An Arabic Framework for Dyslexia Training Tools

Fadwa AlRowais, Mike Wald, Gary B Wills
School of Electronics and Computer Sciences
University of Southampton
Southampton, UK
{fmar1v10, mw, gbw}@ecs.soton.ac.uk

Abstract—**Language features and cultural factors play key roles in the difficulties associated with dyslexia. Thus, addressing the combination of these elements is essential to obtain better coverage of dyslexia issues and a deeper understanding of the needs of Arabic speakers with dyslexia. There is a great deal of progress yet to be achieved in the area of Arabic dyslexia, as little is published about manifestation of dyslexia in this language. This paper presents a framework to integrate the linguistic features and related cultural context of the Arabic language. The aim of this framework is to develop an effective set of guidelines to guide the designers of Arabic dyslexia training tools and support the evaluation of these tools. This would substantially benefit Arabic speakers with dyslexia and could help them obtain literacy skills and attain their potential. The unique features of Arabic and its related cultural context, which could affect Arabic speakers with dyslexia and should be considered in the design of training tools targeting this population, are highlighted. A set of guidelines for the Arabic framework has been developed, that underlie instruments designed for individuals with dyslexia.**

Keywords — Dyslexia; Arabic; culture; guidelines; framework

I. INTRODUCTION

In recent years, there has been an increase in the use of electronic resources in the field of education. Many of these resources offer powerful tools to students with learning disabilities by providing assessment, training or support for these target users. However, all the electronic learning resources targeting students with learning disabilities should be based on appropriate guidelines developed especially for learning disabilities to achieve the educational objectives. One such target would be students who have specific difficulties with reading, which is considered to be one of the indicators of dyslexia.

Dyslexia is an umbrella term that has foundations in the fields of psychology, medicine, linguistics, culture, education, and technology. It presents as a specific learning disability of neurological origin, associated with difficulties in reading, writing, spelling and working memory [1].

Dyslexia can be considered as a language-based learning disability, since the severity of reading, writing and spelling deficits vary across different language orthographies [2]. Readers in languages with a transparent orthography, such as Italian, Spanish, Turkish, Greek and German, face fewer difficulties than readers in languages with non-transparent orthography such as English [3]. Readers in languages with a non-transparent orthography often depend on the lexical method, whereas this is unnecessary for readers in languages with transparent orthography [4]. On the other hand, in languages with both types of orthography, such as Arabic and Hebrew, readers would behave depending on the type of orthography encountered [4].

Dyslexia in Arabic orthographies is different from dyslexia in English. A review of the literature about Arabic reveals that few studies have been conducted to explore dyslexia in this language and most of these studies focus on the difficulties and complexity of Arabic. There are different factors in Arabic that could be contributing to the manifestation of dyslexia among Arabic speakers.

Dyslexia has a culture-specific manifestation, and the difficulties associated with dyslexia can be partly due to characteristics of the culture. Examples are language variations and cross-culture adults (domestic workers). Thus, culture affects language and consequently plays an important role in how individuals with dyslexia struggle to learn the language.

Therefore, it is important to widen the perspective to dyslexia and consider the Arabic features and related cultural factors and the corresponding principle implications in the design of Arabic training tools for dyslexia. This awareness of linguistic and cultural aspects of Arabic speakers could collectively form a framework for Arabic speakers with dyslexia. This underlines the need for a framework of guidelines that includes language features and cultural context of Arabic speakers with dyslexia, and can be utilized to support the design and evaluation of Arabic training tools for this population.

The next section describes the construction of the Arabic framework for training children with dyslexia. Section three introduces Arabic linguistic features and related cultural context that affected Arabic speakers with dyslexia. Section four will discuss the Arabic framework of guidelines for dyslexia training tools. Finally, section five will draw conclusions.

