Chapter III

Construction and Validation of Research Instruments
3.1 Introduction

This chapter is concerned with the construction of tools for the present study. The following tools were developed and validated by the investigator for the study:

- At Risk of Dyslexia Screening Tool.
- Reading Interest Scale
- Multisensory Strategic Intervention.

3.2 Development of At Risk of Dyslexia Screening Tool

The purpose of developing “At Risk of Dyslexia Screening Tool” (ARDST) was to identify students who are at risk of dyslexia studying in government schools at the primary level. The screening tool assists teachers to identify the students in their early stage of specific reading disability (dyslexia) and to provide reading interventions for the students at risk of dyslexia to improve their reading performance. The students who were identified as at risk of dyslexia through administering ARDST can be sent for further diagnosis to a team of experts comprising doctors, child psychiatrists, paediatricians, clinical psychologists, counsellor and special educators to confirm the presence of disability and to obtain disability certificate to avail provisions and concessions.

3.2.1 Understanding of Dyslexia and At Risk of Dyslexia

The term dyslexia refers to difficulty with words or language. It is one of the Specific Learning Disabilities which refers to “a heterogeneous group of conditions wherein there is a deficit in processing language, spoken or written, that may manifest itself as a difficulty to comprehend, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual disabilities, dyslexia, dysgraphia, dyscalculia, dyspraxia and developmental aphasia” (Government of India, Ministry of Social Justice & Empowerment Department of Disability Affairs September, 2012: The Draft Rights of Persons With Disabilities Bill, 2012). The
individuals with dyslexia were referred to as dyslexics and they have severe difficulties in reading and learning to read. There are diverse definitions reported in the area of research about dyslexia. But one of the most complete definitions that emerged from over twenty years of research was put forwarded by Reid Lyon, Sally Shaywitz & Bennett Shaywitz (Hudson, High & Al Otaiba, 2007). They defined dyslexia as follows:

“Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction”. (Lyon, Shaywitz, & Shaywitz, 2003, p. 2)

From the definition it was evident that the individuals with dyslexia have difficulties in the areas like reading, spelling, phonological awareness tasks and decoding. Therefore researchers referred it as a syndrome (Warrington & Shallice, 1980; Eadon, 2005; DSM-IV, American Psychiatric Association, 1994; Miles & Miles 1999) which means a group of associated symptoms. Based on the symptoms and characteristics, it was classified into different types like acquired dyslexia, developmental dyslexia, phonological dyslexia, etc,. Dyslexia is a lifelong condition (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Shaywitz et al., 2003; Oren & Breznitz, 2005) which has no cure (The International Dyslexia Association, 2013). However the researchers like Torgesen (2002) and Snow et al., (1998) stated that it can be prevented and the severity of dyslexia can be reduced if appropriate intervention was provided at an early stage which refers to the individuals who are at risk of dyslexia (National Institute of Child Health and Human Development, 2000; Torgesen, 2000).

Hence, the identification of at risk of dyslexia plays a vital role in preventing the individuals becoming severe dyslexics through providing appropriate reading intervention at the earliest (Snowling & Hulme, 2012). The term “At Risk of Dyslexia” refers to the individuals who are at the initial stage of becoming severe dyslexics either
acquired from their dyslexic parents (Gallagher, Frith and Snowling, 2000; Snowling et al., 2007) or the individuals who have severe problems in alphabet knowledge, phonological awareness and Rapid Automatized Naming (RAN) and exhibit signs of dyslexia in the of 5 to 7 age group were considered as at risk of dyslexia (Karande, Sholapurwala & Kulkarni, 2011) (for more details see chapter 2). In addition the term “At Risk of Dyslexia” also refers to the individuals who have limited exposure to reading, are raised in poverty and an English Language Learners (Torgesen, Foorman & wagner, 2008; Ganschow & Schneider (IDA), 2012).

3.2.2 Significance of Early identification of students at risk of dyslexia

Smythe (2011) stated that there was no medical treatment for dyslexia to reduce the reading problems, but educational remediation helps minimize their reading difficulties and improves their reading skills (International Dyslexia Association, 2012). In the United States of America (USA), the incidence of dyslexia in school children ranges between 5.3 to 11.8% (Katusic, Colligan, Barbaresi, Schaid, & Jacobsen, 2001). In India, there was no exact statistical detail available about the individuals affected with Specific Learning Disabilities (SpLD) (Ramaa, 2000) and the information about children with SpLD was scanty (Karande, et al, 2005, Karande, Mehta & Kulkarni, 2007; Vijayalaxmi et al, 2011). It is disheartening to state that in India 10 to 14% of the 416 million children were said to have SpLD (Krishnakumar, 1999; Krishnan, 2007; Mehta, 2003) it also estimated that in India atleast five students in every average-sized class had SpLD (Thomas, Bhanutej & John, 2003), where dyslexia (or specific reading disability) affects 80% of all those identified as learning-disabled (Karande, Sawant, Kulkarni, Galvankar & Sholapurwala, 2005). Approximately, the incidence of dyslexia in primary school children in India has been reported to be 2-18% (Mittal et al, 1977; Shah, Khanna & Pinto, 1981; Ramaa & Gowramma, 2002). Therefore it is of paramount importance to identify dyslexics at the beginning itself that is, At Risk for Dyslexia to provide appropriate interventions and accommodations to reduce their scholastic backwardness and to prevent dropping out from schools due to their difficulty in learning to acquire literacy skills. The unidentified dyslexics in the mainstream schools lead to chronic poor school performance and even become the school drop-outs (Shapiro & Gallico, 1993; Shaywitz, 1998; International Dyslexia Association, 2012). The earlier identification of
students at risk of dyslexia will help to provide necessary remediation and intervention which in turn reduces the deficits in learning to acquire the literacy skills of the dyslexic students. The researchers recommended that remedial education should begin early, when a child is in primary school to prevent the child becoming a severe dyslexic (Shapiro & Gallico, 1993; Shaywitz, 1998; Dakin, 1991).

3.2.3 Need for the Development of At Risk Dyslexia Screening Tool

In India, there was a lack of a standardized tool to identify the dyslexics as well as students at risk of dyslexia (Ramaa, 2000: Saravanabhavan & Saravanabhavan, 2010; Khursheed, 2015). Karande & Kulkarni (2005) reported that there was a non-availability of standardized educational and psychological test to identify the children with SpLD in India especially to those who are studying in vernacular medium schools. Indeed there are some standardized tools available like Dyslexia Screening Test-Junior, India Edition (DST-J-India) developed by Angela Fawcett and Professor Rod Nicolson (2012), It is a commercial screening tool which costs about Rs. 9700/- and NIMHANS Index for specific learning disability was developed by Kapur, John, Rozario, and Oommen in 1991. These screening tools are useful to identify at risk dyslexia students studying in the English medium schools where the medium of instruction is English. Therefore these tools may be distant to identify at risk dyslexics studying in the government schools (Arun, et al., 2013) where the medium of instruction is Tamil. In addition to these disadvantages, these two screening tools can be used only by the trained professionals like qualified psychologist, counsellors and special educators (Arun, et al., 2013). The investigator of the present study took cognizance of the problems that there was an urgent need to develop a screening tool to identify at risk of dyslexics studying in the government Tamil medium schools and developed the screening tool in such a way that the teachers can use the tool to identify the students who are at risk of dyslexia. The rationale for selecting teachers as the administrators of a screening tool was that the teachers are the individuals who spend most of the time with the students and their academic observation inside and outside the classroom helps to spot students at risk of dyslexia in the initial stage itself (Snowling & Hulme, 2012, Arun, 2013). For example, researchers namely Arun (2013) and Margaret (1997) made use of teachers’ observations in the classroom to identify dyslexics. The researchers like Snowling & Hulme (2012) suggested that there was no
need to use commercially available screening tests designed to identify children at risk of dyslexia, instead the teacher’s observations can be used to identify these children. Based on the insights gained from the review of the relevant literature, the researcher found that there was no screening tool to identify at risk dyslexics which can be used by the teachers (Arun, 2013). As a result, the researcher has developed At Risk of Screening Tool to identify the sample for the present study.

3.2.4 Description of the Screening Tool

The Screening Tool (ARDST) was designed to identify students who are At Risk of Dyslexia. The word screening has various meanings based on the context in which it is used. In the present context, the term screening refers to testing the individuals in order to identify those with particular characteristics or symptoms. Harris and Nagy (2009) in the Mosby's Medical Dictionary define screening as “a preliminary procedure, such as a test or examination, to detect the most characteristic sign or signs of a disorder that may require further investigation”. For the construction of the screening tool the researcher adopted Likert-type rating scale also known as frequency scale (Bowling, 2014; Burns, & Grove, 2005). Frequency scales ask respondents how often or how many times something has happened or should happen (Spector, 1992). The Likert type scale differs from the traditional Likert scale (summated rating scale) where the response set of Likert scale uses descriptors like strongly agree to strongly disagree. Whereas in Likert-type scale, the researchers are free to choose any form. Rattray and Jones (2007) describes “Likert type scales are one of a range of scale types that researchers can choose from, and they identify Frequency, Thurstone, Rasch, Guttman, Mokken and multiple choice formats as alternatives”.

