REPORT

THE IMPACT OF **ABACUS LEARNING** OF MENTAL ARITHMETIC **ON** COGNITIVE ABILITIES OF **CHILDREN**

ALOHA®
MENTAL ARITHMETIC

REPORT
THE IMPACT OF ABACUS LEARNING OF MENTAL ARITHMETIC ON COGNITIVE ABILITIES OF CHILDREN

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REPORT

THE IMPACT OF **ABACUS LEARNING** OF MENTAL ARITHMETIC **ON** COGNITIVE ABILITIES OF **CHILDREN**

ALOHA MENTAL ARITHMETIC

The present document constitutes a summary of the scientific report carried by Doctor K. Vasuki for the University of Madras (India) on the Impact of Abacus Learning of Mental Arithmet of children.

The mentioned study was carried out using a significance sample of the ALOHA Mental Arithmetic students. ALOHA, acronym of Abacus Learning of Higher Arithmetic, is a mental development programme which enhances the brain development of students through the use and visualization of the abacus.

The programme beginnings dates back to 1993 in Malaysia, when Mr. Loh Mun Sung decided to create a programme which, based on the use of the abacus, would go beyond and would enhance the coordination and development of both cerebral hemispheres: left and right.

The programme, currently taught in more than 20 countries of the 5 continents, is directed to children aged between 5 and 13. In this period the plasticity of the brain and, therefore, the learning capacity, are greater.

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SUMMARY

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ABSTRACT

Dr. Vasuki. P.H.D, in philosophy and author of the study

The reading of this report will serve the reader to confirm how the mental development programme, ALOHA Mental Arithmetic, stimulate children's mental capacities and abilities contributing, at the same time, to improving their self-esteem. Additionally, through the different empiric data presented, the reader may ascertain the programme effectiveness in contributing to memory and data recall.

Thanks to its benefits, this innovative learning programme, taught in Asia since 1993, has captured not only the interest of children but also the attention of parents and education professionals. Although the programme it is increasingly popular there wasn´t until now enough literature relating to abacus learning. For this reason, it was necessary to do a scientific study to find out the consequences of learning Abacus Mental Arithmetic during formative stages.

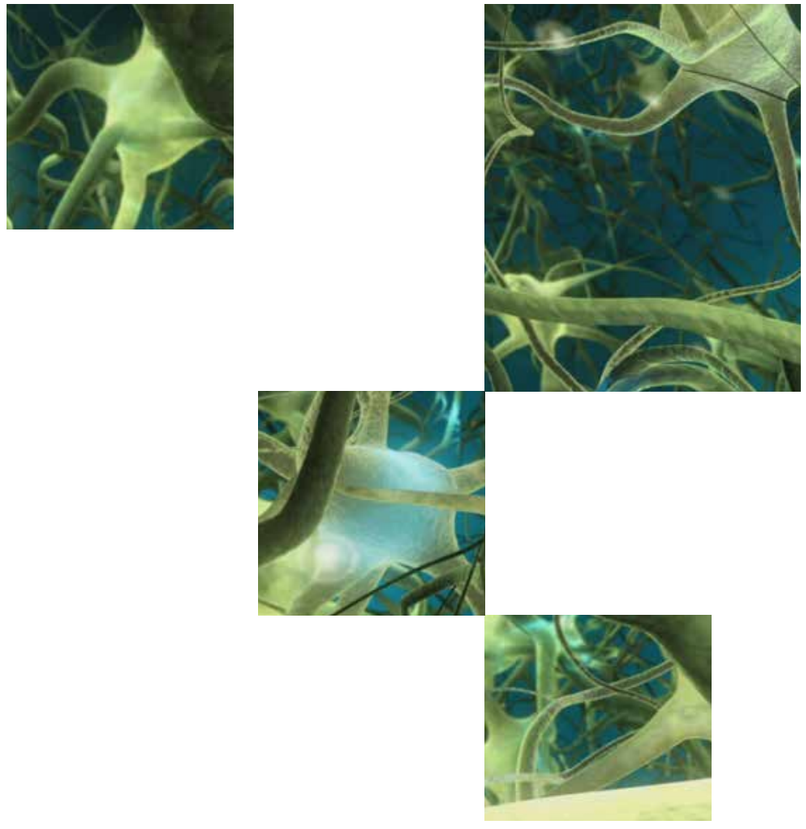
Therefore the present research attempted to study the impact of Abacus Learning on the cognitive abilities such as concentration, problem solving, working memory, associative memory, spatial ability, concept formation and creativity. Also it tried to identify the specific cognitive abilities contributing towards Academic performance of children, which in turn would trigger the parental interest towards this programme.

Based on the objectives and review of literature, wherever necessary, Alternate Hypotheses and Null Hypotheses were framed. The Quasi experimental design with multiple post tests was used for this longitudinal study to gather information regarding the impact of Abacus learning on the selected cognitive abilities of children. The study was conducted in Chennai district of Tamil Nadu. Children of the age 8-12 years, who are learning Abacus, with ALOHA Mental Arithmetic were chosen as the experimental group. As per the control group, children of the age 8-12 years, who are not learning ALOHA, were chosen.

