SEMARAK ILMU PUBLISHING

Semarak International Journal of Current Research in Language and Human Studies

Journal homepage:
https://semarakilmu.my/index.php/sijcrlhs/index
ISSN: 3083-9572

Arabic Language Attributes for Game-Based Arabic Language Learning for Dyslexic Children

Einannabella Nadzri Mohd Nadzri[1], Noor Azli Mohamed Masrop[1,*], Asrina Suriani Md Yunus[1], Ghazali Zainuddin[2], Muhammad Sabri Sahrir[3], Sarifah Nurhanum Syed Sahuri[4]

[1] Faculty of Creative Multimedia and Computing, International Islamic University College Selangor, Selangor, Malaysia
[2] Faculty of Islamic Civilisation Studies, International Islamic University College Selangor, Selangor, Malaysia
[3] Department of Language and Literacy, Kulliyyah of Education, International Islamic University Malaysia, Selangor, Malaysia
[4] Faculty of Major Language Studies, Universiti Sains Islam Malaysia, Nilai, Negeri Sembilan, Malaysia

ARTICLE INFO

Article history:
Received 28 September 2024
Received in revised form 5 November 2024
Accepted 1 December 2024
Available online 30 December 2024

Keywords:

Arabic language attributes; elements; guidelines; game-based Arabic language learning for dyslexic children; game-based learning; Arabic language learning

ABSTRACT

Recent studies on the twenty-first century educational system indicate that gaming has evolved into a reliable educational aid for sustaining interest and motivation in terms of learning- one of it being game-based language learning. Establishing the Arabic language attributes for game-based Arabic language learning for students with dyslexia is the objective of this study. Only a few numbers of studies have focused on dyslexic children, even though prior research has addressed a variety of principles and frameworks for educational aids in Arabic language learning. This paper employed the methodology of systematic literature review (SLR) and fuzzy Delphi method (FDM). There were 18 publications retrieved from the review that are then analysed using FDM which then resulted into four components, namely, background, Arabic linguistic features, learning strategy, and learning hierarchy. The findings of this study can be used as guidelines for instructional materials for dyslexic children or students to learn Arabic language.

1. Introduction

Game-Based Language Learning (GBLL) has been recognised as a teaching tool to keep students engaged and motivated since it is an effective method for enhancing learning. Hence, a need for game-based language learning is brought up as it significantly transformed students' current thinking patterns and motives [1]. As stated in a study by So and Seo [2], game-based learning affects gameplay design elements and concepts with the primary goal of motivating and enticing players to learn.

In learning language system, effective teaching ideas and methods contribute to the development of students' broad skill sets. The highest form of human intelligence, character, and thought can be found in language, which is a component of culture. As the language in which the Qur'an was

* *Corresponding author.*
E-mail address: noorazli@kuis.edu.my

https://doi.org/10.37934/sijcrlhs.1.1.3347b

revealed, Arabic not only forms a crucial component of culture but is also the foundation of Islamic civilization [3]. It should be added that the linguistic component itself consists of spelling, pronunciation, vocabulary, and grammar.

According to Anoual and Lakhouaja [4], learning disabilities (LD) are neurologically-based processing issues that make learning or obtaining knowledge difficult while also needing the development of fundamental skills such as reading, writing, math, and reasoning, as well as listening and speaking. Also stated that learning disabilities are seen as neurological diseases that affect a student's performance and regular academic growth. Dyslexia is a term used to represent a variety of various issues that are frequently detected in the early stages of schooling. Dyslexia encompasses the domains of psychology, medicine, linguistics, culture, and education [5].

Language learning is already recognised to be challenging for dyslexic students, making second language learning considerably more difficult. There has been very little research on the subject of Arabic language acquisition for dyslexic children and its learning aids [4,6,7], especially in Malaysia. Al-Rowais *et al.,* [5] describe Arabic linguistic traits, as well as how Arabic is written using an alphabetic system with 28 letters that represent 34 phonemes, which is characterised by numerous orthographic forms, depending on the place of the word. This characteristic makes learning Arabic letters much more difficult for children with LD [4], particularly dyslexics.