Rating scale is a collective term describing instruments that are evaluative and that use an item format where response choices are ordered on a continuum (Colton & Covert, 2007). It is used to measure opinions and attitudes of an individual as well as used to record direct observation and assessment. Colton and Covert (2007) classified two types of Likert type rating instrument like performance and behaviour rating instruments. The researcher adopted Likert-type behaviour rating scale for the construction of the screening tool because it is descriptive in nature and not evaluative where the response choice of the item tells whether the characteristics or symptoms are
present or not. Fink (1995) identified five response set categories for the Likert – type rating scale namely frequency, endorsement (also called agreement), influence, intensity and comparison. The screening tool measures the occurrence of symptoms of at risk of dyslexia in a frequency. Thus the screening tool (ARDST) is in the form of Likert- type behaviour frequency rating scale with unipolar response choice. It is in the form of a multidimensional scale which consists of five dimensions or five factors. For example the unipolar response choices are numbered consecutively from low to high starting with zero (0) from low to high (Spector, 1992). Each item in the screening tool has a frequency response choice with unipolar response set such as never, sometimes, often and always to find out the presence and absence of the symptoms and characteristics of “At Risk of Dyslexia” in the individuals with its frequency of occurrence, to determine the severity of “At Risk of Dyslexia”.

3.2.5 Dimensions of the Screening Tool

The screening tool is composed of five dimensions viz. deficits in alphabet knowledge, reading, phonological awareness, writing, and co – existing problems based on the difficulties experienced by at risk dyslexics in learning to read and the symptoms of dyslexia that were documented, and the signs and symptoms of at risk of dyslexics recorded in the research and the theoretical review of the field, Dyslexia. The dimensions of the tool were taken after the complete exploration of the review of the studies related to dyslexia and at risk dyslexia. Thus the items given in the tool are exhaustive in nature because a single dyslexic student does not possess all the symptoms. The severity of the problems differs from an individual to individual; it varies from mild to severe cases of At Risk of Dyslexia. Therefore the items in each dimension were selected from the research and theoretical articles on dyslexia. In addition, the items for the screening tool was taken from the symptoms of dyslexia and indicators of at risk dyslexia documented in the renounced international and national dyslexia, disability and specific learning disabilities associations and organisations. Finally, the selected items were verified by the panel of subject experts as well as statistical item analysis procedure for its appropriateness. Each dimension consists of fifteen items and the detailed descriptions of the dimensions are discussed as follows:
**Dimension 1: Deficits in Alphabet Knowledge**

Alphabet knowledge is one of the most fundamental components for learning to read in all languages, without knowledge of the alphabet learning to read is impossible (Torgesen, 2004; Ehri & McCormick, 1998; Whitehurst & Lonigan, 1998). Researchers have observed that the children who exhibit difficulties in acquiring knowledge of the alphabet such as naming the letters, remembering the shapes of the letters and associating the sounds to the letters are the best indicators to identify the students who are “at risk of dyslexia” (Schatschneider & Torgesen, 2004; Hammill, 2004; Scarborough, 1998). Poor knowledge of alphabets in the early stages of reading predicts the success and troubles in developing the reading skills of the individuals at a later stage (Share, Jorm, Maclean, & Matthews, 1984; National Research Council, 1998; Schatschneider, Fletcher, Francis, Carlson & Foorman, 2004).

From the research studies it was evident that at risk of dyslexic children have persistent difficulties in acquiring the alphabet knowledge (Muter, Hulme, Snowling & Stevenson, 2004; Bowey, 2005). Thus the deficits associated with at risk dyslexics in the domain of alphabet knowledge are letter reversals (Narayan, 1997; Moats & Dakin, 2012), letter inversions (Sarva Shiksha Abhiyan (SSA), 2003), trouble in naming the letters (International Dyslexia Association, 2012), problems in differentiating the similar looking letter for example “b and d” (Orton. 1937; Narayan, 2003; Liberman, Shankweiler, Orlando, Harris & Berti, 1971), difficulty in telling the letter names in a sequential order (Mercer, 2002), etc,. Therefore the difficulties faced by the children with at risk dyslexia in developing alphabet knowledge were included in this domain consisting of fifteen items taken from the review of the related studies.

**Dimension 2: Deficits in Reading**

Learning to read is one among the basic literacy skills, a normal child picks up the skill of learning to read easily when compared to a dyslexic child (Singleton, 2005). Reading and learning to read are the core problems of dyslexics and at risk of dyslexics (The Diagnostic and Statistical Manual of Mental Disorders, 2013; British Psychological Society, 1999). Numerous studies have reported that children as well as adults those who are dyslexics have persistent difficulties in reading single words, sentences and decoding the words in isolation (The World Federation of Neurology,
1968; Payne and Turner, 1999; Hulme & Snowling, 2009; Snowling, 2000; Fawcett, Singleton & Peer, 1998). For a dyslexic student, acquiring the skill of learning to read is a much labourious task. Dyslexia is characterized by unexpected and severe problems in learning to read (Fawcett & Nicolson, 1994; Nopola-Hemmi et al., 2001). Children with dyslexia have great difficulties in learning to read and write, despite normal intelligence, adequate learning opportunities, and no serious emotional or personality disorders. According to Critchley (1970) Dyslexia, or specific reading disability, is generally defined as the failure to acquire reading proficiency despite an adequate level of intelligence, normal hearing sensitivity and visual acuity, a supportive learning environment, and an absence of behavioural problems. There was a misconception about dyslexics that they are unable to read. Researchers namely Torgesen and Foorman stated that dyslexics were competent to read but the time taken by them to learn the skills were much longer than the normal readers. The skills like ability to analyze the underlying sound structure of words and the ability to spell words correctly were difficult tasks for an individual with dyslexia (Lundberg, 1995). They also find difficulty in word decoding and word recognition to be nonautomatic, slow, effortful, and dysfluent (Lundberg, 1995). Phonological processing deficits (Ho, Law, & Ng, 2000; Paulesu et al., 2001), are closely related to the development of poor reading skills of dyslexics (Caravolas, Hulme & Snowling, 2001; Wagner et al., 1997; Wimmer, Mayringer & Landerl, 2000). The dimension of reading includes fifteen items which represents the difficulties experienced by at risk of dyslexia in acquiring the skill of reading as reported in the theoretical and empirical studies.

**Dimension 3: Deficits in Phonological Awareness**

Dyslexics and at risk dyslexics have immense difficulties in acquiring the phonological awareness skill which is an important skill for learning to read a language. The term Phonological Awareness (PA) was defined by Adams (1990), and Goswami and Bryant (1990) as an awareness of sounds in spoken words that is often reflected in one’s ability to manipulate, match, or segment different sound units. Words, such as syllable, phoneme and rime, are an essential factor that explains reading skills in both monolingual and bilingual children. Phonological Awareness involves the conscious ability to manipulate individual speech sounds within words (Lundberg, Frost & Petersen, 1988). Many research studies reported that the deficits in the
phonological awareness are the best indicator to identify the dyslexics the earlier stages (Bradley & Bryant, 1983; Bruck, 1993; Fawcett & Nicholson, 1995; Fletcher, et al., 1994; Fox & Routh, 1980; Lindamood, Bell & Lindamood, 1992; Lyon, 1995). Stanovich (1994) proposes that phonological awareness be one of the strongest predictors of reading skills. In addition, a large number of empirical research evidence supports that the primary deficits for at risk of dyslexics occur in the phonological domain (Gallagher, Frith & Snowling, 2000; Ho, Law, & Ng, 2000; Paulesu et al., 2001). The students experiencing difficulties in the domain of phonological awareness is a most important symptom to identify students at risk of dyslexia and differentiates them from the poor readers. According to Snowling, Bishop & Stothard (2000) children with phonological processing problems must be recognized as “at risk” for reading disabilities. The plethora of research in the Specific Reading Disability firmly established the idea that the phonological deficit plays a central causal role in dyslexia and as a predictor symptom of individuals at risk of dyslexia (Nijakowska, 2010; Lyon, Shaywitz, & Shaywitz, 2003; Stanovich & Siegel, 1994; Snowling & Hulme, 1994; Torgesen, Wagner, & Rashotte, 1997; Metsala, 1997; Swan & Goswami, 1997; Snowling, Bishop, & Stothard, 2000; National Reading Panel, 2000; Vellutino, Fletcher, Snowling, & Scanlon, 2004; Torgesen et al., 1999; International Dyslexia Association, 2012; Snowling, 1998; Ramus, 2001). It also suggests that children who exhibits delayed progress in the phonological development are to be considered as at risk of dyslexia (Snowling, 1998). Phonological awareness is the broader construct for knowing speech sounds, rhyming, and alliteration and includes phonemic awareness (Inverizzi, et al., 2010). Phonemic awareness is the highest sub – skill in the continuum of the phonological awareness skills which proved a most difficult skill to be acquired by the dyslexics as well the normal readers. Phonemic awareness problems subsequently to result in difficulties in learning letter–sound correspondences during the process of reading development (Bradley and Bryant, 1983; Liberman & Shankweiler, 1985). Both dyslexics and at risk of dyslexics have difficulties in acquiring word attack skills, decoding skills, and identifying the phonemes, syllables and onset and rime. The most obvious difficulties exhibited by students with reading problems are poor word recognition and weak decoding skills (Chan & Dally, 2001; Bowers, Sunseth & Golden, 1999). The items for the dimension were taken from the
sub skills of the phonological awareness skills mentioned in theoretical and empirical studies. There are fifteen items in this domain indicating the sub skill of the phonological awareness.