II. THE CONSTRUCTION OF THE ARABIC FRAMEWORK FOR DYSLEXIA TRAINING TOOLS

The purpose of the Arabic framework for training children with dyslexia is to address the combination of four parts: Arabic linguistic features, related cultural factors and the

general and Arabic principles that underlie instruments designed for individuals with dyslexia. Fig. 1 illustrates how the Arabic framework for dyslexia integrates these different parts. The following sections will discuss these parts in detail.
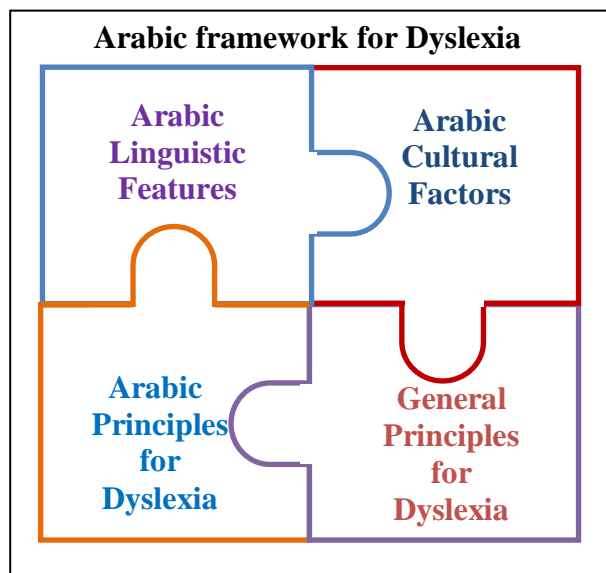

Arabic framework for Dyslexia

Arabic Linguistic Features

Arabic Cultural Factors

Arabic Principles for Dyslexia

General Principles for Dyslexia

Figure 1.   The construction of the Arabic framework for dyslexia training tools.

III.   ARABIC LINGUISTIC FEATURES AND RELATED CULTURAL CONTEXT

In order to identify and understand dyslexia in a specific language, there is a need to recognize the relevant linguistic features [2] and related cultural context of that language. Therefore, it is important to study and identify the unique features of Arabic and it is related cultural factors.

A. Arabic Lingustic Features

 Arabic is written in an alphabetic system consisting of 28 letters to represents 34 phonemes. However, in contrast to many other alphabetic languages, in Arabic, it is rare to use symbols, such as the full stop for abbreviations and acronyms. In addition, there are no upper or lower case variations in Arabic - letters are consistent in shape. Moreover, Arabic is considered a bi-directional language because the script is read and written from right to left, whilst numerals go from left to right.

Arabic script is written in a cursive style with the letters being joined to each other by means of ligatures. Only 22 letters of 28 are two way connecters, whereas the remaining 6 letters cannot be joined since they are one-way connecting letters. As a result, an Arabic word may contain one or more spaces within the same word depending on how many of these letters are used in the word [2]. This, together with the absence of capital letters in Arabic, causes a problem in the identification of the word boundaries in Arabic script [5]. Consequently, readers of Arabic cursive script must learn the spaces that distinguish word boundaries, from spaces within a word in the script. According to Elbeheri [5], readers with dyslexia might face additional difficulty due to the negative influence of the identification of word boundaries in Arabic

script. Another effect of the cursive nature of Arabic is the tendency to preserve the cursive nature of Arabic at the expense of phonological processing. For example, the function word (هذا) is written as /hǝa/ while being pronounced as /ha:ǝa/ [5].

In addition, to preserve the cursive nature of Arabic script, the letters 'al' (ال), which are used as definite article for words in Arabic (similar to 'a' and 'an' in English), are connected to the identified word (next word). These identification letters represent two types of phoneme, since they either appear as silent letters with the word, or as spoken letters, depending on the context of use [6], an additional difficulty for readers with dyslexia.

Each letter may have from two to four shapes depending on its position within the word: initial, medial, final, or as an isolated form [7]. Another important characteristic of Arabic script is the use of dots to differentiate graphemes. The Arabic script consists of 17 base letters, but, with the addition of dots that can vary in number and position, it is possible to make up the remaining 11 letters. Therefore, dots are important in Arabic script to differentiate between a large number of Arabic letters [7]. For example, the letters (ن , ث , ت , ب) have similar shapes, the only difference being the positioning and number of dots within each letter. As a result of these similarities in many Arabic letters, Mahfoudhi, Everatt, and Elbeheri [8] argue that, based on the conclusions of a number of studies, the ability to distinguish individual Arabic letters is a considerable challenge for Arabic readers.