Several ways for educational aids in Arabic language learning have been offered in previous studies, but only a few have been addressed for dyslexic students. This paper adds to existing research by offering results from previous studies on the framework design and components in game-based Arabic language learning for dyslexic youngsters. Importantly, using the Kitchenham-recommended systematic literature review [8,9], this study reviews and carefully evaluates existing studies. The framework elements targeted at game-based language learning (GBLL) for dyslexic children and Arabic language learning for dyslexia are highlighted in this study. The purpose of this research is to investigate the characteristics and components of Arabic language learning components of game-based Arabic language learning (GBALL) for dyslexic students.

The first section of this paper outlines the purpose of this study being conducted. Section two (2) explains the methods employed, while Section three (3) details the findings and results obtained. Finally, Section four (4) wraps up the conclusion of the paper and suggestions for further research.

2. Methodology

This study collected data from online resources and review the literature using the systematic literature review method (SLR) in line with [10,11], and the results are then evaluated using the Fuzzy Delphi method (FDM).

The primary goal of this paper is to identify the Arabic language learning components of game-based Arabic language learning for dyslexic students. For this study, the researcher employs SLR to answer RQ1 and RQ2 while RQ3 utilises FDM evaluation. Thus, the following research issues were addressed by the researcher for this study are:

RQ1: What are the publications that mention game-based language learning specifically in Arabic language learning for dyslexic students?

RQ2: What are the key Arabic language features of game-based Arabic language learning for dyslexic students?

RQ3: What is the importance ranking for each Arabic language attributes of the game-based Arabic language learning for dyslexic students?

2.1 Systematic Literature Review (SLR)

Using an objective search strategy, such as SLR, a study is required to locate as many primary papers as a practice that are pertinent to the study's goal [12]. If the studies yield reliable results, systematic reviews show that the phenomena are robust and transferable [8]. Planning, carrying out, and reporting the review are the three key stages of a systematic review [9,11,13]. Figure 1 details the processes and characteristics of the systematic literature review method.

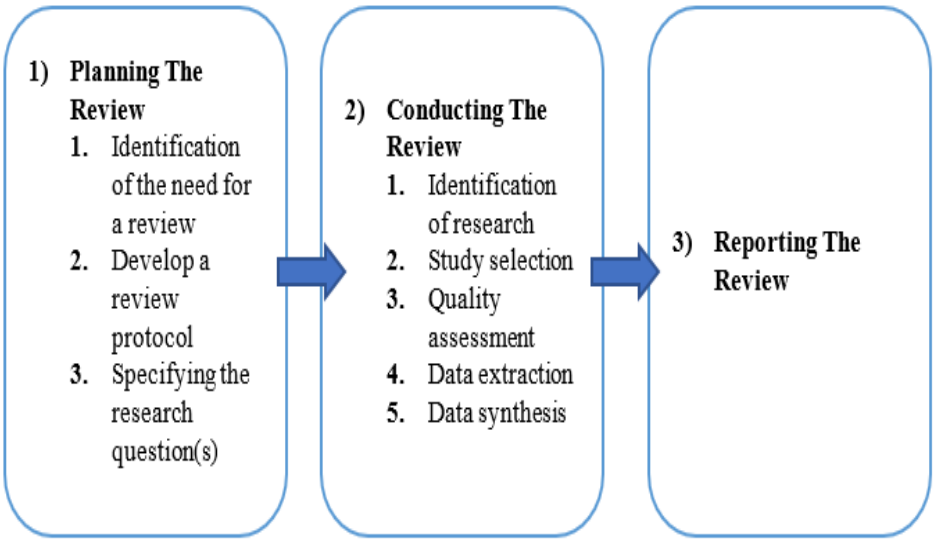

Fig. 1. Phases of systematic literature review [10]

2.1.1 Inclusion and Exclusion Criteria

The articles were sampled by the stated inclusion and exclusion criteria, as indicated in Table 1. Published papers that do not fit the criteria were not considered.

