DEVELOPING A CONCEPT BASED ACTIVITY WORK BOOK TO REMEDIATE DEFICITS IN NUMERICAL SKILLS AMONGST SELECTED FIRST GRADERS

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By

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CERTIFICATE

This is to certify that the thesis entitled "***Developing Concept based Activity Workbook to Remediate Deficits in Numerical Skills amongst Selected First Graders***" is a research work carried out by MINNU RACHEL ISAC under my guidance and supervision.

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DECLARATION

I hereby declare that this dissertation entitled "Developing Concept based Activity Work Book to Remediate Deficits in Numerical Skills amongst Selected First Graders" is a bonafide record of research work done by me under the guidance and supervision of Dr. N Dhanya and has not been previously submitted by me for the award of degree, diploma or recognition elsewhere.

Place: Ernakulam MINNU RACHEL ISAC

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CHAPTER 1

INTRODUCTION

"Children have real understanding only of that which they invent themselves."

Jean Piaget

Child development refers to the sequence of physical, language, thought and emotional changes that occur in a child from birth to the beginning of adulthood. Child development can be actively enhanced through targeted therapeutic intervention and the 'just right' home-based practice, recommended by Occupational Therapists and Speech Therapists.

"If we love our children and want them to thrive, we must allow them more time and opportunity to play, not less. Yet policymakers and powerful philanthropists are continuing to push us in the opposite direction — toward more schooling, more testing, more adult direction of children, and less opportunity for free play" (Dr. Peter Gray, 2013).

Child development covers a complete scope of a personal skills a child masters throughout their life stages, such as physical skills, Cognition skills, sensory awareness, social interaction and emotional regulation and also speech and language skills. Sensory integration is the basic awareness and skills to be developed within the children. Seven basic senses are Important in the life of children, Sense of hearing, sense of vision, sense of touch, sense of smell, sense of taste along with other two important senses named vestibular sense (Vestibular system helps a person to keep stable, balance and upright.) and proprioceptive sense (involve awareness of the spatial and mechanical status of the musculoskeletal framework. They include the senses of position, movement and balance.).

Proprioceptive-vestibular interactions, coupled with corollary discharge of a motor plan, allow the brain to distinguish actively generated from passive head movements. Vestibular contributions to body orientation and to spatial localization of auditory and visual stimuli have long been recognized. The control and perception of body orientation and motion are subserved by multiple sensory and motor mechanisms ranging from relatively simple, peripheral mechanisms to complex ones involving the highest levels of cognitive function and sensory-motor integration. The sense of orientation during locomotion is derived from our spatial relationship with the external environment, sensed predominantly by sight and sound, and from internal signals of motion, generated by the vestibular sense and the pattern of efferent and afferent signals to the muscles and joints.

Children should be given proper knowledge and awareness about their environment where they have to live their entire life. Parents, grandparents and caregivers are the primary source of knowledge to children. Teachers also play a nice role in it, they will influence children and can assess children's capability and try to enhance it. Children must be aware of the senses and must be skilled enough to live their life well.

Skills such as problem-solving skills, cognitive skills, spatial awareness, higher order thinking, sequential ordering are the basic skills to be acquired by children. Once if the child delays / fails in acquiring these skills they will definitely face problems in higher life stages. Basic Geometric concepts about Space, Shape and Size further leads to the idea of mathematics. As someone said the world axis on mathematics, the knowledge of mathematics is important and it must be nurtured since the smaller classes. The Idea of higher mathematics is foundational on the basic idea of spatial and sequential awareness, and also knowing to handle the concept of space, shape and size. Concept based numerical tasks/ activities can facilitate the child's knowledge in mathematics. Mathematical concept can be introduced to children in 3 phases as; Concrete then Semi concrete and finally to the Abstract.

Children who lack in knowledge of spatial – sequential ordering and who deny in handling the concept of space, shape, and size will definitely face deficit in numerical skills in their late life stage. Children having struggle in the areas of space, shape and size obviously shows struggle in mathematics.

We can check the activities such as crawling, hopping, jumping of children and analyse whether they are spatially oriented. Activities such as puzzles, paper – pencil activities, Physical activities, kinesthetic activities. Tasks providing sufficient exposure to those activities is much needed. And must be provided on time. During the 'critical period' of life, these exposures must be experience and it will definitely make children motivated to move forward in life.

Most of the children develop spatial awareness by their own. Still a suitable home environment and exposure must be given to children. Even though children can acquire these skills gradually through their life span there are children who fail to develop spatial awareness, and these children can be provided with activities that can build those neural connections. Give Your Baby Freedom to Explore, Play Hide-and-Seek Games, Fit Things Together and Take Them Apart, Fill Objects and Then Empty Them, Stack and Rearrange Objects, Play Spatial Sports are some activities that can be done to build the brain neurons in children and to promote the spatial awareness among them. It can facilitate the parietal lobe in brain. The exercise that crosses the mid line of the body can strengthen the corpus collosum. Corpus callosum is a long thick band of nerve fibres which connects the two hemispheres in the human brain. Visual perception; visually attracted figures can gain the interest and attention of children. Capacity of mentally generate, transform and rotate a mental image.

Styles of learning- each person have their own unique way of learning. The style of learning influences their social life. Types of learning styles are; visual learners, auditory learners, kinaesthetic learners and tactile learners (VAKT). All these styles of learning can be incorporated together for a better learning experience in children. "Learning style is the preference or predisposition of an individual to perceive and process information in a particular way or combination of ways"

(Sarasin,) Child's learning style must be recognised to provide proper kind of input on introducing tasks to facilitate their senses.

Cognition is the mental action of a person in acquiring knowledge, processing, interpreting and react to it appropriately. Cognition is meant as the storage of information that is the memory. Memory is today defined in psychology as the faculty of encoding, storing, and retrieving information (Squire, 2009).

Brain development is done in a faster rate, as it enables the child to perform in complex ways. Well-developed brain can be effective in developing spatial awareness in child. Parietal lobe in brain is responsible for the spatial relations in a person. So, any damage occurring in parietal lobe can cause spatial awareness issues. If a child shows any kind of spatial relationship problems, they should be remediated with any activities and medication to repair the parietal lobe in brain. Parietal lobe in brain must be activated with tasks / activities to have a good spatial relation. The ones who have damage in parietal lobe will have difficulty in spatial relations, and obviously will have lack of knowledge in certain areas and affect the development of 'numerical skills' in children with learning disability.

Learning disability is a neurological condition, which affects the brain's ability. A child with learning difficulty can have difficulties in writing, reading, language and understanding mathematical concepts. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia (Karanth, 2002).

Developmental problems in brains lead to SLD in students. Children with learning difficulty mostly seem to have struggle in the basic geometric concepts of space, shape and size which further will lead to deficit in mathematical skills. The difficulty in understanding mathematical concepts is refers as 'dyscalculia'.

Signs of learning disability varies from person to person. Common signs that a person may have learning disabilities include the following:

- Problems reading and/or writing

- Problems with math
- Poor memory
- Problems paying attention
- Trouble following directions
- Clumsiness
- Trouble telling time
- Problems staying organized

A child with a learning disability also may have one or more of these, like acting without really thinking about possible outcomes (impulsiveness), “Acting out” in school or social situations, Difficulty staying focused; being easily distracted, Difficulty saying a word correctly out loud or expressing thoughts, Problems with school performance from week to week or day to day, Speaking like a younger child; using short, simple phrases; or leaving out words in sentences, Having a hard time listening, Problems dealing with changes in schedule or situations, Problems understanding words or concepts

These signs alone are not enough to determine that a person has a learning disability. Only a professional can diagnose a learning disability. Each learning disability has its own signs. A person with a particular disability may not have all of the signs of that disability.

An Indian study had found that the prevalence of impairment in reading and written expression was 22% each and impairment in mathematics was 16% (Indian Journal of Psychological Medicine, 2020). Still the prevalence of writing and difficulty seems high in SLD children, mathematical reading impairment is too high. Mathematical impairment is seen common in children with specific learning disability, where the main reason will be the cognitive impairment in children. Cognitive impairment results in distracted mind and less capable in the area of social, spatial, sequential relations.

Concept based mathematical activities can overcome the deficit in the skill and promote to develop abstract knowledge.

Today's children are tomorrow's assets. They should be able to build a self-confidence, that they can make a great appropriate change that the world need. Such children will be able to think logically. Logical thinking is the combination of situational awareness and ability to regulate owns emotions and success in decision making. By Spending time in socialising with others, learning new skills, visualising the outcome of owns on decisions and choices can help one to think logically.

Studies have shown that early detection of the learning disability help in dropping the high incident rates of disabled children. If given the intervention at earlier period of life, complication of these disorders can be prevented and the children can be rehabilitated and brought back to normal phase of life. The role of detecting disability is not the sole responsibility of the doctors or any medical practitioners, rather the family and community workers also play an important role here. Scientific research shows that the first three years of life is best suitable for identification and intervention as the brain structure development and functioning is at its peak. (Dr Vidhukumar, additional professor, psychiatry, Kalamassery). Every elders around the children are responsible in their development.

The role of assessing the deficit in children is not the sole responsibility of teachers in school, it is difficult to be so. It's the responsibility of all primary connecters of the child including parents, caretakers, tutors, and also siblings and friends. Parents, and indeed family members, of children with developmental disabilities experience challenges that differ from those experienced by parents of typically developing children (Woodman, 2014).

Relevance of the Study

In the current situation, it is found that a notable number of students face difficulties in understanding mathematical concepts. As knowledge on basic mathematical concepts leads to higher order thinking and such development in children it is very relevant to prepare or develop any remedial strategies to remediate the children to overcome their difficulty numerical skills. Numerical skills can be introduced to children as concrete method, as the concept-based learning makes children more relatable and easily understand the concept.

It is a fact that the knowledge on basic concepts of space, shape and size are the foundation stone to the complex mathematical concepts. Since the idea of basic concepts should be nurtured in children from early stages of, it is evident to consider students studying in grade 1. This study thereby focuses on developing activities on pre- skills of 3- S (Space, Shape & Size) concept to children to improve their numerical skills. Grade 1 students around the city are considers in the study. A self-developed pre-test is done on selected sample to examine the knowledge in the areas of space, shape and size, then the samples scored the optimal level of score and below to it were further taken for intervention, to help them to remediate the deficit in the areas using the invigilator self-designed 'Concept based activity work book'.

Operational Definition

1. Concept based activity work book:

According to Webster (1909), work book is defined as a book that contains problems or exercises and that students use to practice what they are learning in a class.

In this study 'concept based activity work book' refers to a book aimed at children, which contains interactive contents such as paper-pencil activities, physical activities, activities to develop concept of space, shape and size, and numerical concepts in a colourful and attractive presentation.

2. Numerical skills:

According to Andrew John (2016) Numerical skills refer to the ability to use, interpret and communicate mathematical information to solve real-world problems

In this study 'Numerical skills' refers to awareness of children in the concepts of numbers, before number and after number, bigger number and smaller number, ascending and descending order and place value.

Aim:

The aim of the present study is to provide concrete understanding of the concepts of space, shape and size to remediate the deficits in numerical skills found in first graders.

Objective:

- To develop a tool to assess children for deficits in concept of space, shape, size and numerical skills.
- To identify suitable activities to develop the conceptual understanding of space, shape and size.
- To compile the developed strategies and activities into a workbook.
- To remediate the children identified with numerical deficits using the developed work book.
- To assess the efficacy of the work book in remediating deficits in numerical skills.

CHAPTER 2

REVIEW OF LITERATURE

Review of literature for the topic "Developing a Concept-based Activity Workbook to Remediate Deficits in Numerical Skills amongst Selected First Graders" is discussed under the following subheadings.

2.1 Spatial Knowledge

2.2 Sequential Ordering

2.3 Visual Perception

2.4 Sensory Integration

2.5 Sixth and Seventh Senses

2.5.1 Vestibular

2.5.2 Proprioception

2.6 Physical Development

2.6.1 Fine motor

2.6.2 Gross motor

2.7 Knowledge of Concept of:

2.7.1 Space

2.7.2 Shape

2.7.3 Size

2.8 Pre- Numerical Skills

2.1 Spatial knowledge

Spatial awareness can be defined as an awareness of the body in a space and the persons relationship to an object in a space. Spatial knowledge includes the knowledge of the spatial relationships between objects of an environment in the individual's wayfinding process (declarative spatial knowledge) and the knowledge about how to move in this environment (procedural spatial knowledge) (Sorrentino, 2019).