The sampling procedure adopted to select the abacus learners included simple random sampling and purposive sampling. The same techniques were adopted to select control group. Sample consisted of 160 children (80 boys and 80 girls) for experimental group and the same for control group. During the experiment dropout rate was found to be 12% for experimental group and 10% for the control group. Psychological tests were used to collect the data from both the groups.

The tools used for the study were the following standardized tests: Raven standard progressive Matrices (J.C. Raven,1956) ,letter cancellation test, test of creativity (M.A.Wallach & N. Kogan, 1965, adopted by C. R. Paramesh, 1972),The Porteus Maze Test (Stanley D. Porteus,1967) ,The concept formation test (Komal Dwlvedi, 1976), and The Wechsler Intelligence Scale for Children (Wechsler 1958).

CHAPTER I
INTRODUCTION



"Intelligent mind works hand - in - hand with efficient hand. Efficient hand works hand - in - hand with intelligent mind"

In the last years, ALOHA Mental Arithmetic has become very popular not only in Asian countries –where the programme was originated - but also in school centres in America, Europe, Africa and Oceania.

The reason why this programme based in the use and visualization of the abacus has reach such a success – in spite of the computers and calculators hegemony - is a strenuous workout for the brain. The operation with abacus implies the coordinated action of the principle muscles of the human body – for example; sight, sound and movement of the hands- which in turn enhances the brain development.

NEED FOR MATHEMATICS

In these days of increasing innovations in the fields of technological development and also in day-to-day life, there is a considerable amount of dependence on Maths which is the basis of all such developments.

The fundamental process of addition, subtraction and counting are all mathematical in nature and every one of us uses them in day-to-day life.

Understanding mathematics fosters an ability to think laterally. Constant mathematic exploration and practice will give confidence in one`s metal faculties, intelligence and problem solving abilities. Mathematics possesses certain characteristics, which are suitable for the training of the learner´s mind. These characteristics are:

- **Simplicity**
- **Accuracy**
- **Precision**
- **Originality**
- **Similarity to reasoning of life**

ALL ABOUT ABACUS

History and Development of Abacus

The earliest instruments for counting were stones, slender tree branches, tying knots and carving. All these methods of counting once used widely by many nations are no longer in use. Devices helping with such calculations begun with the prehistoric use of stone counters and progressed with the abacus.

A new Abacus

Abacus is a calculating instrument used by Chinese, Japanese and Koreans since ancient times. It was used in business as well as in other scientific areas such as in astronomical calculations and trigonometry calculations etc. At present, a mid-sized abacus has been warmly welcomed. Abacus is practical, useful in solving mathematical problems and especially is very handy in teaching the concept of numbers to children in lower grades.

Objectives of Abacus Mental Arithmetic Education

- **To train and instil in children the habit of careful observation.**
- **To train and instil in children the habit of good memory and recall of data with maximum efficiency and minimum energy.**
- **To train and instil in children the habit of using multiple skills simultaneously with maximum efficiency and minimum economy.**
- **To train and instil in children the importance of sound reasoning and original thinking.**
- **To expand the child's mental powers and faculties and thus to uplift their morale.**
- **To expand the child's photographic memory and spatial orientation.**

The program comprises of two parts:

1st PART
Abacus calculation

The phase of learning in any type of skill can be normally categorized into 3 stages, namely cognitive phase, the fixation phase and autonomous phase. In the case of abacus calculation, it can be further divided into the following seven phases:

1. **Cognitive phase**
2. **Acceptance phase**
3. **Practice phase**
4. **Proficient phase**
5. **Fixation phase**
6. **Autonomous phase**
7. **Expression phase**

2 nd PART
Abacus mental arithmetic

In this phase, students stop using the physical abacus and start practising with an imaginary abacus to calculate the answer. The learners manipulate abacus beads in their head to carry out a calculation. Due to the development of cerebral physiology and machines that can accurately measure the amount of blood flow in the brain, recent studies have proven that the abacus method of mental calculation is extremely effective in activating the right brain.

The different methods of calculation can be divided into:

1

Viewing

This is also called listening mental arithmetic. Someone will read aloud the number and the listener will perform the calculation.

2

Dictation

The student will use the numbers that he sees and imagines the figures to be the beads on an abacus. He will use this imaginary abacus to perform the calculation.

3

Silent Dictation

The student will dictate to himself silently and use an imaginary abacus to perform the calculation.

Mental calculation improves concentration, develops memory and enhances the ability to retain several ideas at once. Students learn to work with different concepts simultaneously. Mental calculation will enable you to develop a 'feel' for numbers. One will be able to estimate answers in a better way.

The best learning age for the children

According to the analysis on the development of nervous tissues, the development and growth of the nerves will begin since 4 to 6 years old with a quickest speed, the progression will slow down after 12 years old when growth reach to 75%.

Benefits of Abacus Learning

Benefits of Abacus education	
1. Primary Benefit	Greater ability in calculating compared to those without the knowledge of Abacus & Mental Arithmetic.
2. Secondary Benefit	(a) Increase in visualization, concentration,memorization and analytical ability through constant practice. (b) Promotes patience and observatory skills. Since the abacus is made of small beads and through constant use of the abacus, a sense of patience and alertness is formed.

