b) 2088402

20. 40, 84, 620
   c) >

21. Area of this shape is
   b) 1/2 h x b

22. Average of 10, 15, 20, 25 and 30 is
   b) 20
23. \( \frac{7}{8} \div 7 \) is ----------
   c) \( \frac{1}{8} \)

24. ---------- Graph shows gradual change.
   b) line

25. Side x Side is the formula of area of ----------
   b) square
APPENDIX-XXX

POST-TEST SCORES OF ACADEMIC ACHIEVEMENT OF PHASE-II

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APPENDIX-XXXI

END CHAPTER TESTS OF PHASE-II

ECT 1
Subject: Mathematics for Grade 5 Total marks: 10 Time: 30 min
Name of Student: ___________________ Signature’s student: ______________
Name of school: _________________ Marks obtained: __________

Instructions:
- Cutting or erasing the questions is not allowed.
- Paper will be finished within specified time and no extra time will be given.

Choose the correct one
1. The given figure represents --------
a) Line graph    b) Bar graph    c) Pie graph

2. The correct value of 2.07634 up to 2 decimal places is -------------------
   a) 2.07    b) 2.08    c) 2.34

3. 1.004 + 2.401 = ------------
   a) 3.044    b) 3.401    c) 3.405

4. 9.6 ÷ 8 = ------------
   a) 1.2    b) 0.012    c) 0.12

5. 2/3 + 1/6 = ------------
   a) 5/6    b) 1/9    c) 1/6

6. Height of a tree is 4.23 meters while height of a plant is 1.54 meters. How much is tree taller than plant?
   a) 2.69m    b) 2.79m    c) 3.69m

7. How many minutes are in one day?
   a) 24min    b) 3600min    c) 1440min

8. A car covers distance of 90km in one hour. If it moves with same speed then how much distance it will cover in 6 hours?
   a) 15km    b) 540km    c) 54km
9. The supplement of angle $60^0$ is ----------
   a) $30^0$   b) $120^0$   c) $240^0$

10. Name of the youngest girl is ----------
   a) sana     b) wafa     c) komal     d) zara

ECT 2
Subject: Mathematics for Grade 5 Total marks: 10 Time: 30 min
Name of Student: __________________ Signature’s student: ____________
Name of school: ________________ Marks obtained: ____________

Instructions:
- Cutting or erasing the questions is not allowed.
- Paper will be finished within specified time and no extra time will be given.

Choose the correct one

1. The pair of like decimal is ---------------
   a) 0.4, 1.41  b) 0.4, 0.41  c) 1.4, 1.46

2. An angle of measure $75^0$ is -----------
   a) obtuse angle  b) straight angle  c) acute angle

3. The complement of $45^0$ is ---------------
   a) $35^0$  b) $45^0$  c) $25^0$

4. If the side of each length of a square is 6cm then its area will be -----------
   a) 18cm$^2$  b) 24cm$^2$  c) 36cm$^2$
5. 1.6 x 0.9 = --------------
   a) 0.0144       b) 0.144       c) 1.44

6. 1/4 ÷ 1/3= --------------
   a) 2/7             b) 3/4          c) 1/12

7. 2.4 ÷ 2 = --------------
   a) 1.2       b) 1.4       c) 2.2

8. Which figure is parallelogram?

   a) △               b) □              c) □

9. Average of numbers 1, 4, 6 and 5 is -----------
   a) 1               b) 4           c) 5

10. If the length of a rectangle is 5m and breadth is 4m then its area is -------------
    a) 9m²             b) 18m²         c) 20m²

APPENDIX-XXXII

KEY OF ENDCHAPTER TESTS OF PHASE-2

Choose the correct one

1. The given figure represents ----------

   c) Pie graph
2. The correct value of 2.07634 up to 2 decimal places is --------------
   b) 2.08

3. 1.004 + 2.401 = ------------
   c) 3.405

4. 9.6 ÷ 8 = ------------
   a) 1.2

5. 2/3 + 1/6 = ------------
   a) 5/6

6. Height of a tree is 4.23 meters while height of a plant is 1.54 meters. How much is tree taller than plant?
   a) 2.69m

7. How many minutes are in one day?
   c) 1440min

8. A car covers distance of 90km in one hour. If it moves with same speed then how much distance it will cover in 6 hours?
   b) 540km

9. The supplement of angle 60° is ------------
   b) 120°

10. Name of the youngest girl is ------------
    b) wafa
KEY for ECT 2

Choose the correct one

1. The pair of like decimal is ------------------
   b) 0.4, 0.41

2. An angle of measure $75^0$ is --------------
   c) acute angle

3. The complement of $45^0$ is -----------------
   b) $45^0$

4. If the side of each length of a square is 6cm then its area will be ----------
   c) $36cm^2$

5. $1.6 \times 0.9 = -------------$
   c) 1.44

6. $1/4 \div 1/3= --------------$
   b) 3/4

7. $2.4 \div 2 = --------------$
   a) 1.2

8. Which figure is parallelogram?
   b)
9. Average of numbers 1, 4, 6 and 5 is  
   
   b) 4 

10. If the length of a rectangle is 5m and breadth is 4m then its area is  
   
   c) 20m² 

APPENDIX-XXXIII

END CHAPTER TEST SCORES OF ACADEMIC ACHIEVEMENT OF PHASE-II

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