In addition, Arabic contains a special letter called 'hamza' (ء), which is the glottal stop. However, some linguists consider the hamza as an independent grapheme, so the Arabic alphabet would, in this case have 29 instead of 28 letters, but others count the hamza as a diacritical mark [7]. Hamza represents two types of phoneme, either silent or spoken.

Arabic is stressed differently from English, since stress in Arabic is a morphological feature that depends on the syllable structure of the Arabic words [9]. Accordingly, Arabic readers need to gain morphological knowledge to be able to express the position of the required Arabic stress.

In Arabic, short vowels are not regarded as independent graphemes in written form, but are represented as extra diacritical marks. These diacritics are small marks that appear on top and below letters to represent the short vowels which assist readers in pronunciation. They are normally present in religious texts, children's books and sometimes in poetry and text books for foreign learners [8]. In other cases, these diacritic marks are neglected in the majority of reading materials experienced by older children and adults. When the text is presented without diacritic marks, the material is called non-vowelized text. Consequently, a significant number of Arabic words that appear as non-vowelized, when presented out of context, are homographic [2]. That means each of these words can have more than one pronunciation and meaning, which is semantically and phonologically ambiguous. For example, the word (كتب) is homographic as it can mean 'he wrote' when pronounced as 'kataba' (كَتَبَ), or 'it was written' when pronounced as 'kutiba' (كُتِبَ), or it could be (كُتُبٌ) which means 'books' and is pronounced as 'kutubun' [4]. Thus, the

reader needs the context to ensure the correct processing for these words.

Mahfoudhi, Everatt, and Elbeheri [8] state that using diacritic marks has been argued to have a positive influence on reading in Arabic, although they may also have a negative influence by increasing the complexity of the visual representation of words within text. Abu-Rabia, Share, and Mansour [10] found that the reading skills of Arabic children with dyslexia seem to be better with the orthography that depends on visual processing rather than phonological processing. In another study, Al-Wabil, Zaphiris and Wilson [11] state that an additional cognitively demanding skill will be required from the reader with non-vowelized text, because the reader must read the non-existent short vowels.

The most important linguistic feature of Arabic is that it has two orthographic types: transparent (shallow) and non-transparent (deep). In the transparent orthography, the diacritic marks are used, so there is one-to-one association between letters and sounds. In contrast, in non-transparent orthography, the diacritic marks are not used and, as a result, the association between letters and sounds is diminished. This phonological correspondence has an important impact on the accuracy of reading of Arabic. When using non-transparent orthography, readers must rely on contextual or morphological knowledge to be able to interpret the Arabic script. Morphological knowledge can play an important role in providing clues to the correct pronunciation of the Arabic words [2]. However, Arabic morphology is regarded as a highly inflected and derivational morphology, which could add more difficulties to a reader with dyslexia [2]. Moreover, Arabic tends to preserve morphological clues at the cost of clear phonological processing [2]. For example, the word (درسوا) pronounced as 'daraso', the last letter (ا) is not pronounced, since it is only written to indicate the verbal form of the word. In addition, Arabic language is gender specific language [12, 13], because some spoken and written words are different based on the gender.

B. Cultural Factors

The discussions are often surrounded with a cultural framework, since language is seen not just as a cultural trait but also as an identity for one cultural group that differentiates them from others. However, culture affects language and consequently plays an important role in how individuals with dyslexia struggle to learn language. Many cultural factors could influence language, but only two will be presented in this subsection due to their significant impact on dyslexia. These are: varieties of language within the culture and adults across the cultures.

The different ways of speaking one language could interfere in the phonological difficulties faced by individuals with dyslexia. Among speakers of one language there are several ways of using the language, especially within a large culture and these different ways are called varieties. Although Arabic is the official language of 22 countries in the Middle East region, many variations in language exist across all these countries [2]. As a consequence of these varieties in the spoken language, students may be required to interact at home with a