PHYSIOLOGICAL ASPECTS OF LEARNING

Very little is known about the ways cognitive processes are represented in the brain. By the time people are born, they have all the neurons they will ever have, about 100 to 200 billion, and each neuron has about 2.500 synapses. However, the fibres that reach out from the neurons and the synapses between the fibres ends increase during the first years of life, perhaps into adolescence. By age two or three, each neuron has around 15.000 synapses; much more synapses than they will have as adults. The synapses, as junctions across which a nerve impulse passes from an axon terminal to a neuron, muscle cell, or gland cell, is of much importance when developing the cognitive functions.

In fact, children are oversupplied with the neurons and synapses that they will need to adapt to their environments. Nevertheless, only those that are used will survive and unused neurons will be "pruned". That is why Abacus Learning of Higher Arithmetic is addressed to children from 5 to 13 years old.

The training of finger movements encourages synapses to be entwined with each other and constructs neuron networks.

Hemispheric functions

Another important aspect of brain functioning that has implications for cognitive development is lateralization or the specialization of the two hemispheres of the brain.

Functions of Right and Left hemispheres

Left	Right
1. Logical problem solving	1. Intuitive problem solving (impulsive reaction)
2. Logical and verbal skills analytical reassuming	2. Visual learning
3. Simplicity	3. Inventiveness
4. Hard sciences	4. Tolerance of ambiguity
5. Practical interests	5. Non verbal thinking
6. Problem solving	6. Creativity and Imagery
7. Precision	7. Openness to experience
8. Understanding of speech and language.	8. Aesthetic interests
9. Attitude towards Maths	9. Visual - spatial information
10. Long term memory (consolidation process)	10. Non - speech sounds such as music, face recognition
	11. Processing of emotional information
	12. Recognition, memory for Geometric patterns

The fact that the left hemisphere thinks in "words" while the right one thinks in images, is important when calculating because any numeric language received is processed by the left hemisphere. Abacus learners of Higher Arithmetic will send this information through the nerve fibres (Corpus Callosum) to the right hemisphere where it is translated into natural language (spatial disposition). At this point, abacus learners manipulate an imaginary abacus to solve the arithmetic operation. With great speed and accuracy, the students get the result that has to be translated into human language. This means the information has to go all the way back through the Corpus Callosum for them to put mathematical notions into words.
By simply doing this, ALOHA learners are trained for the whole brain development.

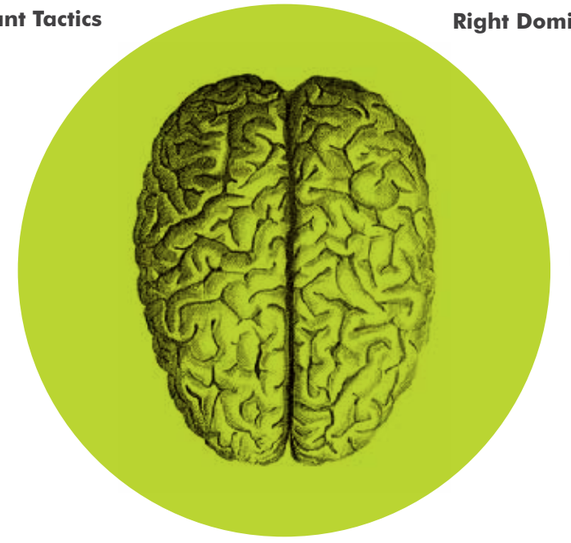
Development of the Right Brain and the Abacus Method of Mental Calculation

Baken,P. (1976) has focused on the significance of left/right hemisphere differences for management in the "Creative Brain". He states that for most people, one of the two hemispheres is the dominant one in terms of our preferred mode of processing. This concept of dominance should not be thought of as a dichotomy, but as a continuum, in which the dominance is distributed in various intensities between the hemispheres. The creation progression of a person could face difficulties or could be failed if lack of co-operation in both brains. Every creation process needs numerous collaborations between these two hemispheres.

A Framework for human Information Processing Tactics (Adapted from Taggart and Robey, 1981

Left Dominant Tactics

Structured
Verbal
Facts
Sequence
Outline
Logical



Right Dominant Tactics

Open-ended
Spatial
Ideas
Relationships
Summary
Intuitive

CHAPTER II
METHODOLOGY

Research is formalized curiosity. It is pocking and prying with a purpose.

Zora Neale Hurston.

RESEARCH PROBLEM

What is the impact of Abacus Learning of Higher Arithmetic on the cognitive abilities of children?

AIM OF THE STUDY

The aim of the present Research is to explore the impact of Abacus Learning of Higher Arithmetic on the specific cognitive abilities of children who are undergoing the first four levels of the ALOHA Programme (divided in eight levels).

OBJECTIVES OF THE STUDY

- **To find about the significance of Abacus Learning.**
- **To find out the cognitive abilities enhanced by Abacus Learning.**
- **To evaluate the effectiveness of Abacus training on cognitive abilities of children.**
- **To make a comparison between the experimental and control group on cognitive abilities due to Abacus training.**
- **To assess the trend across the four levels of Abacus training in the cognitive abilities among ALOHA learners and Non-ALOHA learners.**

HYPOTHESES OF THE STUDY

A significant improvement will be seen across the four levels of training among the children of experimental group on:

- **Concentration**
- **Problem Solving Ability**
- **Working Memory**
- **Spatial Ability**
- **General Mathematics**

Hypotheses Related to cumulative effect of the selected Cognitive abilities

Cognitive abilities will significantly discriminate the Experimental and Control group.

