Integrated intelligent LEARNing environment for Reading and Writing
D3.2 – Learning Strategies Specification Report

Document identifier	**ILearnRW_D3.2 – Learning Strategies Specification Report**
Date	**2013-03-28**
WP	WP3
Partners	DOLPHIN, NTUA, UoM, UOB, DYSACT, EPIRUS, LBUS
WP Lead Partner	DYSACT
Document status	V4.0 / Final

Deliverable Number	D3.2
Deliverable Title	Learning Strategies Specification Report
Deliverable version number	V4.0
Work package	WP3
Task	Task 3.2 Learning strategies specification
Nature of the deliverable	Report (R) / Prototype (P) / Demonstrator (D) / Other (O)
Dissemination level	Public (**PU**) / Restricted to other programme participants (**PP**) / Restricted to a group specified by the consortium (**RE**) / Confidential, only for members of the consortium (**CO**) / Classified with the classification level "Restreint UE" according to Commission Decision 2001/844 and amendments (**Restreint UE**) / Classified with the mention of the classification level "Confidentiel UE" according to Commission Decision 2001/844 and amendments (**Confidentiel UE**) / Classified with the mention of the classification level "Secret UE" according to Commission Decision 2001/844 and amendments (**Secret UE**)
Date of Version	2013-03-28

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Abstract	The present report aims to present background information on the learning profile of students with dyslexia, presenting the various approaches to learning and teaching in dyslexia. A report on the specific difficulties exhibited by students with dyslexica is provided, while the specific intervention approach adopted by ILearnRW and the way it is going to be implemented is described. Finally, an outline of the architecture of the intervention model is described, which consists of a classification of the difficulties or types of errors, mapped onto learner profile entries, which will determine the whole operation of the ILearnRW software. Finally, sample activities addressing the error or difficulty types and mapped on to the learner profile entries are provided.

Keywords	learner profile, learning strategies, teaching strategies

Document Status Sheet

Issue	Date	Comment	Author
v01	2013-03-08	Draft 1	Maria Mastropavlou
v02	2013-03-20	Draft 2	Maria Mastropavlou
v03	2013-03-27	Draft 3	John Rack
v04	2013-03-28	Final	Maria Mastropavlou

Project information

Project acronym:	ILearnRW
Project full title:	Integrated Intelligent Learning Environment for Reading and Writing
Proposal/Contract no.:	318803

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1. Introduction

Reading is one of the basic linguistic skills, along with production and comprehension of oral speech. For most readers, extracting information from written text is an automatic and effortless process once it has been fully acquired. For a quite significant number of individuals, however, dealing with written language is strenuous and sometimes even frustrating, leading to educational and social exclusion, especially in the school environment. The way students with dyslexia and specific learning difficulties (SLDs) process written material is substantially different from that used by most students, as well as their learning profile, rendering the formulation of a specialised teaching approach essential.

This report aims to provide information on the specific characteristics of dyslexia, as defined by types of difficulties and symptoms, as well as on the learning and teaching strategies that are often used to enable students with dyslexia to overcome their difficulties and develop reading and writing skills to a level appropriate to their age. Additionally, information on the curriculum provided to students with dyslexia in Greece and the UK is provided as well as background information on existing learning programmes. Moreover, an intervention model adopted by the ILearnRW project is described, mapping the specific difficulties encountered by students with dyslexia on intervention goals and teaching strategies, providing sample teaching materials and activities. Finally, the application of learning strategies in serious games targeting children with dyslexia is addressed.

2. The cognitive and learning profile of Dyslexia

Dyslexia is a term broadly used to describe difficulties with processing written language. Specifically, it is often seen as a specific learning disability that "...is characterised by difficulties with accurate and/or fluent word recognition and poor spelling and decoding abilities." (Lyon et al. 2003, p.2). These difficulties are seen as a result of limited phonological abilities such as poor phonological awareness. During school years, dyslexia disrupts the acquisition of reading and writing skills but often affects other language skills as well, such as spoken language processing and comprehension. These difficulties typically result in poor school performance, poor self esteem and sometimes educational and social exclusion.

When attempting to build an intervention framework for dyslexia, defining the specific symptoms and difficulties encountered by students with dyslexia is of paramount importance. Although the fact that the difficulties found in dyslexia mainly originate in deficits in the phonological component of the language system (Shaywitz et al. 2008), manifestations of this underlying difficulty in all linguistic levels are evident. That is, students with dyslexia exhibit reading profiles of both reduced fluency and accuracy, producing reading errors on a phonological, morphological or semantic level. The following section provides a description of the underlying difficulties encountered by students with dyslexia and a classification of the most common errors exhibited in alphabetical languages like English and Greek.

2.1. **Specific characteristics and types of difficulties**

Although the exact cause of the difficulties found in students with dyslexia is not yet fully understood, there has been considerable consensus on the role played by phonemic awareness in both the acquisition of reading by typically developing children *and* in the reading problems found in dyslexia. Specifically, it is attested that children with dyslexia find it difficult to segment a word into syllables and a syllable into sub-syllabic units, which leads to difficulties in parsing orthographic units and renders decoding by analogy problematic (Lovett et al. 1994, 1992). On the other hand, dyslexia has also been claimed to cause problems with developing word identification strategies as well as metalinguistic control over the process of reading (Lovett et al. 1994). In other words, the two main affected areas identified in the literature are those of phonological awareness and metalinguistic control of word recognition. These underlying problems lead to a number of specific symptoms that are manifested during reading and writing in the form of phonological, visual, morphological or semantic errors. The following classification describes the most common problems encountered by children with dyslexia and is further exemplified in Table 1 in the Appendix.

2.1.1. Reading difficulties

Phonology – Sub-word level: Letter recognition problems

As stated earlier, the phonological component of language is considered to be the most severely affected in dyslexia. Phonological awareness limitations lead to specific difficulties in letter recognition within words as well as in phoneme discrimination. For example, children with dyslexia often confuse letters with similar acoustic features, such as /v/, /f/ and /θ/. This difficulty is often manifested as letter reversals, so that children might read '**δ**ί**β**α' /**ð**i**v**a/ instead of '**β**ί**δ**α' /viða/, and letter substitutions, like reading 'βάδος' /va**ð**os/ instead of 'βάθος' /vaθos/. Auditory-based errors also include letter reversals and substitutions in consonant clusters, so that clusters 'δρ' /ðr/ and 'θρ' /θr/, 'φρ' /fr/ and 'χρ' /χr/, 'χθ' /χθ/ and 'φθ' /fθ/ are very commonly misread by children with dyslexia, especially in word-medial positions.

Letters are also confused based on their visual similarity, so that 'β' /v/ and 'θ' /θ/ are often confused, leading to errors like '**β**ίδα' /**v**iða/ instead of '**θ**ήβα' /**θ**iva/. Letters in consonant clusters are very frequently reversed, so that 'πί**στ**α' /pi**st**a/ would be read instead of 'πί**τσ**α' /pi**ts**a/ or 'ά**θν**ος' /a**θn**os/ instead of 'ά**νθ**ος' /a**nθ**os/. Additionally, the position of the confused sounds/letters in the word also affects the children's performance, with more omissions being exhibited in word-internal than in word-initial positions. Visually-based errors also include omissions or additions of letters or syllables ('tr**e**ip' instead of 'trip', 'α**κ**ηδόνι' /akiðoni/ instead of 'αηδόνι' /aiðoni/) while reading (see Section 1 in Table 1).

Word-level: Word recognition problems

Children with dyslexia very frequently make reading errors due to limited automatic word recognition abilities, leading them to read via a sub-lexical, letter-to-letter or syllable-to-syllable route rather than a lexical, automatic word retrieval route. As a result, errors or word substitutions based on visual similarity, i.e. substitutions of words for others that begin with the same letter or syllable (e.g. 'negative' instead of 'navigate') are very common. Other visually-based word recognition errors include letter or syllable reversals, leading to reading a different existing word to the one written (e.g. μόνος, /monos/ 'alone' – νόμος, /nomos/ 'law'), word omissions, which mainly involve content words (i.e. adjectives, nouns, verbs, adverbs) rather than function words (i.e. articles, prepositions etc.), or difficulties reading polysyllabic or compound words. Additionally, semantic errors are quite frequent as well, so that a child with dyslexia might read a different word, similar in meaning to the one written (e.g. reading 'καράβι' =boat, instead of 'πλοίο', =ship) (see Section 2 in Table 1).

