

## CONSTRUCTION OF DYSCALCULIA IDENTIFICATION TEST (DIT) FOR ELEMENTARY SCHOOL STUDENTS

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### **ABSTRACT**

*Dyscalculia refers to Inability of a child to acquire arithmetical skills. This is a less known disability as most parents and teachers remain unaware of this problem and they overlook it. Often parents and teachers blame each other for the problem. Parents accuse the teachers of wrong teaching practices and teachers accuse parents of not taking interest in the child. The earlier this disability is detected, the better chance a child will have of succeeding in school & in life. Since very less tests are available to identify Dyscalculic students at primary level, therefore the investigator decided to construct and standardize a test to identify Dyscalculic students. The Dyscalculia Identification Test (DIT) contains 50 objective type questions to test the basic mathematical skills of elementary students. Time duration of this test was fixed as 75 minutes.*

**KEYWORDS:** *Dyscalculia, Identification and Elementary School Students*

### **INTRODUCTION**

Dyscalculia is a mathematical disability in which a person has difficulty in solving arithmetic problems and grasping Mathematical concepts. It is a lack of ability to acquire mathematical skills. If backwardness in mathematics is not attributed to low attendance, general learning difficulties, language disorder, sensory processing, improper teaching environment, lack of motivation, disturbing classroom environment and improper instructions then the child must have suffered from dyscalculia. Butterworth (2003) calls it Number blindness whereas **Kosc (1974)** defined it as a difficulty in mathematical performance due to impairment of those parts of the brain that are involved in mathematical processing

Dyscalculic is a specific disability which affects around 3-6% of the population (Gross-Tsur et. al. 1996). Dyscalculic individuals are not unintelligent, but struggle to learn mathematics. Their teachers and parents associate dyscalculia with dislike towards math. Most parents and teachers remain unaware of the problem and overlook it. Dyscalculic child in spite of having average intelligence is not able to cope with mathematical tasks in the school whereas in all other areas this child is just like any other normal average child. The earlier a disability is detected, the better chance a child will have of succeeding in school & in life but unfortunately a child suffering from dyscalculia is not identified. The reason being lack of awareness among teachers and parents regarding this disability and unavailability of some good tool. Therefore the need of developing the diagnostic test for dyscalculic is felt

This diagnostic test was developed to discover and predict this disability at the early stage to provide early remedial services.

### **Dyscalculia Identification Test (DIT).**

During the process of development of DIT, the steps followed were:

- Planning the test.
- Preparing the Preliminary Draft.
- Item Analysis.
- Establishment of Reliability and Validity.

The details in respect of each of them are given below:

### **Planning of the Test**

The investigator consulted several experts in this field and reviewed relevant literature before selecting different components. The present test was prepared mainly based on the tests for Dyscalculia by Tony Attwood (2003).

### **The 15 Major Components Considered in the Test for Dyscalculia by Attwood Were**

- Understanding the basic words of mathematics
- Visual recognition of numbers
- Recognizing written numbers
- Sequencing numbers
- Grouping numbers
- Addition
- Subtraction
- Multiplication
- Division
- Decimals
- Fractions
- Money
- Estimation
- Shapes
- Area
-

### Selection of Items for Dyscalculia Identification Test (DIT)

It was decided to include the main areas of mathematics namely Number concept, Arithmetic operations, Arithmetic Reasoning or solving word problems, and problems related to Measurement, Money and Time. Some items related to shapes are also added in the test. Knowledge of number concept is the basic requirement to achieve well in Mathematics. The areas namely measurement, money and time is related with day to day activities and it is to be handled using fundamental operations and so the knowledge in all these areas are the basic requirements to solve day to day problems of our life. Since it is diagnostic in nature, it includes sums that represent each type and subtype of tasks that fall under each of the above mentioned seven areas namely:

- Number Concept
- Arithmetic Operations
- Arithmetic Reasoning
- Money
- Time
- Shapes
- Measurement

While writing the items, the investigator took care to see that the items are appropriate to fourth standard students under state syllabus of Punjab. Thus the test is quite comprehensive in identifying the strengths and weakness of the children. The distribution of questions under these six areas is described below:

**Number Concept:** It refers to the basic knowledge about the basic concepts in Mathematics. The seven categories under this area are Basic Words of Mathematics, Visual Recognition of Numbers, Recognizing Written Numbers, Sequencing, Grouping, Place Value, Basic Language of Mathematics.

**Arithmetic Operations:** The basic arithmetic operations are Addition, Subtraction, Multiplication, Division. In this section problems from the whole numbers are included. Since the concept of decimals and fractions is difficult even for Normal students of the fourth standard, the investigator avoided questions from decimals and fractions in this part.

**Arithmetic Reasoning:** It includes word problems, the solution of which requires arithmetic reasoning. It also includes completing the pattern and coding-decoding.

**Problems Related to Measurement, Money and Time:** Problems related to daily life which involves measurement, money and time are included.