Spatial awareness and spatial relations allow children to locate objects and navigate successfully in their environment. Spatial information enables us to make sense of the world and is a fundamental and important element of everyday life.

Spatial perception is defined as the ability to perceive spatial relationships in respect to the orientation of one's body despite distracting information. It consists of being able to perceive and visually understand outside spatial information such as features, properties, measurement, shapes, position and motion.

Hartlage (1969) found that young congenitally blind children are not as good at dealing with spatial concepts as they are with non-spatial concepts.

Hogsette (2009) points out in Writing That Makes Sense: Critical Thinking in College Composition that technical writers may use spatial order to explain how a mechanism works; architects use spatial order to describe a building design; [and] food critics reviewing a new restaurant use spatial order to describe and evaluate the dining area," .

According to Nordquist (2020), spatial order is an organizational structure in which details are presented as they are (or were) located in space—from left to right, top to bottom, etc. Also known as order of place or space structure, spatial order describes things as they appear when observed. In descriptions of places and objects, spatial order determines the perspective from which readers observe details.

Neurologically, Levine states that sequential ordering is carried out on the left side of the brain and spatial ordering is carried out on the right side of the brain.

2.2 Sequential Ordering

Sequential order usually refers to **steps in a process or event**. This pattern works well when using step-by-step directions. Sequential and spatial ordering help our children learn on distinct levels that range from most rudimentary sorting out of simple instructions to the most intricate way of learning and performing. On that basic level, a student has to interpret or perceive a spatial array (such as the shape of a country on a map) or sequential pattern (such as the order of beats in a musical rhythm), perhaps storing these key perceptions for later use.

The Sequential Ordering Problem (SOP) is a model for many real-life applications, ranging from helicopter routing between oil rigs to scheduling on-line stacker cranes in an automated warehouse (D. Ahr et al. (eds.), Operations Research Proceedings 2003).

In chapter six in book "A Mind at a Time", which is titled "Making Arrangements: Our Spatial and Sequential Ordering Systems" Levine focuses on how children organize their world in terms of learning, thinking, and remembering.

According to the study by Narayanamma and Latchireddi (2019), It is evident that visually impaired children of the Government schools have scored higher than that of the children studying in Private managed schools. These scores in each of the components indicated that the Government polices and programmes influenced more for the concept development. Both Government managed schools and Private managed schools the scores attained are high, where as in "Time and Distance Awareness", "Measurements "and "Orientation of Environment" the scores attained by the students was low.

Levine states that children have two ways in which they organize the information they receive from the world around them. He refers to these methods as sequential

ordering and spatial ordering. He defines spatial patterns as, “assembled parts that occupy space and settle on the doorsteps of our minds all at once” (Levine, p.151).

Levine defines sequential patterns as information gaining “admission to the minds one bit at a time and in an order, that’s meant not to be missed” (Levine, p.151). He says that sequential ordering is used when students try to master a science project or learn a telephone number.

Study reveals no significant differences between the scores of Governments and Private school visually impaired children with respect to Awareness of object /situation characteristics, Time and distance awareness, Spatial awareness, 222 Measurements and Orientation of environment, (Narayanamma and Latchireddi, 2019).

2.3 Visual Perception

Visual perception can be defined as the total process responsible for the reception (sensory functions) and cognition (specific mental functions) of visual stimuli. The sensory function or visual receptive component is the process of extracting and organising information from the environment, and the specific mental functions that constitute visual- cognitive component provide the capacity to organise, structure and interpret visual stimuli giving meaning to what we see. Visual perception allows a person to make accurate judgment on the size, configuration and spatial relationship of the object. Visual perceptual skills include the recognition and identification of shape size object colour and other qualities.

Narayanamma and Latchireddi, 2019, says there is a high significant correlation between different areas of Body awareness, Awareness of object /situation characteristics, Time and distance awareness, spatial awareness, Skill oriented concepts, Measurements and Orientation of environment towards Concept Development in Visual perception.

Study by Cayir, (2017) on Developmental Test of Visual Perception to analyse visual perceptions of children was carried out. Their results also suggested that there was a strong relation between reading levels and visual perception skills. The number of the children in the anxiety (poor) reading level were high (79%) as well.

Student's visual perception levels were also analysed using Beery-Buktenica Developmental Visual Motor Coordination Test. Results have shown that most of the students were in the anxiety (poor) level (75%) and the rest of the children were in the instructional level (25%). It has been found that instructional level first grade students had better scores in reading speed, reading comprehension, and reading errors. They also had significantly better scores on the visual perception test. (Çayir, 2017).

According to Smith and Brien (2013), Visual memory involves the integration of visual information with previous experiences. Visual discrimination is the ability to detect features of stimuli for recognition, matching and categorisation. Visual perceptual abilities, aid the manipulation of visual stimulus for visual discrimination.

Visual perception, or sight, is the ability to interpret the surrounding environment through photopic vision, colour vision, scotopic vision, and mesopic vision, using light in the visible spectrum reflected by objects in the environment. Visual perception is the ability to perceive our surroundings through the light that enters our eyes.

Psychologically, visual perception happens when the eye focuses light on retina. According to a study at MIT in the United States in 2017, Visual perception occurs in the brain's cerebral cortex. It is the electrochemical signals get there by traveling through the optic nerve and the thalamus and the process would take 13 milliseconds of time.

Results of the study 'The Impact of Visual Perception Skills Training On Reading Performance In Students With Dyslexia' indicate that training visual perception skills could enhance reading performance in students with dyslexia. Also,

reinforcing visual perception skills could improve comprehension and word recognition in texts in students with dyslexia. Training visual skills can improve reading performance and therefore, lead to significant improvement in reading ability and comprehension in students with dyslexia. Therefore, it can be concluded that training visual skills is an appropriate educational method for all students with dyslexia who have problems in visual perception. (Kalroudi .Hamid, and Koushesh., 2009).

2.4 Sensory Integration

Sensory integration is a child's ability to feel, understand, and organize sensory information from his body and his environment (Polly & Liz). Sensory integration is a term that has been used to describe processes in the brain that allow us to take information we receive from our 5 senses, organize it, and respond appropriately. Sensory integration is also reflected in a child's development, learning, and feelings about himself. The connection between sensory integration and social and emotional development should not be underestimated. How a child integrates through the sensory systems provides a basis for his reality (Emmons Godwin Polly & Anderson McKendry Liz (2005), Understanding sensory dysfunction). The sensory inputs involved in posture control include visual and vestibular inputs and somatosensory inputs (Chiba et al., 2016).

In order to receive information from the environment people are equipped with sense organs. Each sense organ is part of a sensory system which receives sensory inputs and transmits sensory information to the brain. According to Dr. Samuel McLeord, 2018, a particular problem for psychologists is to explain the process by which the physical energy received by sense organs forms the basis of perceptual experience. Sensory inputs are somehow converted into perceptions of desks and computers, flowers and buildings, cars and planes; into sights, sounds, smells, taste and touch experiences.

Ayodhya, (2007) has studied blending problem-solving skills to learners' achievements. The results indicated that there was a significant improvement in the scholastic achievement in Mathematics that was exposed to Polya's method in the majority of the schools.

A. Jean Ayres, an occupational therapist, was working with children and adults with neurologically based disabilities, when she began to realize that some of the difficulties her clients were experiencing were going beyond obvious physical impairments to subtle attention difficulties and learning difficulties that were impacting all areas of their lives—school, community, and home. Dr. Ayres began to focus her efforts on these children with perceptual learning and behavioural problems that could not be attributed to known causes. She believed that the best answers would be found in a better understanding of how the brain processes sensations—not only from the eyes and ears, but from the other parts of the body as well. Dr. Ayres believed that sensory integration occurs automatically in most people, so we just take it for granted.

So, according to Dr. Ayres, in her book Sensory Integration and the Child (1979), she described the nervous system as an interconnected network of nerve cells that are distributed throughout the body. The brain and the spinal cord together are known as the central nervous system. Basically, the central nervous system is responsible for taking in sensations from outside (and inside) the body, sending signals to the brain where they are organized and processed, where a response is formulated and "sent."

Psychologist Gregory (1970) argued that perception is a constructive process which relies on top-down processing.

Stimulus information from our environment is frequently ambiguous so to interpret it, we require higher cognitive information either from past experiences or stored knowledge in order to makes inferences about what we perceive. Helmholtz called it the 'likelihood principle'.

For Gregory perception is a hypothesis, which is based on prior knowledge. In this way we are actively constructing our perception of reality based on our environment and stored information. Sensory integration is what turns sensation into perception. Perception defines reality to an individual! Again, sensory integration defines reality,

Sensory Channels

Vision, hearing, taste, smell and touch are the so-called five senses. In addition to these senses there are more human senses. Sense organs in the muscles, tendons and joints and the sense of muscles is termed as kinesthetics.

Each sensory system is a kind of channel, consisting of a sensitive element (the receptor) , nerve firers leading from this receptor to the brain r spinal cord, and the various relay stations and processing areas within the brain. When a sensory channel is stimulated, we have a sensation that is characteristic.

2.5 Sixth and Seventh Senses

We are aware of 5 senses sight, smell, sound, taste, and touch. However, there are two more senses that don't typically get mentioned always in basic lessons. The sixth and seventh senses – that are called the vestibular and proprioceptive systems. These systems are associated with body movement and can lead to difficulties with balance when they don't work correctly.

Most people are familiar with the five senses:

• touch (or tactile)

• smell (or olfactory)

• taste (or gustatory)

• hearing (or auditory)

• seeing (or visual).

The Sixth and Seven Senses -

Most people still unaware of the sensory systems: The Vestibular and Proprioceptive Systems. These systems function well together for a betterment, if these systems don't work properly, it directly affects a child's ability to interact successfully within self, with others, and in their surroundings. These are 2 sensory inputs for spatial awareness. These systems are associated with body movement and can lead to difficulties with balance when they don't work correctly. These sensory systems also gather information from receptors that respond to stretch and tension in muscles, joints, skin, and tendons (Lackner & DiZio, 2005; Proske, 2006; Proske & Gandevia, 2012).

2.5.1 The vestibular system

The vestibular system coordinates the movement of the eyes, head, and body through space and body movement. The vestibular system allows us to balance, swing on a swing, coordinate the two sides of our body, and catch ourselves when we stumble. Just for fun, stand up, close your eyes, spin quickly three times in one direction, three times in the other direction, keep your eyes closed, and try to stand on one foot. That's your vestibular system at work.

Vestibular system helps a person to keep stable, balance and upright. The vestibular system provides information through the inner ear that tells us about our head position and how (or if) we are moving. Your understanding of movement and balance helps you coordinate the movement of your head with your eyes, enables you to use both sides of your body at the same time, tells you which direction you're going and how fast, and enables you to remain upright. The vestibular system is your body's internal GPS.

According to study Vestibular stimulation has a wide network with the brain structures like cortex, limbic system, cerebellum and basal ganglia. This study has proved that vestibular stimulation as a simple intervention to greatly reduce stress

further preventing an individual falling into severe depression and anxiety. It also shows its positive effects in improving sleep pattern, behavior, cognitive, motor, immune and autonomic functions and also in improving the quality of life (Kumar. S, 2018).

The vestibular system, also known as our balance centre, is responsible for receiving information regarding our bodies movement in space, as well as, acceleration and deceleration of movement. The receptors in this system are located in the inner ear and are stimulated by changes in head position (Emily and Lauren, 2018).

Through a study (Jinu, 2019) have proven that vestibular stimulation as an effective intervention to reduce the structural and functional effects of dementia on brain.

The vestibular system derived from a simple gravitactic sensor that subsequently radiated into multiple epithelial patches and morphologies. The innate link between vestibular sensors and gaze/posture stabilization allowed the evolution of free locomotion with the subsequent employment of such signals for orientation and navigation.

