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Dyslexia, Dysgraphia and Dyscalculia: A Response to Intervention Approach to Classification

Charles Potter

Abstract

This chapter provides a model for classification of dyslexia, dysgraphia and dyscalculia through analysis of the response of children to treatment. The model is discussed with reference to the types of multivariate treatment applied in a particular programme which works interactively online using an electronic data-base for linking functional difficulties in learning to treatment, and through this to firm diagnosis and classification. In applying the model, initial diagnosis of learning disabilities is treated as provisional, based on functional indicators as well as test data. Firm classification becomes possible through longitudinal assessment, analysis of response to multivariate intervention as well as response to specific programmes. Diagnosis can then be linked both to concessions as well as ongoing treatment.

Keywords: dyslexia, dysgraphia, dyscalculia, reading, writing, spelling, numeracy, working memory, assessment, evaluation, response to intervention, incremental validity; multivariate treatment

1. Introduction

The field of learning disabilities has a long history, stemming back diagnostically over the past century to the work of Hinshelwood [1] and Morgan [2] in the 1890's, and the work of Orton in the 1920's and 1930's with children characterised as "word blind" [3, 4]. Methodologically, it can be traced to the techniques for treating reading, writing and spelling difficulties pioneered by Dearborn [5, 6], Monroe [7], Gates [8], Durrell [9], and Fernald [10], to the application of Orton's theories by Gillingham and Stillman [11] and to the differing conceptualisations of treatment developed by Strauss and Lehtinen in the 1940's [12] and by clinicians such as Cruickshank [13], Ayres [14], Dubnoff [15], Frostig [16], Kephart [17], Getman [18], Kirk [19], Spalding and Spalding [20], Freidus [21], and Johnson and Myklebust [22] in the 1950's and 1960's.

In teaching children to read there has also been intense debate between proponents of phonically based techniques and visually-based methods as summarised in Chall [23], as well as between those who have advocated or rejected the practice of classifying and labelling different types of reading disabilities, as outlined by Elliott and Grigorenko [24]. These debates are ongoing [25].

At this point in time, based on over a hundred years of clinical and academic work in the field, the value of teaching reading using phonologically and phonically based methods at entry point to school and also at foundation level in school has become widely accepted [26–28]. In addition, a number of different types of learning disabilities have been identified [29, 30].

Despite these advances, there is still lack of agreement as to typologies of learning disabilities, as well as to how these apply to children and adults. There is also a lack of consensus as to whether it is better to base diagnosis of learning disabilities on purely functional descriptions of the behaviours associated with how learning disabilities manifest in particular children (using terms such as "backward reading", "specific learning disorder, with impairment in reading", or "specific reading retardation"), or whether it is helpful to also apply a label such as "dyslexia", "developmental dyslexia", "dysgraphia", or "dyscalculia" to children for diagnostic purposes.

This chapter describes a programme which uses a response to intervention model of classification [31–33], working from the standpoint that classifications of learning difficulties are provisional and emergent, with the potential of changing from hypotheses to firm and persistent categories as treatment progresses. The model is based on a process of incremental and treatment validity, in which evidence concerning a child's response to particular procedures or techniques can add to an existing combination of assessment methods [34–36].

The model is then discussed in relation to the methods for assessment and treatment of functional difficulties with reading, writing, spelling and arithmetical concepts applied in the programme. As the difficulties of children are specific and manifest in the context of particular households and school environments, initial functional descriptions of behaviour are used in the programme as the basis for treating learning difficulties associated with difficulties with reading, writing, spelling and numeracy.

The approach to diagnosis and treatment is evidence-based, and described in Potter [37, 38]. Initial assessment provides descriptive information concerning a child's functioning, which is then linked to specific treatment programmes. Firm classification of dyslexia, dysgraphia and dysgraphia is then linked to both ongoing assessment and to progress evaluation linked to indicators of progress to establish effects of treatment, and through this to firm classification as learning disabled [39].

2. Classification of learning disabilities

Lyon et al. [40] suggest that classification research involves forming groups or categories, which can then be evaluated for reliability, validity, and coverage. This implies that all classifications are essentially hypotheses about variables, and the relationships between variables. Classifications applying in the area of learning disabilities thus relate to both variables indicating difficulties as well as variables relating to the treatment of difficulties. Classification researchers then evaluate the reliability, validity, and coverage of hypothetical groupings of both independent and dependent variables relating to both difficulties and treatment of difficulties. This is done by conducting and analysing research on the relationships between these variables, as well as the relationships between variables conceptualised as either dependent or independent [41].

Following this logic, classifications applying in the area of learning disabilities are based on the interrelationships between a wide range of variables based on indicators associated with the learning difficulties experienced by particular children at school. As many types of behaviour are associated with both successful and unsuccessful

performance in particular school environments, it would also imply that it would be unlikely that learning difficulties can be conceptualised as related to a single disability. Instead learning disability would need to be represented as a general category, which is composed of disabilities in any one or a combination of several areas or domains as these apply to the development of particular children [42].

This is the standpoint adopted in the programme described in this chapter, based on the position previously taken by others. In the 1968 federal definition of learning disabilities adopted in the United States, for example, seven domains are identified: (1) listening; (2) speaking; (3) basic reading (decoding and word recognition); (4) reading comprehension; (5) arithmetic calculation; (6) mathematics reasoning; and (7) written expression [30, 43], while Fletcher et al. [44] have suggested that the evidence supports six subgroups of learning disability involving reading (word recognition, fluency, and comprehension), math (calculations and problem solving), and probably written expression. The latter could involve either the generation of text (handwriting, spelling) or composition. Further research would be needed on these written expression components to establish whether these are distinct categories or categories which overlap other forms of learning disability.

Within these domains, the programme described in this chapter focuses on three main subgroups of learning disability:

- Reading disabilities (often referred to as dyslexia)

- Written language disabilities (often referred to as dysgraphia)

- Math disabilities (often called dyscalculia)

Other related categories treated in the programme include disabilities that affect focus and attention, working memory, social skills, and executive functions such as personal organisation and deciding how to approach or begin a task. These difficulties are initially described functionally [37]. This is followed by a process of firmer classification based on analysis of response to intervention to programmes focused on improving functioning and performance in these areas, based on a process of evaluation which is empirical, multimethod and evidence-based [45–47].

3. Functional description of different types of learning difficulties: a response to intervention perspective

A response to intervention instructional model uses intervention as a treatment variable and response to intervention as an indicator of underlying learning disabilities. Firm classification is then based on evidence of learning difficulties which are persistent or resistant to treatment. This is the approach adopted in Dr. Charles Potter's Reading Fluency Programme [48], which is described in this chapter. Given the difficulties inherent in measurement particularly where anxiety and emotion are involved, the programme uses a response to intervention approach in which diagnosis can be emergent, based on evidence from both response-to-intervention (RTI) and norm-referenced ability testing collected over time [49].

Since difficulties with reading, writing and/or math are recognisable problems during the school years, the signs and symptoms of learning difficulties in a particular school programme form the point of departure for treatment. Functional description of different types of learning difficulties forms the basis for establishing treatment programmes. Response to intervention then provides the basis for classification as learning disabled.

Learning disabilities are thus initially defined as functional difficulties, based on evidence of unexpected underachievement in a child relative to the achievement which would be typical of other children in a particular school or learning environment. Indicators of unexpected underachievement are used at the outset to describe the difficulty, based on inability to respond to the instruction which is benefitting other children. The definition would also include other functional indicators of learning difficulties, such as ratings or test scores indicating reading, writing and spelling difficulties or difficulties with number concept and mathematical problem-solving, and would also include ratings or test scores indicating neurological markers and signs, as well as unevenness in cognitive functions.

A firm classification as learning disabled would then be based on evidence of difficulties persisting both during as well as after treatment based on longitudinal, incremental assessment and evaluation [50, 51] as outlined in **Table 1**.

The model in **Table 1** is a generic one which can be applied by others. How this has been applied in practice is described in the rest of this chapter with reference to a particular programme applying specific methods of assessment and treatment in a particular country context. As there are a number of different variables which can affect the development of reading, writing and spelling, the methods and materials used with each child vary, based on initial assessment to identify areas of strength and difficulty, as well as specific areas requiring intervention.