OPERATIONAL DEFINITIONS OF THE VARIABLES SELECTED

Cognitive Abilities
Cognitive abilities refer to various psychological aspects involved in the formation and utilization of symbols and concepts.

Concentration
Concentration is a state of deep mental absorption in the present task.

Problem Solving
The act of defining a problem, determining the cause of the problem; identifying, prioritizing and selecting alternatives for a solution; and implementing a solution.

Working Memory
The term working memory is conceptualized as an active system for temporarily storing and manipulating information needed in the execution of complex cognitive tasks

Spatial Ability
It is the ability to generate, retain, retrieve, and transform well-structured visual images.

Associative Memory
The ability to recall an associated data based on matching a partial input pattern. That is reference clues are “associated” with actual memory contents until a desirable match is found.

Creativity
Creativity is a cognitive ability that results in a new or novel way of viewing or solving a problem.

Concept Formation
The development of ideas based on the common properties of objects, events, or qualities using the processes of abstraction and generalization.

Academic Performance
It is the knowledge attained and skills developed in the subjects of school curriculum usually designated by marks assigned by teachers.

Abacus Learning of Mental Arithmetic
It is a process where students are able to visualize the ‘abacus’ in mind and carry out mathematical operations such as Addition, Subtraction, Multiplication and Division.

RESEARCH DESIGN

Schematic representation of Research Design adopted for the present study

GROUPS	Pre-Test	Intervention	Sequence of observations (post-tests)
Experimental Group N=160	0	ALOHA training X	X_1 0_1 X_2 0_2 X_3 0_3 X_4 0_4
Control Group N=160	0	Non-ALOHA training	0_1 0_2 0_3 0_4

Experimental Group -0 X X_1 0_1 X_2 0_2 X_3 0_3 X_4 0_4
Control Group -0 0_1 0_2 0_3 0_4
X- X_1: Level 1 training (3 months)
X_1- X_2 Level 2 training (3 months)
X_2- X_3 Level 3 training (3 months)
X_3- X_4 Level 4 training (3 months)

TOOLS USED FOR THE STUDY

Name of the tests	Explanation	Population	Variable measured
1. letter cancellation test	A test which looks at the attention and unilateral neglect of a person by asking them to circle a single letter such as r in a piece of continuous text.	Any age group	Concentration
2. The Porteus Maze Test (Stanley D. Porteus,1967)	In its multiple different forms, the Porteus Maze Test contains a complex group of straight pathways which turn suddenly at ninety-degree angles and run into several blind alleys. Just one pathway leads directly through the maze.	3 years and above	Problem solving Ability
3. Raven standard progressive Matrices (J.C. Raven,1956)	Ravens Progressive Matrices is a leading global non-verbal measure of mental ability, helping to identify individuals with advanced observation and clear thinking skills.	6 years and above	Spatial ability
4. The Wechsler Intelligence Scale for Children (Wechsler 1958) a) Coding b) Digit span	The current version of the WISC consists of 13 subtests and takes between 50 and 75 minutes to complete. The test is taken individually, with an administrator present to give instructions.	8 years and above	Associative memory
5. Wallach and Kogan test of creativity. (M.A.Wallach& N. Kogan,1965) (adopted by C. R. Paramesh, 1972)	The test consist of 2 subjects- verbal and non verbal tasks with a total of 5 games children can solve in no limit of time. One of the tasks is to imagine and write down all things a design can be, there is no correct or incorrect responses. Another task is to found new uses for common objects.	Any age group	Creativity
6. The concept formation (Komal Dwlvedi ,1976)	There are 36 problems to be solved by conceptualization. Each problem consists of two sets (pairs) of item which contain symbolic characteristics representative of some objects. Students have to find out the pairs.	3 years and above	Concept formation

PILOT STUDY

A pilot study was carried out prior to the data collection in order to clearly define the research question and test the feasibility, reliability and validity of the proposed tools. The pilot study equipped the investigator with an understanding of the questions in the tools and what it tried to measure precisely, enabling easy and convenient elicitation of information from the representative sample.

SELECTION OF STUDY AREA

Chennai, India's fourth largest city and the capital city of Tamil Nadu, was chosen for conducting the study.

SAMPLING FRAME

The study was limited to a representative sample of school going children from the city of Chennai. The population selected for the present study includes school going children between the ages of 8 to 12 years which consisted of both ALOHA learners and Non-ALOHA learners.

SAMPLE CHARACTERISTICS

The Inclusion and Exclusion criteria used for selection of ALOHA learners to the experimental group are presented below:

Inclusion Criteria	Exclusion Criteria
Only ALOHA learners	
Only ALOHA learners of level one	
Children between the age group of 8 to 12 years	Children of low Economic status
Willingness to respond to the psychological tests	Children of non-graduate parents
Only those who have above moderate I.Q.	