A well-developed vestibular system enables a child to be alert, feel safe or 'grounded', control their eye muscles, move safely in the environment or sit still. In contrast, a poorly developed vestibular system has been linked to poor attention span and fidgeting in children.

2.5.2 The proprioceptive system

Proprioceptive system will control body awareness. The proprioceptive system provides information to your brain about your body's position in relation to your environment (which direction you are facing, for example, or how close you are to obstacles). The proprioceptive system also tells you the amount of effort being used to move your body, and regulates both emotional responses and sensory input.

Majority of previous studies have shown positive impact of proprioceptive training on rehabilitation process of injuries. (Payne, Berg, & Latin, 1997; Tropp, Ekstrand & Gilquist, 1984; Freeman, Dean, Hanham, 1965; Tropp, Askling, Gillquist, 1985) on sportspersons related to different games.

Studies have reported positive effect of proprioceptive training on balance abilities (Holm et al., 2004; Han, Ricard, & Fellingham, 2009; Gajanana Prabhu, 2013). Balance abilities solely depend on visual and proprioceptive system, by increasing the difficulty of the task visual system comes in to play to improve balance abilities (Hazime et al., 2012).

The sensory functions, collectively termed 'proprioception' (proprioceptive sensation or kinaesthesia), involve awareness of the spatial and mechanical status of the musculoskeletal framework. They include the senses of position, movement and balance. Proprioceptive sensation is also integral to developing motor control when learning new skills. Conversely, the contribution of the proprioceptive system to motor control during learned skills is largely mediated without sensation; as also are its roles in reflex protection of joints against potentially harmful forces and protection of the body against falls (balance). (Barry.C. Stillman, 2001). Proprioceptive sensation is also integral to developing motor control when learning new skills.

Ganesh (2012) reported the significance of proprioceptive training in improving motor fitness & skill-oriented performance among hockey players. Taskin & Bicer (2015) incorporated multidirectional inclined balance board training for improving proprioception and its effect on agility, quickness & acceleration. They revealed the effectiveness of proprioceptive training in developing agility, speed & quickness. Agility & Vertical jump performances have been improved by proprioceptive training (Miller, Herniman, Ricard, Cheatham, & Michael, 2006; Gaurav, Pooja, Shishir & Tanvi, 2013).

A well-developed proprioceptive system helps a child move safely, get dressed and use tools. It underpins understanding important ideas like 'left and right', the use of

prepositions in English such as 'over and under', 'towards 'or 'away', and concepts of maths and science such as size, weight and force.

2.6 Physical - Motor Development

Physical development (PD) is the growth and development of both the brain and body in infancy and early childhood**.**

PD is the growth and development of both brain and body and involves developing control of muscles and physical coordination. This control is used in a whole range of skills of daily functioning and encompasses children's ability to do a range of different tasks, such as speaking, making friends and understanding the world around them.

Progression towards this control is not defined by the child's chronological age, but by the opportunity to acquire skills. A child with delayed PD may catch up, especially with an appropriate intervention, but young children need to be given regular opportunities and encouragement to practice and refine their physical skills through being active.

Physical growth cycle

The term ‘cycles’ means physical growth does not occur at a regular rate, but rather in periods, phases or “waves” of different velocities sometimes rapidly and sometimes slowly. (pg.108, Hurlock, 2000 (reprint) tata MaGraw-Hill)

There exists a significant difference between physically challenged and normal children studying in same integrated educational settings in terms of their self-concept (Marak, 2013).

Development of nervous system.

Growth of the nervous system is very rapid before birth and in the first 3 – 4 years after birth. Growth during the prenatal period consists primarily of an increase in the number and size of nerve cells. Later growth consists primarily of the

development of immature cells present at birth. After, the age of 3 or 4 growth of the nervous system proceeds at a relatively slow rate. This pattern is the characteristics of both the cerebrum and the cerebellum. The cerebellum, which plays an important role in body balance and posture control, triples its weight during the first year of postnatal life. Growth and development of the brain and nervous system affect all aspects of the child development.

According to Smith and Brien, 2013, motor learning refers to the modification of motor skills. Motor learning literature explores the transfer of learning, sequencing and adapting tasks , type and amount of practise, error based learning, timing and type of feedback and mental rehearsal.

Effect on body proportions

The rapid growth in the size of the brain during the early years is one of the causes of the top-heavy look at the young child. Top heaviness is further accentuated as the child trunk and extremities elongate and become slender.

Effect on mental capacities

With rapid growth and development of the cortical tissues of the cerebrum come rapid changes in mental abilities. The abilities to remember to attach meanings to people and objects, and to reason show marked increases with every passing year throughout childhood. This enables the child to make better personal and social adjustments.

Motor development means the development of control over bodily movements through the coordinated activity of the nerve centres. This control comes from the development of the reflexes and mass activity present at birth. Until this development occurs, the child will remain helpless.

Principles of motor development

In numerous longitudinal studies, groups of babies and young children have been tested and observed over a period of time to see when certain forms of motor behaviour appear and discover whether these forms are similar for other children of the same age. Extensive studies show that various motor performance involving the arms, wrists and finger such as reaching, grasping and thumb opposition, develop in a predictable sequence.

Motor development depends on neural depends on neural and muscular maturation.

Development of the different forms of motor activity parallels the development of different areas of the nervous system. Because the lower nerve centres, located in the in the spinal cord. Are better developed at birth than the higher nerve centres, located in the brain. Reflexes are better developed at birth than voluntary activities.

Physical development covers a wide range of gross and fine motor skills (outputs) that are made in response to sensory input.

Motor development research has previously been considered the Cinderella of developmental science: central to children's experiences, but rarely in the spotlight (Rosenbaum, 2005; Adolph, 2010).

2.6.1 Fine Motor development

Fine motor skills refer to physical skills that involve small muscles and hand-eye coordination. Movements are more controlled and precise and often a well-developed pincer grip is needed. Fine are needed for, mark making in communication, language and literacy, counting equipment in numeracy, doing up buttons and laces.

2.6.2 Gross Motor Development

Gross motor skills refer to the controlling of large body movements that involve large muscle groups, including core stability and posture e.g. pushing, pulling, rolling, crawling, walking and sitting still.

Both gross motor skills and fine motor skills are needed for children to engage in creative activities such as dance and art. They are also important for health as children need to move to be active. They are needed for self-care, like being able to go to the toilet independently, or getting dressed.

2.7 Knowledge of concept of Space, Shape and Size

Geometry comprises of three major components, one is shape. For example, we learn that triangles must have three straight sides and three angles, but the angles may be narrow or wide, and the triangles may be tall or short or tilted in any number of ways. The second component is thinking about space. We learn how objects relate to one another and to us in space: the ball is on top of the sofa, the sofa is under the ball, and we are in front of both. Third component is size, we learn by comparing the biggest and smallest in size of any object.

2.7.1 Space

Space refers to a place where objects can be placed. Perception of objects begins soon after birth. Children are able to differentiate with each object in according to their structure. By the end of infancy, child can develop object perception greatly, and children navigate the everyday world with relative ease. At the same time, they still have a great deal to learn, particularly the analysis of shapes, that is, understanding their essential features. Learning the shape names is easy. As analysing them is much harder, the focus of early geometry education should be on analysis and understanding.

Understanding of spatial concept have great importance in mathematics too, there are many reasons for learning about space, just as there are for shape and number. Space is interesting in itself. Spatial ideas include the following:

- Simple location and position: the dog is on top of the elephant and at the same time the elephant is under the dog.
- Perspective: from where I sit, I see the cat on the left and the whale on the right, but from where you sit, opposite me, you see the cat on the right and the whale on the left.
- The coordinates on the Cartesian plane: the poodle is in the fourth row and the fifth column.
- Directions: the child can get to the treasure chest by walking two steps forward, turning right, and then moving four steps forward, whereupon the child makes a half turn leftward and follows the diagonal for five paces.
- The aesthetic qualities of reflectional symmetry: this symmetrical design is really beautiful but this asymmetrical mess is not.

Spatial knowledge and language predict future academic performance, those children who acquire a solid understanding of space and spatial language tend to demonstrate higher math achievement than students who do not achieve such mastery**.** Spatial ideas underlie much of mathematical understanding and Spatial understanding, language, and symbolism are of practical value **w**here child learns to use appropriate spatial language to get around in the world. Children have an informal knowledge about space on which early math education can build.

2.7.2 Shape

To function well in everyday life, its important for everyone to have a basic concept of space. Space can be referring to the outline of an object. From the young age itself it is important to develop basic special concept including ideas about location, relative position, symmetry, and direction. Babies and toddlers further develop

these abilities as they crawl or walk around, become aware of their surroundings, and think about where they are going.

Understanding of differentiating various shapes like 2-D, 3-D easily. The understanding of such concept makes them motivated to further arithmetic ideas. But at the same time, they may not be able to analyse the basis for their discriminations. They may have no knowledge about the properties of triangles and rectangles. They may not understand, for example, that a triangle must have three sides, that it is a closed figure, or that both figures are polygons. the ability to discriminate means only that the children *see* that the shapes *look* different. At the same time, the children may not *know* anything important about them. We need to distinguish between seeing and thinking, perception and thought.

Children's limited understanding of essential and non-essential properties may stem in part from the limited array of shapes that they see. Children are often exposed to prototypical shapes in books and toys.

2.7.3 Size

Size is a concept abstracted from the process of measuring by comparing a longer to a shorter. Size is meant to compare with another object as bigger or smaller. Size is determined by the process of comparing or measuring objects, which results in the determination of the magnitude of a quantity, such as length or mass, relative to a unit of measurement. Mostly humans perceive the size of the object through visually.

Allometry is the study of differences in shape associated with size. Knowledge of size can be developed from younger ages to get a recognition of biggest and smallest. The knowledge of size further evolved to the knowledge in everyday life and also in mathematics.

Space, shape and size are fundamental mathematical topics that children need to explore. They need to grasp the basic concepts, mathematize and elaborate on their everyday knowledge, and learn to communicate what they have learned. The study

of geometry can be deeper than many adults imagine and can provide young children with enjoyable intellectual challenges.

2.8 Pre- numerical skills

The objectives of an arithmetic program involve not only teaching the skills of computation but also the use these skills in solving problems and forming relational concepts. The areas to be developed include those of arithmetic facts and processes, money, time, and measurement. The use of the skills in relational and problem-solving tasks becomes meaningful when they are included in unit work (pg. 120, kristoe 1975, Teaching educable Mentally retarded children; Holt, Rinehart and Winston).

In the world of retarded, arithmetic demands do not appear to be very substantial. But relational understandings are.

Arithematic facts and possess specific at attention to the development of these skills is the essential focus of instructional period in the daily schedule. The outcomes expected at each level are:

The development of skills seems more amenable to instruction through a formally set- aside period for instruction each day. Children with special learning disabilities exhibit a disorder in one i9or more of the basic psychological processes involved in understanding or in using spoken or written language.

Prevalence of Spatial Awareness and Mathematical Development

Let's dissect some of these skills and abilities and examine what they mean in a young child's mathematical development.

Perceptions of objects/shapes and their attributes. By about 18 months of age, children's acquisition of vocabulary increases greatly, including the ability to verbally name and categorize objects. Children's developing cognitive skills let them see even part of an object, for example, a dog's nose peeking out from under

a bed, and know that it is part of a whole object. Even infants can know that when they observe a dog in a variety of representations (sitting down, jumping up, trying to catch his tail) and partial views (nose only), he is still a dog. Children become capable of recognizing objects in different orientations, illustrating their developing spatial knowledge.

Hull (1979) in a study on "developing competency problem solving ability in mathematics" found that pupils achieved an average gain of nine tenths of a normal year's growth in their measured ability with verbal problem solving.

Bhat (2014) studied the effect of problem-solving ability (PSA) on the achievement in mathematics of high school students. The achievement in mathematics was taken from school records. The findings revealed that 79% variance was contributed by the predicted variable (PSA) to the criterion variable (achievement in mathematics) among high school students.