Morphological and grammatical errors

Children with dyslexia also tend to make grammatical errors while reading, which mainly involve omissions (in English) or substitutions (in Greek) of inflectional suffixes (e.g. *walk* instead of *walk**ed***, in English, or *παίζει* (play$_{\text{-3rd/sing.}}$) instead of *παίζουν* (play$_{\text{-3rd/plural}}$), 'παιδί' (child$_{\text{-sing.}}$) instead of 'παιδιά' (child$_{\text{-pl.}}$) in Greek). Given that Greek is a highly inflectional language, reading errors within inflectional paradigms are frequent in dyslexia. Additionally, function words like articles and clitic

pronouns are also often omitted or substituted while reading, so that a child with dyslexia might read 'η Άννα αγκαλιάζει' (the$_{\text{-fem/nom/sing.}}$ Anna hug$_{\text{-3rd/sing.}}$, =*Anna is hugging) instead of 'η Άννα **την** αγκαλιάζει' (the$_{\text{-fem/nom/sing.}}$ Anna **her**$_{\text{-fem/acc/sing.}}$ hug$_{\text{-3rd sing.}}$, =Anna is hugging **her**). Finally, derivational errors are also very common (e.g. reading '**hung**ry' instead of '**hung**er', **παι**δί' 'child' instead of '**παι**χνίδι' 'toy') (see Section 3 in Table 1).

Phrase / Sentence level: Grammatically-based errors (sentence comprehension)

On a phrasal or sentence level, Greek children with dyslexia have been found to exhibit poor sentence comprehension skills due to slow integration of grammatical information during sentence processing (Mastropavlou, Papadopoulou & Tsimpli 2007) and poor interpretation of syntactic rules. Vocabulary limitations are also frequently found in dyslexia, which cause low text processing and comprehension abilities, difficulties in summarizing and reporting the details of a text (see Section 6 in Table 1).

2.1.2. Spelling problems

Spelling is also severely affected in dyslexia. Specifically, spelling errors are caused by auditory similarities between letters, leading to reversals or substitutions of letters that correspond to acoustically similar sounds, such as 'β' /v/, 'φ' /f/ and 'θ' /θ/ as well as consonant clusters like 'κτ' /kt/ and 'πτ' /pt/, 'φθ' /fθ/ and 'χθ' /χθ/. Additionally, errors very often relate to the transparency of the grapheme-phoneme correspondence of a letter cluster, so that students typically have difficulties with non-transparent or irregularly spelled words (e.g. 'αυ' and 'ευ', which are pronounced either as /av/ and /ev/ or /af/ and /ef/, as in 'Α**ύ**γουστος' /a**v**gustos/ 'August', 'α**υ**τός' /a**f**tos/, 'ε**υ**χή' /e**f**xi/ 'wish' etc.).

Letters with visual similarity also cause very frequent spelling errors, so that children typically substitute 'β' for 'θ', or alternate between 'κ', 'χ', 'γ', and 'λ'). Visual errors also include additions or omissions of syllables, which mainly occur in words with repeating syllabic patterns, as in 'πατάτα' which is frequently written as 'πατατάτα' or 'πάτα'. Writing only the first letter or syllable of a word is also commonly found, so writing 'το' instead of 'τόπι' is also a common error type (see Section 4 in Table 1).

Finally, grammatical errors are also very frequently found in Greek (although not in English), which mainly involve incorrectly spelled verbal (e.g. 'κοιμάμ**ε'** instead of 'κοιμάμ**αι'**, 'sleep'$_{\text{-1st/sing}}$) or nominal suffixes (e.g. 'όμορφ**ι**' instead of 'όμορφ**η**', 'beautiful'$_{\text{-fem/nom/sing}}$) (see Section 5 in Table 1).

2.2. **Learning and teaching strategies for dyslexic students**

Learning is a complicated process that incorporates a number of factors. In general, each individual tends to employ different means of accessing and processing the information that is being learnt, which defines the type of learner he/she belongs to. The issue of learning styles has been extensively discussed and investigated in the literature, with a number of different cognitive, social and emotional factors being taken into consideration. Oxford (1990) classifies learning strategies into *memory* (related to keeping information in memory), *cognitive* (related to processing information), *compensation* (using other means to compensate for weaknesses or difficulties), *metacognitive* (conscious control of learning) and *affective* (related to feelings) strategies, acknowledging a significant role to social and emotional factors.

Focusing on cognitive factors, researchers have claimed that a learning style is actually an individual way of processing information of all types as applied to a learning situation (Smythe 2000) and have concluded in two basic distinctions of learning styles: *verbal* versus *visual* and *holistic* versus *analytic* (Riding & Rayner 1998). More specifically, under a narrower classification, three types of learners have been identified in research: *visual* learners, who perform best when they can visualise the information to be learnt, so that visual presentation of information leads to better learning; *auditory* learners, who are good at integrating auditory (verbal) information and even verbalise written information to achieve better integration; and *tactile/kinaesthetic* learners, who tend to achieve faster and better learning through touching objects or performing gestures (Exley 2003).

2.2.1. The learning profile of a dyslexic student

When it comes to dyslexia, research has indicated that different hemispheric patterns and processing mechanisms are associated with differential learning strategies and particularly to a general preference for visuospatial strategies (Everatt, Steffert & Smythe 1999). Specifically, it has been shown that individuals diagnosed with dyslexia tend to exhibit higher right hemisphere dominance than individuals without dyslexia, which can place them at a disadvantage when performing tasks that are typically undertaken by the left hemisphere, such as language-related tasks (Galaburda 1993). Hemispheric dominance has been related to the way an individual processes information; while the left hemisphere performs an analytic processing of information, placing emphasis on the details of a stimulus (top-down processing), the right hemisphere employs a global or holistic approach to processing information (bottom-up processing). As a consequence, a right-hemisphere-dominant individual, as children with dyslexia are frequently found to be, has greater difficulty performing tasks that require attention to detail, such as reading accurately (Reid 2002). In his Balance Model of dyslexia, Bakker (1992) distinguishes two reading types, the *perceptual* and the *linguistic* reader, classifying individuals with dyslexia as perceptual readers. Using neuropsychological evidence, he claimed that perceptual readers are right-hemisphere dominant individuals and can achieve normal reading comprehension but poor reading accuracy, while linguistic readers are left-

hemisphere dominant and tend to focus on the formal aspects of the text, achieving high reading accuracy but missing out aspects in comprehension.

Additionally, children with dyslexia are quite frequently found to fall behind in metacognitive aspects of learning, which means that they cannot perform conscious techniques to enhance their learning (Tunmer & Chapman 1996). A very important implication of this finding is that students with dyslexia can greatly benefit from making underlying connections and relationships between aspects of the learning material explicit, in other words, from being shown *how* to learn rather than altering the material to be learnt (Reid 2002). In fact, it has been shown that enhancing metacognitive awareness along with adjusting teaching to the student's learning style can lead to the best learning outcomes when it comes to students with dyslexia (ibid).

2.2.2. Teaching approaches to dyslexia

The formulation of effective teaching approaches to dyslexia has drawn considerable interest within the past three decades and has lead to a number of accounts. Reid (2002) claims that teaching students with dyslexia can produce the best outcome if both metacognitive approaches and the students' learning styles are taken into consideration. Specifically, he proposes a teaching approach that incorporates techniques of enhancing metacognitive awareness in combination with targeting the skills that students with dyslexia are considered to be better at, based on their learning style. The following two key areas are proposed:

Enhancing metacognitive awareness – developing metacognitive strategies

Students can develop metacognitive strategies through short activities like *visual imagery* (discussing or sketching images from text), *webbing* (using concept maps of the ideas in a text), *self interrogation* (asking questions about what they already know or expect to learn about a topic) and others. Additionally, encouraging skills that enable good reading, such as constructing mental images while reading, re-reading when necessary and self-correcting (Wray 1994) is also suggested.

Acknowledging students' learning style

Reid (2002) suggests using standardised tools to identify students' learning style, such as the *Learning Style Inventory* (Kolb 1984) or the Dum & Dum approach (Dunn, Dunn & Price 1996), or collecting observational data based on the Interactive Observational Style Identification framework (IOSI, Reid & Given 1999). The IOSI framework identifies the student's learning style based on information related to his/her emotional state (motivation, persistence, responsibility, organisational skills), social (interaction and communication with peers), cognitive (modality, learning speed) and physical (mobility, food intake, productive time of day) and reflection (sound, light and temperature preferences, metacognition, prediction, responsiveness to feedback) skills (Reid 2002).

