CHAPTER – III

METHODOLOGY

3.0 Introduction

This chapter deals with the operationalised definitions of the key words, variables of the study, design of the study, sampling techniques, tool used, description of the samples, procedure adopted for data collection and statistical techniques used for analysis of results of the study. As stated earlier the objectives of the study are:

- To find out the relationship between phonological short-term memory and achievement in Mathematics of children with mild intellectual disability (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 total academic achievement of children with MID.
• To find out the relationship between visual spatial short term memory and total academic achievement of children with MID.
• To find out the relationship between executive loaded working memory and total academic achievement 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 of children with MID on Working Memory of children with MID.

3.1 To achieve these objectives the researcher decided following hypotheses and appropriate research methodology:
• 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 a predictor of achievement in Mathematics of children with MID.

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

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

• There is no significant relationship between visual-spatial short-term memory and total academic achievement of children with MID.

• There is no significant relationship between executive loaded working memory and total academic achievement of children with MID.

• 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 a predictor of Language skills of children with MID.
• There is no significant influence of economic status of the parents of children with MID on working Memory of children with MID.

3.2 Operational Definitions

Working Memory

In this study, working memory has three components namely 1. Phonological Short-Term Memory, 2. Visual Spatial Short term memory and 3. Executive loaded working memory.

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 Battery of Performance Test of Intelligence.

b. Visual Spatial Short-term memory (VSSTM) - VSSTM refers to score obtained on the spatial short-term memory span test of working memory test battery for children test and abstract/irregular picture test of Indian Child Intelligence Test. In this test VSSTM is defined as follows.

b.I. 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 span test of working memory test.

b.II. Child has to arrange the irregular picture presented by investigator exactly in the same way as on Abstract/Irregular picture Test of Indian Child Intelligence Test.
c. 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’s Battery of Performance Tests of Intelligence.

In this test ELWM is defined as follows

c.I. Listen a sentence read by researcher, make judgement about the sentence and then recall the first word of the sentence on listening span test.

c.II Pointing on odd picture among three pictures of line drawings and pointing on the spatial location of the odd one on set of blank response sheet on odd one out test.

c.III. Immediately repeating the digit in the reverse order as presented by researcher on immediate memory test of Bhatia Battery of Performance Test of Intelligence.

d. Language skills: In this study, language skills are the scores of children with intellectual disabilities on language skills on BASIC-MR.14

e. Children with Mild Intellectual Disability: In this study, Children with mild intellectual disabilities are with IQ of 50 to 69 based on the clinical records available with school and parents15.

f. 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).

---

15IQ certified by the registered clinical psychologist.
3.3 Variables

The following variables are taken for this study:

(i) Criterion variable: a. Language skills
    b. Academic Achievement (Hindi and Math Achievement)

(ii) Predictor Variable: Working Memory (PSTM, VSSTM, ELWM)

(iii) Background Variable: Socio-economic status.

3.4 Research Design

The researcher conducted the present study in two stages as follows:

Stage 1-In first stage of study the investigator made selection of schools, sample, tools and pilot study was done to try out the selected tests.

Stage 2-Main study was conducted in the stage two. In main study data was collected by administering standardized tests individually by the investigator on the children with MID. After these tests were administered, the collected data was tabulated and statistically analysed. Details explanation has been given below.

3.5 Sampling Procedure and Sample of the Study

The population of this study consists of children with Mild Intellectual Disability studying in special and inclusive schools of NCR-Delhi. The investigator used non-probability purposive sampling technique. The researcher approached the special and inclusive schools of NCR-Delhi over the phone and through email. The Investigator surveyed 30 schools. Out of 30 schools, there were 16 special schools and 14 inclusive schools according to the information available on the website of NIMH and Amrita foundation for people with disabilities in NCR-Delhi. The selected criteria for the school were infrastructure and minimum availability of five children with mild intellectual disability in the schools. The researcher could select only 7 schools according to the criteria adopted. Out of 7 schools, 2 were inclusive schools
and 5 were special schools. The children with MID were selected based on the clinical records available in their schools and parents certified by a clinical psychologist. The investigator got 53 children with selected criteria, out 53 children, 7 children showed the unwillingness to take part in the study, four were absent, and six could not complete the tests. Finally, 36 children with MID constitute the sample for the study. Out of 36, there were 24 boys and 12 girls with the IQ 50 to 69 from NCR Delhi.

3.6 Selection Criteria

- Children with MID of IQ 50 to 69.
- Children with MID without any associated condition and known organic cause e.g. Autism, cerebral palsy, mental illness, etc. as per their records.
- With mother tongue Hindi and studying in 3rd grade through Hindi medium.