The Inclusion and Exclusion criteria used for selection of Non-ALOHA learners to the control group are presented below:

Inclusion Criteria	Exclusion Criteria
Only Non-ALOHA learners	Children of low Economic status
Children between the age group of 8 to 12 years	Children of non-graduate parent
Willingness to respond to the psychological tests	Drop outs from Abacus Programme
Only those who have above moderate I.Q.	

COLLECTION OF DATA

The school managements and ALOHA centre authorities were informed about the nature, purpose and importance of the study. After obtaining the consent from the respective Institutions, days were fixed for conducting group tests. The respondents were personally contacted during their lunch time, games period and individual tests were administered. The pertinent details were collected from them and tabulated. Data of experimental group was collected during weekends. The present research study involved extensive field-work during the period of data collection.

Sources of data collection

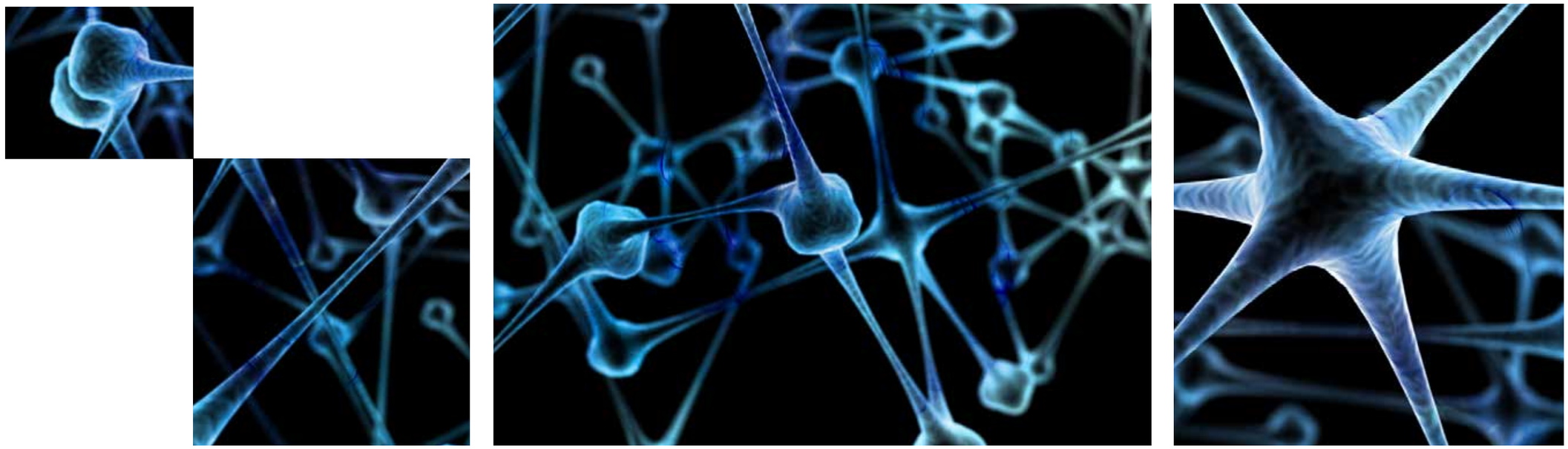
Both primary as well as secondary sources were used for collecting the data.

PROCESSING AND ANALYSIS OF DATA

The collected data was subjected to a number of statistical operations. The data was classified, tabulated and statistically analyzed using SPSS (version.11). The statistical techniques that were applied to analyze the data included:

- **Paired 't' test: To see the difference between pre and post one level.**
- **Unpaired 't' test: To see the difference between each post test of experimental group.**
- **An invariant Analysis with Repeated Measures: To see the improvement across the conditions.**
- **Multiple regressions: To find the Cognitive abilities contributing towards Academic performance of children.**
- **Discriminant Function Analysis: To study the cognitive abilities that are significantly discriminating the groups.**

CHAPTER III
RESULTS AND DISCUSSION



"The principle goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done- men who are creative, inventive and discoverers"

Jean Piaget

TEST OF NORMALITY

The test of normality to determine the probability that the sample came from a normally distributed population is performed using SPSS (version-11).

Descriptive data showing the mean, standard deviation and the coefficients of the Skewness and Kurtosis, for the total sample

S.NO	Variables	Mean	Std. Deviation	Skewness	Kurtosis
1	Concentration	33,48	9,360	0,059	0,024 NS
2	Problem Solving	9,91	1,137	0,004	0,139 NS
3	Working Memory	5,45	0,833	0,002	0,558 NS
4	Spatial Ability	28,22	4,235	0,155	0,184 NS
5	Associative Memory	41,40	6,016	0,231	0,050 NS
6	Creativity	25,58	6,051	0,132	0,479 NS
7	Concept Formation	26,54	6,365	0,069	0,085 NS

NS- not significant

HOMOGENEITY OF GROUPS

In order to confirm the homogeneity of both experimental and control group "t" test was carried out using pretest scores. The non- significant "t" value indicates that abacus learners and Non abacus learners are of same level in their cognitive abilities that have been selected for the present study. Therefore the homogeneity of the groups is ensured.