Intervention then takes place to address the variables related to the areas of difficulty. As this takes place, firm diagnosis and classification of learning disability
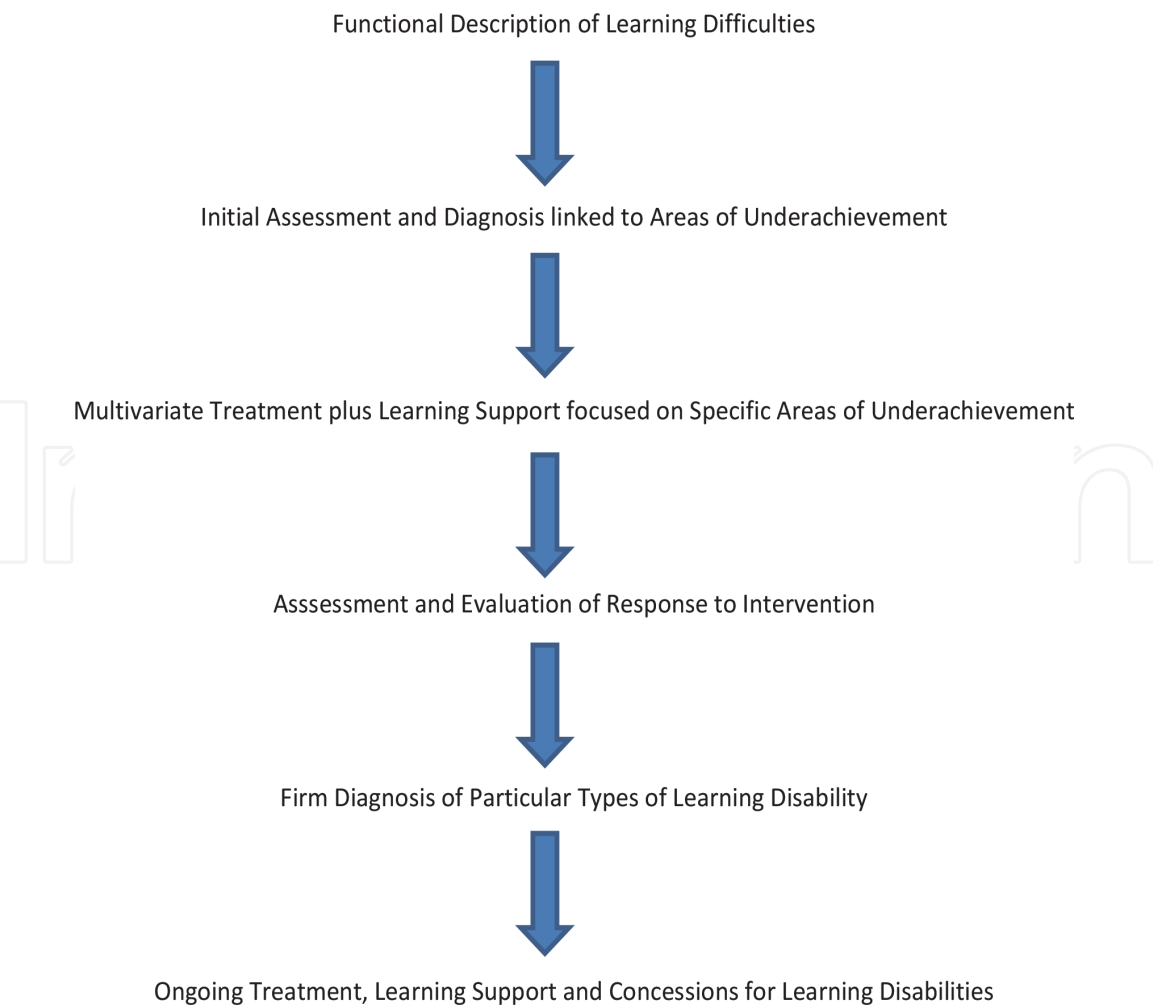
Functional Description of Learning Difficulties

⬇

Initial Assessment and Diagnosis linked to Areas of Underachievement

⬇

Multivariate Treatment plus Learning Support focused on Specific Areas of Underachievement

⬇

Asssessment and Evaluation of Response to Intervention

⬇

Firm Diagnosis of Particular Types of Learning Disability

⬇

Ongoing Treatment, Learning Support and Concessions for Learning Disabilities

Table 1.
Classification of learning disabilities based on response to intervention.

then becomes possible, based on assessment linked to ongoing assessment and progress evaluation of the effects of multivariate treatment, based on use of particular types of methods and materials. Classification as learning disabled can then be linked to concessions to compensate for the areas of difficulty which have been demonstrated to be resistant to particular forms of treatment, as well as to ongoing treatment and learning support.

4. Initial assessment: focus on functional difficulties

The assessment process used in Dr. Charles Potter's Reading Programme[1] is based on the child's family and scholastic history in either the private or government schooling system in South Africa, which is a country classified as both first and third world [52]. The assessment procedures conform to similar procedures used by other educational psychologists in South Africa to provide evidence which can be used for diagnostic purposes against what are termed the ICD DSM IV and ICD DSM V criteria by South African medical aid societies.[2]

The ICD DSM IV and ICD DSM V criteria are designed to enable initial diagnosis to be made against functional descriptions of the learning difficulties experienced by children. These can then be used as the basis for both functional classification as well as for the development of treatment programmes.

As has been described in a previous publication on the work of the programme [37], four screening tests are used at the outset of the assessment process. These are designed to yield information about reading single words and reading words in sequence, and writing and spelling single words and words in sequence. Results on these tests are then reported using reading, spelling and dictation ages, for the reason that the South African ICD DSM IV and DSM V are based on age-related expectancies which are then used by the medical aid societies for the management of claims and benefits.[3]

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[1] Dr. Charles Potter's Reading Programme is an intervention programme linked to the author's practice as a psychologist. The programme uses electronic materials as the basis for intervention, and has assembled an extensive database of reading fluency books as well as developmental writing and spelling materials which are implemented using methods developed as part of my clinical work as a psychologist. Training is offered to prospective users of the materials and methods, and as a result there is now a network of parent, teacher and therapist users in different countries who connect with each other by cell phone and email.

[2] The ICD-10 (International Statistical Classification of Diseases and Related Health Problems – Tenth Revision) is a diagnostic coding standard owned and maintained by the World Health Organisation (WHO) [53]. The coding standard has been adopted by the National Health Information System of South Africa (NHISSA), and forms part of the health information strategy of the South African National Department of Health (NDoH). The standard serves as the diagnostic coding standard of choice in both the public and private healthcare sectors in South Africa for morbidity coding under Regulation 5(f) of the Medical Schemes Act 131 of 1998 [54].

[3] The ICD is produced by a global health agency (The World Health Organisation) with a constitutional public health mission, while the DSM is produced by a national professional association (The American Psychiatric Association). While initially using different diagnostic classification systems, the DSM and ICD have over time become very similar, due to collaboration between the two organisations, with the result that the coding system utilised by the DSM-IV [55] is designed to correspond with codes from the International Classification of Diseases, Ninth Revision, Clinical Modification, commonly referred to as the ICD-9-CM [56]. The coding system for the later revised DSM-IV TR [57] is designed to correspond with codes from the International Classification of Diseases, Tenth Revision, commonly referred to as ICD-10 [53], which has been adopted by South African medical aid societies.

Besides following the medical aid society guidelines in focusing on basic skills in reading and written expression, the assessment procedures are also based on the procedures suggested by Luria [58] for clinical assessment of reading and writing. Qualitative analysis of an initial parent interview is combined with analysis of drawings, pragmatic writing-based tasks and observation in an initial ice-breaking session with the child. This is then followed by a second session with the child during which four screening tests are used to establish levels of basic skills in reading, writing and spelling. This information is also combined with additional evidence from a biographical inventory, parental interview, analysis of school reports and more formal psychometric testing. This includes assessment of arithmetical and mathematical problem-solving skills if these are highlighted as areas of difficulty by the child's school and the child's parents.

Overall, the procedures used in the assessment process thus follow Luria's suggestion [58] that assessment should start with a preliminary conversation, and then include a careful history, detailed observation of behaviour, analysis of neurological symptoms and a series of additional objective tests. Luria suggests that the examination needs to be relatively short, and involve methods of experimental psychological investigation applied to clinical practice.

The methods of examination used in the initial sessions spent working with the child also include pragmatic assessment of repetitive and spontaneous speech, writing, reading, comprehension of texts and the solution of problems, in order to establish how reading, writing and spelling are used by the child as a functional system. This informal evidence is then combined with more formal testing of reading, writing and spelling skills, and interpreted, as Luria suggests, against a framework of knowledge of the types of difficulties normally associated with the functional system under investigation, based on current literature [59].

Assessment leads to a functional description of deficits sufficient for diagnosis of learning disability to meet medical aid requirements,[4] as opposed to an attempt to link this to possible labelling of the child as dyslexic, or labelling in terms of the other types of learning disability commonly described in the literature [37]. This is consistent with the standpoint adopted by Elliott and Grigorenko [24] and Elliott [61], namely, that adding a label adds little of clarity to a functional description of deficits for purposes of intervention. Similarly, the pattern of scores on subtests of an IQ test would best be used functionally, to indicate areas of cognitive and language strength and weakness, as well as areas in sequencing and working memory which may need to be worked with in therapy.

5. Evidence-based multivariate treatment: a response to intervention model

Following Luria [62], the aim is to move from assessment to statement of areas of deficit, and from this to specific programmatic intervention. The statement of

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[4] In South Africa, due to the similarity between the DSM IV and ICD classification systems, the DSM IV criteria have been used since August 2005 for the purpose of deriving ICD-10 codes by all healthcare providers except pharmacists, clinical support and allied healthcare providers [60]. The mandatory submission of ICD-10 codes by these groups was postponed until 1 January 2006. As from this date. The criteria have been referred to as the ICD DSMIV criteria, and ICD-10 coding has been mandatory for all health providers (including pharmacists and clinical support and allied healthcare providers). At time of writing the ICD DSMIV criteria have been phased out by South African medical aids and replaced by the ICD DSM V criteria.

areas of deficit can then be used as the basis for diagnosis for medical aid purposes, recommendations concerning the need for additional more in-depth testing (e.g. cognitive testing, speech and language and/or visual assessment, more in-depth analysis of phonological and phonic skills) or for more in-depth neurological or paediatric investigation,[5] as well as to recommend specific types of programmatic activities which can be used to address the areas of deficit.