3.7 Descriptions of the Tools

The researcher used only seven sub tests of standardized batteries and the tests sent by Prof. Lucy A. Henry, South Bank University, UK and Bhatia’s battery of performance tests of Intelligence, Indian Child Intelligence Test and Working Memory Test Battery for children to assess the working memory components. Each test was selected on the basis of age and norms. For each construct, 2-3 tests were taken to assess it. To assess academic achievement and language skills standardized tests were used. A summary of tests and their sources is given in Table 3.1.

Working memory tests were compiled taking different memory tests. Four tests were taken from the batteries adapted to Indian situation, whereas, two tests were taken from Prof. Henry, out of two one was culture free as it included simple figures. The second one was listening span test was translated and adapted. The compiled tests of working memory components were administered individually. Detail explanation of all these memory tasks are given below in Table 3.1.
<table>
<thead>
<tr>
<th>Task</th>
<th>Sub-Task</th>
<th>Source</th>
<th>Reliability and Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Working Memory</strong></td>
<td>WM (PSTM)</td>
<td>Immediate Memory (IM)(Digit Span Forward)</td>
<td>Bhatia’s battery of performance tests of Intelligence, 1955</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forward Syllable recall</td>
<td>Bhatia battery of performance test on Intelligence, 1955</td>
</tr>
<tr>
<td></td>
<td>WM (VSSTM)</td>
<td>Spatial Short Term Memory Span (SSTMS)</td>
<td>Working Memory Test Battery for Children (WMTB-C, Pickering &amp; Gathercole, 2001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Backward Digit Recall</td>
<td>Bhatia’s battery of performance tests of Intelligence, 1955</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Odd One Out Test</td>
<td>Henry, L.A (2013) South Bank University, Task Reliability-OOO-.79.(Construct Validity-.38 to .67)</td>
</tr>
<tr>
<td></td>
<td>WM (ELWM)</td>
<td>Listening Span</td>
<td>Henry, L.A (2011) South Bank University,(Construct Validity-.38 to .67). Task Reliability-Listening Span-.74</td>
</tr>
<tr>
<td><strong>2 Hindi Language skill test</strong></td>
<td>Language Hindi</td>
<td>Language skills</td>
<td>Peshwaria, R &amp; Venkatesan, S. (1992) BASIC-MR</td>
</tr>
<tr>
<td><strong>3 Academic Achievement</strong></td>
<td>Academic Achievement Grade Level Assessment Device (GLAD)</td>
<td>Hindi and Math</td>
<td>Narayan, J. (1994)</td>
</tr>
<tr>
<td></td>
<td>Socio-Economic</td>
<td></td>
<td>Venkatesan, S. (2011)</td>
</tr>
</tbody>
</table>
**Brief Description of the Tools Used**

### 3.7.1 Phonological Short-Term Memory

Description of the tests—Two tests were used to assess the phonological short-term memory: a digit span test (DS) and syllable span (SP) test taken from immediate memory test of Bhatia’s battery of performance tests of Intelligence. The digit span test consisted 24 items and syllable span test had 21 items. Hence, PSTM test had total 45 items. There were eight stages on 24 items in digit span task. Each stage had three trials with gradual increase in level of difficulties. Similarly, syllable span task had seven stages and each of them had three trials. This test was administered individually with children with MID.

Administration of the test—Each test items comprised digits in digit span test and Hindi syllable in syllable span test in Hindi which were presented at the rate of one per second. In both the tasks, student had to immediately repeat digits or Hindi syllables verbally in exactly same order as presented by the administrator.

Scoring—One mark was given each correct reproduction of digits or syllables. The maximum possible score for digit span and syllable span was 9.

### 3.7.2 Visual-Spatial Short-Term Memory

Two tests were used to assess the visual-spatial short-term memory: (i) Irregular figure short term memory span test and (ii) spatial short-term memory span.

#### 3.7.2.a Abstract/Irregular Figure Short-Term Memory (IFSTMS)-

Description of the test—This test was taken from the Indian Child Intelligence Test, 2005. In this task, irregular pictures were shown in a specific order according to the instruction given in the manual for each stage. The test was administered in one to one setting. The IFSTMS consisted total 18 items. There were 6 stages on 18 items.
Each stage had three trials with a gradual increase in the level of difficulties. The number of pictures showed increased gradually from two to seven at the last trial.

Administration of the test-Each set of pictures was presented to the student precisely for five seconds and then he/she was asked to rearrange in same array. In this test, level of difficulty increased with increase in number of pictures presented. Student was supposed to complete minimum two trials out of three trials presented to qualify and reach to next stage.