**Dimension 4: Deficits in Writing**

Students at risk dyslexia not only have problems with reading alone, they also have difficulties in mastering another literary skill, writing. Hong Kong Education Bureau defines dyslexia as specific learning difficulties in reading and writing irrespective of insufficient learning explorations or any psychosocial deficits. Research findings have also reported the writing problems of at risk of dyslexics. The at risk of dyslexics showed almost as many indicators of writing problems as of reading problems when both writing and reading were assessed. Berninger et al. (2001), Berninger, Abbott et al. (2006), and Berninger, Rutberg et al. (2006) reported that at risk of dyslexics scored below the mean for age-peers on standardized measures of writing. Screening for writing difficulties of dyslexics and at risk of dyslexics was insisted in their research. Students with dyslexia should be screened for writing disabilities also (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008). Therefore, in the ARDST, the sub-scale: deficits in writing was included and consists of fifteen items taken from the relevant studies and the symptoms of at risk of dyslexia listed by the leading organizations in the world conducting research in the field of dyslexia.

**Dimension 5: Co-Existing Problems**

At risk of dyslexic students not only have problems in reading, writing, and phonological awareness tasks, they also have problems in other domains too. The other symptoms of at risk of dyslexia were grouped as co-existing problems in the screening tool. In fact this co-existing deficit discriminates the poor readers from students at risk of dyslexia. From the research findings it was found that at risk dyslexics have problems in the following areas too: Rapid Automatic Naming that causes slow naming of letters, numbers, and pictures, which creates a double deficit (Vellutino, et al., 2004; Shaywitz & Shaywitz, 2001; McCrory, Mechelli, Frith & Price, 2005; Wolf & Bowers, 1999), poor short-term auditory memory (Brady, 1997), reversal of letters or words, or mirror writing (Vellutino, et al., 2004; International Dyslexia Association, 2012; Granet, Castro & Gomi, 2006), attention problem (Swanson, Howard & Sáez, 2006),
difficulties in fine- motor and grass- motor skills for example trouble in handling scissors, rubber, tracing, dressing up, tying up shoe laces, buttoning a shirt, manipulating small objects (building blocks) and, drawing and writing (due to an awkward pencil grip). (Nijakowska, 2010) and deficit in orthographic skills, which are defined as difficulties with letter/number orientation recognition and memory; for example difficulty in remembering names and remembering the alphabet, days of the week, months of the year in a sequential order (Nijakowska, 2010), although these skills may improve with development (Vellutino, et al., 2004; Badian, 2005). Here all the co- existing symptoms of at risk of dyslexia were selected from the relevant research studies. There are fifteen items in this dimension.

3.2.6 Standardization of the Screening Tool

The ARDST is a screening tool developed by the researcher. Pilot testing was done to establish the validity, reliability, norms for interpretation of raw score and scoring procedure towards standardization. The administration procedure for the screen tool was also established.

Pilot Testing

The pilot testing of the screening tool was conducted to establish reliability, validity and the norms for the screening tool. The initial draft screening tool consisted of one hundred (100) items taken from the review of relevant literature and then reduced to seventy five (75) items after establishing the validity and reliability of the screening tool. Therefore, the final tool consists of seventy five items with fifteen (15) items in each of the five dimensions. Forty two teachers participated in the screening process of students at risk of dyslexia. The teachers were selected from the list of schools obtained from the Directorate of School Education, Puducherry which identified the students who had specific learning disabilities under Sarva Shiksha Abhiyan programme in collaboration with National Institute of Empowering Persons with Multiple Disabilities (NIEPMD) and Jawaharlal Nehru Institute of Post Graduate Medical and Educational Research (JIPMER). The teachers were given the screening tool to identify the students who exhibited the symptoms of at risk of dyslexia. The teachers identified one hundred and twenty seven (N =127) primary school students with the symptoms of at risk of dyslexia.
Instruction for Administration of the Tool

The screening tool was developed for the teachers to identify the students at risk of dyslexia studying in the mainstream educational setting because the teachers those spend more time with the students in the academic domain (Snowling & Hulme, 2012, Arun, 2013) and so first notice the problems in students’ reading difficulties. For identification of specific learning disabilities, McKinney and Feagans (1984), and Arun (2013) used teachers’ observation of the students learning problems and used teachers as raters to identify the frequency of symptoms or behaviours exhibited in their learning. In line with these studies, the teacher was chosen to administer the screening tool. But before administering the screening tool, the teachers needed to observe the reading problems of the specific students for a period of one week and then to fill the screening tool. The teacher had to read each item and tick the box that best represented the frequency which a student exhibits the symptoms of at risk of dyslexia. The frequency response choices of the items are never, sometimes, frequently and always.

Scoring

The scores allotted for each response choice was as follows: never = 0, sometimes = 1, frequently = 2, always = 3. The score ranges from zero (0- minimum score) to two hundred and twenty five (225- maximum score).

Validity

Validity of the tool is considered as one of the important processes in the standardization of the tool. Messick (1989) defined validity as “an integrated evaluative judgement of the degree to which empirical evidence and theoretical rationale support the adequacy and appropriateness of inferences and actions based on test scores or other modes of assessment”. Similarly, the Standards for Educational and Psychological Testing (AERA, 1999) defined validity as “the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of the test” (p.9). In simple way the term validity refers to the appropriateness and accuracy of interpretations of test scores. There are different types of validity mentioned in social science research for tool construction but some of the important validity measures are face validity, content validity (i.e., Do the items measure the content they were intended to measure?), criterion-related validity (includes predictive or concurrent
validity (i.e., Do scores predict a criterion measure? Do results correlate with other results?), and construct validity (i.e., do items measure hypothetical constructs or concepts?) (Creswell, 2009).

For the present tool, the researcher established a face validity and content validity for the screening tool. Content validity for the tool was established by getting feedback ratings for the relevancy of the items and appropriateness and accuracy by the subject experts in the field. Content validity judgments require subject matter expertise (Feher, Lea & Lenz, 2010). Therefore six subject experts were chosen; they were 1) Teacher Educator from the Department of Educational Technology, Bharathidasan University, 2) Specific Learning Disability specialist from the Rehabilitation Council of India, 3) Clinical Psychologist from Satya Special school, 4) special educator from NIPMED, 5) Child Specialist Doctor from the NAVODAYA school in Puducherry and 6) Psychologist from the department of Psychology, Pondicherry University. The objectives of the screening tool were explained to them and they rated the items on a four point scale with a response choice of 1) Not relevant, 2) Needs significant revision, 3) Needs minor revision and 4) relevant to estimate the relevancy of each items in the tool. To check the content clarity of the items, the tool was given to teacher, Special educator, teacher educator and head master. The rephrase or refinement or addition or deletion of the screening tool was made on the basis of feedback and suggestions of the experts. The final tool consists of seventy five items with five dimensions.