Physical and mental manipulations of objects/shapes. When children have opportunities to explore two- and three-dimensional objects, they develop an ability to coordinate movement and alignment of those objects (for example, pushing a triangular prism through the triangle hole in a shape sorter). When children have ample opportunities to explore their environments, resulting in the gain of greater fine and gross motor control, they learn to navigate more skilfully. You might notice young children insisting that toys be placed in a certain location or orientation or stipulating that they have to walk on the lines in the sidewalk. These are all instances of children's developing spatial manipulation and awareness skills. These skills are important and useful in children's everyday lives, but they are also early skills related to later mathematic performance.

Spatial language. Spatial language provides children with essential tools to describe their environments and negotiate their wants and needs. And, it turns out, young children's use of spatial language predicts children's later skills at spatial problem solving. Spatial language includes words describing location/position

(under, in front of), attributes *(*long, high, side, angle, same, symmetrical*)*, orientation and mental transformation (left, turn, match) and geometric shape names (rectangular prism, triangle, sphere).

CHAPTER 3

METHODOLOGY

Methodology is defined as the strategy or architectural design by which the researcher maps out an approach to problem-finding or problem-solving. The methodology adopted for the study titled "Developing A Concept-Based Activity Workbook to Remediate Deficits in Numerical Skills amongst Selected First Graders" is given under following headings.

3.1 Selection of Area

3.2 Selection of Sample

3.3 Development of Tool

3.3.1 Self designed Assessment Tool to assess the children who have deficit in numerical skills.

3.3.2 Self designed Concept based Activity Workbook, to remediate the children who deficits in numerical skills**.**

3.4 Collection of Data

3.5 Analysis of Data

3.1 Selection of Area

The study was done among the first-grade students, aged 5years, 6years and 7years in Ernakulam city. The investigator visited schools, orphanages, summer classes around the city. The investigator selected St. Joseph's Public School, Vypin, Home of Faith in Kakkanad, Summer Camp at Vyttila, Bal-Mandir, Thripunitra, Summer camp at Padamugal, Mar Beselious Children Home, Vadavucode due to availability of sample in these places.

3.2 Selection of Sample

A sample of 85 children, who were studying in Grade One, from CBSE boards, were selected for conducting the pre-test, and to identify if they had any deficits in numerical skills. After the pre-test, 17 subjects who depicted deficits were chosen for intervention by Introducing the self-developed concept-based activity workbook. The self-developed 'Concept based activity workbook' was evaluated by 7 experts in the field of learning disability.

The sample for the study was selected using Purposive sampling technique where the focus was on children studying in Grade One and children having deficits in numerical skills. Purposeful sampling means that to learn or understand the essential phenomenon, a researcher selects individuals and sites intentionally (Creswell, 2012). The method selected for the study was Structured Questionnaire in a form of Assessment Tool. The assessment tool contained certain activities for the participants that expected to finish in a given time limit.

3.3 Development of Tool

The important element in research is an appropriate tool. The tools used in this study were:

3.3.1 Self designed assessment tool to identify the children who have deficits in numerical skills.

3.3.2 Self designed Concept based Activity Workbook, to remediate the children who deficits in numerical skills.

3.3.1 Self designed assessment tool to identify the children who have deficit in numerical skills.

An assessment tool was developed by the investigator to identify the children having deficits in the concepts of space, shape and size. These skills are very important as they play a foundation role in acquiring mathematical skills. The

developed tool was designed to identify the numerical deficits in children through activities.

The assessment tool contains activities on the concepts of Space, Shape and Size. There were total of 8 activities. Two activities each to identify the ability in each concept of space, shape and size and other 2 activities to identify numerical skills and pincer grasp. In activity 1, four different shapes in different colour were provided on a worksheet and asked the child to identify the shape and to write the spelling using a colour pencil (same colour of the corresponding shape). Time limit of this activity was 5 minutes. This activity would help to assess the knowledge of shape.

Activity 2, helps in identifying the knowledge in size. The child was provided with 3 different sized banana model and asked to arrange it from smallest to biggest. Time limit was 3 minutes.

In activity 3, six dotted line patterns were provided to trace over it. Children was expected to finish the activity in 6 minutes. This activity would help to identify ability in pincer grip.

Activity 4, was named ‘Match the two halves of my face’. The worksheet has three symmetrical faces, and half of the face was print on the worksheet and the other side of face was separately kept. During the assessment child was asked to find out and fix the other half of the face (using velcro) to get a complete face. The time provided was 4 minutes to complete the task.

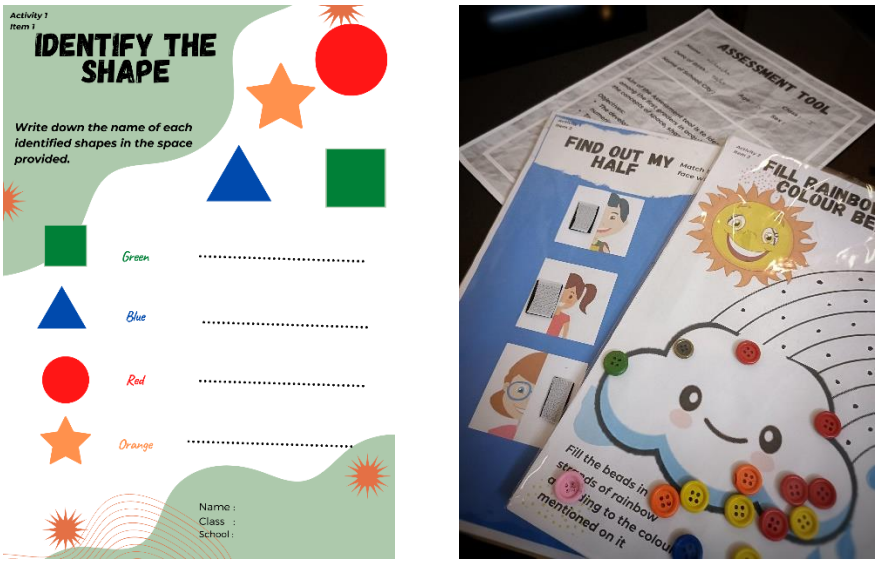

Plate 1

A Glimpse of the Activity from the Activity Book

Activity 5 was a physical activity, where a line was drawn on the floor. The marking of the foot was given in alternative way in the left and right side of the line. The marking of foot was made using foam sheet. In the corresponding position of the foot cut-outs popsticks were kept. The popsticks were kept in alternative side in an increasing order. The child was asked to step on the cutout of the feet, collect the popstick to save it in the cup kept nearby. After picking one popstick from left side, child was directed to cross the line and to step on the cutout of the feet on right side. Then 2 popsticks have to be collected and kept inside the cup nearby. This have to be continued till the child collect all the six popstick sets. The popstick set, foam sheet and cup have colour code. The child has 7 minutes to complete the task.

Activity 6 is to join the sequential numbers and find out the character inside it. It helps to identify the knowledge in sequencing. Within 4 minutes child had to complete it.

Activity 7 was used to identify the fine motor ability of child. The activity contained 7 levels. For the activity investigator prepared a sensory board with a rainbow back ground, covered with a cling sheet. Inside the sheet, coloured buttons

were spread through (6 each button of every colour in the rainbow). During the activity child is asked to place all the red coloured buttons on first row, all orange buttons on second row till violet. Each row much be completed before entering to the next row. Completion of each row was considered as completion of each level. Fine motor skills can be identified through this activity. 8 minutes to complete the activity.

Plate 2

Children doing Physical Activity as a part of Assessment

In activity 8, three different sized greeting cards and envelop suitable for each size was spread over the table. Child was asked to insert the greeting card into its own envelop. The greeting card was self-designed by the investigator. On completion of all tasks, this particular greeting card (customized with child's name) was given to the children as a token of gratitude. Time limit was 4 minutes.

The activities would help in assessing the visual, auditory, tactile, kinaesthetic senses. Each activity is separately timed. Total of 40 minutes was taken to assess each child.

The assessment tool contained certain criteria such as time taken for each activity to get completed, temperament of child, motivation, and way of doing activity to evaluate the child's performance and provide score accordingly.

Scoring

To evaluate the child's performance a simple scoring pattern was developed. Scoring was a 5-level scoring:

0 – 1: Need to acquire skills

1 – 2: Fair

2 – 3: Good

3 – 4: V. Good

4 – 5: Excellent

The tool has 8 tasks and each task carries 5 points. The optimal level is 'Good', If the child scores below the optimal level, it emphasizes the need for intervention.

3.3.2 Self designed Concept based Activity Workbook, to remediate the children who deficits in numerical skills.

A 'Concept based Activity Work Book' was developed by the investigator to remediate the children having deficit in the numerical skills and who lacks in the awareness on the concept of space, shape and size. The concept-based activity work book contains 19 activities. These activities would help in stimulating the visual, tactile, kinaesthetic senses in children.

The concept-based activity work book included, activity to find out the basic shape of any objects that we use in our day – day life to build the idea of shape. Activity to copy draw a figure, to enhance the ability of sequencing and replication. Activity to draw the missing parts and another activity to find the far and nearest person in

a picture, these activities help to improve spatial awareness in children. Activity to find out other half of a person's face can improve the ability in spatial knowledge and shape. Activity to complete a drawing referring a picture helps to build the ability of logical thinking. Tactile sense was improved by the activities like complete the body of caterpillars using finger imprints. Fingers were dipped in colours and imprinted on worksheet to complete it. Other activity which improves kinaesthetic sense was to use moulding clay to decorate a cake (outline of a cake given) and to give dress to a boy (outline of boy is given). The activity to count the shapes and write it in the space provided will improve the knowledge in shape, numerical skills and to follow rule. Activity to observe and follow a pattern, results in the improvement in sequential ability. The activity to arrange the objects according to size and number it will improve the skills in size awareness, numerical skill and sequential ordering. Activity to match the shapes of underwater creatures and activity to park the car without any obstacles can build the ability of spatial order, also improve tactile sense.

The activity works to develop problem solving skills, fine motor & gross motor skills, tactile skills, spatial ordering skills, sequential skills, higher ordering, geometric and concept based numerical skills among first graders.

Plate 3

Assessment tool (Hard Copy)

Plate 4

A Glimpse of the Self – Developed Concept Based Activity Workbook

3.4 Collection of Data

Phase 1: Selection of sample population and screening to identify children with numerical deficits

Phase 2: Intervention for children identified with deficits in numerical kills

Phase 1: Selection of sample population and screening to identify children with numerical deficits

The Investigator attended each child individually for the process for assessment of children to identify deficits in numerical skills. Investigator created a good rapport with each child which was a success in same. Through a casual talk investigator and participant (child) could build a relation, while investigator could observe the child's behaviour and temperament. Then the self-designed assessment tool to identify the children with deficits in numerical skills was introduced to children. Investigator sat along with the children from the beginning till child finishes every activity provided in the assessment tool. The prescribed time to complete the activities in assessment too was 40 minutes, still around 50 minutes – 1 hour of time was spent with each child. Investigator was giving instructions to carry out each activity, and children was following the investigators instructions.

Investigator initially visited St. Josephs Public school, Vypin, were the investigator got 30 students for the assessment. Investigator visited the same school for 4 repeated days to complete the assessment in all 30 students. Investigator also stayed back after school hours, so that enable to take assessment of stay back students and children waiting for parents to pick them up. From the same school, only two children needed intervention. Next, Investigator visited an orphanage named Home of Faith, Kakkanad where investigator could assess 14 children. The investigator could spend two whole days in orphanage with children and could assess the numerical deficits in children using the assessment tool. Among these fourteen children 4 was identified to need intervention. Investigator next visited a

summer vacation class provided by church, in Padamugal and Vyttila. From Padamugal, investigator could assess 21 children. She visited 8 days to conduct the assessment in all selected children. Among 21 children, 7 children was identified with need of intervention. Investigator visited the vacation class at Vyttila, for 3 days and could assess 11 children and could identify 2 children among, who need the intervention. Bal-Mandir , Thripunitra was another orphanage investigator visited, where she could assess 2 children and happy to find that no intervention needed for both. Then investigator visited Mar-Basaleous Children Home, Vadavucode and assessed 4 children. One child was identified to need intervention. Three children were found out from the investigator's neighbourhood, where for the assessment she individually visited their homes. After an effort over two months, investigator could assess a total of 85 children and from these, 17 children were identified with the need of intervention.