Being based on the DSM IV criteria,[6] the diagnosis is related to the ICD10 classifications of possible types of developmental disorders affecting the development of scholastic skills, which are as follows:

- F81 Specific developmental disorders of scholastic skills

- F81.0 Specific reading disorder

- F81.2 Mathematics disorder

- F81.8 Other developmental disorders of scholastic skills

- F81.81 Disorder of written expression

- F81.89 Other developmental disorders of scholastic skills

This classification then enables parents to be able to claim benefits from their medical aid societies. At the same time, the statement of areas of deficit then enables recommendations to be made for more in-depth testing, as well as for commencing treatment. This is done matching the behaviours tapped by the tests used in the assessment process with the functional descriptions associated with the following literature-based based categorisation of types of learning disability associated with the ICD 10 developmental disorders of scholastic skills [42, 64, 65]:

Dyslexia: learning difficulties affecting reading and related language-based processing skills.

Auditory processing problems: difficulties with the sound system of the language, with phonological awareness, with listening in the classroom, and with processing and remembering the sounds associated with the letters in reading, writing and spelling.

Language processing problems: difficulties in processing spoken language, affecting both receptive and expressive language.

Reading Comprehension Deficits: learning difficulties affecting an individual's understanding of what they read.

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[5] The author has worked with children under the care of a number of paediatricians and neurologists, but particularly closely with Dr. Graeme Maxwell, neurosurgeon, of Sandton Clinic until his retirement in 2020, and more recently with Dr. Dimitri Manoussakis, neurologist, of Flora Clinic. The stabilisation of focus and attentional difficulties as well as attendant attentional lapses and symptoms of cortical irritability has been an essential feature of the fluency-based interventions provided in the author's practice. Behavioural, emotional, parental as well as chemical interventions are also likely to contribute to the gains made by children treated by the programmes described in this chapter.

[6] In South Africa, due to the similarity between the DSM IV and ICD classification systems, the DSM IV criteria have been used since August 2005 for the purpose of deriving ICD-10 codes by all healthcare providers except pharmacists, clinical support and allied healthcare providers. The DSM V criteria were published in May 2013, with both ICD-9-CM and ICD-10-CM codes assigned to each of the DSM V diagnoses [63].

Dysgraphia: learning difficulties affecting a person's handwriting ability and fine motor skills.

Visual, Visual perceptual or visual motor deficits: poor eye-hand coordination, difficulties in navigating surroundings, difficulties in visual tracking of print or losing one's place when reading.

Non-Verbal Learning Deficits: learning difficulties affecting the child's social interactions, manifesting in difficulties interpreting nonverbal cues such as facial expressions or body language, or difficulties relating to poor coordination.

Dyscalculia: learning difficulties affecting a person's ability to understand numbers and learn arithmetic or mathematical facts.

As the work done in my practice is related to the ICD 10 classification and medical aid codes, the functional difficulties associated with the ICD 10 codes related to the above categories (dyslexia, reading comprehension deficits, dysgraphia and dyscalculia) form the basis for the types of treatment initially developed for working with the child. Functional difficulties in the other four areas are referred to other therapists (e.g. occupational therapists, physiotherapists, visual therapists and speech and language specialists) working in the field.

This enables the work done in the practice to meet medical aid requirements, while at the same time focusing on use of particular methods and materials in working with reading, writing and spelling difficulties, difficulties with numeracy and mathematical problem-solving, as well as the attentional, emotional and social aspects which accompany difficulties at school (**Table 2**) [37, 38, 66].

The model for evidence-based classification can be represented as follows:
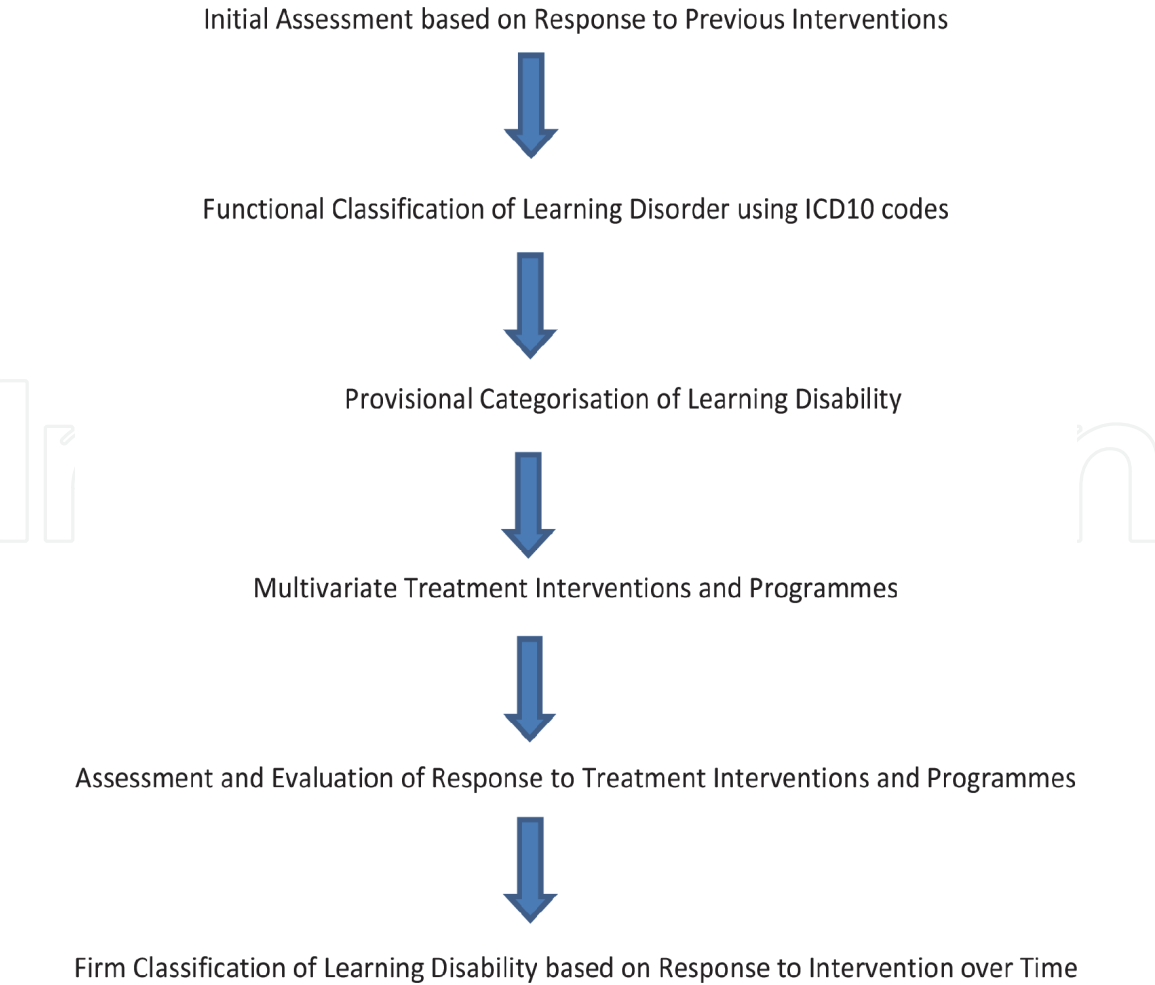
Initial Assessment based on Response to Previous Interventions

Functional Classification of Learning Disorder using ICD10 codes

Provisional Categorisation of Learning Disability

Multivariate Treatment Interventions and Programmes

Assessment and Evaluation of Response to Treatment Interventions and Programmes

Firm Classification of Learning Disability based on Response to Intervention over Time

Table 2.
Diagnosis of learning disability based on response to intervention prior to, during and subsequent to treatment.

The model thus involves evidence-based multivariate treatment as the basis for firm classification of particular types of learning disability based on response to intervention over time. At each stage in the application of the model, classification of learning disability is based on incremental validity based on specific evidence relating to particular types of treatment. It is also related to the emotional, social, family and classroom issues involved in treating learning difficulties at school.

How the model has been applied in practice is outlined in the following sections. While this is done with reference to the multivariate programmes developed in the practice for treating learning disabilities, the model could also be applied in other programmes working in a similar evidence-based way.

6. Applying the model: treatment of reading difficulties

Dr. Charles Potter's Reading Programme is a fluency-based programme for treating learning difficulties [67]. The methods used for treating reading difficulties in the programme are based on the theories of the Russian neuropsychologist A.R. Luria [58, 68, 69] and have been described in a number of previous publications [37, 38, 66, 70, 71]. The materials used in the programme are electronic, and can either be downloaded or sent out by email.

At pre-reading level, the material is activity-based and focuses on developing phonological and phonemic awareness. The methods used in working with the material are described in accompanying manuals [72–86] which can be used by parents, teachers and therapists, and form the basis for the training of programme implementers.