The revised screening tool was given to the subject experts again to find out the content validity index for the tool. Content Validity Index (CVI) was proposed by Waltz & Bausell (1983) and it is also called as CVI. The experts rate items on a 4-points rating scale with different anchors (not relevant, somewhat relevant, quite relevant and very relevant). The index computation is actually a percentage given by the number of experts that rate quite relevant or very relevant an item. The scoring procedure for the response choices are as follows: Not relevant = 1, somewhat relevant = 2, quite relevant = 3, and very relevant = 4. Item - Content Validity Index (I- CVI) and Scale - Content Validity Index (S- CVI) for the screening tool are as follows:
- Item - Content Validity Index (I-CVI): 51 items have (I-CVI) as one (1) and remaining 21 items have (I-CVI) as 0.833.
- Scale - Content Validity Index (S-CVI): 0.915

In addition, content validity was established through selecting the items from the research and theoretical articles on dyslexia for each dimensions and the items for the screening tool were taken from the symptoms of dyslexia and indicators of at risk of dyslexia reported in the renounced international and national dyslexia, disability and specific learning disabilities associations and organisations such as:

1. International Dyslexia Associations (IDA)
2. Maharastra Dyslexia Association, India
3. Madras Dyslexia Association, India
4. Sarva Shiksha Abhiyan (SSA) – Assessment Guidelines for SpLD (Guidelines on Assessment of CWSN)- Module on Training of Resource Teachers under SSA on Multiple Disabilities
5. Indian Association of Clinical Psychologists (IACP)- Practice Guidelines for the Assessment and Intervention of Specific Learning Disabilities
6. Rehabilitation Council of India (RCI), India
7. National Institute for the Mentally Handicapped (NIMH), India
   i) Grade Level Assessment Device for Children with Learning Problems in Schools
   ii) Educating Children with Learning Problems in Primary Schools
8. National Joint Committee on Learning Disabilities (NJCLD) - LD Online
9. Council for Learning Disabilities (CLD)
10. American Psychiatric Association - Diagnostic and Statistical Manual of Mental Disorders (APA- DSM IV- TR)
12. American Speech- Language Hearing Association
13. Learning Disabilities Association of America (LDA)
14. British Dyslexia Association (BDA)
15. National Center for Learning Disabilities
For example, in the alphabet knowledge dimension, the item: the student has difficulties to differentiate the similar looking letters such as b and d was taken from SSA, IDA, Educating Children with Learning Problems in Primary Schools (NIMH), RCI, etc.,

Reliability

The researcher established the coefficient of reliability using two methods of reliability for the screening tool namely, test- retest reliability and internal consistency reliability. The term reliability is defined as “the consistency of measurements (tests or scales) when the testing procedure is repeated on a population of individuals or groups” (AERA, 1999, p. 25). In simple terms, reliability refers to the stability or consistency of examinees’ relative performances over repeated administrations of the same test or parallel forms of the test” (Crocker & Algina, 1986). The test – retest reliability co-efficient of the screening tool is 0.94. The rational for adopting test – retest reliability was to find out the consistency of the symptoms and characteristics of reading difficulties that the students at risk of dyslexia exhibit over a period of time. The tool was administered twice by the teacher with a one month interval to ascertain the presence of persistent characteristics at risk of dyslexia. Internal consistency reliability was also found out for the tool through adopting Cronbach alpha because the screening tool has a multi-dimensional scale consisting of five dimensions and the items are scored as continuous variables such as never =0, sometimes = 1, frequently = 2 and always =3 (Creswell, 2012). Thus, the internal consistency describes estimates of reliability based on the average correlation among items within a test (Nunnally, 1994). The international consistency reliabilities of Cronbach alpha co-efficient for the screening tool are as follows:
Table 3.T.1. Reliability Co-efficient of At Risk of Dyslexia Screening Tool

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Dimensions</th>
<th>No. of Items</th>
<th>Internal Consistency Reliability - Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alphabet knowledge</td>
<td>15</td>
<td>0.803</td>
</tr>
<tr>
<td>2</td>
<td>Reading</td>
<td>15</td>
<td>0.829</td>
</tr>
<tr>
<td>3</td>
<td>Phonological awareness</td>
<td>15</td>
<td>0.866</td>
</tr>
<tr>
<td>4</td>
<td>Writing</td>
<td>15</td>
<td>0.846</td>
</tr>
<tr>
<td>5</td>
<td>Co- Existing Problems</td>
<td>15</td>
<td>0.856</td>
</tr>
<tr>
<td></td>
<td>Over all scale reliability ( No. of items = 75)</td>
<td></td>
<td>0.963</td>
</tr>
</tbody>
</table>

Norms and Interpretation

The percentile norm was established for the interpretation of raw scores. The term norm refers to the performances by defined groups on particular tests and it is used to provide information about performance relative to what was observed in a standardization sample (Kaplan & Saccuzzo, 2005). Percentile refers to the score or point in a score distribution at or below which a given percentage of scores fall. Percentiles allow us to compare someone’s score with those of others making up a norm group. The percentile norm and interpretation are given below:

Table 3.T.2: Percentile Norm Table for At Risk of Dyslexia Screening Tool

<table>
<thead>
<tr>
<th>Sl.no</th>
<th>Percentile Range</th>
<th>Raw Score Range</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 - 25</td>
<td>68 and below 68</td>
<td>Not at all At Risk of Dyslexia</td>
</tr>
<tr>
<td>2</td>
<td>25 - 75</td>
<td>68- 81</td>
<td>Possibly At Risk of Dyslexia</td>
</tr>
<tr>
<td>3</td>
<td>75 - 90</td>
<td>81- 166</td>
<td>Mildly At Risk of Dyslexia</td>
</tr>
<tr>
<td>4</td>
<td>90 - 100</td>
<td>166 and above</td>
<td>Highly At Risk of Dyslexia</td>
</tr>
</tbody>
</table>

Interpretation

For example, a student’s raw score which falls in the percentile range between zero and twenty five with the raw score ranges from zero to sixty eight means that a student is not at all at risk of dyslexia.
The Screening Tool is a standardized tool which aimed to identify students who are At Risk of Dyslexia in their primary grades. It assists teachers to screen these students from the large number of students based on their day to day classroom observation and provide remedial education to reduce their difficulties in reading at the early stage itself and if necessary send the identified students for further diagnosis.

3.3 Development of Reading Interest Scale

The study examined the effectiveness of multisensory strategic orientation in enhancing the reading performance in English, of students at risk of dyslexia. One aspect of the study is to find the association between interest towards reading and reading performance of these students. The research studies conducted by Stanovich (1986), Taylor, Frye and Maruyama (1990), and Walberg and Tsai (1985) indicated that reading interest has a strong positive relationship with the development of reading performance. Anderson, Fielding and Wilson (1988) found that students’ reading interest is one of the best predictors of a student’s growth in reading. In addition, other research revealed that reading interest was linked and related to vocabulary development and fluency development (Taylor, Frye & Maruyama, 1990; Guthrie & Wigfield, 2000; Stanovich, 1986; Anderson, Fielding & Wilson, 1988). The research studies confirmed that reading interest of the students is linked with their reading achievement (Stansberry, 2009; Grabe, 2003). Therefore it is necessary to develop a tool to measure the reading interest of the students at risk of dyslexia.

The purpose of the Reading Interest Scale (RIS) is to find out interest of the students toward reading at a primary level. According to Thomas (2001), reading interest refers to “how excited an individual is to engage in reading some written material. It can also refer to an individual’s perception of how stimulating or fulfilling reading material can potentially be”. For the construction of the Reading Interest Scale, the researcher adopted a Likert-type rating scale. The tool consists of fifteen items with three response choices. The items for the tool were adopted from Allington (2006), Mariotti (2011) and Larsen (1999).

The pilot testing of the screening tool was conducted to establish reliability and the validity of the tool. The initial draft screening tool consisted of twenty items taken
from the review of relevant literature and then reduced to fifteen items after establishing validity of the tool. The scores allotted for each response choice are as follows: never = 1, sometimes= 2 and always = 3. The tool was pilot tested with the sample of thirty four students studying at primary level. The researcher established face validity for the tool. Face validity is a form of validity in which researchers determine if the test seems to measure what it is intended to measure. Essentially, researchers are simply taking the validity of the test at face value by looking at whether a test appears to measure the target variable. The tool was given to subject experts to validate the items in the tool. The subject experts were from Department of Educational Technology, English language teacher and special education teacher. Based on the suggestions from the subject experts, the tool was further modified. The final version of the tool was administered twice with a one week interval. The researcher established the coefficient of reliability using test-retest reliability. The test – retest reliability coefficient of the screening tool was found to be 0.83.

3.4 Development of Multisensory Strategic Intervention

Based on the Diagnosis of reading problems of students at risk of dyslexia, the researcher developed an intervention to enhance the reading performance in English for these students. The development of the Intervention was elaborated in detail.