TABLE I. SUMMARY OF THE ARABIC LINGUSTIC FEATURES AND RELATED CULTURAL CONTEXT

Arabic features	Description
Orthography	There are two types of orthography: transparent (shallow) and non-transparent (deep) orthography.
Morphology	Derivational and inflectional morphology
Diacritical marks	There are 14 diacritical marks represent the short vowels.
Short vowels are ignored	Short vowels are ignored in the majority of reading materials experienced by readers after initial learning grades.
Homograph Language	Two words are homographs if they are spelled the same way but differ in meaning. This is the case with some Arabic words without diacritical marks.
Cursive form	Most of the letters are being joined to each other by means of ligatures.
Direction of writing	Bi-directional (Right-to-Left for text and Left-to-Right for numbers)
Uni-case language	There are no capital and small cases are involved.
Dots are important with some letters	Some letters have similar shapes and the difference is only in the number and/or position of the dots. Addition of dots, in different positions with different numbers making up more letters.
Different forms for each letter	Each letter has from two to four forms which are initial, medial, final and isolated.
Disconnected letters	There are six letters have only two forms: one-way connecting form and isolated form.
Difficult to distinguish words boundaries	There are two types of spaces in the sentence: word boundary spaces and spaces within the same word.
Definite article	The letters 'al' (ال) are used as definite article to identify the word and are connected to the next word. Sometimes these letters are silent in pronunciation and sometimes are spoken.
Numbers with similar shapes	Arabic includes numbers with similar shapes and the main difference is in the direction of the shapes.
Gender specific language	Spoken and written instructions are vary for each gender.
Difficult to deal with abbreviations	Arabic does not always use full stop to discriminate between the abbreviated form of the words and the completed form.
Number of phonemes compared to number of the letters	There are 28 letters, while the number of the phonemes is 34 phonemes.
The glottal stop (Hamza)	Hamza represents two types of phoneme, either silent or spoken.
Stress	Need some stress when pronouncing some letters. Stress in Arabic is a morphological feature that depends on the syllable structure of the Arabic words.
Dialect varieties	The language spoken has some differences in pronunciation from one region to the other. As a result, the language spoken in the daily life differs from the language used in education and formal writing.

language that has some differences compared with the language of instruction at school [5]. Bhatia [14] observed that there is a systematic relation between the rate of language learning and the distance between language variations and the standard language. Language variations are considered an important factor in the development of phonological representations [15]. Moreover, according to Silliman, Bahr, Wilkinson, and Turner [15], because of language variation, children may be less responsive to explicit phonological processes which could make them at risk of being classified as having learning disabilities. Consequently, it is likely that language variations increase the complexity of phonological processes.

A further cultural factor to be considered is adults across different cultures which plays an important role in children's acquisition of language [16]. Kuhl, Tsao, Liu, Zhang, and Boer [16] stated that cultural anthropology studies reveal the significant role of adult speech behaviour when talking to children, since the unconscious speaking style that an adult uses when interacting with children seems to be useful for learning. On the other hand, Shaalan [17] claims that adults across cultures, such as domestic workers, can affect the language skills of children in the Gulf countries. In the Gulf countries, there is widespread use of non-Arabic-speaking domestic workers, especially live-in maids who take care of the children when their parents go out. Most of these domestic workers usually speak a pidginized form of Arabic with the children [17]. Therefore, some parents of Arabic-speaking children, especially those who have children with learning disabilities, have an unsettled feeling about the influence of domestic workers on the language skills of their children [17].

A summary of the Arabic features and related cultural context that could affect people with dyslexia is presented in Table I.

IV. ARABIC FRAMEWORK OF GUIDELINES FOR DYSLEXIA TRAINING TOOLS

After highlighting the unique linguistic features and related cultural context of Arabic, which could be contributing to the manifestation of dyslexia among Arabic speakers, a set of different guidelines that could underlie the instruments designed for students with dyslexia is identified. Formulating this set of guidelines can be considered as a key stage of building the required Arabic framework. The guidelines in this set are extracted from the literature. The total number of these guidelines is 95 guidelines, which are classified into sixteen categories. The sixteen categories are summarized in Table II.

Each category includes a set of guidelines which could help to achieve the objectives of this category. The first category, Enhance Recognition, includes twelve guidelines focusing on some strategies and instructions to help improve recognition and compensate the areas of weakness in memory. These guidelines encompass recommendations to apply some strategies such as repetition [18], cumulative review [19], selection methods [6] and Dual coding theory [18, 20]. These

strategies could enhance recall and recognition and help to retain information in the memory.