Scoring-Span score was the longest list recalled correctly. One mark was given on successful completion of each stage. The maximum possible score was seven.

3.7.2.b Spatial Short-Term Memory (SSTMS)

Description of the test- In this test, the student was shown a set of nine identical cubes, arranged randomly in different spatial locations on A4-sized paper. Each level had three trials. To move to the next level student need to complete two trials out of three.

Administration of the test-The experimenter points to series of blocks at the rate of one block per second. And the child asked to point to same cubes in the same order. The test was administered with each child individually. Test start with pointing to two cubes and maximum series of pointing cube was up to nine numbers of cubes.

Score- Span score was measured as the longest sequence pointed at which the student could complete minimum two trials out of three trials presented. One mark was given on successful completion of each sequence pointed correctly. The maximum possible score was nine.
3.7.3 Executive Loaded Working Memory (ELWM)

Three tests were administered individually with the children to assess ELWM.

3.7.3.a Listening Span Test

Description of the Test- Test was translated from English to Hindi and adapted. Translation and retranslation method was used with the help of four experts in the field of Psychology, Special Education, Educational Psychology and Linguistics. Permission to use the test was taken from the concerned authors. Investigator checked the validity and reliability mentioned in section 3.7.4.

In this test, processing is required with the storage of the first word of the sentence. It contains a different sentence that would either be true or false (e.g. “Log Chal Sakte hai” or “Fool gaa sakte hai”) and then the student was supposed to recall the first word of the sentence. There were total 60 items, spread over four levels, comprising six trials at each level. The child had to clear three trials out of six to reach to next level. The task difficulty varied at each level.

Administration- After hearing the sentence, the student was asked to immediately state whether the sentence is true or false and then recall the first word. In same manner, task moves on presenting two or more sentences at a time and requiring students to remember first words of each sentence in correct order. Making judgment whether the sentence was true or false was not scored.

Scoring- Span score was the longest length of the final word of the sentences in correct order remembered. The maximum possible score was four.

3.7.3.b Odd One Out Span Test: Description of the test- There were total 84 item distributed over six levels of difficulties. Each task had four trials. Initially, children were given practice trial. The student was moved to next trial only after completion of successful two trials.
Administration of the test- Here, students were shown three visual items that cannot be readily named. They were asked to point the items that were slightly different from the other two. This was the processing part of the task, i.e. choosing the ‘odd one out’. The storage part is to remember the spatial location of the odd one out (to the left, middle or right in the grid). Test starts with single list of array of odd one out and recalling spatial location. Difficulty level was increased by presenting two list of array and gradually three lists of odd one out array with recalling of spatial location in correct order up to the length of six.

Scoring- Span score was the longest length of spatial location in correct order remembered. The maximum possible score was six.

3.7.3.c Reverse Digit Span Test (RDS)

Description of the test- This test is similar to the Forward digit span test but way of the response on this test is reverse. The reverse digit span task consisted 11 item spread over eight stages. Each stage had three trials with gradual increase in level of difficulties.

Administration of the test- Student had to repeat digits in correct reverse order immediately. Each digit was presented at the rate of one digit per second.

Scoring- Span score was the longest number of digit reproduces at which the student could complete minimum two trails out of three trials presented. One mark was given each for the number of digits or sound in the maximum correct reproduction. The maximum possible score for digit span was 6.

3.7.4 Reliability and Validity of the Working Memory Tests

All the seven working memory tests have been taken from the standardized tests with their age and norms. Details of these seven tests have been given in the above sections (See 3.7.1 to 3.7.3). Since the sources were different of all tests and
listening span test (See 3.7.3a) was translated and adapted to the Hindi population, investigator checked for the reliability and validity of the tests. Reliability Coefficient (Cronbach’s Alpha) of seven tests of WM was .88 which is very good to for internal consistency of tool. Table 3.2 shows the correlation coefficient between the span tasks. The span task of (DSF, SP .630**), VSSTM (IFSTMS, SSTMS .603**), and ELWM (LST, OOO, and RDS .480* to 905**) were strongly correlated. This shows the construct validity.