3.4.1 Need for Development of Multisensory Strategic Intervention

It was evident from empirical research studies that dyslexics and at risk of dyslexics have persistent difficulties in learning to read and acquiring reading skills (Foorman et al., 1997; National Reading Panel, 2000; Shaywitz & Shaywitz, 2005; Doyle & Snowling, 2000). For instance, Shaywitz and Shaywitz (2004), Fletcher et al., (1994), and Torgesen, et al. (1999) stated that reading was the most difficult task for the dyslexics and the predominant cause lies in the area of phonological awareness for the dyslexics and at risk of dyslexics (Stanovich & Siegel, 1994; Scanlon & Vellutino, 1997; Morris et al., 1998). Phonological awareness is alertness to the sounds in a spoken language. From the review of relevant studies it was found that the reading intervention through differentiated instruction helped minimize their reading problems and enhanced reading skills of the students who were at risk of dyslexia (Mathes et al., 2005; Fielding, Kerr & Rosier, 2007). Thus, the studies reviewed suggested that these
students were to be taught different strategies to learn to read through reading interventions to develop the reading skills. In addition, the empirical studies confirmed that effective reading strategic interventions minimized the problems in learning to read and improved their reading achievement of the dyslexics and students at risk of dyslexia (Krishnan, 2012; Kulkarni & Karande, 2005; Torgesen, et al., 1999; Lonigan, et al., 2003; Ramaa, 1985). For example, the studies by Oakland (1998) and Duff (2008) revealed that the dyslexics who received differentiated reading intervention significantly improved their reading performance when compared to their counterparts who were taught through the traditional method of teaching.

Through reviewing the previous research studies, the researcher of the present study found that there was abundant of reading interventions to teach the dyslexics. But most of the reading strategies were developed for the dyslexics and at risk dyslexics in the monolingual context (Nijakowska, 2010). The sample for the present study was at risk of dyslexics who were bilingual students where their mother tongue is Tamil. So, there was a need to develop an appropriate strategic intervention to develop their reading performance in English based on their reading needs. From the review of relevant studies, the researcher identified that the multisensory instruction as one of the best approaches to teach reading to the struggling readers. There was abundant of research to substantiate the statement (Jeyasekaran, 2015; Ramaa, 1985; Joshi, et al., 2002; Oakland, et al., 1998; National Reading Panel, 2000; Giess, 2005). Multisensory instruction has its roots in the Orton-Gillingham (O-G) Approach (Gillingham & Stillman, 1997) and is the basis for numerous reading interventions for dyslexics (Colony, 2001). In this context, “multisensory” refers to the use of the visual, auditory, and kinaesthetic senses (VAT) in the remediation of reading disability. Multisensory instruction is a type of reading intervention that was used successfully with individuals of all ages (Guyer & Sabatino, 1989; Oakland, et al., 1998; Joshi, Dahlgren, & Boulware-Gooden, 2002). The term strategy was defined in many ways based on the field of research. Initially the term was used in military and originated from it, and was commonly referred to as winning strategies in the war field. In the context of learning, Rubin (1975) defined strategies as “the techniques or devices which a learner may use to acquire knowledge” (p.43). An another definition by Wenden (1987) defined strategies as "any sets of operations, steps, plans, routines used by the learner to
facilitate the obtaining, storage, retrieval, and use of information" (p. 19). According to Oxford and Crookall (1989), strategies can be operationalized as learning techniques, behaviours, and problem-solving or study skills that enhance learning more effectively and efficiently. From literature reviews it was found that other terminologies like tactics (Seliger, 1984) and techniques (Stern, 1992) were synonymously used to refer to strategy. When it comes to the context of language learning or acquisition, it was referred to as language learning strategies. According to Stern (1992), "the concept of language learning strategy is dependent on the assumption that learners consciously engage in activities to achieve certain goals and learning strategies can be regarded as broadly conceived intentional directions and learning techniques." Research has shown that learners can be trained to use appropriate reading strategies to improve their reading performance and comprehension (Carrell et. al., 1989). Thompson & Rubin (1993) found that attempts to teach students the use of these language learning strategies (called strategy training or learner training or strategy orientation) have produced good results. Therefore, the investigator of the present study developed a strategic intervention integrating multisensory approach and technology for the students at risk of dyslexia to improve their reading performance in English.

In the process of developing multisensory strategic intervention, the researcher identified the essential components that need to be the part of the reading intervention. The components for reading intervention were taken from the review of relevant studies (see review table in chapter 2). In addition, the components were also selected based on the present sample's area of difficulty in learning to read in the English language. The information was gathered through diagnosing the reading difficulties of students. The collected information was utilized for the development of the multisensory strategic intervention.

It was evident from the empirical studies that at risk of dyslexics and dyslexics had the ability to learn to read like normal readers but they required differentiated instruction to acquire reading skill (National Reading Panel, 2000; Torgeson, 2002; Scammacca, et al., 2007). Therefore, based on the reviews and the theories, the researcher developed the multisensory strategic intervention for these students to enhance the reading performance in English of students at risk of dyslexia. In the
process of developing the multisensory strategic intervention, the researcher adopted the principles and guidelines of instructional design. The next section provides a brief introduction about the instructional design and its application for the development of the multisensory strategic intervention for enhancing reading performance.

### 3.4.2 Instructional Design for Developing the Multisensory Strategic Intervention

The term instructional design refers to the systematic step-by-step procedure to develop instructional materials in a consistent and reliable fashion to facilitate learning in the most effective way. The terms instruction design (ID) and instruction system design (ISD) were used interchangeably (Reigeluth, 1983; Gustafson & Branch, 2002; Seels & Glasgow, 1998; Schrock, 1995). Instruction is a systematic procedure of teaching and learning activities where learning is structured. According to Gagne and Briggs (1974) an instructional design supplements learning by incorporating various strategies into courseware. Moreover, it is the application of theory to create effective instruction (Reigeluth, 1999; Jonassen, 2004). In addition, it is also referred to as a framework to develop lessons or modules that (Merrill, Drake, Lacy & Pratt, 1996):

- facilitate learning.
- makes acquisition of knowledge and skill more efficient, effective, and appealing.
- encourages participation of learners so that they learn faster and gain deeper levels of understanding.

In short, instructional design can be adopted as a process to create effective and efficient learning material. Indeed, the integration of instructional design helps to develop effective instructional materials which focus on facilitating individual learning, used for producing educational and training programs.

An instructional design (ID) model provides a procedural framework for the systematic production of instruction. The model is a representation of an idea, concept, process, etc. Hence, the instructional design model is a representation of a view on how people learn which acts as a guideline for the instructional designer to create
instructions. Gustafson and Branch (2002, p.1) stated that “models help us to conceptualize representations of reality”; and that “models explain ways of doing”.

The Instructional Design (ID) model incorporates the fundamental elements of the instructional design process which includes the analysis of the intended learner and determination of educational objectives. It advocates how combinations of instructional strategy components should be integrated to produce a course of instruction (Braxton, Bronico & Looms, 1995). In the words of Morrison, Ross, Kemp, and Kalman, (2010), “Instructional design models provide a systematic approach of implementing the instructional design process for a specific educational initiative”.

ADDIE was one of the instructional design models which was fundamental (Gustafson and Branch, 2002) for all Instructional System Design (ISD) and it represents the supreme model among all ISD models. The abbreviation ADDIE is an acronym for Analysis, Design, Development, Implementation and Evaluation.

Rationale for adopting the ADDIE Model

The most commonly used model to create instructional materials is the ADDIE model which was developed by Royce in 1970 (as cited in Sommerville, 1989, p. 7). The acronym ADDIE stands for the five steps that represent a dynamic, flexible guideline for building effective training and performance support tools.

Figure 3.F.1: Diagrammatic Representation of ADDIE Model.
- Analyze - analyze environment, learner characteristics, tasks to be learned, etc;
- Design - develop learning objectives, choose an instructional approach;
- Develop - create instructional or training materials;
- Implement - deliver or distribute the instructional materials;
- Evaluate - make sure the materials achieved the desired goals.