TABLE II. SIXTEEN CATEGORIES OF GUIDELINES FOR TRAINING ARABIC CHILDREN WITH DYSLEXIA

No.	Classification	Number of the guidelines
1	Enhance Recognition	12
2	Address Diversity and Self-advocacy	5
3	Interactive Design	7
4	Enhance Flexibility	4
5	Match the Reality	2
6	Picture Features	5
7	Audio Features	2
8	Interface Features	5
9	Type of the Words	7
10	Enhance Visibility	6
11	Control the Time	5
12	Structure	9
13	Consistency	4
14	Navigation	2
15	Provide Help and Feedback	6
16	Teach Arabic Decoding	14

The second category is Addresses Diversity and Self-advocacy. This category considers the challenge of dyslexia diversity, self-advocacy and stigma risk that is associated with dyslexia [21]. It includes guidelines to aid the learner to avoid the need to approach others for help and increase the independency. The guidelines also encourage considering of the diversity of needs and the ability of the learner.

Next, the Interactive Design category contains guidelines to design an interactive environment to help a learner with dyslexia to achieve effective learning. It comprises recommendations to apply audio, visual and kinesthetic elements [20] in keeping with multi-sensory approach. It also suggests a new interactive strategy to enter the responses to some activities [22]. It gives tips to avoid distracting and irrelevant design elements [6].

Enhance Flexibility category provides enough flexibility to allow for learners' strengths and weaknesses and the coping strategies they have applied to compensate their deficit [6]. It includes consideration for the learner preferences.

Match the Reality category enhances familiarity of objects and components. It contains tips to ensure that instructions, phrases and concepts are coded with well-known vocabulary from school curricula and mass media [23]. It also includes advice to design components of the tool based on the age and local culture of the learners.

Picture Features category embraces the required features for pictures to be more understandable for a learner with dyslexia. It discusses the details, colours [12] and categories of the pictures in the tool [13].

Audio Features category includes the required features for audio to be clearer and understandable for a learner with dyslexia. It includes advice to enhance the clarity [24] and the suitability of the voice in the tool [10].

Interface Features category encompasses the required features for the interface to be easier to deal with for a learner with dyslexia. It focuses on some aspects related to the background [12], the colours of the font [19] and the contrast between background and fonts [18].

Type of the Words category comprises the required features and types of the words to be easy to understand for a learner with dyslexia. It contains recommendations to use concrete words and pictures to define abstract words and concepts and use concrete words to communicate key points where possible [18]. It also includes issues related to the sight words.

Enhance Visibility category includes guidelines to guarantee to keep everything clearly visible for a learner with dyslexia. It covers tips related to the visibility of the control-buttons, labels and all other facilities [6].

Control the Time category involves controlling the time that is required for all the events to be sufficient for a learner with dyslexia. It encourages offering a number of attempts for the learner until mastery of the task is completed [22]. It also discusses adjusting the time dedicated for the learner for some issues e.g. understanding the warning messages generated by the tool [6].

Structure category holds guidelines to organize the structure of the components and contents in a way that can facilitate learning for a learner with dyslexia. For example, it includes advices to commence with the general [6], more easily, and useful knowledge [19].

Consistency category embraces the consistency issues that can facilitate learning for a learner with dyslexia. It comprises guidelines to ensure that data entry, data display and navigation controls are consistent in direction [6] and to keep main information and icons consistent in location in all the screens.

Navigation category suggests special navigation aids to help a learner with dyslexia. For example, sequential lists, block diagrams, visual map and audio-based aids [6].

Provide Help and Feedback category includes guidelines to present help and feedback for a learner with dyslexia in effective form. These guidelines suggest to illustrate complex ideas in the help by using multimedia items [6]. They also emphasise providing different forms of feedback [6].