Comparison between ALOHA learners and Non-ALOHA learners using pre-test scores

S.NO	Variables	Group	N	Mean	STD	"t" value
1	Concentration	E	160	34,76	9,253	2,456 NS
		C	160	32,21	9,321	
2	Problem Solving	E	160	9,90	1,145	0,196 NS
		C	160	9,93	1,136	
3	Working Memory	E	160	5,46	0,633	0,067 NS
		C	160	5,45	0,996	
4	Spatial Ability	E	160	27,73	4,423	2,096 NS
		C	160	28,71	3,993	
5	Associative Memory	E	160	42,21	5,820	2,416 NS
		C	160	40,59	6,118	
6	Creativity	E	160	24,82	6,519	1,639 NS
		C	160	24,41	6,486	
7	Concept Formation	E	160	26,47	6,740	0,210 NS
		C	160	26,62	5,986	

NS- not significant

IMPACT OF ABACUS LEARNING ON THE SELECTED COGNITIVE ABILITIES

The variables chosen for the present study are: concentration, problem solving, working memory, spatial ability, associative memory, creativity and concept formation. A study of was made in order to find out the effect of abacus learning across four levels. Each consists of 3 months duration. Results are presented according to the variables.

Impact of Abacus Learning on Concentration

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	31,20	35,30
	Std. Dev	9,076	9,430
Post 1	Mean	34,20	33,79
	Std. Dev	8,358	8,233
Post 2	Mean	36,39	33,84
	Std. Dev	7,805	8,126
Post 3	Mean	40,44	33,57
	Std. Dev	7,796	6,842
Post 4	Mean	42,16	33,61
	Std. Dev	7,394	6,590
	Total Mean	**184,39**	**170,11**

Concentration is one of the most important cognitive abilities. It is essential for any action as it is required to complete any tasks successfully.

Lack of concentration is very common among students and also this is one of the important factors for their poor performance or under achievement in their academics. An ancient device like the abacus, used for calculations enables the child to improve one of the major aspect of cognitive abilities that is concentration. The results of the present study showed that there is a significant improvement from one stage to another irrespective of gender.

Impact of Abacus Learning on Problem solving

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	9,84	9,90
	Std. Dev	1,165	1,153
Post 1	Mean	11,16	10,69
	Std. Dev	0,934	1,160
Post 2	Mean	11,81	10,95
	Std. Dev	0,813	1,304
Post 3	Mean	12,26	10,27
	Std. Dev	0,819	1,474
Post 4	Mean	12,41	9,18
	Std. Dev	0,805	1,050
	Total Mean	**68,89**	**50,99**

Problem solving abilities which are crucial to academic success in all stages of school rely heavily on higher order cognitive processes and are among the most researched cognitive functions.

During the first two levels of learning the child is taught about thirty two formulas. So when a problem is presented to the child, according to the digits and the kind of the operations child needs to use one or, some time, a combination of the formulas. The infant needs to solve the problem by thinking all the possible ways and then adopting the suitable one because only one formula would be the appropriate one and would give the right answer.

That problem solving, as a basic cognitive function, is involved in all educational activities. Hence, the present results indicate that by undergoing abacus training one can improve his problem solving ability which in turn will help in academics also.

Impact of Abacus Learning on Working Memory

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	5,546	5,42
	Std. Dev	0,651	1,002
Post 1	Mean	6,18	5,49
	Std. Dev	0,742	0,816
Post 2	Mean	6,54	5,38
	Std. Dev	0,790	0,896
Post 3	Mean	7,78	5,25
	Std. Dev	0,796	0,837
Post 4	Mean	7,94	5,17
	Std. Dev	0,712	0,874
	Total Mean	**33,986**	**26,71**

Working memory is implicated in almost all aspects of cognitive performance that is why developing children's working memory is essential. It is the work bench where new and old materials are constantly being processed, transformed and combined with this focus.

Abacus learners show improvement in their working memory just after the first level of training itself, which is three months after joining the course. Also a significant improvement could be noticed in their working memory during level three training, when children finish learning the necessary formulas and start practicing mental calculation.

To perform mental calculations in Abacus Learning they have to temporally hold and manipulate the digits in the memory system and then write the answers. By doing such activities or exercises, working memory gets sharpened. Because the ability to focus is needed to do well on almost any cognitive task one can name, such as mental calculation, people with higher working memory capacity also do better on standardized college admission tests, intelligence tests and reading comprehension tests.

Impact of Abacus Learning on spatial ability

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	27,72	29,01
	Std. Dev	4,423	3,897
Post 1	Mean	30,75	27,95
	Std. Dev	2,490	3,697
Post 2	Mean	31,07	27,73
	Std. Dev	5,768	3,471
Post 3	Mean	31,56	27,66
	Std. Dev	8,406	3,407
Post 4	Mean	30,03	26,75
	Std. Dev	11,499	3,325
	Total Mean	**151,13**	**139,10**

During the process of abacus training, the student needs to create a mental image of the abacus and operate on this image to perform calculations and arrive at the solution. By doing this, the student will have spontaneous grasp of the capabilities like, visualization, that are central to spatial functioning.

The finding that Hatano and Osawa's abacus experts remembered numbers equally well in the forward and in the backward direction was interpreted to mean that their memory used an image of the abacus that permitted mental operations which resembled those available for the object itself.

