CHAPTER – I

INTRODUCTION

1.0 Context

Every child is unique and needs help and assistance in developing, adjusting, refining, adapting to life situations. Some children require more time, more help and assistance than others to accomplish some development of task. For example children with Intellectual Disability often need more attention and help for problems faced in learning social and academic skills. Some of them may be academic problems, slow development of reasoning, problem solving and generalizing skills. These children are also slow in language development (Olivier & Williams, 2005). The problems faced by the children with Intellectual Disability have been stated in various educational policies and commissions. The Kothari Commission observed that many children with disabilities found psychologically disturbed in regular school and these children could be sent to special schools. In 1964-66 The National Policy of Education 1986 has emphasized the need for special support and provision for the proper development of children with various needs. Section IV of the national policy of education entitled “Education for Equality” states that the children with motor handicapped and with mild disability will be provided education in integrated educational settings. In 1991 the Indian Government came up with a plan known as Integrated Education for Disabled Children (IEDC) to inspire regular schools to admit children with special needs (Randhawa, 2011). The UN General Assembly’s declared 1981 as International year of disabled persons. Subsequently, the ‘World Conference on Special Needs Education’ Salamanca in 1994, played a major role in bringing the spotlight to children with disabilities, especially in education as a vehicle for integration and
empowerment. A similar effort was articulated in the Person with Disabilities Act, 1995. The act endeavored to encourage the integration of children with disabilities in the regular schools” (p.12) and also supported the “establishment and availability of special schools across the India” (p.12) in both Government and private sectors as required. In 2001, a modification to the Constitution explicitly included children with disabilities and made access to education, a fundamental right for children ages 6-14 (Bhatnagar & Das, 2014; Kohama, 2012; Singal, Jeffery, Jain, & Sood, 2009; Singh, 2016). According to census 2011, there are 5.6% people with intellectual disability (ID) of total disability population in India. Approximately 85% of the population with Intellectual Disabilities are with Mild Intellectual Disability (MID) (Kowsalya, 2013). MID is the one who although lagging behind from typically developing children have the capacity to lead life relatively independently as compared to the other groups of ID. Children with MID go through similar stages of development as children without Intellectual disability (Kowsalya, 2013; Sharma 1991). Children with MID are an educable group and can be educated along with the typically developing children. If these problems can be diagnosed early. Appropriate intervention can be provided systematically. This will help them to learn early and they also can become productive citizen of the country. In the present study, the investigator has taken children with MID to finding out their difficulties in learning.

1.1 Intellectual Disability

Intellectual Disability is characterized by significant limitations both in intellectual functioning and in adaptive behavior, which covers a range of everyday social and practical skills. This disability originates before the age of 18. The American Association of Intellectual and Developmental Disability, 2010 classification is widely accepted (Schalock & Luckasson, 2015).
In general, to understand ID, there is need to see the difference in the mental age and chronological age of a child. When chronological age is increasing but mental age does not increase at the same pace, it is called as ID. The severity of the ID is directly proportional to this disparity between mental age and chronological age.

1.1.1 Classification of Intellectual Disability

Different methods classify ID differently. There is psychological and educational classification. Psychological classification is based on intelligence quotient, and educational classification relies on the current level of functioning of the ID person/child.

1.1.1.1 Psychological Classification

The following classifications, based on standard scores of intelligence tests, shows the categories of the American Association of Intellectual Disabilities, the Diagnostic and Statistical Manual of Mental Disorders-IV/V, and the International Classification of Diseases-10. This grouping label is linked to IQ.

1.1.1.1.1 Mild ID affects 85% of a person with ID population. IQ score ranges from 50-69. Children within this classification can attain academic success at about the sixth-grade level. They can become self-reliant and in some cases, live independently with the community and social support.

1.1.1.1.2 Moderate ID affects around 10% of the individuals under the classification of ID. IQ ranges from 35 to 54 and has satisfactory communication skills. Many of these persons can manage very well in the group homes and the community. Many are employed and can take care of them with minimal supervision.

1.1.1.1.3 Severe ID is 3-4% of the population within this classification. IQ scores range from 20 to 40. Communication skills and self-help skills are very...
minimal, and many individuals require supervision and assistance. Many of these persons reside in group homes with the help.

1.1.1.4 Profound ID is a minuscule portion of the ID population, approximately 1-2 percent of these affected population. These individuals are with IQ below 25 and require around-the-clock care and support. Their communication skills are very limited, and they need assistance for self-help skills. People with profound ID usually have neurological disorders as well.

1.1.1.2 Education Classification

   Educators classify children with Intellectual Disability as educable mentally retarded (EMR), trainable mentally retarded (TMR), and Custodial Mentally Retarded (CMR). These various classifications help in providing an understanding that at which level a child with ID can function in society, his educational attainment, and his degree of independence.

1.1.1.2.1 Educable Mentally Retarded are those with IQ ranges from 50 to 69. Their intellectual development, when they become adults, roughly corresponds to typically developing children of age 8 to 12 years. EMR children go through the similar stages as normal children. EMR children may only come to notice in their early childhood years when their play, self-help skills are less developing than children of their similar age. For some EMR children, the problem may not be seen until their school years. EMR Children look like to their non-disable peers in the physical appearance, but their motor ability and coordination is little lower compared to the typically developing peers (Kowsalya, 2013). EMR Children are also characterized by a delay in cognitive development that influences the
acquisition of both language and academic skills. Attention, memory, and generalization are the three most important cognitive skills which influence the acquisition of both language and academic skills. EMR children are found lacking in these three skills. However, Most of the time attention problems are confused with working memory problems. These cognitive skills are associated with the academic success and which of this skill is more related to academic achievement need to be sorted out to enhance academic learning.