Teach Arabic Decoding category contains fourteen guidelines. These guidelines encompass special requirements for teaching decoding of Arabic language for a learner with dyslexia, which address some of the difficulties generated from different aspects of the Arabic language and its related cultural context. For example, some of the guidelines in this category discuss issues related to use of right-justified or fully-justified Arabic text. In full-justified, Arabic orthographies use connectors (kashida) elongating specific characters of the cursive script without producing extra white space between words as in English [11, 6]. For example, there is a connector between the third letter and the fourth letter in the first word from the right of this phrase (السـلام عليكم). Another guideline suggests to offer automatic diacritization, so the appearance of diacritics can be controlled with options for full diacritics, partial diacritics and no diacritics [11, 6]. This category also includes a guideline that recommends to use one of the preferred Arabic fonts for dyslexia e.g. Arabic Transparent, and avoid angular types of Arabic fonts such as Koufi and Andalus [11]. In addition, there is a guideline that proposes to smooth the letters to their simplest form [19], for example (ل) could be simplified to (ﻟ). This category provides advice to discriminate the boundaries between words from spaces within words, especially in the case of words with disconnected letters [11]. It also suggests separating dialogues for each gender, because Arabic language is a gender specific language [12, 13]. It considers some issues related to the glottal stop (hamza) such as the discrimination between the two types of the Arabic glottal stop and the stress of the pronunciation of the glottal stop when it needed [25]. It includes a guideline that advocates to reduce using of abbreviations in the Arabic training tools. This category recommends to teach sound of the letter then present the different forms of this letter, before synthesizing this letter with short and long vowel sounds [19]. It also advises to consider the short and long vowels as separate phonemes from consonants in keeping with the explicit phonics approach which is the strategy of choice for the learners with phonological deficits [19]. It recommends to support the learner with practices to distinguish between the sounds of some letters and the similar sounds that are produced by diacritics.

V. Conclusion

Dyslexia can be considered as a language-based learning disability, since the severity of reading, writing and spelling deficits vary across different language orthographies. Moreover, dyslexia has culture-specific manifestations and the difficulties associated with dyslexia can be partly related to cultural factors. Thus, the combination of language features and cultural factors is important to obtain better coverage of dyslexia issues and deeper understanding of the requirements of students with dyslexia.

This paper presents an Arabic framework of guidelines to integrate the linguistic features and related cultural context of the Arabic language. The guidelines in this framework can be utilized to support the design of training tools for Arabic students with dyslexia and guide the evaluations of these tools.

For the purpose of setting up the Arabic framework, the unique features of Arabic language and related cultural context, which could be contributing to the manifestation of dyslexia among Arabic speakers, are identified. In addition, a comprehensive set of guidelines has been developed by extracting the different principles from the literature that underlie the instruments designed for students with dyslexia. These guidelines were classified into sixteen categories depending on the goal of each guideline.

The Arabic framework could be helpful in improving designers' knowledge of the needs of children with dyslexia. It could also be used to check the ability of the training tools to consider the difficulties related to Arabic student with dyslexia, which could prevent them from benefitting from these resources. This could substantially help Arabic students with dyslexia obtain literacy skills and attain their potential.

REFERENCES

[1] IDA - International Dyslexia Association (2002). Frequently Asked Questions About Dyslexia: What is Dyslexia? (Formal Definition). Retrieved (August 07, 2011) from: http://www.interdys.org/FAQWhatIs.htm

[2] G. Elbeheri, J. Everatt, G. Reid, and H. Al-Mannai, "Dyslexia assessment in Arabic," Journal of Research in Special Educational Needs, vol. 6, pp. 143-152, 2006.

[3] K. Spencer, "Predicting word-spelling difficulty in 7- to 11-year olds," Research in Reading Journal, vol. 22, 1999.

[4] R. Beland, and Z. Mimouni, "Deep dyslexia in the two languages of an Arabic/French bilingual patient," Cognition Journal, vol. 82, pp. 77-126, 2001.

[5] G. Elbeheri, "Dyslexia in Egypt," in Provision and use of information technology with dyslexic students in university in Europe: An EU funded project, I. Smythe, Ed. Cardiff: WDP, 2005, pp. 136-144.

[6] A. Al-Wabil, H. ElGibreen, A. Al-Suwaidan, and R. Al-Salloom, "Heuristics for the creation and evaluation of educational game software for children with dyslexia," International Conference on Information and Multimedia Technology (ICIMT), Hong Kong, 2010.

[7] G. Elbeheri, "Dyslexia in Egypt," in The international book of dyslexia: a guide to practice and resources, 2nd ed., I. Smythe, J. Everatt, and R. Salter, Eds. UK: Wileys, 2004, pp. 79-85.