Table 1
The inclusion and exclusion criteria of the study

No.	Inclusion Criteria	No.	Exclusion Criteria
IC1	Studies that include any of the keywords or logical words as stated beforehand	EC1	Papers that are not written in English or Malay language
IC2	Papers that are published between 2013 to 2022	EC2	Articles that do not mention Arabic language learning OR dyslexic children
IC3	Studies that include anything related to Arabic language learning tools for dyslexic children	EC3	Papers that are not related to educational games for dyslexic children in language learning
IC4	Studies that include guidelines or framework development on a game-based language learning for dyslexic children	EC4	Papers that do not mention any framework, elements, or guidelines of game-based language learning for dyslexic children
		EC5	Studies that are closed-source with limited information

2.1.2 Quality Assessment

In accordance with [11], each SLR was evaluated with four quality assessment (QA) questions according to the criteria that were modified for them. The following are the QA questions:

QA1: Is it likely that all significant research was found in the literature search?
QA2: Is the evaluation of the study's quality and validity reliable?
QA3. Does the study elaborate on Arabic language elements or features in game-based Arabic language learning for dyslexic children?
QA4: Do the findings achieve the research objective?

Table 2 shows how the questions were scored and defined. The following values were used to generate the scores: Y = 1, P = 0.5, and N/Unknown = 0. The scores will show the quality of the articles as well as the answers to the research questions.

Table 2
Details of the quality assessment questions

Questions	Scoring		
	Yes (Y) = 1	Partly (P) = 0.5	No (N)/Unknown = 0
QA1	The authors either searched four (4) or more digital libraries and employed additional search methods, or they identified and cited every publication on the subject.	The authors examined three or four (4) digital libraries without employing any additional search techniques, or they searched a restricted set of publications and conference proceedings.	The authors were given up to two (2) digital libraries or a small collection of articles.
QA2	The authors established the quality explicitly and obtained them from each primary study.	The research question in the study addresses quality issues.	There has been no specific attempt to assess the quality of individual primary research.
QA3	The details of the features and attributes of Arabic linguistics in game-based Arabic language learning for dyslexic students.	Merely a description of the Arabic features or principles in game-based Arabic language learning for dyslexic students was presented, which was either insufficient or incorrect.	In the study, there is no elaboration on the Arabic aspects or principles in game-based Arabic language acquisition for dyslexic students.
QA4	The findings respond to the study's research purpose explicitly	The findings are intricately linked to the research purpose	The findings are not detailed and cannot be easily deduced

2.2 Fuzzy Delphi Method (FDM)

The Fuzzy Delphi Method (FDM) is a highly structured kind of group interaction. According [14], FDM can be utilised to find an agreement among experts on a subject. FDM is a relatively recent method in Malaysian educational research, having been presented in 1998 by Kaufman and Gupta [15]. In terms of expert selection, it is claimed that a larger panel will result in a more wide range of skills but eventually leads to diminishing returns [16]. Clayton [17] states that the suitable number of experts is 5 to 10 people.

For this study, FDM is used to analyse the importance of items from the SLR data retrieved. The procedures are adapted by [18]. The results and data retrieved from the SLR are compiled and defined to build a questionnaire. The questionnaire is then asked to assess by the experts on a precise 7-point Likert scale. According to [19], there are 7 steps in data analysis for Fuzzy Delphi:

2.2.1 Selection of experts

The number of experts that were invited to assess the importance of the evaluation criteria about the factors that would be measured. For this study, a total of 6 experts in the dyslexic children education and Arabic language education field for more than 5 years.

2.2.2 Determination of linguistic variables

For this process, all linguistic variables are turned into triangular fuzzy integers. This step also covers the conversion of linguistic variables to fuzzy number addition [20]. For each response, expert opinion was represented by 3 fuzzy values (fuzziness expert opinion).