1.1.1.2.2 Trainable Mentally Retarded children are with IQ between 25 and 50. This group children can be trained in daily living skills and functional academics.

1.1.1.2.3 Custodial Mentally Retarded children are those who have IQ below 25. These children with severe and profound retardation need more assistance for their daily living and leisure activities (Rathore, 2015).

1.2 Definition Used for Intellectual Disability

In last 20 years, psychologist, psychiatrist, and health professionals have put many efforts to name ID appropriately (Carulla et al., 2011). The term ID, formerly also known, as ‘Children with Learning Difficulties’ and ‘mental retardation,’ has remained open to confusion. Historically in the US, ID referred as ‘Mental Retardation.’ The term mental retardation has newly been replaced with the term ‘Intellectual disability. However, the term ‘learning difficulty’ is more prevalent in the UK. People with mild to moderate ID are often referred to as having MLD (moderate learning difficulties) and with severe ID are referred as CMR or SLD (Severe learning difficulties). Nowadays most of the major academic journals throughout the world and all the National Institute for the person with disabilities use
the term ‘Intellectual Disabilities’ (Carulla et al., 2011; Chavan & Rozatkar, 2014; Henry, 2011a). This change-over in terminology is supported by the organization like the American Association on Intellectual and Developmental Disabilities (AAIDD), International Association for the Scientific Study of Intellectual Disabilities (IASSID), National Institute for the empowerment of person with Intellectual Disabilities, and President’s Committee for People with Intellectual Disabilities.

Further, People with ID can be divided into two groups based on the presence and absence of organic cause. Individuals with ID who have the specific disorder and their exact cause is known such as Down syndrome, Williams syndrome, Fragile X, etc. are often treated as separate group than people with unknown biological causes (Henry, 2011b; Rutter & Taylor, 2005b, 2005a). This perspective provides different approaches to research. The present study takes the later approach of children without any known organic causes of ID. The Investigator designed research to see the working memory of children with MID.

1.3 Models of Intellectual Disabilities

These models provide the framework to understand and see memory performance into developmental view.

1.3.1 Developmental Model

This model sees typically and atypically developing children with the same frame of development. This model does not assume any structural difference between typically and atypically developing children. According to this model, the difference between the two groups follows the same sequence of the cognitive developmental stage. However, atypically developing children are slower as compared to typically, and they do not necessarily reach the highest stage of development. When matched on the mental age with typically developing children, their performance should mostly
match the performance of that atypically developing children (Zigler, 1969; Zigler & Balla, 2013).

1.3.2 Difference Model

This model assumes that typically and atypically developing children differ in their cognitive structure. They have structural deficits either in their cognitive structure or processing deficit. It does not support the idea that both are similar and follows the same sequence of cognitive development. According to this model, both groups differ on how they carry out the cognitive tasks. The atypically developing children have impairment in few or all the construct essential to perform the cognitive task. This model expects that children matched on metal age in both the group will perform differently. Atypically developing will perform poorly as compared to the children of same mental age (Ellis, 1969; Routh, 2009; Zigler & Balla, 2013).

1.3.3 Optimal Performance

This model states that atypically developing children can perform up to or sometimes better than typically developing children of the same age on naturalistic, every day remembering the task. These children differ on their performance much more as compared to typically developing children depending on the type of test used. These children are good at naturalist remembering task as compared to the formal memory test. In fact, children matched on the IQ may perform better than typically developing children due to the experience and association they have (Burack & Zigler, 1990; Henry, 2011b).

1.4 Historical Perspective of Memory

Memory occupies a central and fundamental to almost all the activities a child perform in day-to-day life. It includes a simple operation of calling a name to solving an intricate puzzle or a problem. It is a cognitive function, which has its importance in
all the areas of human behaviour. Whether it is bringing a list of grocery or manipulating an object. A list of continuous work and behaviour will come to support memory (Radvansky, 2015). Memory plays a very influential and prominent role at the base of the understanding organism. It affects our daily life. Hence, there is no strange that history is full of researches on memory. It stretches back to the ancient Greece time of philosophers when psychology did not emerge as an independent discipline. Plato was the first one to explain memory as a link between perceptual and rational world. Many philosophers followed him and developed his idea. One of the prominent followers was Aristotle. He talked about memory as an association between stimuli and experience. Likewise, many philosophers and scientist contributed to the development of memory.

However, a German scientist Herman Ebbinghaus (1850-1909) did the first scientific investigation. He is the one who introduced non-sense syllables and the concept of a learning curve, the forgetting curve, overlearning and savings. Few of the most prominent figures in the field of psychology and who are considered as the founder of modern psychology are William James and Wilhelum Wundt (1832-1920). They did some early primary researches to see the functioning of memory. James (1842-1910) explained memory regarding primary and secondary memory, which is quite similar to today’s short-term and long-term memory. Likewise, he spoke about retrieval problems. A German biologist elucidated the concept of the engram. The engrams are physical traces left by experiences on the brain. One of another prominent figure in the history of human memory is Sir Fredrick Bartlett (1886-1969). He worked on how brain stores memories and talked about “schemas”. The present view of memory is influenced by many movements in the field of psychology
such as Gestalt Movement, behaviorism, verbal learning, neuroscience and cognitive revolution (Radvansky, 2015).

By examining the history, one can understand the unevenness and contradictions in the researches done. There are inconsistent results, views, and attitudes about the aspects and nature of memory. Hence, going through the history one can find that memory has been explained through three primary definitions (Spear & Riccio, 1994): First, memory is defined as a location to store information. Second, it is defined as engram or memory traces; these engrams hold experiences. Third, it is a process of acquiring, store and retrieving information (Dehn, 2011; Spear & Riccio, 1994). One of the most important constructs of memory is working memory. There are different memory models, which define working memory differently. Conventionally, working memory is an active process of simultaneously processing and temporarily maintaining information (Bayliss, Jarrold, Baddeley, & Leigh, 2005; Dehn, 2011). It is also defined as a workspace to perform cognitive tasks i.e. either to use temporarily stored information or to retrieve information to process from long-term memory (Hulme & Mackenzie, 1992; Richardson et al., 1996).