The present investigation shows that spatial ability rapidly improves during the level one training of abacus and then gets stabilized. Spatial abilities are now understood as important for higher-order thinking in science and mathematics.

Impact of Abacus Learning on Associative Memory

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	42,83	40,42
	Std. Dev	5,313	6,182
Post 1	Mean	45,09	34,74
	Std. Dev	5,035	4,909
Post 2	Mean	46,97	34,62
	Std. Dev	4,826	4,978
Post 3	Mean	49,52	34,45
	Std. Dev	4,478	5,217
Post 4	Mean	48,79	33,40
	Std. Dev	6,136	4,520
	Total Mean	**233,20**	**177,63**

The present findings suggest that ALOHA learners show a continuous progress in their associative memory from the first level itself. The children reach a plateau during their fourth level in their ability of association.

Abacus Learning is basically with numbers. Associating the numbers with the beads of the abacus and vice versa is a basic exercise done in the training. As the levels go on, the difficulty level also goes up which in turn enhances associative memory. A gradual progress in the associative memory as per the level indicates that their performance is becoming better across the conditions.

Impact of Abacus Learning on Creativity

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	49,5429	50,9315
	Std. Dev	10,02470	8,24174
Post 1	Mean	51,89	51,88
	Std. Dev	9,535	5,538
Post 2	Mean	53,24	51,14
	Std. Dev	9,460	5,912
Post 3	Mean	54,59	50,43
	Std. Dev	9,316	5,255
Post 4	Mean	55,01	48,71
	Std. Dev	9,315	5,107
	Total Mean	**270,27**	**253,09**

The contemporary education focuses on theory and its rote memorization. Theory of course is important but many students cannot get an actual feeling of comprehension only through it. Abacus Programme creates an environment conducive for a comprehensive and wholesome experience that incorporates many forms of the abilities, like creativity, and integrates them into a unique learning.

In order to give equal rein to the overall intelligence of the cerebrum, both the right and left brain must be trained at the same time. The creativity will be at its greatest only when both brains are communicating and co-operating with each other. The unique programmes like abacus prevent children from being repressed. A constant practice in visualization and imagery given in Abacus Learning may stimulate creativity in children.

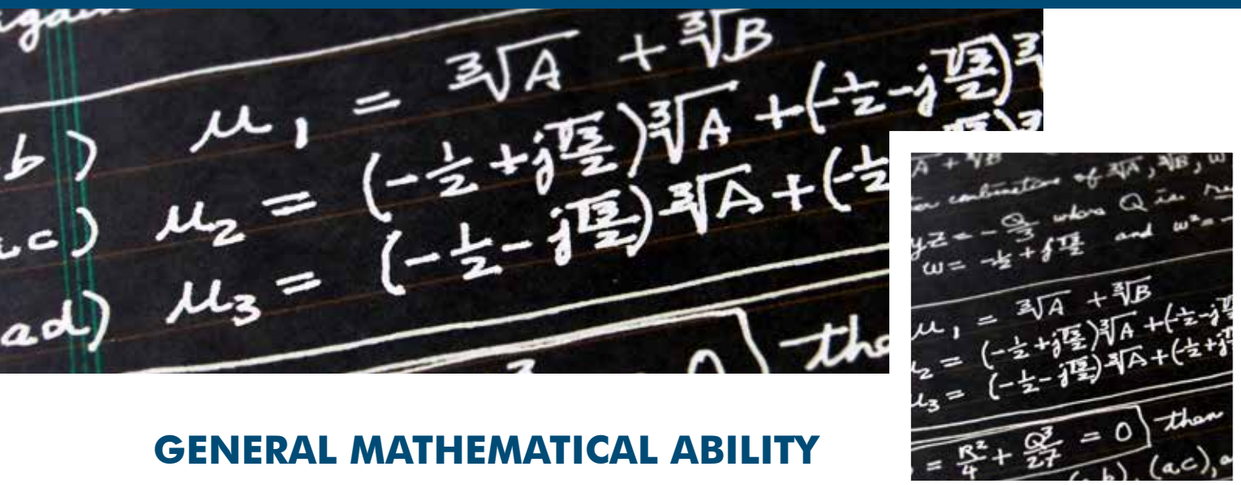
Impact of Abacus learning on Concept formation

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	26,99	26,53
	Std. Dev	6,807	6,214
Post 1	Mean	27,96	28,87
	Std. Dev	5,932	3,251
Post 2	Mean	28,68	29,73
	Std. Dev	5,620	19,884
Post 3	Mean	31,39	28,14
	Std. Dev	4,001	3,913
Post 4	Mean	32,34	28,16
	Std. Dev	3,592	3,975
	Total Mean	**147,33**	**141,43**

Not only for the experts but also for the beginners, Abacus Learning is useful to easily grasp images in addition and subtraction problems, because the beads are moving in front of their eyes. It also allows understanding the decimal system and the concept of digit positions. Once children understand numbers, they will probably become fond of mathematics.

Even though concept formation has improved across the four levels of training, there was a strong upward shift during third level of the training. This may be due to the fact that during the first two levels of training all the necessary formulas are being taught and by the end of the second level the child is expected to know all the formulas.