2.2.3 Getting average rating

All Likert scale responses must be converted to a fuzzy scale upon receiving responses from the chosen experts. This is referred to as the average replies of each fuzzy number. The formula is expressed in Eq. (1);

$$M = \frac{\sum_{i}^{n}=1mi}{n} \tag{1}$$

2.2.4 Determining threshold "d" value

This step of the method determines the value of threshold "*d*". The threshold value is crucial in determining the degree of agreement among professionals. The equation is employed to determine the distance between each fuzzy number m = (m_1, m_2, m_3) and n = (n_1, n_2, n_3). The formula for Threshold, (d) value is stated in Eq. (2). The threshold value is crucial in determining whether experts agree or disagree. An expert agreement has been established if the threshold value is less than or equal to 0.2. If the total agreement (group consensus) for each item does not exceed 75%, the second round should be used.

$$d(\tilde{m}, \tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]} \tag{2}$$

2.2.5 Identifying the alpha level of aggregate of fuzzy assessments

The level of an alpha aggregate of fuzzy evaluation is calculated after expert agreement by accumulating fuzzy numbers for each item. It had previously been determined that a 75 percent consensus would be required to demonstrate expert agreement; as being less than 75% will be either rejected or given a second round of evaluation. The process of calculating and determining fuzzy values: A_{max} = 1/4 (m_1 + 2m_2 + m_3)

2.2.6 Defuzzication

The purpose of this analysis is to calculate the fuzzy score (*A*). To ensure that the third requirement is met, the value of the fuzzy score (*A*) must be greater than or equal to the median value (α - cut value) of 0.5 [21]. According to experts, the value of fuzzy scores (*A*) can be used as a determinant and priority for an element, among other things.

2.2.7 Ranking

The model element is chosen based on expert agreement on the defuzzication value, with the highest value element defined by the model's most significant position. Conditions for items acceptance are:

i) Threshold Value, (*d*) ≤ 0.2
ii) Average percentage of expert consensus, (%) ≥ 75.0%
iii) Fuzzy score, (%) ≥ 0.5

3. Results and Findings

3.1 Systematic Literature Review (SLR)

This step entails compiling and summarizing the findings of the articles collected. The data for both quality and categorization was taken from the previously examined articles. In addition to the quality assessment, the following data were retrieved from the original study. From the databases, eighteen (18) publications linked to game-based Arabic language learning elements for dyslexic students were identified. Table 3 shows the average quality scores for studies per year.

Table 3
Details and quality evaluation scores of the studies retrieved

ID	Title	Author	Year	Q1	Q2	Q3	Q4	Total Score
S1	Educational Software for Dyslexic Children: A Systematic Literature Review	[22]	2021	1	1	0.5	0.5	3
S2	Dyslexic Arabic Students in the Arab Countries: A Systematic Review of Assistive Technology Progress and Recommendations	[23]	2021	1	1	0.5	1	3.5
S3	Exploring the Use of the ICT in Supporting Dyslexic Students' Preferred Learning Styles: A Preliminary Evaluation	[24]	2017	1	1	1	1	4
S4	RALF: an adaptive reinforcement learning framework for teaching dyslexic students	[25]	2022	1	1	1	1	4
S5	Game-Based Interventions as Support for Learning Difficulties and Knowledge Enhancement in Patients with Dyslexia: A Systematic Literature Review	[26]	2022	1	1	0.5	0.5	3
S6	Strengthening Jawi Writing for Dyslexia Students through Online Games - Analysis of E-Jawi Games Online in Malaysia	[27]	2015	1	1	1	1	4
S7	Measuring the Impact of Developing a Game-Based Mobile Application to Increase Reading Skills Levels for Dyslexic Students at Primary Schools In Saudi Arabia	[28]	2022	1	1	0	1	3