Learning plays a vital role in every one’s life. It is the basis of survival of human on this earth. It plays a major role in the progress and development of human society. Learning is futile if one cannot utilize its product in the future. Whatever is learned needs to be somehow stored in the mind so that it can be used whenever required in the future. So this faculty of the mind is to store the past experiences or to learn and reproduce them for the use when required are known as “Memory” (Mangal, 2002).

Matline, (2005) defined memory as - “Memory is the Process of Maintaining information over the time.” The theories of memory consider the types of memory in
both architecture of the memory system and the processing within the structure. Architecture is the way in which memory system is organized, and processing refers to the activities occurring within the memory system. Learning and memory include a series of stages. The primary process starts with encoding, storage, and retrieval (Matlin, 2005).

The first stage is encoding. Encoding is the process of changing physical stimuli into a form that brains memory system can interpret, use and memorize. It has three types: (i) Acoustic, which means sounds and spoken words, (ii) Visual, means image snapshots and (iii) Semantic, means Facts and concepts. Encoding is also done by binary coding using 2 + type encoding which is more efficient than another type of encoding. Storage is the second stage, which is the process of keeping memories intact in the brain’s memory system over the time. Storage is like bank systems where one want to accumulate and withdrawal whenever he/she wants. There are types of memories that are short-term memory, long-term memory, semantic memory, photographic memory and paranormal memory. Third stage: Final part of the process is retrieval “the process of locating specific memories in storage and bringing them into consciousness.” It is like withdrawing money from the bank account after storing in the account. There are two types of Retrieval 1. Recall (unaided retrieval) 2. Recognition (retrieval with prompt). Retrieval can also be categorized as 1. Explicit: which means deliberately remembered and 2. Implicit: this is unintentional recollection (Cowmoo, 2012; Eysenck & Keane, 2005).

Defining Working Memory Conventionally, working memory can be defined as a dynamic memory system that is responsible for the temporary maintenance and parallel processing of information (Bayliss et al., 2005). Alternatively, working memory defined as the use of briefly deposited information in the performance of
more difficult cognitive tasks or as a mental work station (Hulme & Mackenzie, 1992; Richardson et al., 1996). Altogether, working memory can be understood as an inclusive and comprehensive system that ties various short and long-term memory storage and functions (Baddeley, 1986). There have been many efforts to limit working memory to memory related functions. However, many researchers and practitioners still broadly use working memory. Consequently, in this study, working memory is defined as a temporary storage system under attentional control that underpins our capacity for complex tasks (Baddeley, 2007; Dehn, 2008, 2015).

Working memory is a vital cognitive process underlying thinking and learning. It is limited in its capacity. Even normal individuals can also handle only about 4 bits of information at a time (Cowan, 2014). Information remains in the working memory may be only for 2 seconds rest it is manipulated (Swanson, 2015). However, there are individual differences in the capacity of working memory. Since working memory is central to cognitive processes and learning. Active learning of the child mainly depends on his/her working memory capacity. For instance, a child diagnosed with reading disability may have a severe deficit in verbal working memory (Dehn, 2008, 2015).

There are various models of working memory. The brief descriptions of these models are given below.

1.5 Models of Working Memory

1.5.1 Information Processing Model (1960s)

This model uses computer processing as a metaphor to explain the functioning of memory. This model describes cognitive processing concerning selective perception, encoding, storage, retrieval, response organization, and system control.
There are three components of Information Processing Model (IPM): Sensory memory, working memory and long-term memory.

**Figure 1.1: Information Processing Model**

![Information Processing Model Diagram]

In the Sensory Memory, the sensory information stays for $\frac{1}{2}$ to 3 seconds approximately. The sensory store has limitation to retain five to seven letters or pictures at a time. The sensory memory works as a screening of information. It processes that information which is related to the present situation. It works so fast that it is hard to control what have been attended by the child consciously. According to this model, sensory information given to a child is either deleted or forwarded to short-term memory. The information provided to child lasts in short-term memory only around 15-20 seconds unless it is repeated. After rehearsing in short-term memory, it gets stored in the long-term memory. Long term plays a role of unlimited repository capacity. Many of the researchers have found that long-term memory can hold millions of pieces of information (Anderson, 2009; McLeod, 2007).

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1.5.2 The Atkinson-Shiffrin Model/Multi-Store Model (1968)

In this model sensory memory, short-term memory, and long-term memory has control process. The sensory system buffers information from sense modalities. It is a brief memory that holds sensory information. The sensory store nourishes the information and then transfers to short-term memory. It serves as a work place for sensory and long-term memory in this model and holds information for a short period, usually for a minute. Long-term memory stores the exchange of information from short-term memory (Matlin, 2005).

Figure 1.2: Atkinson & Shiffrin, 1968; Multi Store Model (MSM)²

It can store information for a longer period (Dehn, 2015; Hulme & Mackenzie, 1992). The first time the idea of a control process, which filters the only certain amount of information was introduced. It was assumed to be a filtering device which limits the capacity of short-term memory (serves processing function) and long term and sensory memory (serves storage function). Figure 1.2 gives an example of the Atkinson-Shiffrin Model (Dehn, 2015; Radvansky, 2015).

Hence, there are four distinct components in this model and the earlier model viz. Information processing model has three components. In this Atkinson-Shiffrin model, information is retained which is nourished by sensory store and long term memory can exchange information from short-term memory for a short period.