Most of the modern instructional design models were further development of the ADDIE model (Dick, Carey & Carey, 2005). ADDIE model provides an entire instructional design method with carefully planned built-in activities and feedback. It can be utilized as an efficient tool for creating various educational training packages as well as other learning materials. The ADDIE model follows an Input-Process-Output paradigm (abbrev. IPO) which supports guided learning for the construction of knowledge in a shared learning environment. The common instructional design procedures organized by ADDIE are represented diagrammatically in figure 3.F.1:

**Figure 3.F.2: ADDIE Model of Input-Process-Output Paradigm**

![ADDIE Model of Input-Process-Output Paradigm](source: Beck and Schornack, 2003)

ADDIE adopts an Input-Process-Output (IPO) paradigm as a way to complete its phases. The input phase reacts to the variables identified in the learning context by accepting data, information, and knowledge. The sources of the inputs were adopted from within or outside the system. The design using this model therefore analyses the sources of the inputs (people, knowledge, materials, energy, etc.). The process (identifying needs, resources, delivery mechanisms, interactions, navigations, structuring etc) phase seeks ways to stimulate creative and divergent thinking by utilizing procedures, to interpret, explain, configure, and display multiple approaches to events that are likely to occur in learning. It refers to the process of transforming the inputs to outputs or product (Learning materials, resources, experiences, environments etc). The outputs are the end product of the processing the inputs.
The ADDIE model offers an efficient tool to plan, implement and evaluate the teacher’s instructions. Carr-Chellman (2014) stated that it is a “process by which instruction is created for classroom use through a systematic process of setting goals, creating learning objectives, analyzing student characteristics, writing tests, selecting materials, developing activities, selecting media, implementing and revising the lesson.” (p. 3). From the teacher’s perspective, instructional design is a disciplined approach to designing learning situations in a classroom, helping to focus the teacher’s efforts specific learning goals that are then supported by appropriate objectives, tests, technology and activities. Its main goal is to help students achieve the desired learning outcomes. (Carr - Chellman, 2014). ADDIE is the line of best fit for the development of multisensory strategic intervention to improve the reading performance of students at risk of dyslexia.

Development of Multisensory Strategic Intervention based on ADDIE Model

In this section, the process of developing the multisensory strategic intervention for reading development for students at risk of dyslexia is based on the principles of ADDIE model described in detail.

Diagnosing the reading difficulties of students at risk of dyslexia

In this phase, the researcher identified the reading problems of the students at risk of dyslexia. To identify the areas of reading difficulties of students, the researcher administered a diagnostic test. Reading was the prime difficulty for students at risk of dyslexia (Torgesen, et.al.1999; Fletcher, et.al. 2002; Snowling & Hulme 2011). Therefore the researcher took cognizance of their predominant area of difficulty in reading.

Initially the diagnostic test was administered individually to the students at risk of dyslexia to identify the problems in oral reading. Two passages in English were given to the students to read. The passages were selected from the III standard text book. Each student at risk of dyslexia was instructed to read the passages loudly. Each student reading was observed by the researcher for five minutes and the errors marked in reading. The number of words read correctly by the students was noted. From the reading performance of the students, the researcher found that the students were found
making errors in oral reading in English. The reading errors committed by students were mispronunciation, missing words and phrases, missing affixes, misreading a word for another word and frequent errors in reading sight words. It was evident from the diagnostic test that the students at risk of dyslexia require a strategic orientation in oral reading to enhance their reading fluency.

There was a plethora of research evidence that emphasised the significance of teaching reading fluency to students at risk of dyslexia (Breznitz & Share, 1992; Young & Bowers, 1995; Torgesen et al., 1999; Meyer & Felton, 1999; Wolf & Bowers, 2000). Therefore the researcher included a reading fluency component in the development of strategic intervention to enhance the oral reading fluency to minimize reading errors. In addition to this, Stevenson and Newman (1986), Adams (1990), Lonigan (2006) and Kim, et al., (2010) stated that alphabet knowledge and phonological awareness were the fundamental components for the development of reading skills which were also signs to identify students at risk of dyslexia.

The students were also diagnosed in alphabet knowledge which comprised of recognition of letters, name of letters and sound of letters, and phonological awareness test including rhyme awareness and phonemic awareness. The students were also diagnosed a second time to check the consistency in their reading performance. From the diagnostic test the researcher noted that there were inconsistencies in reading performance of the students at risk of dyslexia in alphabet knowledge, phonological awareness and oral reading fluency. The scores secured by these students in diagnostic test 1 and diagnostic test 2 were tabulated in table 4.T.1 (chapter 4). The researcher took cognizance of all their reading problems faced by the students at risk of dyslexia and identified the components of reading that needed to be included in the development of the multisensory strategic intervention to enhance their reading performance in English.

3.4.3 Rationale for Selecting the Components that Affect Reading Performance

Reading is a skill which is composed of many sub-skills, to improve the students’ reading performance. The reading intervention was set to focus on developing the sub-skills as a pre-requisite to reading namely, alphabet knowledge and
phonological awareness. From the diagnostic test, the researcher identified the areas of reading difficulties of the students at risk of dyslexia. The students had difficulties in the areas of alphabet knowledge, phonological awareness, word recognition and fluency. The predominant area of difficulty for students at risk of dyslexia lie in the domain of phonological awareness (Vellutino et al., 2004; Carroll & Snowling, 2004). The identified components and its teaching strategies were substantiated through the related studies.

Researchers namely Torgesen, et al. (1997) and Vellutino, et al. (2004) stated that the phonological awareness was the core deficit area for dyslexics. Ehri et al., (2001) and Shaywitz, & Shaywitz (2003) confirmed that phonological awareness foretells reading success at a later stage in an individual (Helen, Smith & Connors, 2007) and predominant skill in the process of learning to read (Share, 1995; Adams, 1990). Therefore phonological awareness is one of the elements in the remedial intervention for all children including at risk of dyslexia. On the contrary, researchers namely Beck & Juel (1995) argued that training in phonological awareness task alone was not sufficient for the development of reading performance (Bus & Van Ijzendoorn, 1999; Ehri et al., 2001; Harm, McCandliss, & Seidenberg, 2003; McCandliss, Beck, Sandak & Perfetti, 2003; Torgesen, 2005; Snowling & Hulme, 2011). In addition to phonological awareness training, dyslexics need to be given training in other components of reading (Foorman et al., 2003; Griffin, Burns & Snow 1998; Hatcher et al., 2006; Cunningham, 1990; Stuart, 1999). Blachman, Tangel, Ball, Black, and McGraw (1999) found that students who received a combination of phonological awareness, letter-naming, and letter-sound training developed their reading performance than their peers who received training in phonological awareness task alone (control group). Hence, the investigator of the present study took cognizance of the input gained from these research studies and incorporated these suggestions in the development of strategic intervention for the students at risk of dyslexia. Therefore, other components and pre-requisite skills of reading were also considered to develope reading intervention for the struggling readers.

Torgesen, Rashotte, Alexander, Alexander and MacPhee (2003) suggested that the reading fluency was essential to increasing the rate at which text is translated into
spoken language. Fluency refers to reading words in passages in a flowing, accurate, quick, and expressive manner. Carnine et al. (2004) and Chard (2000) recommended that fluency training through repeated reading and guided reading for about 15-20 minutes on oral reading passages should be incorporated in daily lessons till students attain the expected level of reading accuracy and rate (Rasinski, 1990; Koskinen & Blum, 1986; Chard et al., 2002). The investigator took these insights into account on the importance of training in oral reading fluency and hence the fluency was another component of reading in the development of intervention to the students at risk of dyslexia.

It was evident from the empirical studies that the instruction at the phonological level combined with alphabet knowledge (Bailet, et.al., 2009; Vellutino, et. al., 2006; Justice, et, al., 2003; Whiteley, Smith & Connors, 2007; Moore & Hammond, 2011) supported the development of word recognition skill which improved the oral reading fluency of at risk of dyslexics. In addition reading requires the memorization of phonemes, sight words and high frequency words in order to decode texts (Gunning, 2009, as cited in Ureno, 2012). Another pivotal problem for dyslexics is accuracy in reading, fluent word recognition (Stanovich, 1988; Coltheart, et al., 2001). Orientation in all these reading components leads to the development of reading performance of the students.

In addition, the components of reading were selected, based on reading difficulties faced by the students of the present study in learning to read. In order to identify the problems encountered in learning to read, the diagnostic tests was administered to the students. The diagnostic test focused on identifying the areas of reading difficulties of these students. The students were tested on alphabet knowledge, phonological awareness and oral reading fluency. After the first diagnostic test, the same diagnostic test was administered to these students the next day. The average scores of these students secured in diagnostic test 1 and 2 are given in the table 3.T.3.
Table 3.T.3: Mean Scores of the Students At Risk of Dyslexia in Diagnostic tests

<table>
<thead>
<tr>
<th>Components of Reading</th>
<th>Diagnostic Test 1</th>
<th>Diagnostic Test 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alphabet Knowledge</td>
<td>18.25</td>
<td>15.09</td>
</tr>
<tr>
<td>Phonological Awareness</td>
<td>8.31</td>
<td>6.65</td>
</tr>
<tr>
<td>Oral Reading fluency</td>
<td>31.34</td>
<td>24.90</td>
</tr>
</tbody>
</table>

From the table 3.T.3, it is evident that the students reading performance in all the three components of reading was low. There exist inconsistencies in their reading performance which indicates the students had difficulties in alphabet knowledge, phonological awareness and oral reading fluency. The first two components of reading were pre-requisite skills for reading. Hence, the researcher designed a multisensory strategic intervention focussing on alleviating their reading difficulties in the component of reading.