Further research has investigated the effectiveness of two contrasting teaching approaches to dyslexia: a top-down, implicit teaching approach that dedicates the largest part of teaching time to reading texts and visual word recognition training and only leaves a small portion to teaching to explicit, word-level decoding activities, and a multisensory, bottom-up teaching approach that aims to develop phonemic awareness through explicit teaching of grapheme-phoneme correspondence rules. Torgesen et al. (1999) investigated two such approaches, an embedded phonics instruction approach, an example of a top-down approach, and the *Lindamood Auditory Discrimination in Depth programme* (1998), a bottom-up explicit teaching approach. Their findings indicated that a primarily bottom-up approach that employs explicit phonic teaching can be most beneficial for students with dyslexia, given the fact that limited metacognitive and graphophonemic awareness as well as predominantly bottom-up, visual processing commonly characterise the syndrome.

The full use of multi-sensory approaches encompasses visual-motor coordination / visual discrimination of shapes, which is achieved with the use of images, colour varied font, varied text size, pages with illustrations, line spacing, gaps between paragraphs; auditory stimuli, such as dichotic listening and rhythm exercises; tactile activities that enhance grapho-motor skills through primary school games such as drawing letters/words by hand and asking students to identify them (embossed letters).

Lovett et al. (1994) investigated two teaching programmes developed for students with dyslexia, one of which focuses on direct teaching of grapheme-phoneme correspondences, while the other targets word identification strategies by enhancing metacognitive control of word identification. Specifically, the first approached studied was the *Phonological Analysis and Blending / Direct Instruction* (PHAB/DI) programme, which employed direct instruction of phonic rules, providing opportunities for overlearning, aiming to establish higher levels of transferring knowledge to newly encountered material. The second approach was the *Word Identification Strategy Training* (WIST), which trained students to use word identification strategies such as word identification by analogy, identifying known parts within words, attempting variable vowel pronunciations and stripping affixes of multisyllabic words (p.808). While both programmes were found to enhance phonological awareness as well as transfer of knowledge skills, the WIST programme seemed to facilitate transfer of skills to irregular words and the PHAB/DI appeared to improve nonword reading.

To sum up, children with dyslexia seem to fall behind compared to their peers in two main areas: phonological awareness, as it is encapsulated by grapheme-phoneme correspondence knowledge, and metacognitive control of their learning process. Therefore, the teaching strategies that have proven to be most effective in facilitating the process of learning to read by students with dyslexia involve multisensory, direct teaching of phonological routines and enhancing metacognitive skills by training students to detect similarities, relationships and systematic patterns in language.

2.2.3. Teaching spelling

As far as spelling is concerned, it is often suggested that because dyslexia causes children to remain at a visually-based stage of reading and spelling development (logographic stage) for a longer period of time compared to their peers (Frith 1985), improving phonological skills in dyslexia will also improve spelling. In fact, the relevance of phonological awareness in spelling has been repeatedly suggested in the literature (e.g. Bryant & Bradley 1985, Bruck & Treiman 1990), leading to phonological teaching approaches being used to address spelling problems as well. More recent research has claimed that the use of multisensory techniques has also been frequently suggested in the literature. A commonly used technique of teaching spelling is the *simultaneous oral spelling*, which involves having the student hear the word, pronounce it and spell it out loud, pronounce each letter while writing the word and finally read the word as it has been written. The simultaneous oral spelling technique enhances the relationship between visual, auditory and motor (kinesthaetic) modalities and has been found to produce satisfactory progress in students with dyslexia (Thomson 1990). In fact, this method has been found to more effective with students with dyslexia compared to controls (Thomson 2009), indicating that the involvement of the motor modality can be used as a means to compensate for weaknesses related to phonological awareness.

3. Available services for students with dyslexia in special and mainstream education in Greece and the UK

Dyslexia constitutes one of the most common specific learning difficulties that are found within the mainstream educational setting. The difficulties encountered by children with dyslexia are usually first identified by their teacher, who then follows the procedures defined by the state for special education services in the public and private sector. The educational setting students with dyslexia are finally placed in is highly relevant to the purposes of the project, as addressing the students' learning needs and providing educational and learning support that best fits to their educational setting is one of the main research aims of the project. This section provides information on the educational services that are available for students with dyslexia in Greece and the UK.

3.1. **Greece**

Students with dyslexia can be placed in three different types of educational setting. According to the relevant legislation (law 3699/2008), the learning needs of students are addressed (a) within the mainstream classroom, (b) in an inclusive education school, (c) in private settings.

In the first case and depending on the severity of the difficulties exhibited by the student, the teacher collaborates with the student's family and the general educational counsellor of the school district in dealing with the student's difficulties and trying to facilitate his/her learning within the mainstream classroom. Usually a short-term intervention programme is designed and applied for a two-month period before the student is referred to special education services outside the mainstream classroom.

In the second case, when an inclusive education programme is available in the school unit, the teacher works closely with a special education teacher, who is invited to observe and facilitate the student's learning within the mainstream classroom. An individualised short-term intervention programme is designed and applied by the mainstream and special education teachers for two months.

In the third case, students with dyslexia are seen by a special educator or a speech therapist in the private sector, who designs and applies an individualised intervention programme in an extra-curricular setting. Private sector settings typically provide individual intervention sessions to students with dyslexia, which may or may not be dependent on the school curriculum.

3.2. **UK**

The current SEN system

The UK system for meeting the needs of those with special educational needs is undergoing reform at the present time with a new law being debated in Parliament and expected to come into force in September 214. This is drawing on a wide consultation and a number of important reports. For example, in January 2010 Brian Lamb (Lamb, 2010) published a report on parental confidence in the Special Needs system and in OFSTED (2010) published its review of SEN provision based on the inspection of 345 cases in over 200 schools, colleges and nurseries. The OFSTED report highlighted the fact that almost 20% of the school population were identified as having special needs.

School Action:

If schools are concerned about a child's progress, or parents raising concerns, the decision may be taken for some measures to be put in place using the staff and resources that are already in place in the school. This might involve working in a small group with a teaching assistant, working on different materials in class (perhaps with support for some of the reading demands of the task) or even some extra work at home.

School Action Plus:

If progress remains a concern despite the measures a school is able to use from its own resources, then they may seek advice from learning or literacy support teachers, educational psychologists or others from outside the school. External specialists may put in place programmes that the school staff can deliver or provide support directly.

Statement:

Where a child's needs cannot be met without additional external resources or where it is necessary for them to attend a specialist school, then they are likely to be given a Statement of SEN.

One of the main problems with the current system is that parents are confused by the terminology. Comments that Dyslexia Action has received show that some parents think of a Statement as simply a report which sets out what should be done. Others, however, are fearful that it could give powers to the Local Authority to make decisions against their wishes.

Dyslexia Action has agreed with the common policy and practice that a Statement should not usually be necessary in order to meet the needs of children with dyslexia. In some cases, where there are additional needs and other factors to take into account, a specialist placement may be required, but this is very clearly the exception.

Most children with literacy difficulties including those with dyslexia receive support within their school settings, some attend specialist centres such as those run by Dyslexia Action and the costs of doing so are usually met by parents

Proposed Reform

The latest statement on the Government's plans was published in May 2012 in the Green Paper: Support and Aspiration: A new approach to special educational needs and disability – progress and next steps' (DfE, 2012). As a result of the consultation, proposals have been refined and focus on the following 4 key measures:

- A single assessment system which should be more streamlined, quicker to process and better involve children and young people from 0–25 and their families.
- An education health and care plan (EHC Plan) to replace the Statement of Special Needs, which will ensure that services work together and come with a personal budget for families who want it.
- A requirement on local authorities to publish a 'Local Offer' indicating the support available to those with special educational needs and disabilities and their families.
- The introduction of mediation opportunities for disputes and a trial giving children the right to appeal if they are unhappy with their support.

In relation to dyslexia, provision is most likely to be made available through the Local Offer (DfE, 2012). In this, local authorities will be required to set out information for parents which helps them to understand what services they and their family can expect from a range of local agencies. A key feature of the Local Offer is that it should make clear what provision is normally available from early years settings, schools, colleges and other services, including health and social care.

3.3. **What Works: Interventions and Good Practice**

Recent reports such as Rose 2009 and OFSTED 2010 have highlighted those features of practice that promote successful outcomes. OFSTED's report was concerned with good learning outcomes in general, but the points made are relevant to literacy and dyslexia.