1.5.3 Levels-of-Processing Models

According to this model of memory proposed by (Craik & Lockhart, 1972) memory is of one kind rather than of three types (Sensory, Short Term, Long Term). This theory emphasized that the ability to remember to; depend on how deeply information is processed. The level of such information processing may be shallow or profound. The greater the depth of processing leads to better memory. It is also called as the depth of processing approach. In this model, mental techniques were uses to retain information such as rehearsal. Craik and Lokhart proposed two types of rehearsals. Maintenance rehearsal is repeating the information repeatedly. It is a rote memory with no connection with prior learning. On the other hand, the second type of rehearsal is elaboration means relating new facts/idea with old and building connection to remember. It is much more efficient than the maintenance rehearsal. What will happen if you spend more time rehearsing? Craik and Lokhart (1972) predicted that the answer to this question depends on the type of rehearsal. If there is shallow maintenance rehearsal, then increasing the time of rehearsal will not influence anymore. However, if there is a deep elaborative rehearsal, then growth in rehearsal time will be helpful. During this period, one can associate a different kind of images, and memories to strengthen the stimulus and later recall accurately. However, there were many objections to this model as even shallow and superficial learning can have long-term memory traces. Retention of information may be related to the cues and material rehearsed. Likewise, this model could not sustain the objection raised (Baddeley, 1986; Dehn, 2011).

1.5.4 Baddeley’s Working Memory Model/Multi Component Theory

In real terms, the first elaborative model of working memory was proposed by (Baddeley & Hitch, 1974) and further revised (Baddeley, 1986, 2000). This theory is
the most prominent theory of working memory. This theory divides working memory into four components: the phonological loop, visuo-spatial sketchpad, episodic buffer, and central executive. However, initially only three components were included (Baddeley & Hitch, 1974).

**Figure 1.3: Baddeley Model of Working Memory**

![Baddeley Model of Working Memory](image)

The episodic buffer was added later with the revised versions (Baddeley, 2000). In this model, the central executive is considered the controlling system under which phonological loop and visual-spatial sketchpad work. However, episodic buffer acts a binding agent between visual-spatial sketchpad and phonological loop. It also combines information from long-term memory. Episodic buffer is limited in its capacity to process and with hold information. Since this combines all the systems; it provides a unified memory trace of an event. For instance, recollecting a favourite actress’s show. One will remember how she looked, her voice, what she talked about and what kind of studio that was, etc. All came together to provide a single complete

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memory trace. This model emphasized processing of information through multisensory approach for better working memory. It has three following components: 1) Phonological Loop, 2) Visual Spatial Sketchpad and 3) Central Executive Function. The brief description is given below.

1.5.4.a Phonological Loop

Phonological loop component of working memory is proposed as a specific storage system for the speech based information and acoustic information too. This system is considered as slave system as it does not have the capacity for controlling and decision-making. Phonological loop is merely a temporary storage for heard information, especially speech based information. Phonological loop is responsible for the ability of the child to remember a small amount of heard information over short periods. Phonological loop believed to be located in the left hemisphere of the brain according to the neuroimaging evidence (Jonides et al., 1993).

1.5.4.b Visual-Spatial Sketch Pad

Visual-spatial sketchpad is second component, which deals with the visual and spatial information. It holds information for a brief period of time. Like phonological loop, the visual-spatial sketch pad stores visual and spatial information. It is a slave system. The visual subcomponent is responsible for the storage of static information (i.e. information about objects, shape, and colour). The spatial subcomponent is in charge of the storage of dynamic spatial information (Information of motion and Direction) (Henry, 2011a).

1.5.4.c Central Executive

Central executive is the third component serves as the control centre and has processing capacity. It regulates the other three systems initially explained as 1) Having the capacity of some storage 2) Having the possibility of interfacing with
long term memory and 3) Allocating resources between working memory components and long-term memory (Henry, 2011a). Central executive is the most major component of the working memory system. Every time we engage in any complex activity (e.g. reading a text, solving a problem, performing two tasks at the same time), one makes significant use of the central executive function. It has an extra capacity to provide attention as and when it is required by either of the systems when demand becomes taxing. For example, solving a complex puzzle and walking. One might stop walking if he/she get stuck with the puzzle to solve it, putting extra load on the central executive (Dehn, 2011; Kane, Bleckley, Conway, & Engle, 2001; Radvansky, 2015).

In addition to three components described above episodic buffer was added recently to this model.

1.5.4.d Episodic Buffer

Episodic buffer is the most recent addition to the working memory model and represents the significant change to the original model of the working memory (Baddeley, 2000). The episodic buffer not just stores information but it binds the information with long-term memory.

In the present study, the original model of working memory by Baddeley and Hitch (1974) is used. In this model, working memory is conceptualized by four components; Phonological loop, Visual-Spatial Sketchpad, Central Executive and Episodic buffer. As the episodic buffer is still very much in development and yet hardly measured (Dehn, 2008). It is not taken in this thesis. The visuo-spatial sketchpad and phonological loop are responsible for the temporary storage of respectively visual-spatial short-term memory (VSSTM) and Phonological short-term memory (PSTM). Both of these are called the slave systems are coordinated by
central executive. The central executive controls overall working memory system. It includes focusing, dividing, and switching attention and flexible to carry out goals. It also gives meaning to current experiences and direct resources to competing for cognitive demands. Hence, no doubt there are many ways to measure central executive resources. It has been divided into two major areas. First is executive loaded working memory (ELWM), It requires both storage and processing simultaneously. Another division includes assessment of executive functioning. However there are two categories of central executive, ELWM has widely accepted a measure of central executive (Henry, 2011b). Hence, in the present study, ELWM is the measure of the central executive.