3.4.4 Selection of Reading Strategies for Developing Reading Performance

Research studies have stated the predominant reading components and its teaching strategies (see conceptual framework chapter) that need to be integrated in teaching reading skills to the students at risk of dyslexia. The following reading components and its teaching strategies were taken from the review of related studies and incorporated in the model development for the present study:

Table 3.T.4: Components of Reading and its Teaching Strategies

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Components of Reading and its Teaching Strategies</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Phonics</strong>: Teaching the alphabetic principle i.e. the sound of the alphabets which help the students to establish the grapheme (letter) – phoneme (sound) association.</td>
<td>Ehri (2013), Adams (1990), Oakland, et al., (1998), Mann &amp; Wimmer, (2002)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Letter Tracing</strong>: Tracing the shape of the alphabets in air, hand and sand with index and middle fingers. Letter tracing helps the students to recognize the shape of the alphabet.</td>
<td>Ott (2007), Oxford (1990), Metsala &amp; Ehri, (2013).</td>
</tr>
<tr>
<td>3</td>
<td><strong>Sound Articulation</strong>: Teaching how to pronounce the sound of the letters and practicing the sound of the alphabets.</td>
<td>Wise, Ring &amp; Olson (1999) Wise, Ring, Sessions and Olson (1997)</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
</tr>
</tbody>
</table>

### Phonological Awareness

| 7 | **Rhyming Awareness**
Rhyme Recognition: Identifying the rhyming words in a set of words.
Rhyme Generation: Producing rhyming word that rhymes with other words.
|---|---|---|
| 8 | **Phonemic Awareness**
**Phoneme Isolation**: Recognizing individual sounds in a word.
**Phoneme Identification**: Recognizing the same sounds in different words.
**Phoneme Categorization**: Recognizing the word in a set of three or four words that has the “odd” sound.
**Phoneme Addition**: Making a new word by adding a phoneme to an existing word.
**Phoneme Substitution**: Substituting one phoneme for another to make a new word.
<table>
<thead>
<tr>
<th></th>
<th><strong>Sound sorts</strong>: This strategy is used to help children pay attention and cue in to the sounds in words by asking them to distinguish between words with the same sounds and words with different sounds, and to categorize the words. <strong>Sound-matching</strong> activities help students learn to listen to words in order to hear if they begin or end with the same sound.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Word Recognition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td><strong>Configuration</strong>: Recognizing the shape of the words.</td>
<td>McClellan (1977), Larson (2004).</td>
</tr>
<tr>
<td>10</td>
<td><strong>Analogy</strong>: Using known words or part of words to identify the unknown words.</td>
<td>(Barone, Hardman, &amp; Taylor, 2006), Goswami (1998), Morrow &amp; Morgan (2006)</td>
</tr>
<tr>
<td>11</td>
<td><strong>Flashcard</strong>: A word printed on an index card, with the aim of recognizing it within a specific time period.</td>
<td>Ehri (2002), Share &amp; Stanovich (1995), Metsala &amp; Ehri (2013).</td>
</tr>
<tr>
<td>13</td>
<td><strong>Decoding</strong>: letter – sound correspondence are used to sound out letters and blended together to pronounce a word.</td>
<td>Caldwell &amp; Leslie (2009) Barone et al., (2006)</td>
</tr>
<tr>
<td><strong>Oral Reading Fluency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td><strong>Neurological Impress</strong>: A student and a teacher read the same text together sitting side-by-side, the teacher reads the passage on the ears of the student in a slow and low tone together that the student follows the reading with her / his figure on the text and reads along with the teacher.</td>
<td>Flood, Lapp and Fisher (2005), Baştug &amp; Kaman (2013). Oladele (2013).</td>
</tr>
<tr>
<td></td>
<td><strong>Choral reading</strong>: reading aloud in unison with a group of students. After hearing the teacher read, the students reread the text together.</td>
<td>McCauley &amp; McCauley (1992)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>17</td>
<td><strong>Echo reading</strong>: A rereading strategy assist the students to develop expressive and fluent reading in which the teacher reads a short segment of text (phrase or sentence), and the student echoes back the same phrase or sentence while following along in the text.</td>
<td>Ellis (2009), Kuhn and Paula (2008)</td>
</tr>
</tbody>
</table>

All the listed components of reading and reading strategies were incorporated in the process of developing a reading strategic model integrating multisensory approach and technology to enhance the reading performance in English of students at risk of dyslexia.

### 3.4.5 Development of Reading Strategy Model to enhance the Reading Performance at Primary Level

The reading strategic model was developed after going through the various strategies and components of reading suggested in different studies for the development of reading. The investigator identified and organized the reading strategies and techniques that have contributed positively to the teaching-learning process for the development of the reading performance of students at risk of dyslexia.

The objective of developing the reading strategic model was to improve the reading performance in English of students who are at risk of dyslexia. The identified reading components and its teaching strategies were schematically represented in the Input-Process-Output design of figure 3.F.3 as follows:
Appropriate technologies were utilised as a supplementing device in the teaching learning process in the strategic orientation. There was abundant of research studies that substantiated the statement ‘technology was used as a supplementing device to improve the reading performance of students with dyslexia and at risk of dyslexia’ (Nicholson, Fawcett & Nicholson, 2000; Magnan & Ecalle 2006; Ecalle, Magnan, Bouchafa & Gombert, 2009; Segers and Verhoeven, 2005; Kast, 2011). It was also emphasised that integrating technology and multisensory techniques in teaching learning process improved the reading performance of the students at risk of dyslexia (Wise, Ring & Olson, 1999; National Reading Panel, 2000; Van Daal & Reitsma, 2000; Saine, et al., 2011).

The model illustrates how the inputs were imparted through multisensory techniques and reading strategies to develop the reading performance of students at risk of dyslexia. The following techniques are interlinked with the reading strategies in the treatment.
The learning processes of normal students depend on the normal function of sensation, attention, perception, imagery, symbolisation and conceptualisation. In case of at risk of dyslexics or dyslexia, many research insights consistently highlighted the problems in the involvement of the sensation towards learning. The sensation towards learning comprises sensory involvement like, vision and auditory (seeing and hearing), tactile (touching), and kinaesthetic (movement), olfactory (smelling) and gustatory (tasting). The students at risk of dyslexia have abnormal functions in one or more than one sensation component, specially the reading problem due to the abnormality in seeing, hearing, touching and movement. It does not mean the dyslexics are a combination of hearing, visual or orthopaedic impairment. Dyslexia is a hidden disability due to minimal brain dysfunction rather than a physical disability. In the past decade, abundant research findings stressed Multisensory techniques of teaching feed academic nourishment to dyslexics. The following were the multisensory techniques recommended for dyslexic students for integrating the curriculum in classroom teaching.

- Visual Techniques help the student to learn through seeing for better eye contact. Using picture or text cards, videos, models, computers, and flash cards enhances the visual contact. (Diana, 2002).

- Auditory Techniques help students learn through sound and stimulate verbal conversation. It includes the strategies such as, auditory trainers and peer assisted reading, video, song, speaking, rhymes, chants, and language games (Praveen, 2010).

- Tactile Techniques help the student to learn through a sense of touch. It includes strategies such as using small objects, use of modelling materials like clay and sculpting materials, to create models to develop fine motor skills (Praveen, 2010).

- Kinaesthetic Techniques involves the learners body movement to stimulate learning. Strategies like, Clapping, foot stomping, or any other movement combined with activities like counting or singing learning-songs are involved to enhance the fine and gross motor movement at early stages of education. (Praveen, 2010).
Multisensory methods not only enhance the academic performance but also successfully integrate curriculum in the classroom teaching learning processes. One more effective strategy was equivalently helpful for academic enrichment of student at risk of dyslexia is the Scaffolding Technique. The practice of providing enough assistance (not too much or too little) to help students succeed is called scaffolding, Meichenbaum and Biemiller (1998). It provides guidance and assistance for the poor performer in learning activity. Therefore, Multisensory technique provides a permanent solution to the academic problems of dyslexics and scaffolding provides guidance to improve learning whereever it is assumed to be intervened. Many forerunners on the dyslexic’s research recommended that diverse learning experience enhances the reading ability as well as in other academic areas. It was suggested that ‘One size does not fit all’. A combination of strategies in the classroom teaching enhances the learning behaviour of the special needs learner. So the researcher in the present study designed an innovation strategy by combining multisensory techniques and scaffolding techniques supplemented with technology to enhance the reading of students with dyslexics.

After identifying the techniques and reading strategies, it was organized to meet the demands to develop reading performance in English of students at risk of dyslexia. Based on the opinion of the experts in the field and the empirical evidence, a multisensory reading strategic model was developed by the researcher. It is believed that the components of reading can be oriented through this model to enhance the reading performance of students who are at risk of dyslexia.