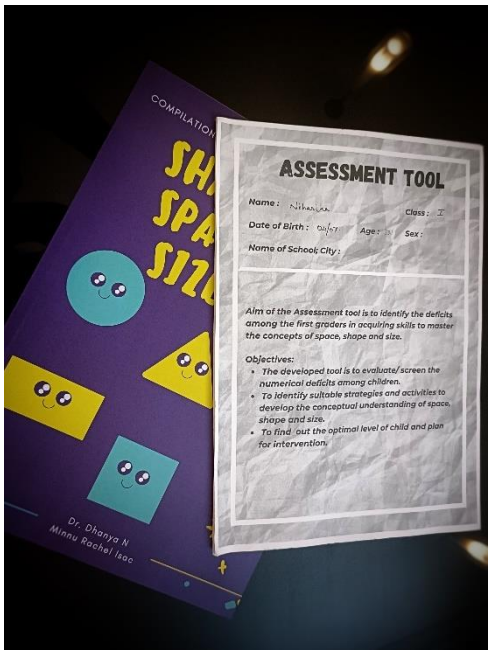

Plate 5

Developed Assessment Tool and Workbook

Phase 2: Intervention for children identified with deficits in numerical skills

The children who scored below the 'optimal level' of score in assessment test were identified to provide intervention. So, the investigator's newly self-developed Concept based Activity Workbook was used to remediate the deficits in numerical skills in children.

Investigator re-visited St. Josephs school, to provide intervention for 2 identified children. As it was vacation period school authorities directed the investigator to parents of these children. The cooperative parents invited to home and investigator could meet these children at their own homes. Investigator taught the children using the developed workbook and instructed parents to teach them in every alternate days. After a three-week gap, investigator revisited both the students and assessed them with the workbook as well as the assessment tool. It was happy to see increment in ability after remediating with the workbook. Similarly, Investigator revisited Home of faith, The mother superior of the institute encouraged the visits and was much cooperative. Those 4 Students who needed intervention was taught using the developed workbook, staffs helped them to make familiar with the workbook provided in the 3-week period. On investigators visit after 3 weeks it was overwhelming to see the changes occurred in children. Seven children who needed intervention from the vacation class, Padamugal was gathered in church a day and investigator could teach them in personal using the self-developed workbook. Still 3 weeks of intervention period was provided, as some parents couldn't follow up with the workbook, those children could gain much ability but not as much to the children of parents who followed the instruction of investigator. On revisit to meet 2 children who was identified to have intervention from Vyttila vacation class, investigator could teach them using the workbook. During the 3 week of intervention period parent of one child took initiative to teach both the children. After 3 weeks they were much aware about the concepts and able to do the activities very well. Investigator visited Mar-Baselious children home again to provide intervention one child, and teach her the concepts using the self-developed workbook. The assessment after 3 weeks period, child was familiar with the developed workbook. Investigator visited the neighbourhood child at his home to

teach using the developed work book. During the 3 week intervention period, his parent followed the investigators instruction and regularly taught him the concepts. After 3 weeks of intervention period the child was much aware about the concepts.

The individual time spent with each child, helped them to study the concept of shape, space and size along with the self-developed workbook. During the 3 weeks of intervention period, investigator along with support of parents / guardians would teach the child and develop their skills with concept based numerical activities from the developed workbook.

3.7 Analysis of Data

The survey results so obtained were consolidated and analysed using simple percentage analysis method.

Figure 1 given below depicts the research design of the thesis entitled “Developing a concept-based activity work book to remediate deficits in numerical skills in first graders” at a glance.

Figure 1

Research Design

CHAPTER 4

RESULTS AND DISCUSSION

The results obtained after the analysis of data and its discussion is described in this chapter. For the ease of understanding and convenience as well, the results are discussed under the following sub headings:

4.1 Background Details of the Selected Children

4.2 Assessment of the Conceptual Awareness and skills of Selected Children

4.3 Overall Assessment and Grading of Children

4.4 Development of Activity Book for Remediation of Selected Children

4.5 Impact of the Intervention Programme

4.6 Comparison of the Scores of Assessments before and after Intervention

4.7 Evaluation of the Developed Activity Workbook

4.1 Background Details of the Selected Children

The table below depicts the general information of the selected children taken for the study.

Table 1

Background Details of the Selected Children

Sl. No	Particulars	Responses of children (N=85) %
1	**Age of the Children (in years)**	
	5	18
	6	69
	7	13
2	**Gender**	
	Male	47
	Female	53
3	**Residential area**	
	Urban	54
	Rural	46

From the table it is evident that more than half of the selected children (69 %) were six years of age. Eighteen per cent were five year old and 13 per cent were of 7 years. A little more than the half of the selected children (53 %) were girls and 47 per cent was boys. As regards their area of residence, more than the half of the

selected children (54 %) were from urban area and 46 per cent came from rural areas.

4.2 Assessment of the Conceptual Awareness and Skills of Selected Children

The level of knowledge of the selected children about the concept of space, shape, size and numerical skills are discussed below.

4.2.1 Ability in identifying shape and name it using sketch pen of same colour of the shape.

The ability of respondents in identifying the shape and to spell it is given below.

Table 2

Ability in identifying shape and naming it using sketch pen of same colour of the shape.

SL No	Particulars	Responses (N=85) %
1	Identification of 1 shape	21
2	Identification of 2 shapes	12
3	Identification of 3 shapes	25
4	Identification of 4 shapes	10
5	Don’t know	32

The above table depicts the ability of the selected children in identifying the given shape and naming it using sketch pen having same colour as that of the shape. It is clear from the table that only one fourth of the children had the ability for the same. Thirty two per cent children could not do the activity, 21 % could identify one

shape, 12 percent could identify two shapes and one fourth (25 %) could identify 3 shapes. Only 10 percent of children could identify all the four shapes.

4.2.2 Spatial – Sequential Orientation among the Selected Children

Table 3 represents the spatial – sequential orientation skill of the selected children.

Table 3

Spatial Orientation Skills of the Selected Children

SL No	Particulars	Responses (N=85) %
1	**Putting card in perfect envelop**	
	Not Fair	0
	Fair	15
	Good	19
	Better	27
	Best	39
2	**Find out the other half**	
	Not Fair	2
	Fair	3
	Good	20
	Better	34
	Best	41

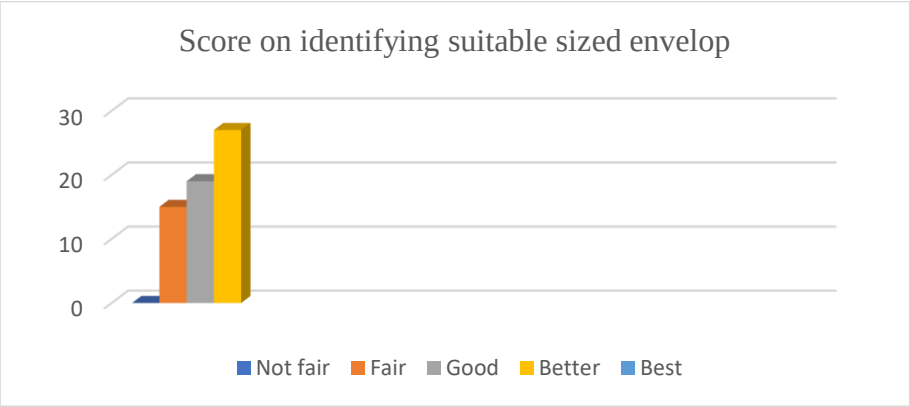

Figure 2

Score Obtained for identifying suitable sized envelope

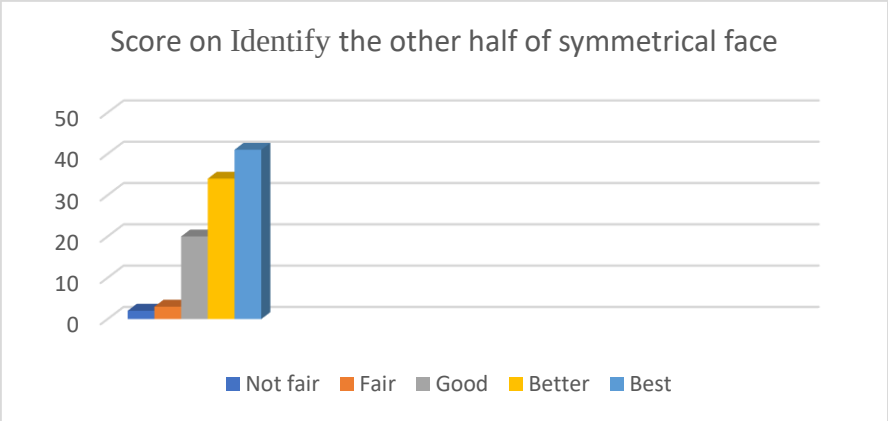

Figure 3

Score Obtained for Identify the other half of symmetrical face

As regards the spatial orientation of the children, two activities were given for testing. In the first test where to children were asked to put a letter into the right envelope, it was seen that only 39 per cent children fell into the 'best' category when scored for their performance. Fifteen per centage children scored 'fair' for the activity. The second activity given was to 'Find out the other half'. Although 41 per cent and 34 percent scored 'best' and 'better' respectively nearly five per

cent children scored ‘not fair’ and ‘fair’ which entreated that they needed remediation to improve. The above table and the figures 2 & 3 clearly indicate the conceptual awareness in the area of spatial orientation.

The following table and figures 4 and 5 depict the sequential orientation skills of the selected children

Table 4

Sequential Orientation Skill of the Selected Children

SL No	Particulars	Responses (N=85) %
1	**Join the numbers**	
	Not Fair	5
	Fair	8
	Good	22
	Better	30
	Best	35
2	**Awareness of size- Find Biggest and Smallest**	
	Not Fair	2
	Fair	4
	Good	23
	Better	31
	Best	40

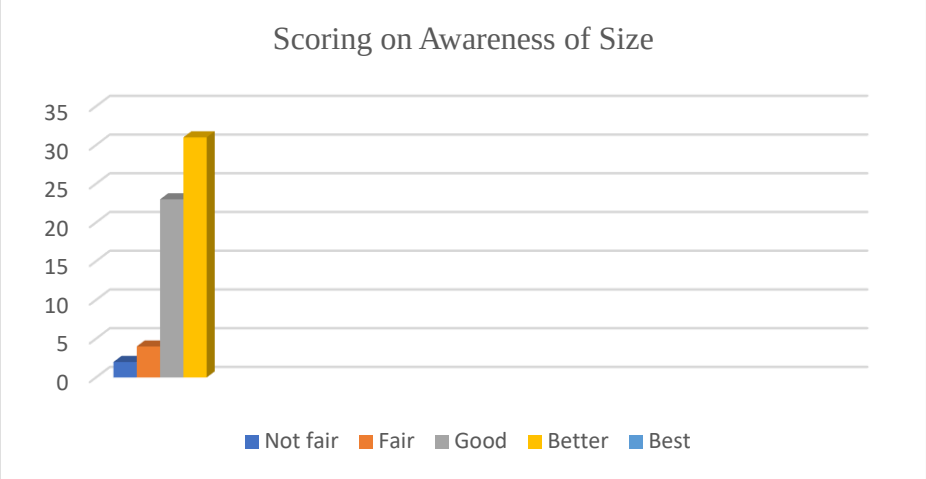

Figure 4

Scoring for Awareness of Size

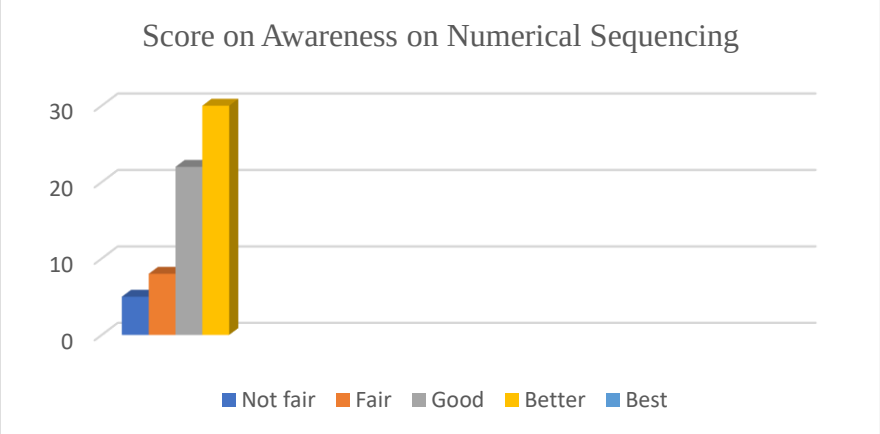

Figure 5

Awareness of Numerical Sequencing

From table 4 and figure 4 and 5, the level of conceptual skills is the area of sequential orientation are clearly depicted. Two activities namely ‘Join the numbers’ for understanding their ability of numerical sequencing and another activity ‘Find biggest and smallest’ to test their awareness on size were given. In the first activity, 35 per cent children scored ‘best’ but five per cent and eight per cent children fell into the ‘not fair’ and ‘fair’ category respectively.