1.6 Measuring Working Memory

In this section, methods of assessing working memory are discussed. Working memory has four components according to Baddely (2000). In the present study as discussed before (Baddeley & Hitch, 1974) model has been used. In this model episodic buffer was added by Baddeley later in 2000, which has been discussed earlier under this model. There are four components in this model. For measuring these components, a brief explanation is given below.

1.6.1 Measuring Phonological Loop

According to Henry (2011) it assesses the ability to recall speech based information, which is called as PSTM. PSTM can be measured broadly divided into three categories: memory span, non-word repetition, and matching span. Memory span consist the digit span, letter span or word span and fixed length span. The most often used measure of PSTM is digit span. Digit span is included in many intelligence tests such as Wechsler Intelligence Scale for Children, British Ability Scale, Bhatia’s battery of performance tests of Intelligence, Indian Child Intelligence Test, etc. These
tests use the incremental method of assessing PSTM that is the length of the “to-be-recalled” lists is gradually increased to determine the longest list that can be recalled correctly and reliably. Another measure of PSTM is non-word repetition. Here, the child is asked to repeat unfamiliar nonsense sounds that do not resemble real words. Several tests are assessing PSTM using non-word repetition. For example, Children’s Test of Non-word Repetition (Gathercole, Willis, Baddeley, & Emslie, 1994) is the well-established and standardized test to assess PSTM. A further measure of PSTM is ‘matching span.’ Here, two very similar lists of items are presented, and the participant is asked to say if they are identical or slightly different. However, matching span test does not produce any threshold span. Hence, there are different ways of measuring PSTM. Similarly, there are the numbers of standardized tests available to measure PSTM. For instance, the working memory test battery for children WMTB-C (Pickering & Gathercole, 2001), automated working memory test, WISC, BAS, children’s test of non-word repetition (CN-Rep: Gathercole & Baddeley, 1997), etc. (Henry, 2011b).

In this study, the investigator used two tests to assess the PSTM: a digit span (DS) and syllable span (SP) test taken from immediate memory test of Bhatia’s battery of performance tests of Intelligence.

1.6.2 Measuring the Visuo-Spatial Sketchpad

The visuo-spatial sketchpad is measured as VSSTM. It mainly assesses visual and spatial short-term memory. Spatial short-memory is mostly measured by the ‘Corsi Block Tapping’ task, which involves randomly arranged a set of nine or ten blocks in different spatial locations. The experimenter points to these randomly arranged sets of blocks, one at a time and the child is asked to point to the same blocks in the same order. Span measured as the longest sequence reproduced correctly
in the same manner as indicated by the experimenter. The working memory test battery for Children (Pickering & Gathercole, 2001), automated working memory assessment is often used to assess spatial short-term memory (Alloway, 2007). Similarly, these two tests also assess visual short-term memory. Another measure of visual-spatial short-term memory is visual patterns test developed by Della Sala, Gray, Baddeley, & Wilson (1997). Here, grids that have some internal squares filled and others are left blank, are used. In literature, this task is also called as ‘pattern Span’. Further, a visual span is also measured using series of visual items that are not easily nameable. Such task often uses the non-sense pictures or abstract pictures. Here, matching span test of abstract or irregular pictures can also be used. There are tests measuring visual short-term memory such as, visual irregular (nonsense) picture span in the test of memory and learning; visual sequential Memory (Reynolds & Bigler, 1994); Abstract/Irregular Figure Test of Memory span in ‘Indian Child Intelligence Test, 2005’ (Indian adaptation) and ‘Revised Amsterdam Kinder Intelligence Test’ (Lucy Henry, 2011a; Khire, Nico, Hoksberge, Usha, & Sarawade, 2005).

In this study, two tests were used to assess the visual-spatial short-term memory: (i) Abstract/Irregular figure short term memory span test from Indian Child intelligence test and (ii) spatial short term memory span from working memory test battery for Children.

1.6.3 Measuring Central Executive

There are many measures available to assess central executive controls. However, it is noteworthy that all the test of executive control should include novelty, complexity and the need to integrate information (Anderson, 1998; Henry, 2011b). Listening span task (Henry, 2001; Leather & Henry, 1994; Siegel & Ryan, 1989),
reading span task (Daneman & Carpenter, 1980) are the most common measure of executive loaded working memory (Henry, 2011a). Other tests for measuring central executive are working memory test battery for children (Pickering & Gathercole, 2001), odd one out span task (Henry, 2001; Hitch & McAuley, 1991; Russell, Jarrod & Henry, 1996), counting span task (Case, Kurland, & Goldberg, 1982), backwards/reverse span task, self-ordered pointing task (Petrides & Milner, 1982), visual n-back task (Miller, Price, Okun, Montijo, & Bowers, 2009) and letter memory task (Clair-Thompson & Gathercole, 2006).

In this investigator has used three tests to assess ELWM, listening span and the odd one out test Henry, 2011 and reverse digit test from Bhatia battery of performance test on Intelligence.

1.6.4 Measuring the Episodic Buffer

This area of working memory is the most recent one. Hence, there is no widely accepted measure of the episodic buffer. There are only a few visuo-spatial and verbal ‘binding’ tasks to measure episodic buffer (Lucy Henry, 2011a).