Development of Model Lesson Plan

Based on the analysis and design phases, the researcher developed a multisensory strategic intervention to enhance the reading performance of students at risk of dyslexia. The objectives of the multisensory strategic orientation and model lesson plan were evolved and discussed in detail in this phase.

Objectives of the reading strategy model

The students at risk of dyslexia were expected to achieve the following objectives at the end of the strategic orientation of reading. The objective statements
were framed on focusing the development of reading performance in English of students at risk of dyslexia. The following were the objectives:

The students will be able to

i) acquire knowledge of alphabets.
ii) apply the knowledge of phonological awareness to read a word.
iii) read high frequency words
iv) pronounce words by applying word decoding strategies
v) develop fluency in oral reading.

Sample Lesson Plan

Subject: English
Standard: III

General Objectives: The students will be able to acquire the knowledge of reading skills.

Specific Objectives: The students will be able to:

i) recognize the shapes of the alphabets.
ii) recall the names of the alphabets.
iii) pronounce the sounds of the alphabets.
iv) understand the letter (grapheme) - sound (phoneme) relationship.
v) recite the alphabets in a sequential order.
vi) identify the rhyming words.
vii) generate the rhyming words.
viii) identify the high frequency words.
ix) read the text aloud correctly.

Teaching Aids: Text, Animated Videos, Audios, Blackboard, Textbooks, Worksheets and Flash Cards.

Motivation: The instructor will motivate the students to make them ready to learn (learning readiness) through telling alphabet stories and doing brain gym activities.
Lesson Outline:

Instruction in Alphabet Knowledge for 20 Minutes: The instructor will introduce the alphabets “a” and “b” through animated video and text. The shapes of the letters and its different forms (upper case and lower case letters) will be explained to the students. The instructor will teach how to pronounce the name and sound of the alphabets supplemented with animated video and audio. The instructor will provide the model pronunciation of the name and the sound of the letters and students will repeat the same. The students will be made to visually see the alphabet, hear the sound of the alphabet and trace the shapes of the alphabet through their hands and the sands through using their index and middle fingers. The instructor will narrate a story of the alphabets “a” and “b”. The students are made to hear the story of the alphabets and repeat the same, and practice the name and sound of the alphabets. The instructor and the student will participate in the alphabet games, finding the names of their friends and objects that start with the letter “a” and “b”. The students will complete the worksheets with the help of the instructor.

Instruction in Rhyming Awareness for 15 Minutes: The instructor will explain the pattern of rhyming words to the students. The instructor will sing a poem which contains rhyming words. The student shall be made to listen to the recitation of a poem and recite along with the instructor with actions and expressions. The examples of the rhyming words will be taught to the students. The instructor will ask the students to identify an odd word in the presented stimuli and match the rhyming word with its pair in the worksheets.

Instruction in Word Recognition for 10 Minutes: The instructor will introduce the high frequency words through using flash cards. The student will be made to hear the pronunciation of the words and repeat the words along with the instructor. The instructor and the students will spell out the words together and trace the spelling of the words with their hand by using their index and middle fingers. The students shall be made to recognize shape of the letters in the word and fill the letters of a word in a configuration box. They shall also be made to follow the instructor in reading the sentences loudly which contain the high frequency words.
**Instruction in Oral Reading Fluency for 15 Minutes:** The instructor will provide model reading of a text passage. The student shall be made to hear the model reading of the text passage given by the instructor. They are made to rehearse the reading passage alone as followed by the instructor.

**Homework:** The students will be given home assignments.

### 3.4.6 Empirical Symbiotic Validation of the Reading Strategy Model at Primary Level

The reading strategy model focuses on developing reading performance of at risk dyslexics through providing orientation in the four components of reading, namely alphabet knowledge, phonological awareness, word recognition and oral reading fluency. These four components play a pivotal role in the development of reading skills in English at early stages of reading acquisition. Research studies reported that students with dyslexia and at risk dyslexics have difficulty in acquiring alphabet knowledge (Adams, 1990; Scarborough, 1990; Muter, Hulme, Snowling & Taylor, 1998) and phonological awareness skills (Stanovich & Siegel, 1994; Fletcher et al., 1994; Scanlon & Vellutino, 1997; Torgesen, Wagner, & Rashotte, 1997; Morris et al., 1998; Foorman et al., 1997; Shaywitz et al., 1999; Shaywitz 2003; Bus & Ijzendoorn; Ehri et al., 2001; Vellutino, et al., 2004). It was evident from the research studies in the field of dyslexia that students with dyslexia need to be provided intensive training in developing the alphabet knowledge and phonological awareness skills in order to minimize their reading difficulties and to improve their reading skills.

The students with reading disabilities should be given explicit instruction in phonological awareness skills (Smith, Simmons, & Kameenui, 1998). Training provided in phonological awareness helps enhance reading skills of dyslexics (Schneider, Kuspert, Roth, Vise & Marx, 1997; National Reading Panel, 2000; Castles & Coltheart, 2004; Hulme, Snowling, Caravolas & Carroll, 2005). Some research studies emphasized that reading instruction only at the level of phonological awareness was insufficient to develop the reading acquisition of the dyslexics (Torgesen, 2005; Hatcher et al., 1994; Snowling & Hulme, 2011; Beck & Juel, 1995). Dyslexics need to
be taught alphabet knowledge, grapheme - phoneme relationship, along with the phonological awareness skills (Griffin, Burns & Snow, 1998; Foorman et al., 2003).

The alphabet knowledge in English is significant constituent of emergent literacy (Whitehurst & Lonigan, 1998). The alphabet knowledge deals with learner's knowledge of shape, name and corresponding sound of the alphabets. Wagner, Torgesen and Rashotte (1994), McBride-Chang (1999), and Burgess and Lonigan (1998) stated the importance of teaching alphabet knowledge skills to develop the reading performance because it enhances the phonological awareness skills and reading fluency of a child.

Empirical studies revealed that teaching of the name and sound of alphabets improved phonological awareness skills and word recognition (Carroll, 2004; Stahl & Murray, 1994; Johnston, Anderson & Holligan, 1996). Levin et al.’s (2002) study reinforced the hypothesis that knowledge of letter-sound association of alphabets helped students in word recognition tasks. Thus, it was evident from these research studies that alphabet knowledge is a prerequisite skill for learning other components of reading.

For word recognition, a student uses a various strategies to read a familiar word, all of which require the mastery of alphabet knowledge (Ehri, 2003). For reading an unfamiliar word, a student makes use of decoding strategy which requires knowledge of letter-sound association to recall the sound of each alphabet and then blend the sounds into words. Therefore, alphabet knowledge is one of the fundamental skills to develop word recognition skill. Ehri (2003) and Perfetti (1992) studies revealed the significance of the knowledge of grapheme (letter) - phoneme (sound) relationships to recognize sight words from memory.

The empirical study by Blachman (2000) revealed that phonological awareness intervention was more effective when combined with instruction in alphabet knowledge tasks for the enhancement of reading performance. There was plenty of research evidences that stated the close association between alphabet knowledge and phonological awareness skills in reading acquisition (Kim et al., 2010; Blair & Savage, 2006; Foy & Mann, 2006; Carroll, 2004; Gunning, 2009).
Phonological awareness skills and knowledge of the alphabet are predominant predictors of later reading achievement. These two skills were the necessary precursor for recognition of sight words and decoding of words. Research studies emphasised the significance of providing training in alphabet knowledge and phonological awareness to develop reading skills of students with dyslexia at early stages of reading (Lonigan, Schatschneider & Westberg, 2008; Tunmer, et al., 2006; National Reading Panel, 2000; Honig, 1996; Adams, 1990; Riley, 1996). The research studies revealed that:

- The instruction in phonological awareness skills is a necessary part of learning to read which acts as a foundation for the phonics skills necessary for becoming a proficient reader at the primary level (Lonigan, Burgess, and Anthony, 2000).
- Alphabet knowledge helps promote phonological awareness skills and understanding the sound-symbol associations of alphabets (Hammill, 2004; Storch & Whitehurst, 2002; Hohn & Ehri, 1983).
- Phonological awareness and alphabet knowledge work together to facilitate sight word reading (Ehri, 2005).
- Proficiency in sight word reading enhances reading fluency (Cunningham & Allington, 1999).

Hence, it was evident from these research studies that instruction in alphabet knowledge, phonological awareness, word recognition and reading fluency enhanced the reading performance of all readers including students who are at risk of dyslexia. Based on these research studies, the reading strategic model was validated symbiotically.

This chapter described the construction and validation of research instruments for the present study. The next chapter deals with the methodology adopted for the present study.