Similarly for the concept of size also, although 40 per cent children were awarded ‘best’, two per cent and four per cent children scored ‘not fair’ and ‘fair’ which meant they needed intervention.

4.2.3 Ability in Motor Skills (Gross Motor and Fine Motor)

The table 5 showcase the motor skills of the children studied.

Table 5

Motor Ability of the Selected Children

SL No	Particulars	Responses (N=85) %
1	**Trace over the dotted line and pencil grip**	
	Completed 1-2 pattens	23
	Completed 2 – 4 patterns	26
	Completed 4 – 6 patterns	51
2	**Ability to follow rules**	
	Completed 1 – 2 levels	14
	Completed 3 – 4 levels	55
	Completed 5 – 6 levels	31
3	**Fine motor ability to handle buttons**	
	Completed level 1	27
	Completed level 2	37
	Completed level 3	33
	Completed level 4	2
	Completed level 5	1
	Completed level 6	0
	Completed level 7	0

As depicted in the above table three activities were organised for assessing the motor abilities of the selected children. The first activity was to trace over the

dotted line and check the pencil grip. Different pictures with dotted lines were given and it was interesting to note that more than half of the selected children (55 %) could complete 4 – 6 patterns and a little more than one fourth (26 %) completed 2 – 4 patterns. Regarding the ability to follow the rules, half of the respondents (55 %) could complete 3 – 4 levels and 31 per cent completed 5 – 6 levels. Their fine motor ability was checked using the activity of buttoning and it was seen that 33 and 37 per cent could complete level 2 and 3 respectively. None of them couldn't complete level 6 or 7.

To check the fine motor skills further, the investigator prepared a sensory board with a rainbow back ground, covered with a cling sheet. Inside the sheet, coloured buttons were spread through (6 each button of every colour in the rainbow). The child had to place all the red coloured buttons in the first row, all orange buttons in the second row etc till it reaches the colour violet. Each row much be completed before entering the next row. Completion of each row was considered as completion of each level. None of the selected children could go beyond level 5. It was interesting to know that 33 per cent of children could complete level 3, while only one per cent completed level 5.

4.3 Overall Assessment and Grading of Children

The table below shows the level of conceptual awareness among the selected children. Based on their performance in the activities given, the children were categorised into ability groups to enable ease for selection for intervention purpose.

Table 6

Grading of Children based on Performance in Activity

SL No	Category	Responses (N=85) %
1	Not fair	3
2	Fair	6
3	Good	11
4	Better	42
5	Best	38

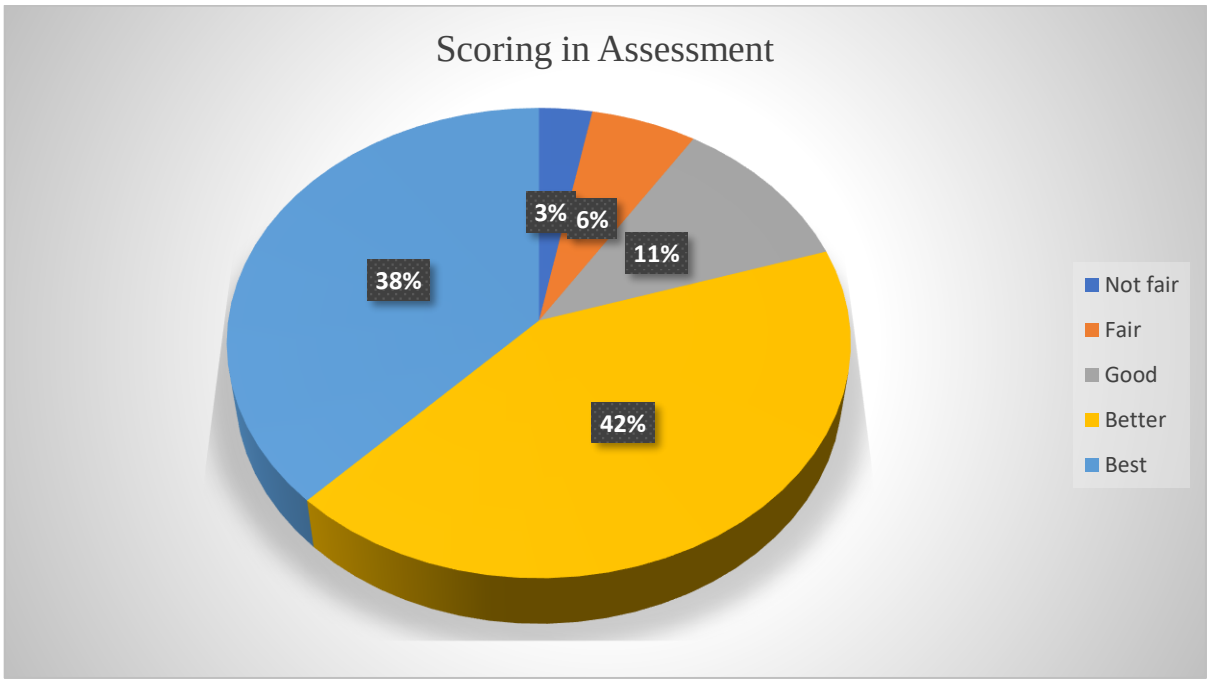

Figure 6

Grading of Children based on Score Obtained

Based on the performance the children showed in the activities and the scores they obtained for the same, the children were categorised for ease of identifying them for intervention. From the above table and figure it was heartening to note that 38 per cent and 42 per cent fell in the 'best' and 'better' categories and 11 per cent in the 'good' category. A meagre size per cent fell in the 'not fair' and 'fair' category respectively and they were selected for intervention.

4.4 Development of Activity book for Remediation of Selected Children

Concepts of space, shape and size are prerequisites / precursors of general mathematical abilities. Those children who lacks a clear and concreate understanding of the above concepts will suffer mathematical deficits too. Thus, to help children overcome these deficits and develop a strong foundation in their pre-primary and primary years, the investigator developed an activity booklet.

The concept-based activity work book included, activity to find out the basic shape of any objects that we use in our day – day life to build the idea of shape. Activity to copy draw a figure, to enhance the ability of sequencing and replication. Activity to draw the missing parts and another activity to find the far and nearest person in a picture, these activities help to improve spatial awareness in children. Activity to find out other half of a person's face can improve the ability in spatial knowledge and shape. Activity to complete a drawing referring a picture helps to build the ability of logical thinking. Tactile sense was improved by the activities like complete the body of caterpillars using finger imprints. Fingers were dipped in colours and imprinted on worksheet to complete it. Other activity which improves kinaesthetic sense was to use moulding clay to decorate a cake (outline of a cake given) and to give dress to a boy (outline of boy is given). The activity to count the shapes and write it in the space provided will improve the knowledge in shape, numerical skills and to follow rule. Activity to observe and follow a pattern, results in the improvement in sequential ability. The activity to arrange the objects according to size and number it will improve the skills in size awareness, numerical skill and sequential ordering. Activity to match the shapes of underwater creatures and activity to park the car without any obstacles can build the ability of spatial order, also improve tactile sense.

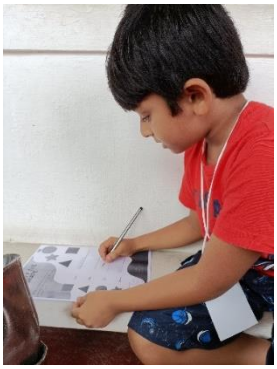

Plate 6

Sessions of Assessing children using self-developed Assessment Tool

Plate 7

Sessions of Assessing children using self-developed Assessment Tool

4.5 Impact of the Intervention Programme

4.5.1 Awareness in basic shape and spatial knowledge

Table 7

Basic shape awareness

SL No	Particulars	Responses (N=17) %
1	**Basic shape awareness**	
	Ability to identify the basic shape of an object	88
	Colour the picture according to the instruction given.	88

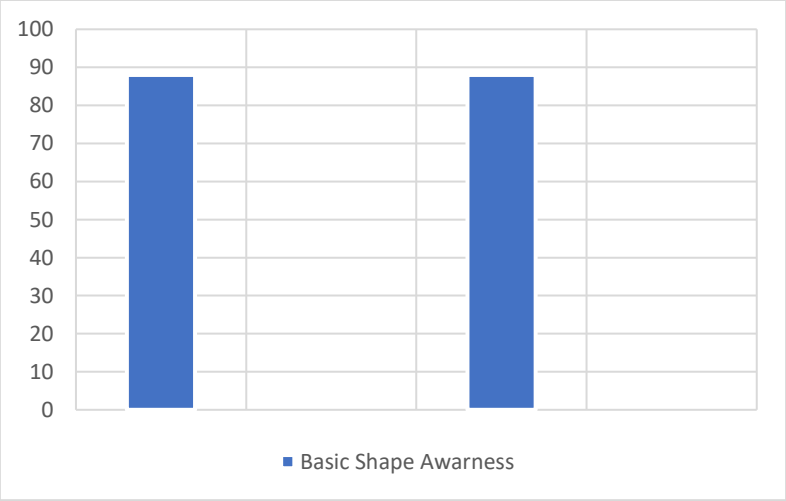

Figure 7

Basic Shape Awareness

From the table 7 and figure 7 it is very evident that more than three fourth of the children selected for intervention were able to identify basic shape of objects and able to colour the picture according to the given instruction (88 % each).

4.5.2 Awareness of the concept of spatial knowledge and distance

The table below and figures 8 & 9 depicts the level of awareness developed in the areas of spatial knowledge and distance.