1.7 Working Memory and Intellectual Disability

Researches on working memory and ID show that the range of memory difficulties is very wide among individuals (Baroff & Olley, 2014; Weiss, Weisz, & Bromfield, 1986). For instance, Ellis (1963) demonstrates that memory traces in children with ID decay much faster as compared to children without ID. Children with ID do not use memory strategies to perform tasks (Belmont & Butterfield, 1971). They also have difficulty in applying logic, tactic, and foresight (Byrnes & Spitz, 1977). Based on the research findings the investigator attempted to explore this area among children with MID.
1.8 Academic Achievement

It refers to the performance of a child on academic achievement test given in
taught subject or the proficiency and progress of the student at the end of the course.
It involves the performance of the identifiable operations and acquisition of skills.
Working memory has the substantial impact on academic achievement (Alloway &
Alloway, 2010). There are plenty of researches supporting this idea in typically
developing children (Alloway et al., 2005; Gathercole & Pickering, 2000, 2000;
Henry & Winfield, 2010; Leather & Henry, 1994). There are fewer researches done
on atypically developing children too. For instance, Henry and Winfield, J. (2010) has
shown that phonological short-term memory is one of the significant predictors of
reading and spellings difficulties faced by children with ID. Similarly, Conners,
Atwell, Rosenquist, and Sligh (2001) have established the success in learning to read
to working memory. However, there are researches done on working memory and
academic achievement among ID, mostly in abroad and all the studies available so far
have taken English medium, higher grade, and state level syllabus. If language
difficulties identified in time will help in identifying the instructional modification to
enhance the student’s academic success (Kaderavek, 2011). Curriculum based
language skills ensure the academic success of the students and even life skills.
Children learn better in their mother tongue. It is always better for children with ID to
learn a concept in their mother tongue. There is substantial evidence that children with
ID who are at the beginning of becoming bilingual make satisfactory progress when
initially supported through their mother tongue (Ware, Lye, & Kyffin, 2015). The
reading and writing skills are vital for developing language proficiency. The reading
skills are divided into two main categories reading decoding and reading
comprehension. The reading decoding is dependent on phonological processing-the
ability to detect and manipulate the sound units of oral language. The reading comprehension involves the higher level of the cognitive process. Each type of reading skills draws from short-term, long-term and working memory somewhat differently. The reading comprehension may be related to the central executive working memory and long-term memory (Kudo, Lussier, & Swanson, 2015). Writing expression is a complex cognitive activity that requires the integration of several cognitive processes and memory components. It starts from planning, processing, then to grammatical aspect and motor programs. All these steps place a very heavy demand on working memory. Working memory components are linked to basic academic skills in typically developing children and groups of a student with particular reading or arithmetic learning difficulties seem to be characterized by working memory deficit (McLean & Hitch, 1999; Swanson, 2015). The working memory in children with ID is likely to contribute to difficulties in learning read, write and calculate. Mathematic skills are divided into two types-basic arithmetic and mathematics problem solving. Both types of math’s skill require short-term and working memory components. Even simplest mathematics calculations require working memory components. Complex problems like carrying and borrowing need complex memory tasks. Most of the researches have been done on the typically developing children. There is evidence of working memory components involvement in mathematics achievement in typically developing children (Barnes et al., 2014; Holmes & Adams, 2006).

1.9 Language Skills

Language and communication are often used as synonyms. However, the two has the different meaning. Communication uses symbolic and non-symbolic information (i.e. facial expression, body language, and gestures). On the other side, Language is a complex and dynamic system of conventional symbols used for thought
and expression. Further Language has four types of skills: listening, speaking, reading and writing. These four core competencies are further divided into several major aspects. One of the divisions is based on the structure of language. The structure of language comprises form, content, and use. It includes phonology, syntax, morphology, semantics and pragmatics. Another division uses input and output as the base. It divides the four skills into receptive and expressive skills. The present study uses the second classification of receptive and expressive skills for research. The receptive skills include listening and reading skills. It refers to the receiving and comprehension of language. Expressive skills include speaking and writing skills. Here, the investigator would also like to throw light on the psychological aspect of language. Psychologists try to see how individuals learn and use language to communicate ideas. Speech perception is necessary for language comprehension. Perception is involved when we hear speech and read words. Echoic memory and short-term memory helps us to store the stimuli long enough to process and interpret them. Long-term memory provides the link between previously processed information and the information that are referring now. It reflects that memory is an essential component of language (Matlin, 2005). Hence, to understand and help the children with and without ID to learn the language. Studying the cognitive processes contributing to language is important.

Children with ID usually lack behind in the development of language (Lynch et al., 1995; Steffens, Oller, Lynch, & Urbano, 1992). A young child who shows a developmental lag in language is called language delayed (Kaderavek, 2011). Most of the children acquire language without anyone knowing how he or she does so. It is a natural phenomenon, and the knowledge of the process is usually not needed in normal children. Unfortunately, some do not learn to talk on their own. They need
some support. Language is vital to human existence, and no one knows how language is acquired. Still, we are not sure, what variable to manipulate to attain language. It is important to recognize that each theory cannot explain the complex process of language. However, each theory makes a contribution towards understanding how language develops. However, it is not possible to explain each theory in detail. Thus, the researcher would like to discuss theories in short to understand language development: Behaviourism Theory (1957) suggests that learning happens when environmental stimulus prompts a response. Behavioral principle rewards the frequency of desired positive behavior and decreases the negative behavior. It is the first time Jean Piaget, (1952) emphasis on cognitive development and its relationship with various skills including language development. Jean Piaget examined the problem-solving skills and proposed a sequence of cognitive development from beginning cognitive stage (sensory motor stage) to advance cognitive ability (formal operational stage). The interpretation of theory says there is a linkage between children’s motor ability, play behavior and language development. This theory even evaluates the cognitive skills requirement for language development. Further, Nativist Theory (1962, 1978) named as psycholinguistic theory works of Noam Chomsky emphasized that child has inherent ability to learn the language. This mechanism is called as Language Acquisition Device (LAD). In 1974, Social Interaction Theory stated communication interaction plays a central role in children’s acquisition of language. Children’s language development is strongly related to children’s appreciation of others communication intentions, their sensitivity to join visual attention, and their desire to imitate others behavior and speech. Infant-directed talk, coordinating attention and parent-child communication routine concepts are based on the social interaction theory. Whereas the Vygotsky’s Sociocultural Theory (1962,
1978) believed that cognitive development is socially mediated. A child’s interaction with others influences his or her cognitive understanding. Vygotsky also states that language plays a critical role in shaping learning and thoughts. Zone of proximal development, Scaffolding and Mediation are the concept Vygotsky theory. Information processing theory, also called connectionism, was initially called parallel distributed processing models. Parallel distributed processing (PDP) model are similar to the processing of computer software. PDP reflects a network in which neurons communicate in succession like a chain reaction. An important attribute of information refers to the allocation of resources. How much energy is distributed to the different units of the system; processing one part of the system may be limited by requirements of parallel processing units. Here the main principle is weighting, to describe how some stimuli are more easily initiated as compared to others. Same way thinking of the brain as a computer highlights many facts. Here is an example how this connectionism works in behavioral terms of reading development. Weighting suggests that connections between recognizing a letter shape and the phonological processor must be particularly strong. At the later stage of reading proficiency, a reader depends on less on the connection and weighting is reduced. This theory shows that different cognitive function plays a major role in the development of language and reading skills (Bodrova & Leong, 2006; Elman, 2001; Kaderavek, 2011; Kuhl, 2004). However, how far this contributes may bring change in the strategies to teach children with ID in their schools. In this study, investigator attempted to examine the relationship of working memory which is the higher level of cognitive function with the academic achievement and language skills.
1.10 Need and Significance of the Study