The programme works with children from pre-reading and school readiness level. The transition to foundation level is made once the child has developed alphabetic awareness and the associations between the letters of the alphabet and the sounds used to represent the letters in English. The child is then introduced to reading through a series of fifteen foundation level reading books, using a structured language experience approach which integrates reading, writing, phonics and spelling with drawing and illustration. This is done through six activity books based on families of rhyming words, which accompany the first six of the foundation level reading books, with the methods used described in accompanying manuals [75, 82, 86].

Once the child has developed the ability to read three letter words and words based on short vowel sounds and beginning and ending consonant blends and clusters, repetitive paired reading is introduced, focusing initially on reading of sentences. Comprehension is developed through drawing and illustration of reading content.

Once the child can read and write phonically based words as well as sentences using three letter words in context, reading fluency work is commenced using large print phonically based reading books, based on the model for treatment of reading acquisition, reading fluency and reading comprehension development represented in **Table 3**.

The procedures used are documented in a user's manual which includes both theory and the methods used in programme implementation [72]. In addition, there is a parent implementer's manual which presents a step by step approach to implementation [78].

7. Methods used for treatment of reading fluency difficulties

The development of the large-print, phonically based material used for developing reading fluency in the programme has been described in a separate
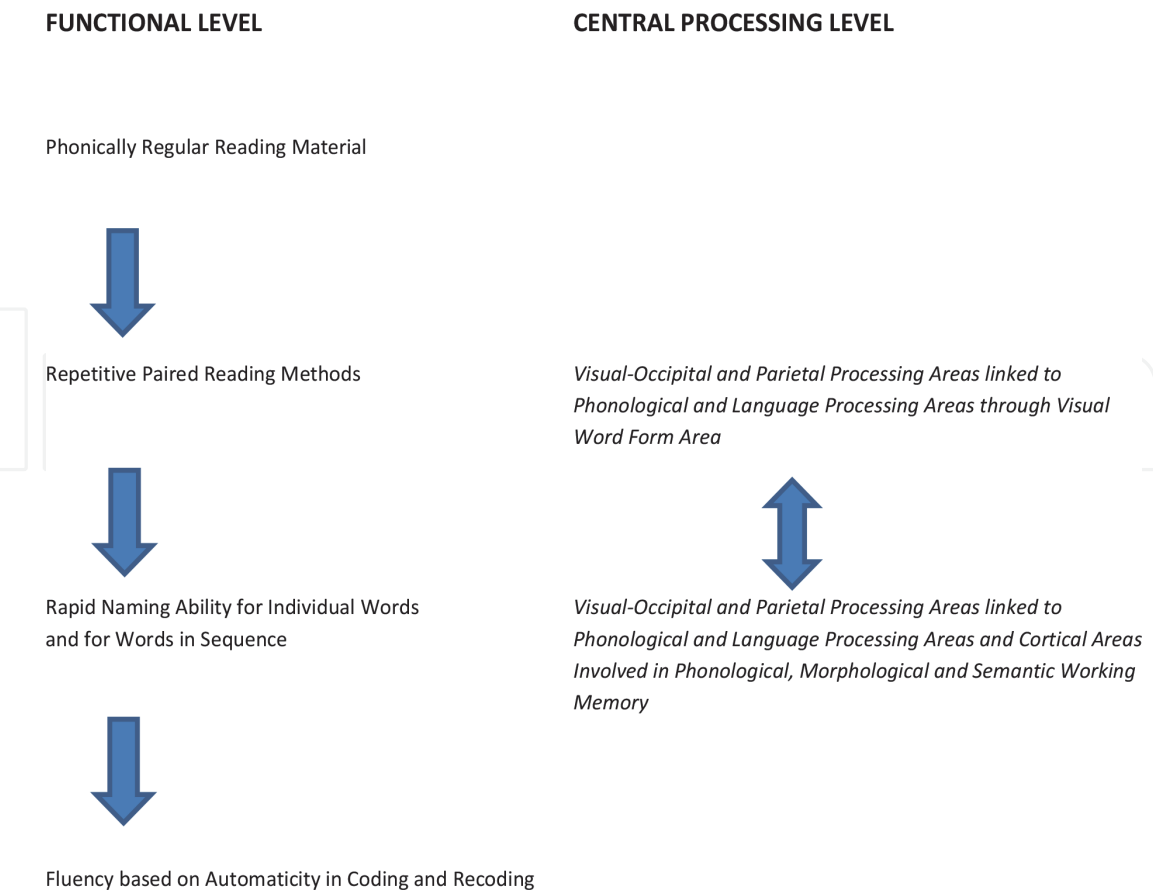
FUNCTIONAL LEVEL	CENTRAL PROCESSING LEVEL

Phonically Regular Reading Material

⬇

Repetitive Paired Reading Methods

Visual-Occipital and Parietal Processing Areas linked to Phonological and Language Processing Areas through Visual Word Form Area

⬇ ⬆⬇

Rapid Naming Ability for Individual Words and for Words in Sequence

Visual-Occipital and Parietal Processing Areas linked to Phonological and Language Processing Areas and Cortical Areas Involved in Phonological, Morphological and Semantic Working Memory

⬇

Fluency based on Automaticity in Coding and Recoding

Table 3.
Model for Reading fluency development.

publication [66]. The methods used for developing reading fluency involve use of a paired reading method called the 3 x 3 Oral Impress Method. This is designed to be used with a series of electronic reading fluency books which are graded, and written in a way which builds repetition into the words used, as well as phrases used in sentences.

The material presents letters and letter strings associated with particular sounds repetitively in an uncluttered format. Repetitive oral reading is then used together with visual tracking of the printed words to develop and then automatise the associations between the configuration of the letters within phonically regular words and their sounds as used in the written language the child sees, the spoken language the child hears, and the words read by both adult and child [87].

This is done by working with the reading material three paragraphs at a time in the following way (**Table 4**).

The aim, as Luria suggests [58, 68], is to enhance cerebral organisation based on a repetitive process. This was also Heckelman's view when he pioneered the use of

Paragraph One	Child reads	Parent and Child read together	Parent reads
Paragraph Two	Parent reads	Child reads	Parent and Child read together
Paragraph Three	Parent and Child read together	Parent reads	Child reads

Table 4.
The 3 x 3 Oral impress method.

paired reading as a procedure [88–90], suggesting that paired reading is "one of the most direct and fundamental systems of reading" involving a "combination of reflexive neurological systems." We have reported similar positive results [38, 66], supporting Heckelman's position that gains made are based on increasing neurological integrity.

The model for developing using the phonically-based, large print reading materials to develop reading fluency would be conceptualised as based on the coding and recoding of phonic associations [91–93]. Following Dehaene [94, 95], what the 3 x 3 Oral Impress Method does when used with our phonically based large-print reading fluency books is to present the visual word form area in the brain with strings of letters representing sounds repeatedly. This would have the effect of strengthening the connections between the visual areas in the brain and the areas of the brain involved in processing sounds and oral language, thus enabling the child first to read, and then to read fluently.

8. Treating difficulties with rapid naming

The relationship between rapid naming and reading difficulties has been established by a number of researchers [96–102]. What has not been clearly established is whether rapid naming is a separate factor influencing reading performance, and whether it is responsive to training [103, 104]. Recent research indicates that training interventions in this area are possible [105, 106], but that more controlled studies are still necessary on whether rapid naming can be trained, and how it can be trained. The descriptions provided in this section should be viewed in this context.

Our methods focus on teaching rapid naming of letters, words and numbers, as well as teaching rapid reading. At initial stages in the programme, rapid naming of letters is conducted using phonogram cards. Rapid naming of words is conducted using key words drawn from our phonically-based large print reading material. Rapid naming of numbers is trained through rapid marking of arithmetic worksheets. Rapid reading is also taught developmentally using the 3 x 3 Oral Impress Method [72], which focuses on accurate naming of phonically regular words and sentences, and then on rapid and accurate reading of a wider range of reading material.

The material used is phonically graded as well as repetitive, and the aim in the initial stages is to work with words which become increasingly familiar to the child, to develop accurate and rapid naming ability for individual words and words in sequence. This is done through the repetitive methods used to develop automaticity in reading [74], as well as through activities in which the child is asked to name letters and numbers in worksheets based on both familiar and unfamiliar content. Tachistoscopic work is then introduced at later stages in the programme [107], working repetitively with words of increasing length drawn from an electronic dictionary, as well as with words drawn from graded revisualisation materials and the child's school books.

Using computer-based presentation, length of words presented, time exposure of the presentation of each word and time between the exposure of each word can be treated as variables. Other variables involve the ways in which words can be presented, read, revisualised and written down, following the procedures outlined in **Table 5**.