GENERAL MATHEMATICAL ABILITY

Mean, Standard deviation for experimental and control group

		Group	
		Experimental	Control
Pre-test	Mean	78,36	82,11
	Std. Dev	11,535	7,739
Post 1	Mean	83,08	80,23
	Std. Dev	9,068	7,997
Post 2	Mean	86,06	80,14
	Std. Dev	7,575	7,632
Post 3	Mean	90,14	79,95
	Std. Dev	6,098	7,533
Post 4	Mean	92,31	78,97
	Std. Dev	5,427	7,542
	Total Mean	**429,95**	**401,40**

General Mathematics is one of the important subjects in the school curriculum. Proficiency in mathematics is achieved through Arithmetic ability whose two major characteristics are speed and accuracy. The results of the present study imply that children who undergo abacus training showed a remarkable improvement in their mathematical performance than their counter parts.

During the process of Abacus Learning, children become number friendly as they manipulate many digits of many rows in an easy and effective manner. They are given practice to do the sums within a given time without making careless mistakes.

In addition, they acquire the ability to do mental calculation utilizing the abacus image, which allows quick calculation without actually using the abacus.

CONTRIBUTORS TO ACADEMIC PERFORMANCE OF CHILDREN

Cognitive Predictors of the Academic performance of the children

General details	Predictor variables	Unstandardized Co-efficients		Standardized co-efficient	"t"ratio
		B	Std. error	Beta	
R=0.734 R_2=0.568 Adj R_2=0.557 F=52.194	Working memory	1,301	0,274	0,344	4,478**
	Problem solving	1,659	0,218	0,548	7,603**
	Concept formation	1,270	0,064	0,009	0,200 NS
	Associative memory	0,195	0,047	0,304	4,164**
	Concentration	9,127	0,035	0,124	2,619**
	Spatial ability	2,421	0,085	0,019	0,286 NS
	Creativity	2,953	0,032	0,040	0,935 NS

** Significant at 0.01 level
NS Non Significant
The correlation between the observed and predicted values of cognitive aspects for the children (R=0.754) showed stronger positive relationship.

Academic performance is used as a yard stick to label children as good performers and bad performers. It is one of the criteria which is given priority by the academicians, parents and also by the society from primary till the child completes education and enters into his career. Student's grades and marks are a salient aspect of school life as measures of academic achievement.

ALOHA learners were found to be better performers in mathematics than their Non-ALOHA counter parts.

It is implied that using abacus training as a tool, children's academic performance can be strengthened by developing cognitive predictors that are identified in this present investigation.

SUMMARY

The present research found the cognitive abilities that are being enhanced by the Abacus Learning of Highter Arithmetic (ALOHA) among children are incredible. The statistical analyses have demonstrated the effectiveness of abacus training by showing improvement in the following seven abilities: concentration, problem solving, associative memory, working memory, concept formation, creativity and ability to create a mental image and perform operations (spatial ability).

As these abilities develop, the children will also improve in their academic performance, increase speed and accuracy and help to create a genius discovering its power within. The findings of this research indicate that undergoing abacus training helps in academic excellence by improving the abilities required to get good grades. As the grades or marks obtained in the examination are generally considered as the level of achievement, the success in a performance gives confidence to the learner and motivates for higher achievement.

Another aspect of brain functioning that has implications for cognitive development is lateralization. Children use both their hands in handling the abacus and also to do visualization, during which, children learn to visualize the digits in the form of beads as in the abacus and do all the manipulations using visual imagery.

In fact, the finding of the current research paved the way to label the ALOHA Programme as "The course of Cognitive development".

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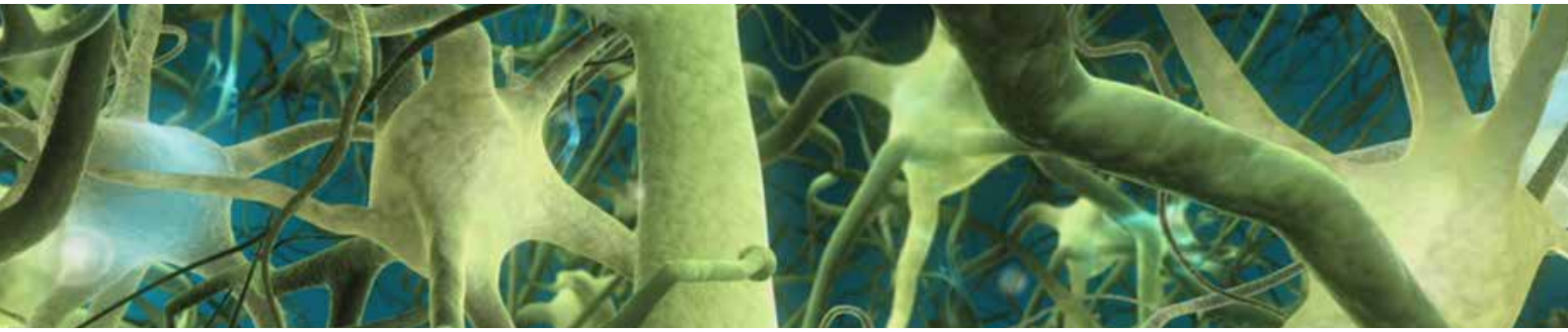

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