The present study aims at exploring the relationship between working memory and language skills; working memory and academic achievement among Children with Mild Intellectual Disability (MID). The working memory is very fundamental to learning which is involved in learning all aspect of life (Radvansky, 2015). It has been found that it affects academic achievement, language skills learning among typically developing children (Gathercole & Pickering, 2000; Gathercole, Pickering, Knight, & Stegmann, 2004). The working memory is central to every day activities for both children with or without special needs. It may have more implications specifically in children with MID. Hence the Investigator has decided to attempt to understand which aspect of working memory affects academic achievement and language skills among children with MID. This will help educationist to plan education of these kids in inclusive setup, and the wastage of human resources can also be minimized. With these objectives, the investigator decided to study this area. The investigator decided to study the relationship between working memory and its impact on learning Math and Hindi language in children from Hindi language medium. Various studies have reported that a child with MID lag behind to normal children in all walks of life. Hence, the researcher aimed to investigate academic achievement in Hindi as the Hindi language learned as not only subject but also medium of instruction. As researches have already proven that, a child who is good in language found to be a good academic achiever. The investigator also decided to explore achievement in mathematics, as mathematics considered as difficult subject and children with MID find difficulty in doing the complicated task. Therefore, how far they lag in this subject will help educational planner to recognize their limitations for inclusive education and Mathematics. There are researches on academic achievement and
language skills in typically and atypically developing children. However, most of them are restricted to English population (Henry, 2001). In the present study, the investigator has attempted to investigate only working memory and its relationship with language skills and academic achievement in Math and Hindi among children with MID studying in 3rd grade.

1.11 Statement of the Problem

The present study proposed to investigate the relationship between Working memory, language skills and academic achievement in Hindi and Mathematics among Children with Mild Intellectual Disability in the IQ range 50 to 69 studying in 3rd grade in special and Inclusive Hindi medium schools of NCR Delhi. The Study focuses on the following objectives.

1.12 Main Objectives of the Study

• To find out the relationship between phonological short-term memory and achievement in mathematics of children with MID.

• To find out the relationship between visual-spatial short term memory and achievement in mathematics of children with MID.

• To find out the relationship between executive loaded working memory and achievement in mathematics of children with MID.

• To determine which component of working memory predicts achievement in mathematics of children with MID.

• To find out the relationship between phonological short-term memory and achievement in Hindi of children with MID.

• To find out the relationship between visual-spatial short-term memory and achievement in Hindi of children with MID.
• To find out the relationship between executive loaded working memory and achievement in Hindi of children with MID.

• To determine which component of working memory predicts achievement in Hindi of children with MID.

• To find out the relationship between phonological short-term memory and language skills of children with MID.

• To find out the relationship between visual-spatial short-term memory and language skills of children with MID.

• To find out the relationship between executive loaded working memory and language skills of children with MID.

• To determine which component of working memory predicts language skills of children with MID.

• To find out the influence of economic status of the parents on working memory components of children with MID.

1.13 Hypotheses

• There is no significant relationship between phonological short-term memory and achievement in mathematics of children with MID.

• There is no significant relationship visual-spatial short-term memory and achievement in mathematics of children with MID.

• There is no significant relationship executive loaded working memory and achievement in mathematics of children with MID.

• Working memory components do not act as the predictor of achievement in mathematics of children with MID.

• There is no significant relationship between phonological short-term memory and achievement in Hindi of children with MID.
• There is no significant relationship visual-spatial short-term memory and achievement in Hindi of children with MID.
• There is no significant relationship executive loaded working memory and achievement in Hindi of children with MID.
• Working memory components do not act as the predictor of achievement in Hindi.
• There is no significant relationship between phonological short-term memory and language skills of children with MID.
• There is no significant relationship between visual-spatial short-term memory and language skills of children with MID.
• There is no significant relationship between executive loaded working memory and language skills of children with MID.
• Working memory components do not act as the predictor of language skills of children with MID.
• There is no significant influence of economic status of the parents of the children MID on working memory.

1.14 Operational Definitions

1.14.1 Working Memory

In this study, working memory has three components namely (a) Phonological Short-Term Memory (b) Visual-Spatial Short-term memory and (c) Executive loaded working memory.

1.14.1.a Phonological Short-Term Memory (PSTM) - PSTM refers to immediately repeating the digits and syllables exactly in same order as presented by the investigator on immediate memory test of Bhatia’s Battery of Performance Tests of Intelligence.
1.14.1.b Visual Spatial Short-term memory (VSSTM) - VSSTM refers to score obtained on the cube point test and irregular picture test of Indian child Intelligence test.