Table 8

Awareness of the concept of Spatial Knowledge and Distance

SL No	**Particulars**	**Responses (N=17)** %
1	**Spatial Knowledge**	
	Identify the missing side of the face and place accordingly	94
	Fix the underwater creatures on the slot	88
2	**Distance Awareness**	
	Figure out the child near and far to the school.	94

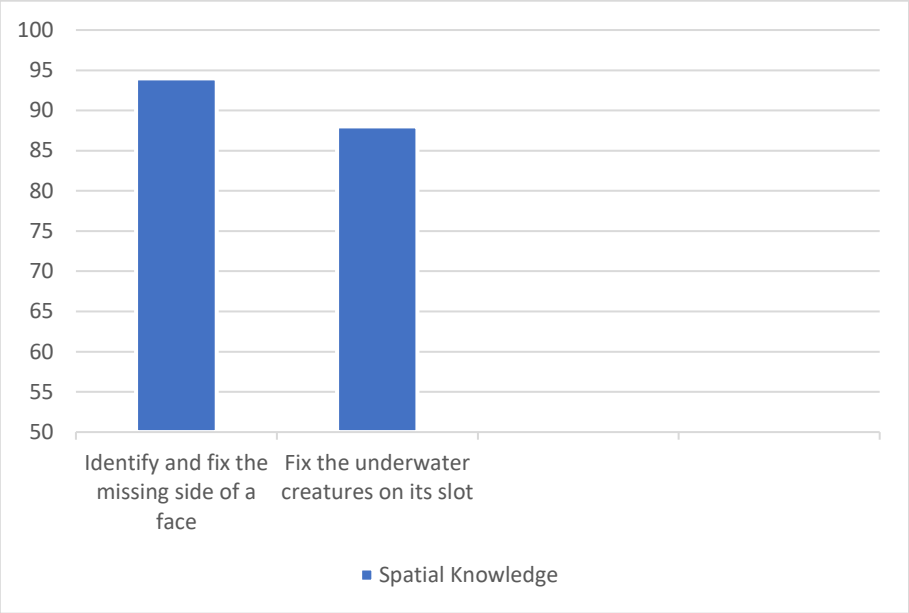

Figure 8

Concept of Spatial Knowledge

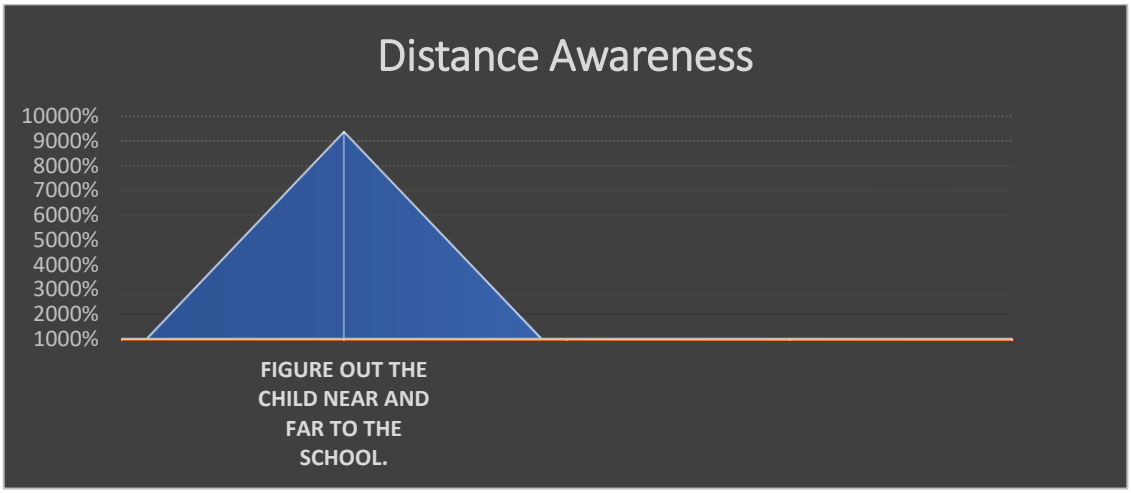

Figure 9

Concept of Distance

In order to improve the concept of spatial awareness and distance, activities were given to the children. In the first activity wherein, the children were given a picture with a missing part wherein they have to identify the correct one and place accordingly. It was quite heartening to note that majority of the children (94 %) could complete the activity correctly. In the second activity wherein, the children had to fix the underwater creatures on the slot, it was interesting to note that 88 per cent of children did it correctly. In order to make them understand the concept of distance, children were made to do activities to measure distance between familiar places. It was soothing to note that 94 per cent of the children could figure out whether they lived near or far from the school. The activity book was indeed successful in building these concepts in children.

4.5.3 Ability to Copy Draw a Figure

The ability of the selected children in copy drawing a figure is discussed in Table 9 and figure 10 respectively.

Table 9

Ability to copy draw a figure

SL No	**Particulars**	**Responses (N=17)** %
1	Redraw according to the reference picture	100
2	Complete a drawing, referring the completed figure	100
3	Draw the other symmetrical side of a figure	100

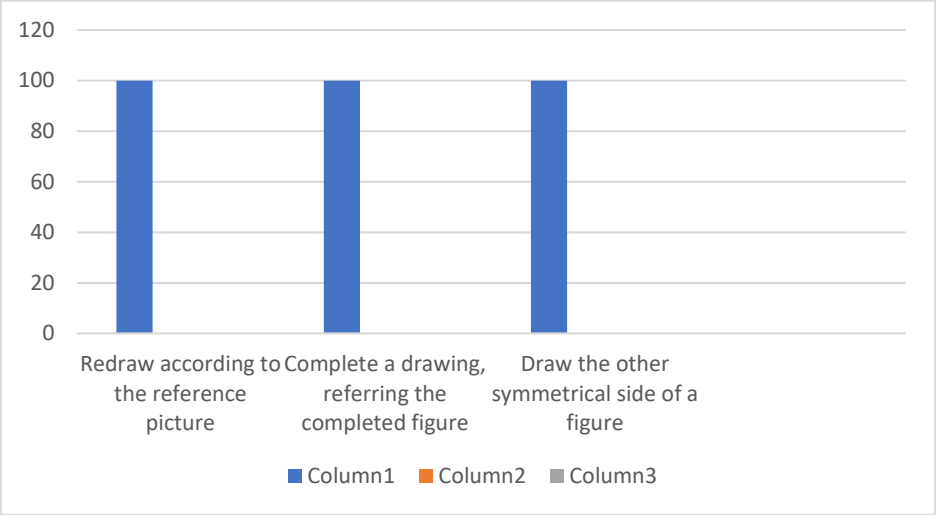

Figure 10

Ability to Copy Draw

The above table clearly depicts the success of self-developed concept- based workbook intervention. It was overwhelming to note that all the students (100 %) were able to copy draw a figure given after intervention.

4.5.3 Tactile Sensory Activity

The table given below depicts the ability of respondents in tactile- sensory activities.

Table 10

Ability in tactile sensory activity

SL No	Particulars	Responses (N=17) %
1	Fingertip imprint draw	100
2	Decorate a cake with moulding clay	100
3	Dressing a toy using moulding clay	100

It was interesting to note that, all the children selected for intervention (100%) developed their skills in tactile sensorial activities like finger tip imprint drawing, decorating a cake with clay and dressing a toy using clay.

4.5.4 Awareness on the concept of size & numerical skill, Higher thinking order ability, Logical – spatial awareness

The table below and figure 11, 12 and 13 showcase the level of awareness of respondents in the areas of size & numerical skills, higher thinking order, logical and spatial awareness.

Table 11

Awareness on the concept of size & numerical skill, Higher order thinking ability, Logical – spatial awareness

SL No	Particulars	Responses (N=17) %
1	**Awareness on the concept of size & numerical skill**	
	Count and write the number of each fruit	100
	Count and write the number of each shape in a picture	94
	Numbering an object according to their size	100
2	**Higher order thinking ability**	
	Follow and replicate the pattern	100
	Draw the missing parts in the picture	94
3	**Logical – spatial awareness**	
	Find the way	94
	Park the car without any obstacles	88

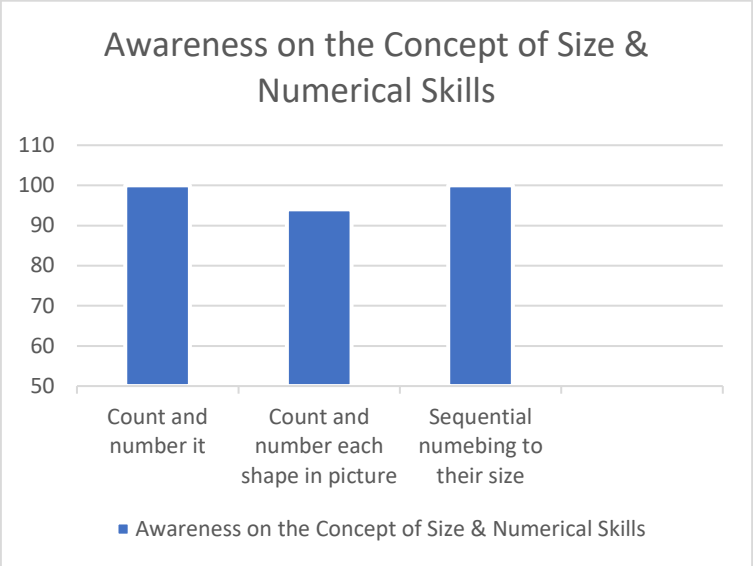

Figure 11

Awareness of the Concept of Size & Numerical Skills

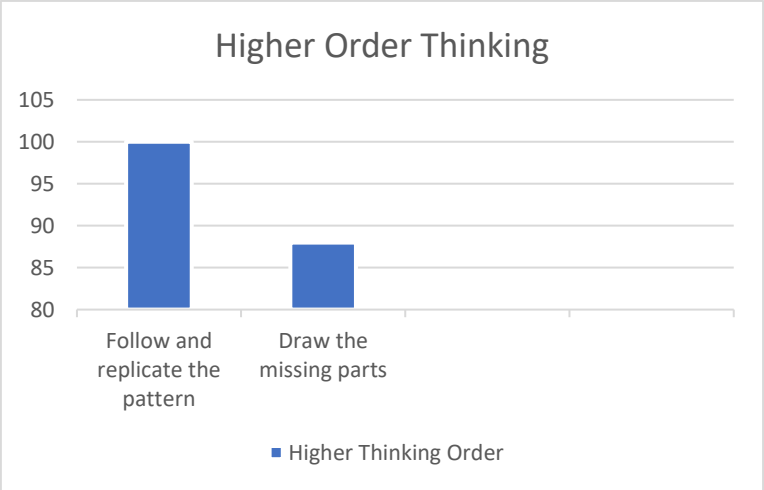

Figure 12

Awareness in Higher Order Thinking

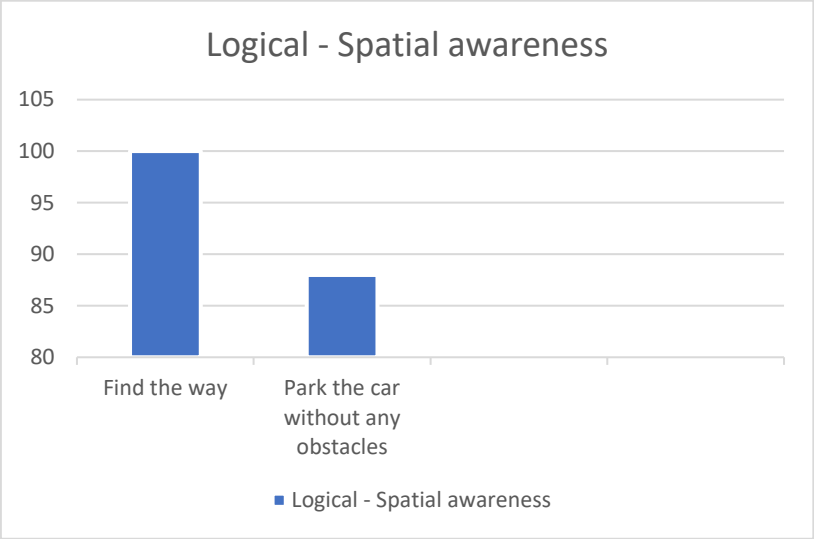

Figure 13

Logical – Spatial Awareness

As regards the awareness level of the children who underwent intervention in the area of concept of size and numerical skills, it was really soothing and satisfying to note that all the children (100%) learnt to count and write and could number and arrange objects according to their size.

For developing their higher order thinking ability skills, activities such as follow and replicate the pattern and draw the missing parts in the picture were taught to them. It was interesting to note that majority of the selected children (100 % & 94 %) developed the concepts.

Ninety-four per cent children could understand and do the activity called ‘Find the way’ and 88 per cent children could do the activity ‘Park the Car without any obstacles’. This shows that the concept of logical spatial awareness was clear to them after intervention and the activity book was thereby successful in building these concepts in the selected children.