**Shapes:** It includes geometrical figures and pictographs.

### Preparation of the Draft Test

A draft test consisting of 102 items were prepared. The items were selected to measure the ability in each of the above six areas. The prepared items were scrutinized by experts and modifications were made according to their suggestions. The subcomponents included under each component and the distribution of questions are given in table 1.

**Table 1: Details regarding the items in the Dyscalculia Identification Test (DIT) (Initial Draft)**

| Component Item        | Sub-Components                                  | No. of Items |
|-----------------------|---|--------------|
| Number concept        | i) understanding the basic words of mathematics | 5            |
|                       | ii) Visual recognition of numbers               | 7            |
|                       | iii) Sequencing                                 | 2            |
|                       | iv) Grouping                                    | 2            |
|                       | v) Place value                                  | 7            |
|                       | vi) Fractions                                   | 3            |
| Arithmetic operations | Whole numbers                                   | 6            |
|                       | i) addition                                     | 4            |
|                       | ii) subtraction                                 | 4            |
|                       | iii) multiplication                             | 3            |
| Arithmetic reasoning  | iv) division                                    | 3            |
|                       | Word problems                                   | 7            |
|                       | Complete the pattern                            | 6            |
|                       | Coding  | 1            |
| Measurement           | Decoding  | 1            |
|                       | Measurement                                     | 10           |
| Money                 | Estimation                                      | 5            |
|                       | Money   | 10           |
| Time                  | Money   | 10           |
|                       | i)clocks  | 3            |
| Shapes                | ii)calendar                                     | 7            |
|                       | i) shapes                                       | 6            |
|                       | ii) pictograph                                  | 3            |
| <b>Total Items</b>    |   | <b>102</b>   |

The items were written in two languages, namely – English and Punjabi. After writing the first draft, the test was given to 10 mathematics teachers and 10 teacher educators for expert opinion. They were asked to scrutinize the test on the basis of level of difficulty, language, appropriateness of the time allotted, whether the items are according to Dyscalculia Identification. Experts pointed out that some of the items were not relevant for the identifications of dyscalculics, whereas some others were not suitable for class 4th students. They also suggested some modifications in the text and structure of some of the items. Keeping these suggestions in mind, 13 items were deleted, and the wording of some was modified. According to the suggestions, a structure of some of the items was also improved. Thus, the second draft consisted of 89 items. The distribution of items in DIT after the expert view is presented in Table 2

**Table: 2 Details Regarding the Items in Dyscalculia Identification Test (DIT) After the Expert Views**

| Component Item        | Sub-Components                                  | No. of Items |
|-----------------------|---|--------------|
| Number concept        | i) understanding the basic words of mathematics | 4            |
|                       | ii) Visual recognition of numbers               | 5            |
|                       | iii) Sequencing                                 | 2            |
|                       | iv) Grouping                                    | 2            |
|                       | v) Place value                                  | 5            |
|                       | vi) Fractions                                   | 3            |
| Arithmetic operations | Whole numbers                                   | 5            |
|                       | i) addition                                     | 4            |
|                       | ii) subtraction                                 | 4            |
|                       | iii) multiplication                             | 2            |
| Arithmetic reasoning  | iv) division                                    | 2            |
|                       | Word problems                                   | 6            |
|                       | Complete the pattern                            | 6            |
|                       | Coding  | 1            |
| Measurement           | Decoding  | 1            |
|                       | Measurement                                     | 8            |
| Money                 | Estimation                                      | 5            |
|                       | Money   | 7            |
| Time                  | Money   | 7            |
|                       | i)clocks  | 3            |
| Shapes                | ii)calendar                                     | 7            |
|                       | i) shapes                                       | 6            |
|                       | ii) pictograph                                  | 3            |
| <b>Total items</b>    |   | <b>89</b>    |

### Preliminary Try Out

The preliminary try out was done at two stages. Firstly, it was tried out on a sample of 20 students of class 4. These students were asked to point out any difficulty in understanding the items. Whenever the students pointed out the difficulty, it was noted down and necessary modifications were made. The modified DIT was administered on 235 students of schools affiliated to Punjab School Education Board, Mohali. These students were from class 4 belonging to Ankur Public School Mahilpur, Guru Nanak Public School Chabbewal, G.E.S. Parowal, G.E.S. Lalian, G. E. S. MazaraDhinghrian, D.B. Model School SailaKhurd, New Dashmesh Public School Saila Kalan, G.E.S. Golian and G.E.S. Satnaur of Hoshiarpur District. The Test was administered on these 235 students for the purpose of Item Analysis. That is, to screen statements on the basis of Discrimination Power. Items failing to discriminate were deleted. The rapport was established with the group. They were told the objective of administering the test. They were assured that their responses would be kept confidential and used only for research purpose. Once they were clear about all these, each student was given a copy of the Test on which he/she had to respond. Before responding the Test, the students read the instructions given in the Test. They were told that there was no time limit for responding. The Test was collected as soon as they finished responding. On an average student took 120 minutes. The scoring scheme was developed. One mark was given for each correct response. The data obtained from this try out were used for Item Analysis.