[8] A. Mahfoudhi, J. Everatt, and G. Elbeheri, "Introduction to the special issue on literacy in Arabic," Springer Science and Business, 2011.

[9] Y. Hifny, S. Qurany, S. Hamid, and M. Rashwan, "ARABTALK: an implementation for Arabic text to speech system," 4th Conference on Language Engineering (CLE), Egypt, 2003.

[10] S. Abu-Rabia, D. Share, and M. Mansour, "Word recognition and basic cognitive processes among reading-disabled and normal readers in Arabic," Reading and writing Journal, vol. 16, 2003.

[11] A. Al-Wabil, P. Zaphiris, and S. Wilson, "Web design for dyslexics: accessibility of Arabic content," 12th International Conference on Computers Helping People with Special Needs (ICCHP), Austria, 2006.

[12] A. AlSuwaidan, A. AlZahrani, E. Meldah, H. AlNukahilan, and S. AlIsmail, "Designing software for cognitive training of children with learning difficulties: the memory challenge project," in Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications, Chesapeake, VA: AACE, pp. 737-740, 2010.

[13] A. Al-Wabil, E. Meldah, A. Al-Suwaidan, and A. AlZahrani, "Designing educational games for children with specific learning difficulties: insights from involving children and practitioners," in 5th International Multi-Conference on Computing in the Global Information Technology (ICCGI), Spain, Conference Publishing Services, pp. 195-198, 2010.

[14] T. Bhatia, "Literacy in monolingual societies," in Annual Review of Applied Linguistics, R. Kaplan, Ed. Rowley, MA: Newbury House, 1984, pp. 23-38.

[15] E. Silliman, R. Bahr, L. Wilkinson, and C. Turner, "Language variation and struggling readers: finding patterns in diversity," in Speaking, reading and writing in children with language learning disabilities: new paradigms in research and practice, K. Butler, and E. Silliman, Eds. London : Lawrence Erlbaum Associates Inc., 2002, pp. 109-143.

[16] P. Kuhl, F. Tsao, H. Liu, Y. Zhang, and B. Boer, "Language/culture/mind/brain progress at the margins between disciplines," Annals of the New York Academy of Science, vol. 935, pp. 136-174, 2001.

[17] S. Shaalan, "Consideration for developing and adapting language and literacy assessments in Arabic-speaking countries," in Multicultural Psychoeducational Assessment, E. Grigorenko, Ed. New York: Springer, 2009, pp. 287-314.

[18] N. Beacham, "Dyslexia-friendly Computer-based Learning Materials," in L. Phipps, A. Sutherland, and J. Seale, Eds. Access All Areas: Disability, Technology and Learning, Oxford: JISC TechDis Service and ALT, 2002, pp. 73-77.

[19] K. Hazoury, A. Oweini, and R. Bahous, " A Multisensory Approach to Teach Arabic Decoding to Students with Dyslexia," Learning Disabilities: A Contemporary Journal, vol. 7, pp.1-20, 2009.

[20] M. Abdullah, S. Hisham, and S. Parumo, "MyLexics: An Assistive Courseware for Dyslexic Children to Learn Basic Malay Language," SIGACCESS Newsletter, Comput., vol. 95, pp. 3-9, 2009.

[21] K. Deibel, "Understanding and Supporting the Use of Accommodating Technologies by Adult Learners with Reading Disabilities," SIGACCESS Accessibility and Computing, vol. 86, pp. 32-35, 2006.

[22] K. Spencer, "Recovering reading using computer mastery programs," British Journal of Educational Technology, vol. 27, pp. 191-203, 1996.

[23] T. Helland, and R. Kaasa, "Dyslexia in English as a Second Language," Dyslexia, vol. 11, pp. 41-60, 2005.

[24] H. Sampath, J. Sivaswamy, and B. Indurkhya, "Assistive Systems for Children with Dyslexia and Autism," SIGACCESS Newsletter Accessibility and Computing, vol. 96, pp. 32-36, 2010.

[25] A. Al-Wabil, H. Al-Khalifa, and W. Al-Saleh, "Arabic Text-To-Speech Synthesis: A Preliminary Evaluation," in C. Montgomerie, and J. Seale, Eds. Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications, Chesapeake, VA: AACE, 2007, pp. 4423-4430.