OFSTED September 2010 'A Statement is Not Enough':

Children and Young People learnt best when:

- Teachers presented information in different ways to ensure all children and young people understood
- Teachers adjusted the pace of the lesson to reflect how children and young people were learning
- The effectiveness of specific types of support was understood and the right support was put in place at the right time.
- Assessment was secure, continuous and acted upon

- Teachers' subject knowledge was good, as was their understanding of pupils' needs and how to help them
- The staff understood clearly the difference between ensuring children and young people were learning and keeping them occupied
- Respect for individuals was reflected in high expectations for their achievement
- Lesson structures were clear and familiar but allowed for adaptation and flexibility
- All aspects of a lesson were well thought out and any adaptations needed were made without fuss to ensure that everyone in class had access

Children and Young People's learning was least successful when:

- Expectations of disabled children and young people and those who had SEN were low
- Activities and additional interventions were inappropriate and were not evaluated in terms of their effect on children and young people's learning
- Resources were poor, with too little thought having been given to their selection and use
- Teachers did not spend enough time finding out what children and young people already knew or had understood
- Teachers were not clear about what they expected children and young people to learn as opposed to what they expected them to do
- Communication was poor: teachers spent too much time talking, explanations were confusing, feedback was inconsistent, language was too complex for all children and young people to understand the tone and even body language used by adults was confusing for some of the children and young people, who found social subtleties and nuances difficult to understand
- The roles of additional staff were not planned well or additional staff were not trained well and the support provided was not monitored sufficiently
- Children and young people had little engagement in what they were learning, usually as a result of the above features

Sir Jim Rose's review (2009) highlighted the importance of teachers having an understanding of the normal processes of development in reading and spelling and, in particular, the Simple Model of Reading. A Survey of practitioners who were consulted for this review identified the following features of good practice as most important.

- Using multisensory methods for teaching & encouraging multisensory learning
- Planning and delivering lessons so that pupils/ students experience success
- Planning and adapting the teaching programme to meet individual needs
- Teaching a structured programme of phonics
- Building in regular opportunities for consolidation & reinforcement of teaching points already covered
- Maintaining rapport with pupils/students
- Planning a purposeful and engaging balance of activities in lessons
- Teaching pupils/ students to be aware of their own learning strategies
- Teaching pupils/ students to develop effective learning strategies

- Showing sensitivity to the emotional needs of pupils/students
- Teaching pupils/students to improve their working memory
- Selecting appropriate resources to support particular learning needs

The features of good practice identified by OFSTED and by Rose show close agreement, and resonate well with reports that Dyslexia Action receives from parents about what they have found helpful or unhelpful. It is interesting to see that good practice for those with dyslexia is not just about individualised learning programmes and the specific content of these programs. The ethos and organisation of learning within the classroom and across the whole school also make a big difference. In summary, effective learning for children with dyslexia depends on:

a) A whole school ethos that respects individuals' differences, maintains high expectations for all and promotes good communication between teachers, parents and pupils
b) Knowledgeable and sensitive teachers who understand the processes of learning and the impact that specific difficulties can have on these
c) Creative adaptations to classroom practice enabling children with special needs to learn inclusively and meaningfully, alongside their peers
d) Access to additional learning programs and resources to support development of key skills and strategies for independent learning

4. The intervention model adopted by ILearnRW

The intervention approach adopted by ILearnRW entails three distinct sections that are interrelated and interact throughout the design, construction and operation of the software. These are (a) the types of difficulties commonly encountered in dyslexia, (b) the learner profile entries, which are mapped onto the difficulty types, and (c) a number of specialised activities, which are in turn mapped onto the learner profile entries and the difficulty types.

To begin with, a classification of the types of difficulties most commonly encountered by students with dyslexia has been made and is illustrated in Table 1 (available in the Appendix). Difficulties are related to two main skills: reading and spelling. Reading and spelling difficulties are classified into sub-categories, based on the language level they relate to. Under the proposed scheme, reading difficulties can:

- relate to phonological knowledge and skills and can depend on the auditory or visual characteristics of letters and sounds (categories 1.1 and 1.2 in Table 1);
- relate to the word level and include word recognition problems, which are manifested as visually-based or semantically-based errors (categories 2.1 and 2.2 in Table 1);
- involve grammatical skills and morphological knowledge manifested at the word level (category 3 in Table 1);

Additionally, spelling difficulties can include:

- auditory-based difficulties (category 4.1 in Table 1);
- visually-based difficulties (category 4.2 in Table 1);
- grammatical difficulties, related to morphological knowledge and analysis skills (category 5 in Table 1).

Reading and spelling difficulties on a phrasal, sentence and/or text level are classified separately and can relate to:

- grammatically/syntactically-based difficulties (category 6.1 in Table 1);
- vocabulary and text processing difficulties (category 6.2 in Table 1).

The classification of the types of difficulties was used to construct a number of entries that will comprise an initial evaluation of each learner and determine the learner profile. Specifically, each profile entry is mapped onto one or more difficulty types, so that the child is initially evaluated on each entry, while the outcome of this evaluation will formulate the learner profile, which will then determine the intervention activities presented to the child. The learner profile entries will be informed through a short screening procedure, during which the profile entries will be presented to the teacher or parent of the child in the form of simply worded questions / parameters, which the he/she will have to set to a value between 1 and 10, depending on the severity of each problem, prior to the child's first use of the software. The learner profile entries are presented in Table 2 (available in the Appendix).

After the initial screening of each child, the informed learner profile will map onto an individualised intervention plan, which will include specialised activities that target the difficulties that have been rated as most severe during the initial screening. To that purpose, a number of activities in the form of *mini games* or *serious games*, each of which maps onto one or more profile entries will be included in the software database. The activities selected are designed based on the direct teaching approach, while multisensory techniques are also employed where possible. The structure of a sample activity is described in the Section 6, while more sample activities are provided in Table 3 (available in the Appendix). The following diagram provides an outline of the intervention approach adopted by ILearnRW.

INDIVIDUAL METHODOLOGICAL PLAN
Outline:

1. Types of difficulties – Diagnostic profile (*Initial Evaluation/Screening)

↓

2. Domains under examination/goals: phonological awareness, reading skill (comprehension), spelling

↓

3. Approaches: visual, auditory, tactile, kinaesthetic

↓

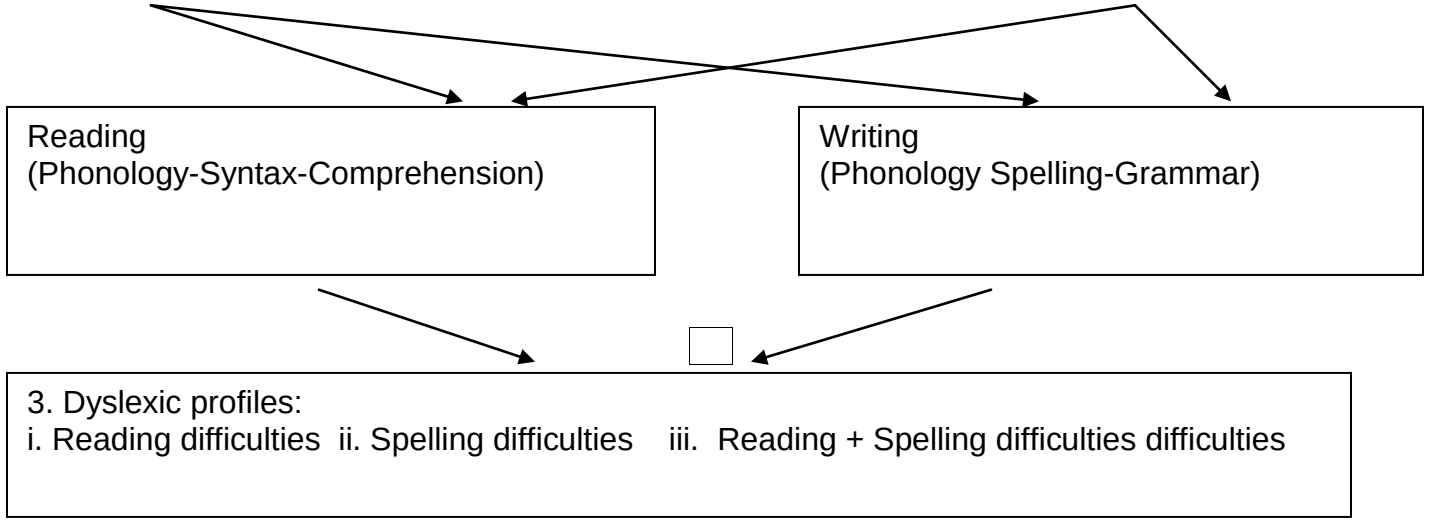
4. Intervention procedure – Activities (*Re-Evaluation: short-term targets):

Texts: graded classified according to the following sequence: letter-syllable-word-sentence-paragraph {one criterion of the classification: the phoneme-target}
Resources bank: include any additional material, technique, approach (two-three per activity)
Games: i) based on texts, ii) independent games
*Final evaluation (long-term target)