Table 3.2: Correlation coefficient between all WM measures

<table>
<thead>
<tr>
<th></th>
<th>DSF</th>
<th>SP</th>
<th>IFSTMS</th>
<th>SSTMS</th>
<th>LST</th>
<th>OOO</th>
<th>RDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSF</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>.630**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFSTMS</td>
<td>.006</td>
<td>.232</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSTMS</td>
<td>.575*</td>
<td>.012</td>
<td>.203</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LST</td>
<td>.430</td>
<td>.545</td>
<td>.367</td>
<td>.475*</td>
<td>.523*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>OOO</td>
<td>.055</td>
<td>.045</td>
<td>.367</td>
<td>.475*</td>
<td>.523*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>RDS</td>
<td>.430</td>
<td>.045</td>
<td>.367</td>
<td>.475*</td>
<td>.523*</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

*Sig at.05 level **Sig at.01 level. DSF-Digit Forward Span, SP-Syllable Span, IFSTMS-Irregular figure short term memory test, SSTMS-Spatial sort term memory test, LST-Listening Span test, OOO-Odd one out, RDS-Reverse Digit Span.

3.7.5 Academic Achievement

In this study, academic achievement refers to marks obtained by children with Mild Intellectual disability in mathematics and Hindi subject on the grade 3 of Grade Level Assessment Device developed by (Narayan, 1994). This device is based on the standard curricula content of class I to IV in India. Here, the researcher had taken two
subjects: Mathematics & Hindi of III Standard from GLAD. Math subject had some exercises in English. Investigator used translation and retranslation method with help of two experts in English subject as well as Hindi subject. The reliability and validly of the test are: Criterion Group Validity-Class-1(.76), Class-II (.86), Class-III(.76) Class IV-.74 Content Validity-compared with minimum level of learning Face validity, Test Retest Reliability-Class-1 (.98), Class-II (.98), Class-III (.99) Class IV-.68.

3.7.6 Language Skill Assessment Tool

Standardized test of “Peshwaria, R. and Venkatesan, S. (1992). BASIC-MR, Behavioral Assessment Scales for Indian Children with Mental Retardation was used to assess the language skills of the children with intellectual disabilities. This scale is suitable for children with intellectual disabilities between 3 to 16 years. The reliability and validly of the test are Inter-Rater Reliability- 0.835. Construct Validity-Pre-Test- (0.726), Post Test - (0.804).

3.7.7 Pilot Study

A Pilot study is a “Small scale version or trial run in preparation for a major study” (Polit-O’Hara & Beck, 2006). A pilot study was conducted in Mysore city of Karnataka. Total 15 Hindi native speaker children were taken for the pilot study which were divided into two groups. Group one had 8 typically developed children, whereas, group two had 7 children with Mild intellectual disability. The pilot study was conducted with the following objective (i) to check whether children with and without ID can understand the instructions and perform the test (ii) to check the validity and reliability of the working memory tasks which is given in the table.
3.8 Main Study

**Procedure of the Data Collection**

Prior permission and written consent was taken from the special and inclusive schools of NCR, Delhi for the data collection. The oral consent from each student was also taken before administering the test individually. A separate area was used for administrating tests to avoid distractions. The test was conducted in three sessions to avoid fatigue and to control other administering precautions. Each session lasted for approximately 50 minutes. In the first session, task comprising PSTM and VSSTM were administered. In the second session, ELWM task and language skills assessment were administered. And in the third session, Hindi and math’s academic achievement tests were administered. Appropriate break and reinforcement was given to keep them active and motivated for the study.

3.9 Statistical Analysis

To achieve 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 0.05 (details are given in Chapter IV). Descriptive statistics were calculated for all the variables. The researcher used Pearson product moment correlation for the following objectives as the researcher wanted to check the relationship between the variables.

- To find out the relationship between phonological short-term memory and achievement in Mathematics.
- To find out the relationship between visual-spatial short-term memory and achievement in Mathematics.
- To find out the relationship between executive loaded working memory and achievement in Mathematics.
• To find out the relationship between phonological short-term memory and achievement in Hindi.

• To find out the relationship between visual-spatial short-term memory and achievement in Hindi.

• To find out the relationship between executive loaded working memory and achievement in Hindi.

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

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

• To find out the relationship between executive loaded working memory and language skills.

Data was checked for all the assumptions of Pearson’s Product Moment Correlation. The investigator also used multiple regression analysis for the following objectives as researcher was interested in checking the best predictors of dependent variables.

• To determine which component of working memory predicts Mathematics Score.

• To determine which component of working memory predicts Hindi Score.

• To determine which component of working memory predicts Language skills.

The data was normally distributed on Shapiro-Wilk value which was more than .05 and data was checked for all the assumptions of multiple regressions. The investigator also used ANOVA to check the influence of socio-economic status of parents on the working memory of children with MID. Data was collected for total 53 children. However only 36 children with MID were considered for the analysis. The researcher has used SPSS 20 software for the analysis.