The methods used for developing rapid naming in the child's programme thus link with the methods used for training fluency in reading, and include activities methods designed to develop rapid naming of words as well as activities aimed at
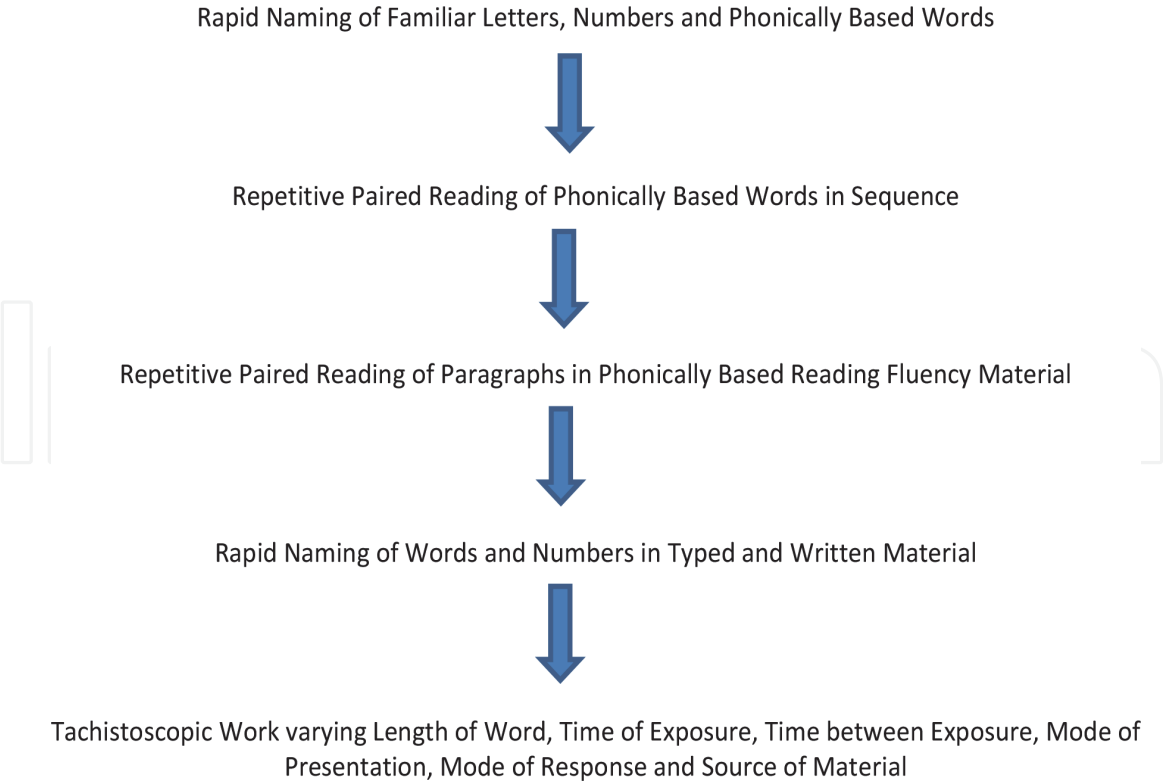
Rapid Naming of Familiar Letters, Numbers and Phonically Based Words

Repetitive Paired Reading of Phonically Based Words in Sequence

Repetitive Paired Reading of Paragraphs in Phonically Based Reading Fluency Material

Rapid Naming of Words and Numbers in Typed and Written Material

Tachistoscopic Work varying Length of Word, Time of Exposure, Time between Exposure, Mode of Presentation, Mode of Response and Source of Material

Table 5.
Methods for treating rapid naming difficulties.

developing increasing familiarity with words. Based on Luria's theories of automaticity [58], repetition would be intrinsic to the development of fluency in reading. As Dehaene [95] has noted, familiarity with material influences fluency. The aim of our methods is to use repetitive paired reading to develop the coding, recoding, working memory and rapid naming abilities necessary for fluent and accurate reading, and for self-teaching [108].

9. Developing automaticity in writing and spelling

Fluency in writing and spelling is addressed in our programme through a variety of methods involving linking the teaching of phonic associations with training in basic skills in writing and copying. This is done by teaching the child how to work from print to sound, how to analyse words based on phonic analysis of how words work, and how to use the letters and letter combinations used to represent the vowels in words as the basis for remembering how words are spelled both individually and in sequence. This is done through a process we call "phonological referencing" which focuses on the coding and recoding of phonic associations [80].

This is done using word families of between five and six words, supported by sentences in which the words are analysed in sequence, revisualised and then tested. The aim is to use revisualisation of words and sequences of words as an integral part of the process of learning to write and spell, with the aim of developing the phonological, phonic and sequential working memory processes involved in writing rapidly and accurately in sequence [84, 85].

The model for using our phonically-based, large print materials for developing writing and spelling fluency, is represented in **Table 6**.
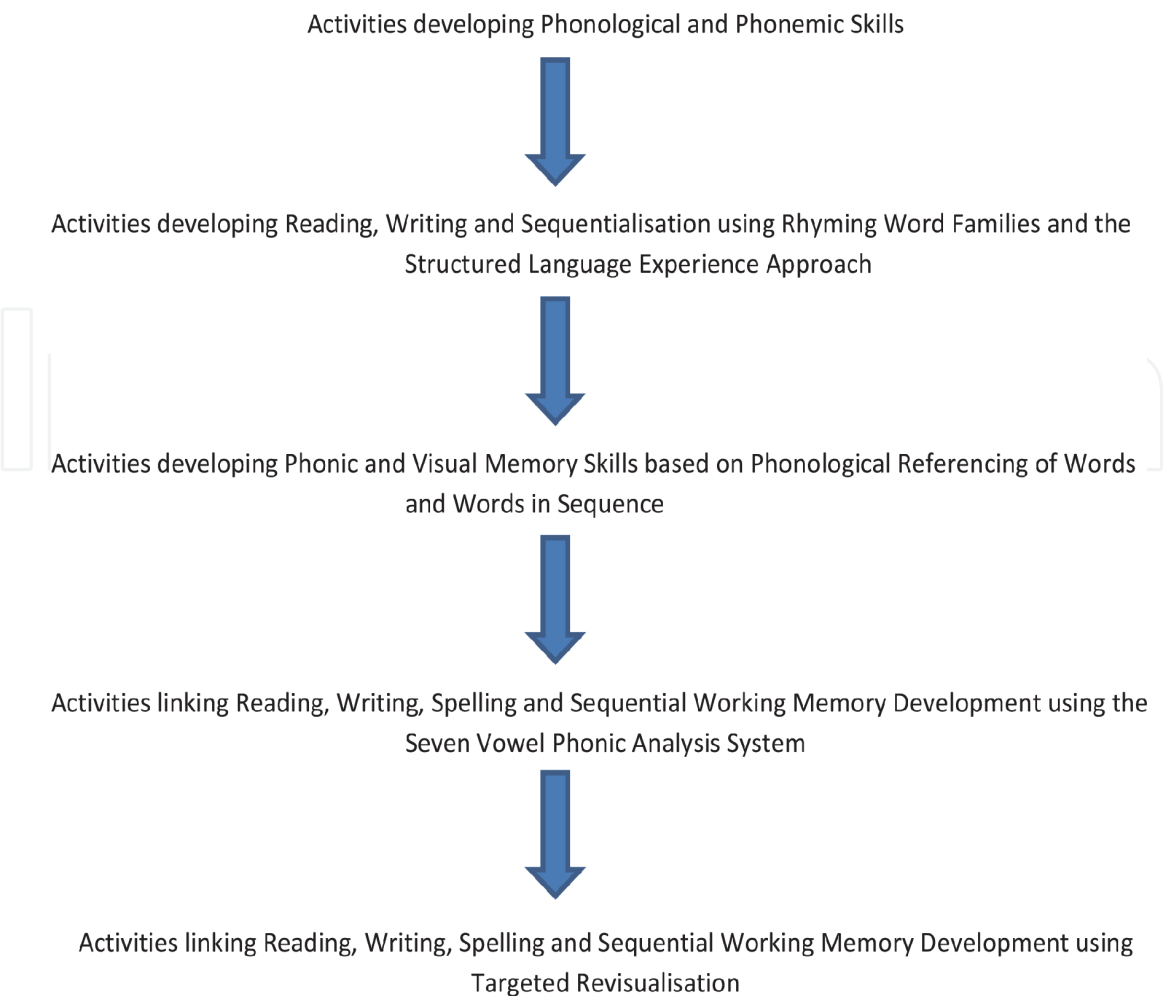
Activities developing Phonological and Phonemic Skills

⬇

Activities developing Reading, Writing and Sequentialisation using Rhyming Word Families and the Structured Language Experience Approach

⬇

Activities developing Phonic and Visual Memory Skills based on Phonological Referencing of Words and Words in Sequence

⬇

Activities linking Reading, Writing, Spelling and Sequential Working Memory Development using the Seven Vowel Phonic Analysis System

⬇

Activities linking Reading, Writing, Spelling and Sequential Working Memory Development using Targeted Revisualisation

Table 6.
Model for developing writing and spelling fluency based on activities involving development of reading, writing, spelling, phonic analysis and revisualisation.

Following Luria's theories [58], our methods use repetition as intrinsic to the development of automaticity in writing and spelling fluency. As with reading fluency, the aim is to develop the coding, recoding and working memory abilities necessary for fluent and accurate writing and spelling [91–93, 108, 109].

At initial stages in the programme, the aim is to build phonological, orthographic and morphological awareness through phonological referencing [86]. This involves developing the child's phonic analysis, visual memory and sequential working memory skills by methods which combine phonic analysis and revisualisation [74].