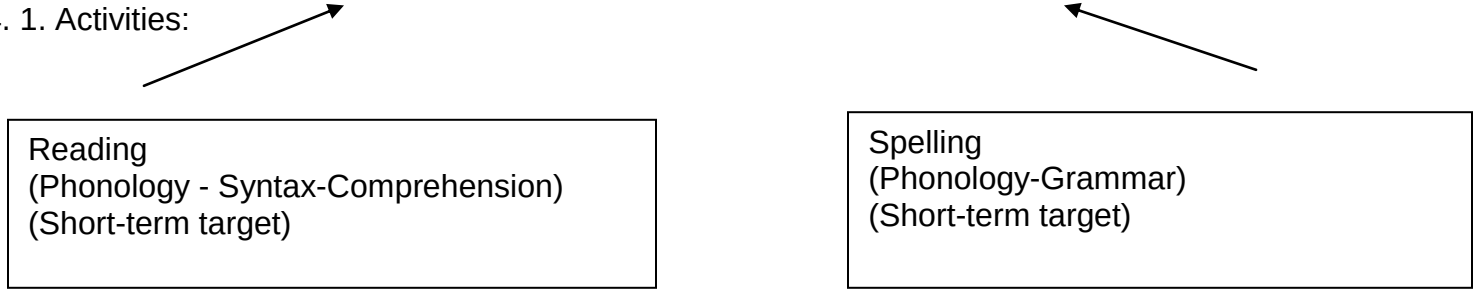
B. Methods-Material:

1. a. Questionnaire for parents, educators, specialists b. Individual evaluation form (children 9-11 years old)

2.



4. 1. Activities:



4.2 Evaluation of Progress: re-evaluation forms, final evaluation form

5. A sample activity

General Information
Activity No: 8
Title: Letters in a chest
Type: Mini game
Brief description:

The child sees a box with a typed word and a number of blank coloured boxes next to it. Each of the boxes corresponds to a letter of the printed word. The boxes are differently coloured by syllable (the boxes for the letters of the first syllable are in green, the second syllable in pink etc). The child is asked to type the letters of the printed word inside the coloured boxes. Next, the first card with the printed word disappears and more boxes appear under the letter boxes, this time one box for each syllable, coloured in the same way as the letter boxes (1st box is green, 2nd is pink etc). The child copies the syllables into the boxes. In a final stage, the child copies the whole word in one bigger box. The child can hear each syllable and the final word by clicking on the boxes after filling them in.

Learning outcomes:
- Syllabify, segment words into syllables and syllables into sub-syllabic units.
- Combine letters into syllables and syllables into words.
- Read and spell multisyllabic and compound words.
- Improve spelling of words with complex syllabic structure.

Language:
Greek

Relevant error types:
1.2.3, 1.2.4, 2.1.5, 4.2 (see Table 1 classification)

Relevant profile entries:
6, 7, 10, 16, 17, 18, 19, 20 (see Table 2)

Level of Difficulty:
Basic to Elementary

Age level:
9-11 yrs

Detailed description:

Procedure:
Scenario

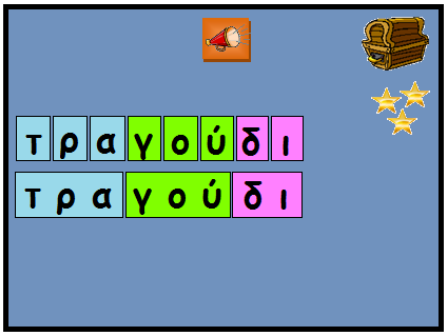
The child is introduced into the scenario through a short animated video. There is a cupboard with 10 shelves, each containing an increasing number of words. The words included in the higher shelves are of greater difficulty, while those of the lower shelves are easier: shelves 1 to 3 contain words with simple syllabic structure of increasing number of syllables (shelf 1 contains 2-syllable, shelf 2 3-syllable and shelf 3 contains 4-syllable words); shelf 4 contains 2-syllable words of more complex syllabic structures, shelves 5 to 7 contain 3-syllable words with syllabic structures of increasing difficulty and irregularity (for example, syllables with glides are included in shelf 7), shelves 8 and 9 contain 4-syllable words of increasing syllabic complexity and shelf 10 contains 5-syllable words.

The child has to correctly syllabify and spell the words to collect stars. Each word gives stars depending on the shelf it belongs to (for example, shelf-1 words give one star each, while shelf-10 words give 10 stars each). The child has to collect stars in a chest so as to achieve higher levels.

Playing

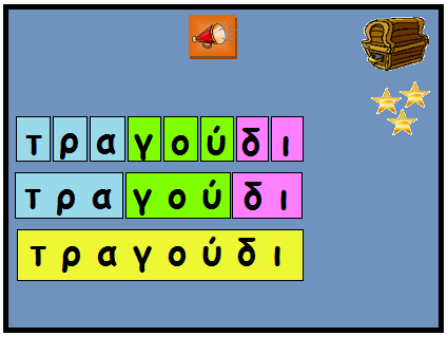
The child sees a typed word and a number of blank coloured boxes under it. Each of the boxes corresponds to a letter of the printed word. The boxes are differently coloured by syllable (the boxes for the letters of the first syllable are in blue, the second syllable in green etc). The child is asked to first press the speaker button in order to hear the word and then type the letters of the printed word inside the coloured boxes.

Next, the first card with the printed word disappears and more boxes appear under the letter boxes, this time one box for each syllable, coloured in the same way as the letter boxes (1st box is blue, 2nd is green etc). The child copies the syllables into the boxes.

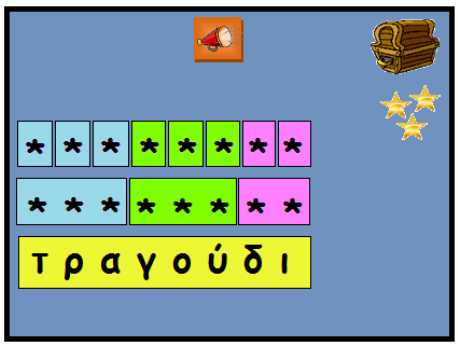


If the child makes a mistake (letter reversal or incorrect letter), the game will ask him/her to hear the syllables written and correct his/her mistake before proceeding to the final stage.

In the final stage, the child copies the whole word in one bigger box.



In the second half of the words of each level, parts of the word disappear from the boxes of the previous stage, while in the last 3 words of each level, the whole word disappears from the boxes of the previous stage and the child has to write the letters in the new boxes by memory.



If the child passes all stages of a word with no errors, he/she collects all the stars of the word. If he/she makes an error, he/she loses either a part of a star (in the first 3 levels) or a whole star for each error.

Materials:

The words included in the activity are of the following structure (each of the following difficulty levels corresponds to a shelf in the cupboard):

- Shelf 1 (10 words): CV-CV, CV-CVC, e.g. ‘γόμα’ /γoma/ or ‘μόνος’ /monos/
- Shelf 2 (10 words): CV-CV-CV(C), e.g. ‘κανόνι’ /kanoni/
- Shelf 3 (10 words): CV-CV-CV-CV(C), e.g. ‘καλοκαίρι’ /kaloceri/
- Shelf 4 (15 words): CCV-CV(C), CV-CCV(C), V-CCV(C), CVC-CV(C), CV-CCCV, CCCV-CV, V-CCCV, e.g. ‘σπόρος’ /sporos/, ‘κόλπο’ /kolpo/, ‘κάδρο’ /kaðro/, ‘ληστής’ /listis/, ‘αφρός’ /afros/, ‘κάστρο’ /kastro/, ‘στρώμα’ /stroma/, ‘άστρο’ /astro/ etc.
- Shelf 5 (15 words): CCV-CV-CV(C), CV-CCV-CV(C), V-CCV-CV(C), CVC-CV-CV(C), e.g. ‘στεφάνι’ /stefani/, ‘κάρβουνο’ /karvuno/ etc.
- Shelf 6 (15 words): CV-CCCV-CV, CCCV-CV-CV, V-CCCV-CV, e.g. ‘ομπρέλα’ /obrela/, ‘αστράκι’ /astraki/ etc.
- Shelf 7 (15 words): CV-CV-CGlV, ‘παιδάκια’ /peðaca/,

- Shelf 8 (20 words): CV-V-CV-CV, CV-CCV-CV-V, e.g. γαϊδούρι /γajðuri/, ‘παϊδάκι’ /pajðaci/, ‘τετράδιο’ /tetraðio/
- Shelf 9 (20 words): CV-CCV-CV-CV(C), CCV-CV-CV-CV(C), CVC-CV-CV-CV(C), CV-CVC-CV-CV(C), CCCV-CV-CV-CV(C), V-CCCV-CV-CV(C), CVC-CV-CV-CV(C), etc., e.g. ‘πλαστελίνη’ /plastelini/, ‘ασπρόρουχα’ /asproruχa/ etc.
- Shelf 10 (20 words): CV-CCV-CV-CV-CV(C), CCV-CV-CV-CV-CV(C), CVC-CV-CV-CV-CV(C), CV-CVC-CV-CV-CV(C), CCCV-CV-CV-CV-CV(C), V-CCCV-CV-CV-CV(C), CVC-CV-CV-CV-CV(C), etc., e.g. ‘αστρονομικός’ /astronomikos/ etc.