4. 6 Comparison of the Scores of Assessments before and after Intervention

Table 12

Comparison of Knowledge Level in Selected Children

SL No	Particulars	Responses	
		Pre-test (N=85) %	**Post-test (N=17)** %
1	Basic shape awareness	58	88
2	Spatial knowledge	52	88
3	Distance awareness	47	94
4	Ability to copy draw a figure	59	100
5	Tactile sensory activity	47	100
6	Awareness on the concept of size & numerical skill	52	94
7	Higher thinking order ability	52	88
8	Logical – spatial awareness	52	94

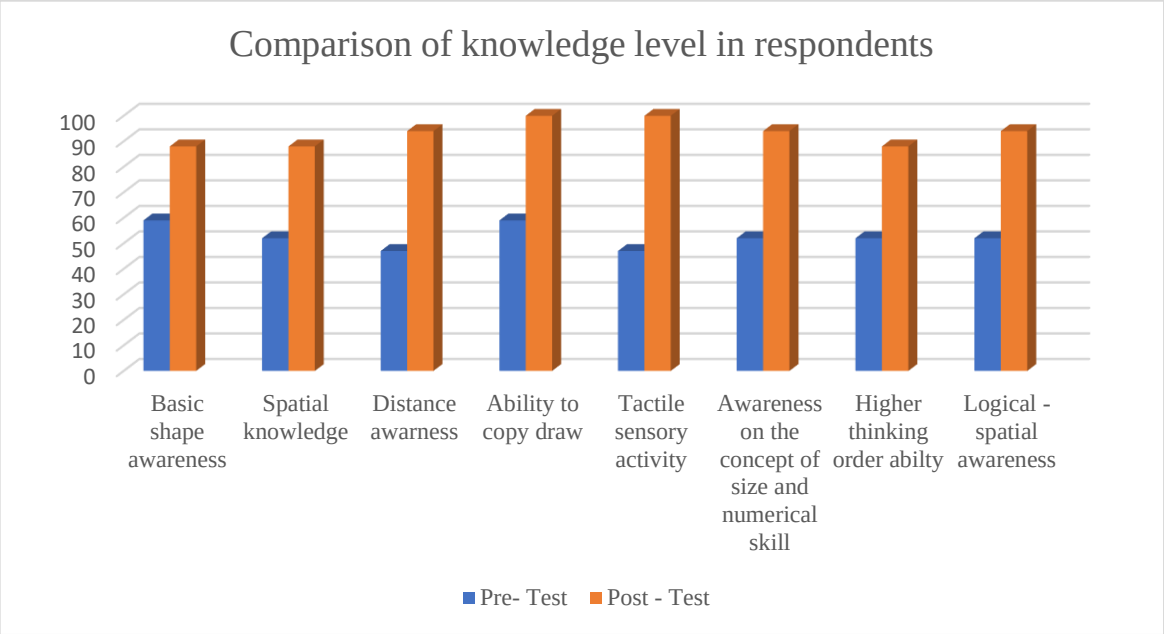

Figure 14

Comparison of knowledge level of respondents

The above table 12 and figure 14, highlights the fact that the workbook activities was highly effective in developing the necessary basic skills which are precursors to mathematical skills. Regarding the awareness of basic shape, before the intervention only 58 per cent were aware of the concept which increased to 88 per cent after intervention. Similarly, the awareness in spatial knowledge increased from 52 to 88 per cent. Ninety-four per cent understood the concept of distance which was earlier known only to 47 per cent. It was heartening to note that all the children developed the ability to copy a figure and tactile sensory activity which was earlier known only to 59 per cent and 47 per cent. The other concepts were also developed well as are seen in the scores.

4.7 Evaluation of the Developed Activity Workbook

The activity workbook was evaluated by 7 experts. It was really enlightening to note that the workbook was highly appreciated by all the experts. The evaluators guaranteed the efficacy of the self-developed 'Concept based activity work book'.

The workbook was given a score of 90 per cent for content, 90 for suitability, 96 for attractivity, 85 for effectiveness, 93 for simple language and 97 for its handy nature.

Sl. No	Particulars	Score by Experts (N=7) %
1	Content	90
2	Suitability	90
3	Attractivity	96
4	Effectiveness	85
5	Simple	93
6	Handy	97

Figure 15

Evaluation of the Self- Developed Tool

CHAPTER 5

SUMMARY AND CONCLUSION

The study undertaken by the researcher was on "Developing a Concept-based Activity Workbook to Remediate the Deficits in Numerical Skills among Selected First Graders". In the present study two separate tools were developed by the researcher to conduct the pre-test and the post-test. The study aims in identifying the children with deficits in numerical skills and provide concrete understanding of the concepts of Space, Shape and Size (3-S), to remediate the deficits in numerical skills found in first graders. Considering the fact that the knowledge on basic concepts of space, shape and size are the foundation stone to the complex mathematics, it is important to nurture these skills in children from early ages of life. Study was conducted among the first graders in and around the city. The places selected for the study included St.Joseph's Public School, Vypin, Home of Faith (Orphanage) Kakkanad, Summer Camp at Vyttila, Summer Camp at Padamugal, Bal-Mandir at Thripunithra and Mar Baselious Children Home at Vadavucode. The sample for the present study was done on eighty-five (85) students who were studying in first grade. After the pre – test on these children seventeen (17) students were identified and directed to get Intervention. Intervention was done by teaching the children using the self-developed activity workbook. The self-developed concept-based assessment tool was evaluated by 7 experts in the field of learning disability. The method of sampling adopted was Purposive sampling. The tools used for the research included a self-designed assessment tool to assess the deficit in numerical skills among first graders, and a Self-designed Concept based Activity Work Book, to remediate the children who deficits in numerical skills. Data was collected, consolidated and analysed using Percentage analysis.

Findings

The findings of the study can be summarized as follows:

Background Details of the Samples

- More than half of selected children (69 per cent) were 6 years of age.
- Little more than the half of the selected children (53 %) were girls and 47 per cent was boys.
- Participation of respondents from urban area was 54 per cent and rest from rural areas.

Assessment of the Conceptual Awareness and skills of Selected Children

The following section entails most prominent response of the respondents on the level of knowledge.

Knowledge in identifying shape and name it using sketch pen of same colour of the shape.

- Majority (32%) of children who studies in grade 1 is not aware of the spelling of shapes.
- Only 10 percent of respondents could identify all the 4 correctly. Some respondents could identify the shape and colour, and as they were unaware of spelling guessed the spelling based on the phonetics of the shape.
- Almost 25 percent of respondents could identify 3 shapes but had confusion to spell it.

Spatial – Sequential orientation among the selected children.

- Almost 40 per cent of the respondents are well aware about different size of an object. 6 per cent of respondents shown difficulty in the size awareness.

- About 41 per cent of the respondents could correctly match the other side of a symmetrical face. It depicts the good amount of knowledge in spatial awareness.
- About 35 per cent of respondents know the numbers in sequence and able to connect it and form a picture.
- Almost 39 per cent of respondents scored best in identifying suitable sized envelope for different cards of different sizes. No respondents scores 'Not fair'.

Ability in physical activity.

- Respondent's ability to trace over the dotted line (Fine-motor ability) is 'good'. 51 per cent of respondents could complete all the 6 patterns provided.
- Considering the physical strength of the respondents, out of 6 levels 55 per cent respondents could complete 4 levels, only 31 per cent respondents could complete the task.
- Almost 33 per cent respondents could only complete till level 3 of an activity to identify the fine motor ability. No one could complete the task. Advanced - complex task to enhance fine motor skills needed to be practiced more by the respondents.

Overall Assessment and Grading of Children

The following session depicts the average scores obtained by the respondents on conducting pre- test.

- The scoring was a 5-level scoring, which had 'Not fair', 'Fair', 'Good', 'Better' and 'Best'. Out of the entire sample population, who underwent the pre assessment are scored in wide range.
- Around 38 percent of respondents could score 'Best'.
- A majority of respondents 42 percent have scored 'Better'.

- Eleven per cent of respondents scored ‘Good’ and 6 percent scored ‘Fair’.
- Three percent of respondents could only score ‘Not fair’.
- The fixed ‘Optimal level’ is ‘Good’. Those children who score equivalent or less than optimal level (i.e. Good, Fai, Not fair) are said further directed for Intervention. Therefore, Twenty percent of respondents were introduced for intervention, using the self-designed Concept-based activity work book.

Development of Activity book for Remediation of Selected Children

As knowledge on basic mathematical concepts leads to higher order thinking and such development in children it is very relevant to prepare or develop any remedial strategies to remediate the children to overcome their difficulty numerical skills

The procedure was carried out in 2 phases as, pre -test and post – test. For pre-test, investigator developed a tool for assessment of children with deficits in numerical skills. The tool contained 8 activities to identify the respondent’s knowledge in the areas of space, shape and size along with physical development (fine motor and gross motor). Then the Concept based activity work book was developed. The work book contains 19 activities. These activities would help in stimulating the visual, tactile, kinaesthetic inputs in children. It works to develop problem solving skills, fine motor & gross motor skills, tactile skills, spatial ordering skills, sequential skills, higher ordering, geometric and concept based numerical skills among first graders.

Impact of the Intervention Programme

The following section entails most prominent response of the respondents on the level of knowledge after they got introduced with ‘Self-designed activity work book’.

Basic shape awareness, Spatial Knowledge, Distance awareness

Basic shape awareness

- Around 88 percent of respondents proved the ability to identify the basic shape of an object and also to colour the picture according to the instruction given.
- Almost76 percent of respondents could identify and shape of any objects that we use in our day-to-day life.

Spatial Knowledge

- Around 94 % of respondents could correctly identify the other half of a face and could join it following the rule.
- In an activity to fix underwater creatures from its missing place, 88 percent of respondents had the ability.

Distance awareness

- About 94 percent of children are aware about the distance measures.

Ability to copy draw a figure

- All of the students could develop the ability to copy draw a figure given. Three different activities like Redraw according to the reference picture, complete a drawing referring the completed figure, and draw the other symmetrical side of a figure were all the respondents could successfully achieve the ability.

Tactile sensory activity

- Increased knowledge of the respondents in their ability in doing the tactile - sensory activity. All the respondents (100 %) could complete the three activities to enhance the tactile sense loke, Fingertip imprint draw, decorate a cake with moulding clay and Give dress to a boy using moulding clay.

Awareness on the concept of size & numerical skill, Higher thinking order ability, Logical – spatial awareness

- Whole 100 per cent of the respondents could build the knowledge in numerical skills and also in the size awareness.
- All the respondents developed the ability to follow a particular pattern.
- Around 94 per cent of respondents could recognise the missing part in picture and to draw the missing parts correctly.
- Almost 94 per cent of respondents could find the way activity well.
- Only 88 per cent of respondents could achieve a logical – spatial awareness by parking cars in garage activity.

Comparison of the Scores of Assessments before and after Intervention

The following section aids in comparing the knowledge level of the respondents in pre-test and in post-test in the areas of concept on space, shape, size and other numerical skills.

- Children could only score 58 per cent in pre- assessment which incremented to score 88 per cent of respondents have the knowledge on basic shape after intervention provided to them.
- Spatial knowledge before introduced for intervention children could score only 52 per cent and could see a hike to score 88 per cent.
- Almost 94 per cent score in distance awareness where the ability in it was much below the optimal level score.
- In the activity of copy draw a figure, students could only score 59 per cent while after intervention the score reached the maximum limit (100 per cent).
- Tactile sensory activity ability score could also reach the maximum limit from 47 per cent score after the intervention.

- The awareness in the concept of size and numerical skill, the knowledge to link the size concept with the sequential numerical skills to order the object got a hike to 94 per cent score.
- Higher-thinking order among the children were 52 % which was incremented to scores 88 per cent.
- Almost 94 per cent increment happened in logical-spatial awareness knowledge after exposed to intervention and trained using the self-developed concept-based activity work book.

Evaluation of the Developed Activity Workbook

An expert evaluation was done by 7 experts in the field of special education. The evaluator guaranteed the efficacy of the self-developed. The workbook was given a score of 90 for content, 90 for suitability, 96 for attractivity, 85 for effectiveness, 93 for simple language and 97 for its handy nature.

Conclusion

The present study discusses "Developing Concept-based Activity Work Book to Remediate the deficit in Numerical skills among first graders". It also analyses children's various background details (includes age, residential area, board of education) upon their ability level on the topic.

The study concludes that there is a notable issue arises in the numerical skills in children. The knowledge on Basic concept about Space, Shape and Size were also lacking in these children which leads to complex numerical skill deficits. The designed activity work book by the investigator was sufficient to provide intervention in the areas of numerical skills.

Limitations

- The most important limitation of the study was the sample size for the evaluation of developed tool.
- There were only limited studies available for reference on the topic.

Recommendations

- Sample size can be increased for the accuracy of evaluation.
- Marketing the developed workbook can be tried to find out the acceptance.

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