### Item Analysis

The purpose of item analysis was to select the items from those included in the preliminary draft. This was done item-wise. The scores were collected students as well as item wise. The total scores of all students were arranged in descending order. The total sample was divided into three group si.e high, average and low achievers of the DIT as per the criterion given by Kelley. The high and low achieving groups were treated further whereas the average group was discarded. The means of these two groups were compared with the help of t-test to study the discrimination power of each item. It was found that 39 statements failed to discriminate between two extreme groups. Therefore 39 statements were rejected. The statement numbers of rejected statements were 1, 2, 6,10, 12, 16, 19, 21, 22, 27, 28, 30, 37, 38, 39, 40, 41, 44, 48, 50, 52, 54, 57, 59, 60, 62, 65, 66, 68, 73, 75, 76, 77, 81, 82, 83, 84, 85, 89.

### The Final Draft

The final form of the test contains 50 items and based on another try out on 20students, the time for the test was fixed as 75 minutes. The final test was also printed with the necessary instructions. English and Punjabi versions of the final test was constructed. Scoring Key was also prepared. It was scored using the scoring key by giving one score for the correct answer and zero for the wrong answer. Details regarding the items in the Dyscalculia Identification Test (DIT) are given in table 4.

**Table 4: Details Regarding the Items in Dyscalculia Identification Test (DIT) (FINAL)**

| S. No.       | Components            | No. of items |
|--------------|-----------------------|--------------|
| 1.           | Number concept        | 16           |
| 2.           | Arithmetic operations | 9            |
| 3.           | Arithmetic reasoning  | 8            |
| 4.           | Measurement           | 4            |
| 5.           | Money                 | 3            |
| 6.           | Time                  | 5            |
| 7.           | Shapes                | 5            |
| <b>Total</b> |                       | <b>50</b>    |

### Establishing Reliability and Validity of the Test

#### Reliability

Reliability of the DIT was established with the help of Test-Retest Reliability Method as well as Split-half Reliability Method. For establishing reliability by Test-Retest Method, the DIT was administered twice on 140 students of class 4 belonging to Ankur Public School Mahilpur, Guru Nanak Public School Chabbewal, G.E.S. Parowal, G.E.S. Lalian, G.E.S. Mazara Dhinghrian, D.B. Model School SailaKhurd, New Dashmesh Public School SailaKalan, G.E.S. Golian and G.E.S. Satnaur of Hoshiarpur District with a gap of 30 days. The Test was administered on the same day on the students from these schools. The instructions are given and the procedure of administration was also the same. From the data, a correlation coefficient was computed. The Test-Retest reliability coefficient was found to be **0.67**. For establishing reliability by Split-half Method, the DIT was administered on 163 students of class 4belonging to Daulat Ram Public School Padrana, Asean Public School Tutomazara G.E.S. SailaKhurd, G.E.S. Bhajjal, G.E.S. Pakhowal, S.D. Model School Garshankar, Navjot Public School Garshankar, G.E.S. Jian and G.E.S. Kukran of Hoshiarpur District. Acorrelation coefficient was computed form of the obtained data. The Splithalfreliability coefficient was found to be **0.69**. Since reliability coefficients found by Test-Retest and Split-half

methods were high and almost the same in both the cases, so DIT was considered to be reliable.

### Validity

To validate this measurement instrument, Researcher consulted the curriculum as well as the textbooks. The purpose was to gain insight into what the learners were expected to learn so that the instrument can be validated accordingly. As stated in the previous sections the main focus of this study was to identify the students suffering from dyscalculia. Thus, only questions on students' understanding of mathematical calculations were asked. Zeller (1988) states that establishing *content validity*—involves specifying the domain of content for the concept and selecting indicators that represent that domain of content. After constructing the test items, Researcher consulted experts in the field of Mathematics education. The Content Validity of the test was established by having a discussion with the experts from the field of

Mathematics Education. On the basis of experts' opinion, the DIT was found to be valid. To further ensure that the contents chosen were within the prescribed domain of study for the learners concerned, Researcher consulted Mathematics teachers teaching class 4TH in the schools. This gave the teachers the chance to crosscheck and contribute to the content areas that were tested in this test. Their responses indicated that the contents examined in this test reflected the prescribed Mathematics contents for the learners. Piloting the test instruments also helped to refine it. While drawing up the test items, Researcher constantly referred to the literature available on the dyscalculic students as a workable guide. Butterworth screener (2003), Sir Tony Attwood (2003) Dyscalculic Test and some online tests guided the design of

Researcher's questions. After the tests had been written and the grading had been completed, Researcher returned to the schools to show the participating learners their scores on the test.

The researcher did not restrict at revealing them their scores but also discussed the solutions with them. By engaging in this activity, Researcher was making sure that the learners (and their teachers too) were persuaded that the scores assigned to them accurately represented their abilities in these learning areas. The process of validity just described is what Lincoln and Guba (1985) refer to as *member checking*, a process that has the advantage of making the respondent on record as having said certain things and having agreed to the correctness of the investigator's records of them.

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