6. APPENDICES: Error Types, Profile Entries and Sample Activities

Table 1 Error type classification

#	Problem type	Sub-type: context or specific problem	Clarification/ Example		Relevant profile entry	Relevant activities
A	READING		GR	ENGL		
1	PHONOLOGY - SUB-WORD LEVEL: LETTER RECOGNITION PROBLEMS					
1.1	Difficulty in recognizing letters: Auditory-based errors					
1.1.1	Letter recognition: Confusing letters (consonant clusters and consonants) with similar acoustic features depending in word initial, internal and final position.	word-initial position word-internal position	δρ-θρ, φρ-χρ, χθ-φθ, κτ-πτ, θ-δ, φ-β, χ-γ, κ-γ, τ-ντ, π-μπ, σ-ζ, μ-ν, λ-ρ, δ-β, ξ-ψ, φ-θ, κ-χ, κ-π, κ-τ	dr-br	1 2.1 2.2 2.3 2.4	1 2 5 9
1.2	Difficulty in recognizing letters: Visually-based errors					
1.2.1	Difficulty in recognition of symbols: Reversals of letters or sequences of letters.	letters in consonant clusters syllables (GR: cvcv)	τσ-στ, πίτσα-πίστα, στεφάνι/τσάντα καλάμι - λακάμι		5.1 5.2	3 4 5 7
1.2.2	Substitutions of letters: Confusing letters or symbols with similar form.		α-ο φ-β-θ ψ-ω 3-ε-ξ κ-χ-γ-λ	a-o b-d-q-g m-n-h r-t-f k-x	4.1 4.2 4.3 4.4 4.5	1 5 9 7

			η-μ π-τ δ-ρ-σ-6		4.6 4.7 4.8	
1.2.3	Letter or syllable omissions.	letters syllables (GR: cvcv)	έκτος - έτος κατώτερος-κατερος		6.1 6.2	4 5 7 8
1.2.4	Addition of letters or syllables that do not belong to the word.	letters syllables (GR: cvcv)	ένας-έναςα, αηδόνι-ακηδόνι κατώτερος-κατατώτερος	treip instead of trip	7.1 7.2	5 7 8
2	WORD LEVEL: WORD RECOGNITION PROBLEMS					
2.1	Word recognition: Visually-based errors					
2.1.1	Confusing words with similar letters, letter reversals.		μόνος-νόμος		8.1	5 7
2.1.2	Confusing words that begin with the same letter or syllable.		κανάτα-καντίνα, καμήλα-καλάμι	negative – navigate	8.2	5 6 7
2.1.3	Confusing words with common parts.		γάτα/γατά-κι	caught - laugh	8.3	5 7
2.1.4	Word omissions (content words).				9.1	13
2.1.5	Difficulties reading multi-syllable or compound or unknown words.		αεροδρόμιο, εύθραυστος		10.1 10.2 10.3	6 8
2.2	Word recognition: Semantically-based errors					
2.2.1	Word substitutions based on semantic relation while reading (semantic errors):		καράβι - πλοίο, άσπρο - λευκό		11	6 11

3	Morphological errors					
3.1	Suffix omissions (English) or substitutions (Greek).					
3.1.1		in nouns and adjectives	παιδί-παιδιά, ανθρώπων-ανθρώπους, ψηλός-ψηλή	toy-toys	12.1	11 14
3.1.2		in verbs	τρέχει-τρέχουν, χαίρεται-χαίρεσαι	play-plays-played-playing	12.2	12 14
3.2	Omission of function words (articles, prepositions etc.).				9.2	10 14
3.3	Morphologically-based word substitutions – derivational errors.		παίζω - παιδί - παιχνίδι	hungry - hunger	13	6 13
B	WRITING-SPELLING: LETTER-WORD LEVEL					
4	Visual-phonological errors					
4.1	Difficulty in writing letters: Auditory errors					
4.1.1	Phoneme-grapheme correspondence.	low G-P correspondence: irregular spelling	αυ:αφ/αβ - ευ:εφ/εβ, υι/υΐ, αυ/αϋ, αι/αϊ, ει/εϊ, κλπ. ο-ω-ι-η-υ-ει-οι-ε-αι /	μαύρος, ευχή, αϋπνία, παιδί/παΐδι, αστεϊσμός	14	1 9 7
4.1.2	Reversals or substitutions of letters or sequences of letters based on their acoustic similarity or contrast.	consonant clusters	κτ-πτ-φθ-χθ-βδ-γχ		15.1	7 9
		consonants	δ-β βίδα-δίβα χ-γ χαλί-γαλί / ξ-ψ ξύλο-ψύλο / χ-κ χακι-κακί /φ-θ/φ-β/θ-δ/σ-ζ/λ-ρ/τ-ντ/π-μπ/μ-ν		15.2	
4.2	Difficulty in writing letters: Visual errors					
4.2.1	Reversals and/or substitutions of letters or sequences of letters or syllables based on their visual similarity.	consonants	β-θ / δ-ρ-σ-6 / κ-χ-γ-λ / ε-3-ξ / ω-η-ψ, e.g. βυθός-θυβός/ δώρα-ρόδα/δάσος-ράσος/ σάλα-6άλα/3-	a-o / r-t-f / k-x	16.1	8

			ε έλα-3λα / κοχύλι-χογύλι/ώρα-ήρα			
		syllables (GR: cvcv-vccv) letters in consonant clusters: τσ-στ/ κτ-πτ-φθ-χθ-βδ-γχ	καλάμι - λακάμι αφρός-αρφός, πίτσα-πίστα, όχθη-όθχη, άγχος-άχγος		16.2	
4.2.2	Letter omissions in consonant clusters		άφθονος-άφονος		17.1	7
4.2.3	Addition of letters that do not belong to the word /Capitals with lowercase letters.		παήρα-πήρα/ άΛογο	treip instead of trip	18	
4.2.4	Additions or omissions of syllables (segmentation)		πατατατα-πατα		17.2	
4.2.5	Writing a word with only one letter or syllable		το για τόπι /γ για γάλα	b for boat, fa for father	19	
4.2.6	Using the same word differently spelled within the same text.		μαθητής – μαθιτίς – μαθιτής – μαθητίς	phenotype – phainotipe-phenotepi	20	
5	Grammatical errors: Grammar-related spelling errors					
5.1	Incorrectly spelled nominal suffixes (nouns and adjectives)	Nominal suffixes: nouns & adjectives	παιδή - παιδί, ανθρώπον - ανθρώπων, βουνώ - βουνό, ομορφι - όμορφη κλπ.		21.1	11 14
5.2	Incorrectly spelled articles or pronouns	Articles, pronouns	της γυναίκες - τις γυναίκες, της πήρε - τις πήρε κλπ.		21.2	10 14
5.3	Incorrectly spelled verbal suffixes	Verbal suffixes	αγαπό - αγαπώ, χαίρομε - χαίρομαι κλπ		21.3	12 14
6	PHRASE / SENTENCE / TEXT LEVEL:					

6.1	Grammatically-Syntactilly based errors					
6.1.1	Poor sentence comprehension due to poor interpretation of syntactic rules.				22.1	12
6.1.2	Poor comprehension of inflectional suffixes (e.g. past forms of verbs).				22.2	
6.2	Vocabulary and text processing					
6.2.1	Inability to summarize or identify the main idea of a paragraph.				23.1 23.2	13
6.2.2	Difficulties reporting details of a text.				24	

Table 2 Profile Entries (presented as Screening Questions to parents / teachers)