The phonic abilities of the child are established from analysis of the child's errors on spelling tests, in the child's descriptive writing, creative writing and school work, as well as through a series of phonic inventories [79]. Based on the pattern of errors, we initially involve the child in work with word families and phonogram cards targeting specific phonic errors in the profile. In the process, the child is introduced to working with the Seven Vowel Phonic Analysis System, which is a procedure for teaching children through activities involving mapping the combinations of letters used in writing words to the sounds made when those words are spoken orally [73, 74].

The aim is to combine phonic analysis and revisualisation in developing skills in word attack, spelling and sequential working memory. This is done through activities focusing on analysis of the letters and letter combinations used to represent the

vowel sounds in words, combined with revisualisation activities focused on remembering sequences of words [84]. The sequence of instruction followed, and the links between phonological referencing, the introduction and application of the Seven Vowel Phonic Analysis System, and the combination of phonic analysis and revisualisation in the Targeted Revisualisation Programme [83], are represented in **Table 7** below.

The sequence of instruction followed in implementing the programme thus integrates reading, writing and spelling through activities which are phonically-based, linking phonological, phonemic, visual memory and sequential working memory development. The methods used are outlined in a series of manuals which can be used by therapists, teachers, schools and parents [81–85].

10. Mapping the associations between spoken and written words

Both phonological referencing and the Seven Vowel Phonic Analysis System are used for point to point analysis of the links between the sequences of letters used in written words and the sequence of sounds made which the words are spoken orally. This is done through activities in which the child is taught to map the associations between the sequences of letters used in written words and the sequences of sounds used when the words are spoken orally [80].
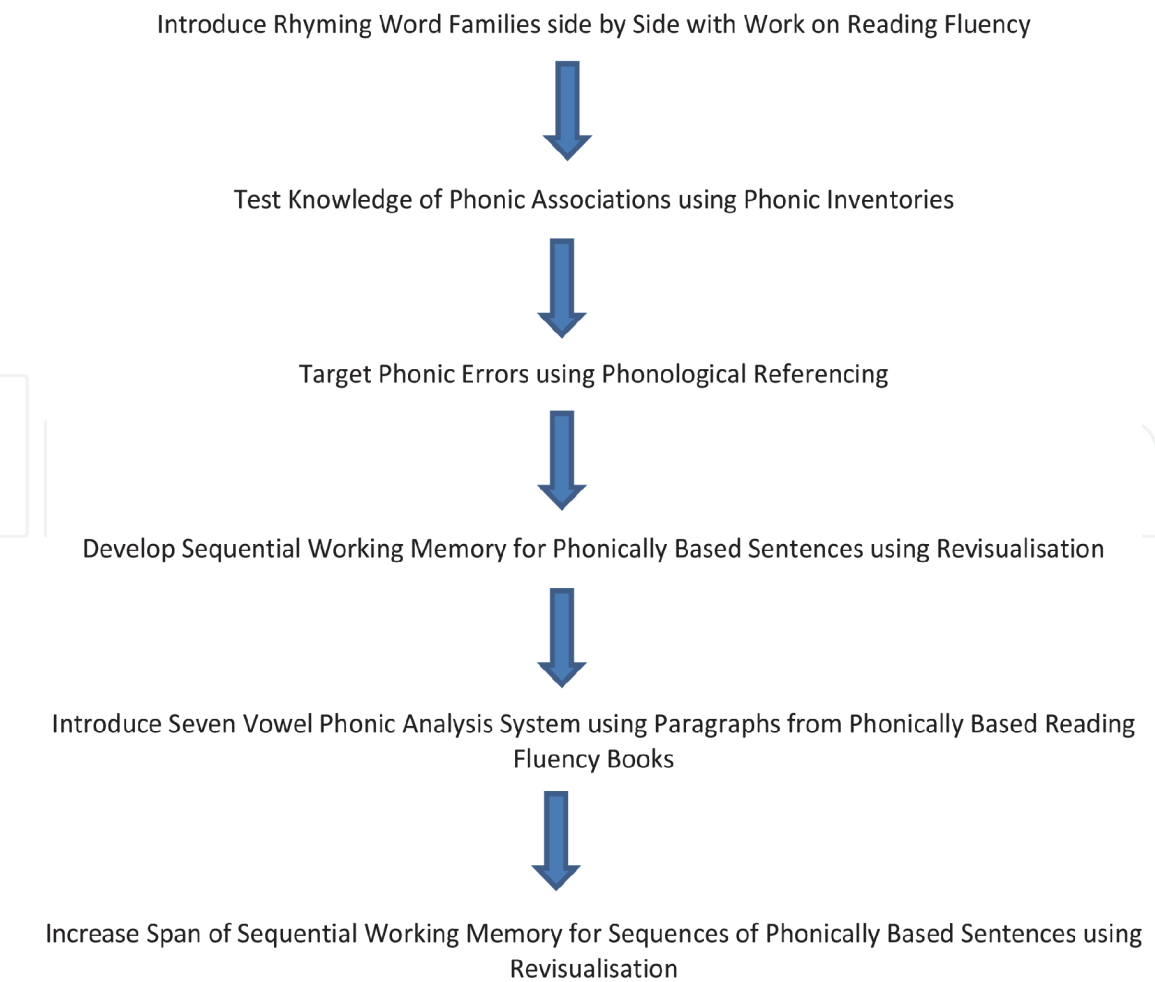
Introduce Rhyming Word Families side by Side with Work on Reading Fluency

⬇

Test Knowledge of Phonic Associations using Phonic Inventories

⬇

Target Phonic Errors using Phonological Referencing

⬇

Develop Sequential Working Memory for Phonically Based Sentences using Revisualisation

⬇

Introduce Seven Vowel Phonic Analysis System using Paragraphs from Phonically Based Reading Fluency Books

⬇

Increase Span of Sequential Working Memory for Sequences of Phonically Based Sentences using Revisualisation

Table 7.
Introducing phonological referencing and the seven vowel phonic analysis system.

The sequence of instruction followed in teaching the child is as follows:

- After the child has learned the associations between sounds and letters, the child works with word families as well as with phonogram and rime cards, which are used side by side with the process of phonological referencing. The basis for mapping is to link the individual letters and sequences of letters with the sequences of sounds made when the words are spoken out loud, based on the principle that "what we say is what we write."

- This stage involves activities in which the hand is placed under the chin to increase the ease by which the vowel sounds in words can be identified as part of the process of mapping letters to sounds and sounds to letters.

- Particular focus is placed on identifying the vowel sounds in words (which are spoken when the mouth opens) and the consonant sounds (which are spoken when the mouth closes). The letters the child has written or typed form the departure point for linking what is written on paper with both sounds and mouth movements.

- The aim is to enable the child to identify the vowel letters and the consonant letters used in written words, and then to link these back to the sounds made when the word is spoken orally.

- Reverse mapping between the sequence of sounds in the word and the letters used in writing the word then takes place. Once the vowel sound in the word has been identified, the letters used to represent the vowel sound are then colour coded. In the process, short vowel sounds are identified as normally being made by one letter working by itself, while long vowel sounds are identified as normally being made by two letters working together.

As the focus lies on mapping the consistency between the sequences of letters used in written words with the sequences of sounds used when the words are spoken orally, the aim is to enable the child to build the variety of phonic associations necessary to read, write and spell in sequence. Visual memory, revisualisation and dictation activities are also used to develop the metacognitive and working memory processes necessary to remember and write sounds and letters in sequence, and words in sequence [110–116].

11. Increasing the transparency of written English

Much has been written about the transparency of the English language compared to other languages [117–122], for the reason that the phonic associations underpinning English orthography are varied, with similar sounds being represented by different letter combinations. This means that both reading and spelling in English are not as easy for children to learn as in many other languages such as Italian, Afrikaans, Welsh, German, or French [123–130]. This has potentially negative effects on the progress of children with learning disabilities [118, 119, 131–133].

Our materials attempt to overcome this problem at initial stages in the programme through the use of carefully chosen vocabulary. Phonic associations are initially taught through graded rhyming word activities, and then developed through activities involving reading, writing and use of working memory in

spelling. Once the child has been introduced to the phonological referencing and colour coding process with individual words and families of rhyming words, he or she is also introduced to activities involving use of visual memory and revisualisation of words in sequence.

Word families of written words are used as the basis for analysing individual words, while written sentences are used as the basis for analysing words in sequence. This is done through activities based on sentences and paragraphs which include words in which the y and w combine with other letters to form long vowel sounds. These letter-sound associations are identified and then mapped using the Seven Vowel Phonic Analysis System [73, 74, 83].

In the process, the child is taught that a, e, i, o and u are the letters normally used to represent the vowel sounds in words, but that y and w can also be used to represent the represent the vowel sounds in positions at or near the end of written words in English. The Seven Vowel Phonic Analysis System is then worked with and applied through activities in which the child speaks the word out loud and then identifies the letters used as vowels in the word. Through activity-based learning, the child is introduced to the principle that there needs to be a vowel in every word, that the letters a, e, i, o and u are used to represent the vowels in all positions in words, and that the use of y and w as vowels at the end of words is both logical and consistent, applying to nearly all words in English.