In this test, VSSTM is defined as follows

1.14.1.b.1 The child has to immediately point to a series of line drawing of cubes presented by investigator exactly in the same order on spatial short-term memory test of working memory test battery for children.

1.14.1.b.2 The child has to arrange the irregular picture presented by investigator exactly in the same way as on Irregular picture Test of Indian Intelligence Test.

1.14.1.b.3 Executive loaded working memory (ELWM) - ELWM refers to scores obtained on the listening span test, odd one out test and reverse digit test of Bhatia Battery of Performance Test of Intelligence.

In this test, ELWM is defined as follows

1.14.1.b.4 Listen to a sentence read by the researcher, make a judgment about the sentence and then recall the first word of the sentence on listening span test.

1.14.1.b.5 Pointing to odd picture among three pictures of line drawings and following this pointing on the spatial location of the odd one on the set of blank response sheet on odd one out test.

1.14.1.b.6 Immediately repeating the digit in the reverse order as presented by the researcher on immediate memory test of Bhatia’s Battery of Performance Tests of Intelligence.
1.14.2 **Language Skills:** In this study, language skills are the scores of children with ID on language skills on BASIC-MR. This test assesses the child's performance of listening and answering the questions.

1.14.3 **Children with Mild Intellectual Disability:** In this study, Children with mild ID are with IQ of 50 to 69 based on the clinical records available with schools and parents.

1.14.4 **Academic Achievement** It refers to the marks obtained by the child in Hindi and Mathematics of 3rd grade on GLAD Test (Grade Level Assessment Device).

1.15 **Variables of the Study**

Criterion variables: PSTM, VSSTM and ELWM

Predictor Variables: a. Academic achievement (Hindi and Mathematics)
   b. Language Skills

Background Variable: Socio-economic status

1.16 **Tools**

Tools were selected from the following areas.

1.16.1 **Working memory**

1.16.1.a **Phonological Short-Term Memory**—Two tests were used to assess the phonological short term memory: a digit span (DS) and syllable span (SP) test taken from immediate memory test of Bhatia Battery.

1.16.1.b **Visual Spatial Short-Term Memory**—Two tests were used to assess the visual-spatial short term memory: (i) Irregular figure short term memory

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5IQ certified by the registered clinical psychologist.
span test taken from the Indian Child Intelligence Test\textsuperscript{7} and (ii) spatial short

term memory span taken from working memory battery for children\textsuperscript{8}.

1.16.1.c Executive loaded working memory (ELWM)-ELWM refers to scores

obtained on the listening span test, odd one out test (Henry, 2011, 2013)\textsuperscript{9,10}

and reverse digit test of Bhatia’s Battery of Performance Tests of

Intelligence.

1.16.2 Language skills-BASIC-MR, Behavioral assessment Scales for Indian

Children with Mental Retardation.\textsuperscript{11}

1.16.3 Academic achievement-Grade Level Assessment Device (GLAD).\textsuperscript{12}

1.16.4 Socio-economic status-NIMH Socio-Economic Status Scale, Revised Version

(2012).\textsuperscript{13}

1.17 Statistical Analysis

To examine objectives of the present study, the investigator used parametric

statistics because 1) data was normally distributed on the normal probability curve;

2) Shapiro-Wilk value was greater than .05 (details are given in Chapter IV).

Descriptive statistics were calculated for all the variables. The researcher used


Intelligence Test}. Pune.

\textsuperscript{8}Pickering, S., & Gathercole, S. (2001b). \textit{Working Memory Test Battery for Children

(WMTB-C): Manual}. Pearson

\textsuperscript{9}Henry, L.A. (2011). London South Bank University. Adapted from: Leather, C.V., &


Predictors of Early Reading Ability. \textit{Journal of Experimental Child Psychology},

58(1), 88-111.


(2001). How does the severity of a learning disability affect working memory


for Indian Children with Mental Retardation. NIMH.

\textsuperscript{12}Narayan, J. (2003). \textit{Grade level assessment device for children with learning

difficulties}. Secunderabad: NIMH.

\textsuperscript{13}Venkatesan (2009). Readapted from 1997 Version NIMH Socio Economic Status

Pearson Product Moment correlation to check the relationship between the variables and applied regression analysis to find which component of working memory acted as a predictor of language skills and academic achievement. The investigator also used ANOVA to check the influence of socio-economic status of parents on the working memory of children with MID.

1.18 Suggestions for Further Research

- Learning requires working memory as a perquisite. Hence, further researches required to find out which working memory is prominent and contributes to which area of learning and academic achievement in children with ID.
- Further studies are needed to disentangle the manner in which specific subcomponents of the central executive influence development of mathematical skills in children.
- Working memory functioning in all the groups such as severe, moderately intellectually disability is needed to be examined to understand their process of working memory.

1.19 Delimitations of Study

- The study is confined to Hindi speaking children of NCR-Delhi studying in 3rd grade.
- The study is restricted to children with MID.
- Academic achievement was assessed only in Hindi and mathematics.

1.20 Overview of the Study

The thesis consists of five chapters. The first chapter deals with the introduction, genesis of the problem, need of the study, statement of the problem, explanation of the problem and objectives of the study, hypotheses, research design, statistical techniques used to analyses the data, tools and delimitation of the study.
A review of the literature has been presented in the second chapter, in the third chapter, the methodology employed for the study along with operational definitions of the items. The variable studied are also discussed in this chapter along with the hypotheses, sampling procedure, tool used for collection of the data, techniques for analysing data. The fourth chapter deals with analysis of the data, result, and discussion. In the fifth and final chapter, the summary covers the findings, conclusion, and education implications.