#	Profile Entries	Specific types or examples	Rating scale	Covered Problems	Activities	Covered in ILearnRW
1	Does not match sounds with the correct letters while reading		0-10	1.1.1	1 2 5 9	
2	Confuses and substitutes letters with similar sounds (χ-γ, τ-ντ, π-μπ, σ-ζ, μ-ν, λ-ρ, δ-β, ξ-ψ, κ-π, κ-τ) while reading:					
2.1		when encountered as single consonants	0-10	1.1.1	1	
2.2		when in consonant clusters like δρ-θρ, φρ-χρ, χθ-φθ, κτ-ττ	0-10	1.1.1	2	
2.3		at the beginning of a word	0-10	1.1.1	5	
2.4		in the middle of a word	0-10	1.1.1	9	
4	Confuses letters that look alike (α-ο, δ-ρ-σ-6, π-τ, φ-β-θ, ψ-ω, η-μ, 3-ε-ξ, κ-χ-γ-λ) while reading:					
4.1		α-ο	0-10	1.2.2	1	
4.2		δ-θ-φ	0-10	1.2.2	5	
4.3		ψ-ω	0-10	1.2.2	7	
4.4		3-ε-ξ	0-10	1.2.2	9	
4.5		κ-χ-γ-λ	0-10	1.2.2		
4.6		η-μ	0-10	1.2.2		
4.7		π-τ	0-10	1.2.2		
4.8		δ-ρ-σ-6	0-10	1.2.2		
5	Reverses the order of:					
5.1		letters	0-10	1.2.1	3 4	
5.2		syllables	0-10	1.2.1	5 7	
6	Omits while reading:					
6.1		letters	0-10	1.2.3	4 5	
6.2		syllables	0-10	1.2.3	7 8	
7	Adds while reading:					
7.1		letters	0-10	1.2.4	5 7	
7.2		syllables	0-10	1.2.4	8	
8	Confuses words that:					
8.1		have similar letters - letter reversals (e.g. μόνος - νόμος)	0-10	2.1.1	5 7	
8.2		begin with the same	0-10	2.1.2	5	

		letter(s) (e.g. τρέχω-τραβώ, κανάτα-καντίνα, καμήλα-καλάμι)			6 7	
8.3		have one part of the word in common (e.g. γάτα-γατάκι, laugh-caught)	0-10	2.1.3	5 7	
9	Omits words in the sentence:					
9.1		nouns, verbs, adjectives etc.	0-10	2.1.4	13	
9.2		articles, prepositions, connectives (e.g. when, while), weak pronouns (e.g. it, me) etc.	0-10	3.2	10 14	
10	Has difficulty reading:					
10.1		polysyllabic words	0-10	2.1.5	6	
10.2		compound words	0-10	2.1.5	8	
10.3		unknown words	0-10	2.1.5		
11	Substitutes words with others that have similar meanings		0-10	2.2.1	6 11	
12	Confuses grammatical endings of words while reading:					
12.1		errors in nouns and adjectives (e.g. παιδί-παιδιά, ανθρώπων-ανθρώπους, ψηλός-ψηλή)	0-10	3.1.1	11 14	
12.2		errors in verbs (e.g. τρέχει-τρέχουν, χαίρεται-χαίρεσαι)	0-10	3.1.2	12 14	
13	Substitutes words with others that have the same root (derivatives like 'hungry-hunger', παίζω-παιδί-παιχνίδι) while reading:		0-10	3.3	6 13	
14	Has difficulty spelling irregularly spelled words (words like μ**αύ**ρος, **ευ**χή, **αϋ**πνία, παιδί/π**αΐδ**ι, αστ**εϊ**σμός κλπ)		0-10	4.1.1	1 9 7	
15	Reverses or substitutes letters that **sound** similar when writing:					
15.1		in consonant clusters like κτ-πτ-φθ-χθ-βδ-γχ	0-10	4.1.2	7	
15.2		isolated consonants like δ-β, χ-γ, ξ-ψ, φ-θ, θ-δ, φ-β, σ-ζ, λ-ρ, τ-ντ, π-μπ	0-10	4.1.2	9	
16	Reverses or substitutes letters that **look** similar when writing:					
16.1		in consonant clusters like κτ-πτ-φθ-χθ-βδ-γχ	0-10	4.2.1	8	
16.2		isolated consonants like δ-β, χ-γ, ξ-ψ, φ-θ, θ-δ, φ-β, σ-ζ, λ-ρ, τ-ντ, π-μπ	0-10	4.2.1	7	
17	In writing, omits:					

17.1		letters in consonant clusters, e.g. άφθονος-άφονος, όχθη-όθη	0-10	4.2.2	8	
17.2		syllables	0-10	4.2.4	7	
18	Adds letters that do not belong to the word in writing		0-10	4.2.3	8	
19	Writes a word with only one letter or syllable (e.g. ΄το' for 'τόπι')		0-10	4.2.5		
20	Writes the same word differently with the same text/sentence.		0-10	4.2.6	7	
21	Makes spelling errors in grammatical endings of words:					
21.1		endings of nouns or adjectives	0-10	5.1	11 14	
21.2		misspells articles or pronouns	0-10	5.1	10 14	
21.3		misspells verb endings.	0-10	5.1	12 14	
22	When reading a sentence:					
22.1		has difficulty understanding who the subject or the object of the sentence is.	0-10	6.1.1	12	
22.2		misunderstands because of wrong comprehension of word endings (e.g. past forms of verbs)	0-10	6.1.2		
23	When reading a paragraph, finds it difficult to:					
23.1		summarise the paragraph	0-10	6.2.1	13	
23.2		identify the main idea	0-10	6.2.1		
24	Has difficulty reporting the details of a text		0-10	6.2.2	13	

Table 3 Sample Activities

##	Activity name	Description	Aim of activity	Level of difficulty	Relevant Problem Type	Relevant profile entries
1	Word play	The child is presented with 3 or 4 words along with pictures depicting their content. The words include the target letter in different positions. The target letter is depicted at the top of the screen. The words contain the target letter in different positions, but letters commonly confused with the target letter (with visual or auditory similarity) are also included in the words. The child is asked to circle (or click on) the target letter in every word. Every time the child clicks on the correct letter, the word transforms into a star and moves in the childs chest as an award. Every time the child clicks on a wrong letter, the word breaks and falls on the floor (bottom of screen). The child has to collect a specific number of words (stars) to complete the level. In the first levels, 3-4 words are presented in each level, while the number of words increases in higher levels. In the second part of the game, the target letter is given **auditorily.**	To recognize the importance of the permanent position (initial-internal-final) of a letter in a word. To visually identify problematic letters. To match sounds to letters.	1-2	1.1.1 1.2.2 4.1.1	2 4 14
2	Similar Letters	The child sees a card with a letter matrix The matrix includes 16 or 18 letter symbols that correspond to 3 or 4 different letters repeated a number of times and placed in mixed positions within the table. The child is asked to spot and click on all instances of each letter using a different colour. For example, the child has to select a colour from the top of the screen and click on all instances of letter 'b' with green, then pick another colour and click on all 'ds' with red, all 'p's with blue etc.	To distinguish similar symbols of letters.	1	1.1.1	2
3	Finding the missing letters or syllable	The child first sees a word and identifies its meaning by selecting out of 2 pictures (e.g. 'σπίτι', =house). Then, the word is presented with a missing syllable or constonant cluster (e.g. '--ίτι' or '---τι'). The child has to use the appropriate letters to complete the word. The child can hear the sound of the letters he/she selects to gain feedback, so if he/she selects 'πσ' instead of 'σπ', he/she hears 'πσίτι' instead of 'σπίτι'.	To choose the appropriate consonant clusters or syllables in order to make the right word.	2	1.2.1	5

4	Making and finding syllables	The child is given two letters separately (in cards or on screen) and is asked to combine them in the correct order to make a syllable. Once the child forms a syllable, the syllable is presented auditorily. Then, a set of three words appear, one or two of which include the syllable the child created, while the other includes the two letters in the reverse order. The child is asked to identify the syllable he/she made inside the word(s) on the screen. Correct selections transform into stars and move into the child's chest (inventory of points), incorrect selections break into pieces and fall on the ground (bottom of screen). In the first levels the child makes 2-letter syllables, in higher levels more letters are given to the child, who has to create syllables of more complicated structures (CCV, CVV, CVC, CCCV, CCVC, etc.).	Perform syllable synthesis and identification. Syllabify, segment words into syllables and syllables into sub-syllabic units. Combine letters into syllables and syllables into words. Identify syllable structures, process consonant clusters (avoid reversals).	1 to 3	1.2.1 1.2.3	5
5	Making words	The child is presented with separate letter combinations or syllables and is asked to add two or three different letters either at the beginning or the ending of the presented syllable in order to create a meaningful word with meaning. The child can draw from a letter bank provided in a box at the top of the screen. Each letter from the letter bank can only be used once for each word and the child has to create as many words as possible within 1 minute. Each correct word that is created is then presented auditorily and then transforms into a star and moves to the child's chest as an award. Each incorrect word breaks into pieces and falls on the floor (bottom of screen). In the first levels, two syllables are given to the child who has to add one letter or cluster at the beginnin. In higher levels, one syllable is given and the child can add whole syllables at the beginning or ending. As more letters are provided in the letter bank, the child can add even 2 syllables to create a new word. E.g. -all (b, c, f, g, h, m, p, t, w, sc, st, str, thr) -ίδι (έως 4) (φ, γ, μ, ξ, φρ) -όνος (έως 7) (π, μ, φ, τ, κ, γ, θρ, χρ, κλ) -ώρα (έως 6) (δ, χ, φ, τ, ψ, μπ, ντ) -έλι (έως 6) (θ, χ, μ, ρ, β, τ, κ).	To construct words using combinations of letters or syllables. To recognize the role of the positions of the letters in the words To retrieve words based on phonological cues. To construct words using combinations of letters or syllables. To distinguish between words with common parts.	1 to 3	1.2.1 1.2.2 1.2.3 1.2.4 1.1.1 2.1.2 2.1.1	5 4 6 7.1 2 8.2 8.1