The use of the Seven Vowel Phonic Analysis System thus enables the letters used to represent the sounds in both simple and complex written words to be identified through phonological referencing, and to be analysed following the principle that "what we say we write." The aim is make written English as transparent as written Welsh, in which the use of the seven vowels a, e, i, o, and u, as well as y and w, also applies [122, 123, 133], making it logical and easier for children to learn.

12. Combining phonic analysis and revisualisation in developing sequential working memory for words

The methods for teaching spelling in our programme have been described in Potter [38, 70] and follow the phonologically and phonically-based stages in spelling described by Moats [134, 135], as well as the stages in a set of three phonic inventories based on the foundation level curriculum taught in primary schools in South Africa [79]. Phonic associations are initially introduced through graded rhyming word activities involving reading, writing and use of working memory in spelling. Focus is placed on teaching through synthetic phonic approaches incorporating teaching children to isolate sounds and blend sounds into words, as well as how to create families of rhyming words based on similar phonological and phonemic elements [75].

These are introduced side by side with reading fluency activities using our foundation level and then our basic level readers, through methods which use activity-based learning to build the variety of phonic associations necessary to read, write and spell. Phonic analysis is then introduced using phonological referencing [80], which is applied working with families of between five and seven words, each of which are based on a similar consonant blend of cluster. These are then contextualised in short sentences in which the words are then phonically analysed and revisualised in sequence. The aim is to develop the working memory integrities necessary to write accurately in sequence.

In the ck word family, for example, the following words would be written in the child's writing book.

shock
brick
check
stack
cluck
trick

The vowel in each word would then be underlined in colour and matched with the way the mouth opens in making each vowel sound and the way the mouth closes in making each consonant sound. After this, the child would work with his or her reading partner and phonologically reference each word in the ck word family, by linking the sounds in each word when the word is spoken out loud with the letters used when the word is written down.

This would be done through an activity-based process, in which the child is asked to:

a. Point to the written word on the page and say it.

b. Look at the two letters at the beginning of the written word. Say the sound of these letters out loud.

c. Look at the vowel in the middle of the written word. Say the sound of this letter out loud.

d. Look at the two letters at the end of the written word. Say the the sound of these letters out loud.

e. The phonic rule applied in each of the words would then be focused on working with the reading partner. This would be done by focusing on how the beginning sound, the middle sound and the ending sound work together to make each word, and how the ck ending applies in each word.

Each of the words in the family would then be contextualised in sequence in a short sentence. The sentence would be written down by the child, and the vowel or vowels in each word in the sentence underlined in colour. After this, each word in the sentence would then be revisualised in sequence working memory tested by asking the child to rewrite the sentence from memory. These sequential revisualisation techniques would then be used further at higher levels in the programme [84].

13. Linking the development of phonic associations, visual memory and sequential working memory skills

The sequence of instruction followed with each child varies based on evidence of how the child learns, but is conducted with the aim of linking the development of phonic analysis, visual memory and working memory skills as represented in **Table 8**.

It will be apparent from **Table 8** that the aim at each level of the programme is to work to combine phonological and phonic skills development with the development of visual memory and sequential working memory. This is done through methods which to combine the process of phonic analysis with the process of revisualisation in developing sequential working memory for words [83, 84], through a longitudinal process in which:

- The child is taught to map the associations between the sequences of letters used in words and the sequences of sounds used when words are spoken orally through phonological referencing, as well as through use of phonogram and rime cards.

- The child is taught that each written word is logical and can be analysed on the principle that "what we say is what we write."

- The child is shown how to use revisualisation to remember the sequences of letters used in individual words and the sequences of words in used in sentences.

Phonological Referencing of Written Words in Word Families

Phonic Analysis linking Letters in Written Words to Sounds when Words Spoken Orally

Development of Visual Memory for Letters and Letter Strings in Sequence

Copying and Analysis of Written Words and Sentences in Graded Phonically Based Material

Phonic Analysis linking Vowel Sounds and Letters used in Written Words in Sequence

Development of Visual Memory for Letters and Letter Strings in Sequence

Work with the Seven Vowel Phonic Analysis System

Phonic Analysis linking Vowel Sounds and Letters used in Written Words in Sequence

Sequential Revisualisation of Sentences and Sequence of Sentences

Work with the Targeted Revisualisation Programme

Phonic Analysis based on Application of the Seven Vowel Phonic Analysis System

Sequential Revisualisation of Graded Written Paragraphs

Work to Develop Rapid Processing and Working Memory for Words

Table 8.
Methods linking phonic analysis, visual memory for strings of letters and words and sequential working memory for written words, phrases, sentences and paragraphs.

Both phonic analysis and revisualisation are thus used to develop the child's ability to store each word in working memory in sequence. This is initially done working with words in the context of sentences, and then with sequences of sentences. The child's sequential working memory is tested through dictation.

At each level in the programme, the methods used are repetitive and follow the procedures for developing automaticity outlined by Luria [58, 68, 69], and are summarised in illustrated implementer manuals for users [74, 81, 83–85]. Once the child is able to recall sentences of between five and seven words accurately, span of sequential working memory is increased by phonic analysis and revisualisation of sentences of increasing length, as well as by phonic analysis and revisualisation of increasing numbers of sentences in sequence.

As our reading fluency materials are graded and phonically based, sentences and paragraphs from these can be used as the basis for activities which link reading, writing, spelling and sequential working memory work. More complex graded paragraphs and sequences of paragraphs are then introduced once the Targeted Analysis, Revisualisation and Sequential Spelling Programme is commenced, as described in the section following.

14. The targeted analysis, revisualisation and sequential spelling programme

Once the child is able to recall the words used in individual sentences and sequences of sentences accurately, the materials used in the Targeted Analysis, Revisualisation and Sequential Spelling Programme are introduced. The methods target words with more than one vowel, which are first written, then typed, then colour coded and then syllabified. The target words are then revisualised and tested [136].

After analysing and recalling the target words, the text of the graded materials is then worked with, focusing on each word in each sentence in sequence. Sequential revisualisation techniques are used. We call this process "targeted revisualisation" as each word is targeted in sequence, using techniques which combine the procedures used for phonic analysis of the target words with the types of mental imagery the child uses in recalling words. These build on the activities linking phonic analysis and revisualisation, and the methods used for developing sequential working memory used at previous levels in the programme.

The aim is to use accuracy in use of sequential working memory for words as the basis for developing fluency and automaticity in writing and spelling [38]. This is done in four stages, as outlined in **Table 9**.

The Targeted Analysis, Revisualisation and Sequential Spelling Programme is applied using graded paragraphs, which increase in complexity as well as length. As these are worked with, the process of combining phonic analysis and revisualisation in using the Seven Vowel Phonic Analysis System is applied repetitively. This is done by working from printed word to sound, and from sound back to print. These phonological recoding skills provide the building blocks on which writing and spelling fluency is developed [71].

On a phonological and phonic level, the methods used are based on the coding and recoding of phonic associations through activities in which the child writes, types and colour codes the vowels in words by underlining the letters used to represent the vowel sounds in colour as well as using the colour coding feature in a word processing programme. This adds a visual dimension to the targeted revisualisation process, as the methods used are designed to make the letters used to represent the vowel sounds in words stand out in colour [83].

Level of mediation	Focuses of phonic analysis	Focuses of revisualisation	Focuses of use of sequential working memory
Stage One: Focus on Words based on Short Vowel Sounds	Introduce concept that vowels are used in all spoken and written words. Identify and mediate short vowel sounds a, e, i, o, and u.	Construct, deconstruct, mentally image and revisualise words and rhyming word families containing short vowel sounds.	Use working memory in writing rhyming words based on short vowel sounds in sequence.
Stage Two: Focus on Words based on Long Vowel Sounds	Identify and mediate long vowel sounds involving use of digraphs involving a, e, i, o, and u. Introduce the letters y and w as vowels in positions at or near the end of words.	Construct, deconstruct, mentally image and revisualise words and rhyming word families containing long vowel sounds, including use of the letters y and w as vowels in positions at or near the end of words.	Use working memory in writing sequences of words containing both long and short vowel sounds, including use of the letters y and w as vowels in positions at or near the end of words.
Stage Three: Focus on Sequentialisation of Words in Sentences	Identify letters used as vowels in words used in sequence in sentences.	Identify, phonically analyse, mentally image and revisualise single syllable and polysyllabic words in sequence in sentences.	Use working memory in writing single syllable and polysyllabic words in sequence in sentences and sequences of sentences.
Stage Four: Focus on Sequentialisation of Words and Sentences in Paragraphs	Identify letters used as vowels in words used in sequence in sentences, and in sentences used in sequence in paragraphs.	Identify, phonically analyse, mentally image and revisualise single syllable and polysyllabic words in sequence in paragraphs.	Use working memory in writing sentences in sequence in paragraphs of increasing length and phonic complexity.

Table 9.
Stages and focuses of mediation in the targeted analysis, revisualisation and sequential spelling programme.