		-τάρι (μ,α,ι,ν,γ,ρ,α,π,τ,χ,ο) καρ- (α,ο,τ,ι,σ,λ,ε,β,ο,ζ,ι,υ,α,φ) φα- (κ,η,ε,σ,α,ν,ι,ρ,δ,υ,...)			2.1.3	8.3
6	Automatic word recognition	Words are presented to the child one by one for a specified period of time (longer at first, becomes shorter as child practises). After the initial presentation, the word disappears and two pictures are presented, one of which depicts the meaning of a word and the other depicts the meaning of a phonetically or semantically similar word (e.g. shoe - snow, shoe - trousers). The child is required to pick the right picture. The words are of increasing length and complexity (morphologically complex and compound words are used as the activity progresses).	Improve automatic word recognition. Distinguish between words that begin with same letter/syllable. Distinguish between words with similar meaning. Distinguish between words of the same derivational family. Improve recognition of multisyllabic words.	4 to 5	2 2.1.2 2.2.1 3.3 2.1.5	8.3 8.2 11 13 10
7	Puzzle bank	The child enters a maze full of puzzles, which he/she has to solve in order to find the way out. The puzzles included word games, crosswords, unscramble words, word-search puzzles, completing rhymes. The child collects stars by solving the puzzles and finds the way out of the maze.	Improve grapheme-phoneme correspondence. Improve letter recognition. Improve visual vocabulary.	3 to 4	1.2 2.1 4.1 4.2	4 5 6 7 8 9 14 15 16 17 18
8	Letters in a chest	The child sees a box with a typed word and a number of blank coloured boxes next to it. Each of the boxes corresponds to a letter of the printed word. The boxes are differently coloured by syllable (the boxes for the letters of the first syllable are in green, the second syllable in pink etc).	Syllabify, segment words into syllables and syllables into sub-syllabic units.	1 to 3	1.2.3	6

		The child is asked to type the letters of the printed word inside the coloured boxes. Next, the first card with the printed word disappears and more boxes appear under the letter boxes, this time one box for each syllable, coloured in the same way as the letter boxes (1st box is green, 2nd is pink etc). The child copies the syllables into the boxes. In a final stage, the child copies the whole word in one bigger box. The child can hear each syllable and the final word by clicking on the boxes after filling them in. Each correct response gives the child a number of stars (depending on the letters of the word), which move to the child's chest as an award. In higher levels, the word disappears after each stage and the child has to write it in the boxes from memory.	Combine letters into syllables and syllables into words. Read and spell multisyllabic and compound words. Improve spelling of words with complex syllabic structure (consonant clusters).		1.2.4 2.1.5 4.2	7 10 16 17 18 19 20
9	Matching game	The child sees a list of 10 words and at the same time he/she hears a speech sound. He/she is then asked to click on all the words that begin with the sound he/she heard within 1 minute. Each correct click transforms the word into a star, which moves into the child's chest as a reward. Each incorrect click breaks the word, whose pieces fall on the floor (bottom of screen). The words presented contain commonly confused letters (both with phonetic or visual similarity). In higher levels, the child hears combinations of speech sounds (consonant clusters: χρ, θρ, φρ, κτ, πτ, στ, τσ etc.) and syllables of increasing complexity (CCV, CVC, CCCV, etc.), while irregularly spelled combinations also appear (ευ - /ef/, /ev/, αυ - /av/,/af/, αι/αϊ - /e/,/ai/ etc.). In higher levels, the target sound or syllable is included in medial or final position in the words presented.	Match sound to letter, syllable, word (speed counts) Distinguish between similar sounds (auditorily presented). Improve spelling of irregularly spelled words. Distinguish between letters with similar sounds	2 to 4	1.1.1 1.2.2 4.1.1 4.1.2	2 4 14 15
10	Article Hunter	The child is presented with short texts (3-4-sentence long), where all or most articles are missing. The child fills in the blank with the correct articles and collects points for each correct answer. In the next stage, the cihld sees a short text with all articles differently coloured. Some of the articles are correct and some are incorrect (gender or case errors). The	To correctly produce and identify articles and (direct, (accusative) and indirect (genitive)) object pronouns.		3.2	9.2

		child has to judge each article as correct or incorrect by clicking on a √ or **x** icon next to it, thus collecting points for every correct and losing points for every incorrect response. Similar texts with direct object clitic pronouns (e.g. ***τον*** είδε, 'him saw', =(he) saw ***him***, ***τους*** χτύπησε, 'them hit', =(he) hit ***them*** etc.) missing or incorrectly written appear in higher levels, while indirect object clitics (e.g. ***του*** είπε, 'his said', =(he) said to ***him***, ***της*** έδωσε ένα δώρο, 'her gave a present' =(he) gave ***her*** a present etc.) are targeted in the final (highest) levels.			5.2	21.2
11	Persons and objects	A number of words appear in an image depicting a child's bedroom. The words are scattered on the floor of the bedroom and three boxes are placed next to the wall. Each box has an article written on a label (ο, η, το) and has 2 or 3 words of the same gender already in it. The child has to collect the words from the floor and put them away in the correct box, based on their gender, as fast as possible so that mom doesn't see the mess when she comes in the room. The nouns in the first levels are all animate (easier to classify by gender), while inanimate nouns and abstract nouns are presented in higher levels. Adjectives are presented after the noun levels are finished.	Retrieve semantic and grammatical gender of words. Recognise gender based on the suffix of a noun or an adjective. Improve spelling of noun and adjective suffixes.	2 to 3	2.2.1 3.1.1 5.1	11 12.1 21.1
12	Verb endings	The child is presented with short texts (3-4-sentence long), where all verbs have lost their endings. The text is presented on a fridge as fridge magnets. The verb endings have fallen and scattered on the floor. The child has to pick up the endings and place them next to the correct verb. When all verbs are complete, the child can open the fridge and get a chocolate. Verb types are of increasing difficulty as levels progress (first frequent, active verbs, then irregular and passive verbs). In higher levels, the sentence structures are of increased complexity (e.g. two subjects, long distance relations etc.).	Identify correct verb suffix within a sentence. Improve grammatical spelling of verbs. Achieve target link between verb and subject (verbal agreement).	5 to 7	3.1.2 5.3 6.1.1 6.1.2	12.2 21.3 22.1 22.2
13	What happened?	The child is presented with short narratives (3-4-sentence long at first, 5-6-sentence long at higher levels). After reading the text, the child is asked to: judge a number of short statements as true or false and select out of a number of pictures the ones that depict the events that took place and put them in the correct order (the pictures presented also include non-target ones, which present the correct event with incorrect details, e.g. colours of clothes etc.). The child collects star-awards for	Sequence events of a text. To pay attention to content words (avoid omissions). To report on details of a text.	6 to 7	6.2.1 2.1.4 6.2.2	23 9.1 24

		each correct response.				
14	Correct the endings	The child sees short texts (2-3 sentences at first, 4-5-sentence long at higher levels) which contain spelling errors in grammatical endings. The child has to click on the wrong endings. In higher levels, each incorrect ending the child clicks on appears on a separate box on the right, where the child has to type the correct ending. For every correctly identified mistake the child gets one star in his/her chest as an award, while for every successfully corrected mistake the child gets 3 bonus stars. The first levels contain simple mistakes (e.g. on nouns of nominative case singular, *ο σκύλως* instead of *σκύλος* etc.). As levels progress, the presented errors include singular genitive case of nouns and adjectives (e.g.*της αυλίς* instead of *αυλής*), plural genitive case of nouns and adjectes (e.g. *των γατόν* instead of *γατών*), verbal endings of 1st/2nd/3rd singular (e.g. *τρέχο* instead of *τρέχω, γράφη* instead of *γράφει*), 2nd plural active (e.g. *τρέχεται* instead of *τρέχετε*) and passive (e.g. *χτενίζετε* instead of *χτενίζεται*). Errors on articles and pronouns also appear.	Identify spelling errors of grammatical endings. To correct spelling errors in grammatical endings. To process function words, identify and correct spelling errors.	5 to 7	3.1 3.2 5	12 9.2 21

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