Both phonic associations and visual contrasts are then used to identify the letters representing the vowel sounds in words, with the aim of enabling the child to develop working memory for individual words as well as sequential working memory for words in sequence. Fluency in writing and spelling is then based on increasing span of sequential working memory as well as automaticity in recalling the sequences of letters used in individual words, the sequences of words used in sentences, and the sequences of sentences used in paragraphs.

At higher levels in the programme, rapid reading of words and working memory for words are also developed through use of tachistoscopic methods conducted side by side with targeted revisualisation [107]. Children who have worked in this way report effects in improving word attack in reading, as well as improvements in rate of processing words, rate of reading, spelling accuracy and rate of work.

15. Treatment of difficulties with calculation and numerical problem-solving

In addition to the strands in the child's programme focused on treating difficulties with reading, writing and spelling, numerical and problem-solving activities are also included in the programme, using electronic materials which can be worked with online, as well as sent to parents and children by email [71]. The aim of using this

format-based multivariate treatment system is to enable treatment of the functional difficulties identified in assessment, while at the same time addressing needs indicated by the errors made by the child in his or her school work.

The format system is flexible and comprehensive enough to be able to focus on areas of strength as well as needs, while also enabling email delivery of the activities included in each child's individual programme. Number concept development can also be linked to language and problem-solving activities, with support programmes linked to the developmental model outlined in **Table 10**.

Number Concept and
Numerical Fluency

Numerical Reasoning and
Numerical Problem Solving

Addition and Subtraction with numbers to 20

Addition and Subtraction with numbers to 50

Sequencing of 2's, 3's, 5's and 10's

Development and Learning of Multiplication
Bonds and Tables using Hundred Squares,
Occlusion and Audiofiles

Short Multiplication and Division

Long Multiplication and Division

Units of Measurement and
Time Concepts

Fractions

Decimal Fractions

Higher Level Numerical, Algebraic
and Mathematical Concepts

Table 10.
Model for development of number concept, numerical fluency, numerical reasoning and numerical problem solving.

These activities are then implemented side by side with the mathematical curriculum taught at school.

It will be apparent from **Table 10** that at the same time as treating numerical and mathematical difficulties identified in the initial assessment, the learning support provided is both diagnostic and based on clinical teaching, as well as linked to numerical and mathematical concepts covered in the child's work at school. As with other areas of our programme, the aim is to treat functional difficulties as well as to evaluate the child's response to specific types of interventions, as outlined in the section following.

16. Progress evaluation

Work with each child is conducted longitudinally, and is based on a cycle in which evaluation forms an integral part of both planning and implementation. Feedback on specific activities in the format is also provided by photographs sent by email or WhatsApp, enabling the planning of the next format in the child's programme to be evidence-based, linked to ongoing evaluation of learning needs. Assessment is then built into programme implementation at regular intervals.

The model used for implementation is action research based [137–139], and can be summarised as follows (**Table 11**).

Table 11.
Action research cycle for planning and implementation of activity-based online programmes.

As the programme's data base is extensive, the planning and implementation model implies that each child's programme is evidence-based and multivariate, addressing a number of different learning needs through use of a variety of graded activities. The programme is then implemented using online sessions supported by learning materials provided by email [71].

The aim is that programme implementation can take place with support from parents, teachers, tutors or au paires as reading partners, working with a variety of electronic materials delivered by email or made accessible online via links to websites. Methods used in the programme are documented in illustrated implementer manuals, and are demonstrated working online, supported by cell phone and email contact.

Both evaluation programme activities and evaluation of progress are linked to evidence from the child's school work and school reports at regular points in primary, with full re-assessment and summative evaluation being conducted at point of transition to high school. The aim at this point is to make a firm diagnosis of learning disability which can be linked to concessions.

The aim is to ensure that firm classification and labelling of a child as learning disabled is valid [36], based both on longitudinal analysis of test results as well as response to specific interventions [140, 141], on the model described in the section following.

17. Firm classification of particular types of learning disability on the basis of response to intervention

In implementing the different types of interventions which have been described in this chapter, the programme focuses on a number of different variables related to the areas of difficulty. Interventions are normally longitudinal and conducted side by side with the curriculum taught in the child's school.

The programme works with the aim of providing fluency-based interventions which can develop basic skills and competences in reading, writing, spelling as well as numeracy. At the same time, evidence-based learning support is provided focused on areas of the school curriculum with which the child is experiencing difficulties. This type of multivariate intervention is implemented using formats based on an online session providing counselling followed by an intervention, supported by electronic materials which can then be used by parents and children working in conjunction with a teacher or therapist, or independently [71].

At the outset the child's difficulties are described functionally. This enables labelling to be avoided, until such time as the child has had benefit of focused

Initial Assessment

Referral for Treatment by other Therapists

Initial Diagnosis based on Functional and ICD10 Descriptors

Reading Fluency and Comprehension Interventions

Writing and Spelling Fluency and Written Language Interventions

Numeral Fluency and Problem-Solving Interventions

Multimethod Progress Evaluation and Summative Assessment

Firm Classification as Learning Disabled in terms of Response to Intervention

Concessions and Ongoing Learning Support

Table 12.
Classification of learning disabilities based on response to multivariate fluency-based interventions.

multivariate treatment, and is also likely to be more developmentally and neuro-logically mature [142–145]. As maturation takes place, firm diagnosis and classifi-cation of learning disability then becomes to the child's benefit, as it can be linked to concessions related to areas of ongoing difficulty. This can be linked both to cross-sectional assessment as well as evaluation of response to interventions which have been based on multivariate treatment using particular types of methods and materials.

In our programme, firm classification as learning disabled is thus normally undertaken at the end of a child's primary school years, based on evidence collected by use of different methods over time [146, 147], within a model of inference based on a process of incremental validity [34, 35, 148]. Diagnosis can then be linked to concessions to compensate for those areas of difficulty which have been demonstrated to be resistant to particular forms of treatment, as well as to ongoing treatment and learning support in particular areas of the high school curriculum.

The model for classification of learning disabilities is reflected in **Table 12** on the previous page. It will be noted that the model is multimethod, based on summative assessment linked to progress evaluation of longitudinal interventions conducted across a number of areas of functional difficulty, enabling triangulation across different data points over time [131].

This enables firmer conclusions as to the type of learning disability involved, as well as classification of learning disability based on specific evidence relating to response to particular types of treatment [141].

18. Summary and implications

This chapter has focused on treatment of the functional learning difficulties associated with dyslexia, dysgraphia and dyscalculia, as three dimensions of learn-ing disability. As each of these dimensions can be associated with a range of reading, writing, spelling and working memory difficulties, the model of classification described in this chapter has been described with reference to a particular programme which uses a large data base to implement a variety of different activ-ities with children diagnosed as having learning problems.

Owing to the measurement error implicit in testing young children who may have attention and focus difficulties in addition to functional difficulties with read-ing, writing, spelling and maths, the model of classification assumes that initial diagnosis of learning disabilities is at best provisional. For this reason, labelling of children is avoided at the outset. Functional indicators based on actual versus expected performance are used in preference, using ICD10 codes and descriptors as opposed to labelling using terms such as Dyslexia, Auditory Processing Problems, Language Processing Problems, Reading Comprehension Deficits, Dysgraphia, Visual Perceptual or Visual Motor Deficits, Non-Verbal Learning Deficits or Dyscalculia.

Detailed description of the initial assessment process has been provided in order to show that functional ICD 10 descriptors can be used instead of labels as the basis for establishing needs and areas of treatment. Treatments can then be targeted at these descriptors, being related to focus on specific problems with reading, writing and spelling, as well as numerical concepts and mathematical problem-solving. Difficulties outside these areas are then referred to other specialists.

Detailed description of particular methods, materials and programmes has also been provided in this chapter to indicate that once initial functional classification has taken place linked to specific areas of difficulty, multivariate interventions can

then be developed and implemented. Firm classification then becomes possible based on the child's progress over time.

One implication is that initial diagnosis of learning difficulties can be rigorous despite being provisional, providing detailed descriptions of specific areas of difficulty which are made with a view to undertaking multivariate treatment. Firm classification can then be made based on response to intervention at a time in the child is likely to be more developmentally and neurologically mature, and prior making a transition to new forms of teaching and new areas of learning at high school level.

Another implication is that the process of establishing firm diagnosis and classification would best be conducted at the end of a child's primary school years, with a view to establishing concessions as well as the possibility of further treatment at higher levels in the curriculum. At this point firm diagnosis as having dyslexia, dysgraphia or dyscalculia can act to the child's maximal benefit, in maximising the chances of obtaining the concessions and further treatments necessary to making the grade.

As the response to intervention classification model described in this chapter has been successfully applied in practice,[7] a third implication is that the model is feasible and may have wider relevance. It offers the possibility that firm classification as learning disabled can be based on the child's response to treatment which has been focused, multivariate and multimethod. In terms of the model, firm diagnosis of children as dyslexic, dysgraphic or dyscalculaic becomes an outcome taking place after treatment, linked to the possibility of concessions as well as additional interventions.

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[7] The author has applied the response to intervention classification model working in association with Robert Thomas-Stark, psychologist, of the Centre for Therapeutic Excellence, Johannesburg. To maximise validity, this has involved longitudinal and cross-sectional assessment by two therapists, leading to a collaborative diagnostic report.

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