S8	An Approach to Digital Game-Based Learning: Video-Games Principles and Applications in Foreign Language Learning	[1]	2018	1	1	1	1	4
S9	Game User Interface Criteria for Dyslexic Children	[29]	2021	1	0.5	1	1	3.5
S10	Developing effective educative games for Arabic children primarily dyslexic	[4]	2018	1	1	1	1	4
S11	"Let's Play a Game!" Serious Games for Arabic Children with Dictation Difficulties	[30]	2020	1	1	1	1	4
S12	Understanding the Needs of Arab Learners with Dyslexia for Adaptive Systems	[31]	2022	1	1	1	1	4
S13	An Arabic Framework for Dyslexia Training Tools	[5]	2013	1	1	1	1	4
S14	YUSR: Speech Recognition Software for Dyslexics	[32]	2013	1	1	0.5	1	3.5
S15	Usability Features for Arabic Assistive Technology for Dyslexia	[33]	2018	1	1	1	1	4
S16	Computer-Assisted Learning Language for Learning Disabilities in The Arabic Language: Diagnosis, Training and Assistance	[34]	2019	1	1	1	1	4
S17	Communication Technology for Users with Specific Learning Disabilities	[35]	2017	1	1	1	1	4
S18	Importance Of Assistive Mobile Applications for Dyslexic Students in Saudi Arabia	[36]	2021	1	1	1	1	4

Table 3 displays the papers obtained as well as the quality evaluation results for each paper. Only a few studies focused on game-based Arabic language learning for dyslexic children between 2013 and 2022. Each year between 2015 and 2020, 1 paper was chosen. Meanwhile, between 2013 and 2017, 2 publications were published and chosen for this investigation. 3 papers from the year 2018 are also tagged. Papers from 2021 and 2022 were the most frequently retrieved, with 4 papers chosen each year.

The quality assessment scores for all the papers are higher than 3. According to Kitchenham [13], any publications with a quality score of 2 or more are considered good quality. Hence, all of the acquired papers are reliable for this study.

3.1.2 The elements of Arabic language learning for dyslexic students from SLR

To achieve the answer for 'RQ2: What are the key Arabic language features of game-based Arabic language learning for dyslexic students?', the researcher/ experts? proposes breaking the theme down into a total of 4 components, namely: 1) background; 2) Arabic linguistic features; 3) learning strategy; and finally, 4) learning hierarchy. Figure 2 shows the distribution of Arabic language features for game-based Arabic language learning for students with dyslexia while Table 4 appeals to the summary matrix of the retrieved data. The data and elements retrieved from the SLR are then listed in Table 5.

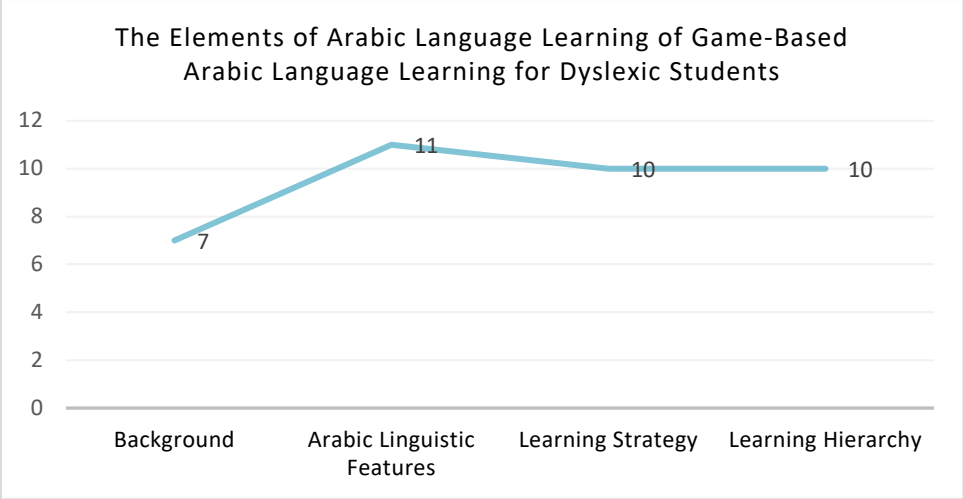

Fig. 2. Distribution of the elements of Arabic language learning game-based Arabic language learning for dyslexic students

Table 4
Summary matrix: the elements of Arabic language learning of game-based Arabic language learning for dyslexic students

Elements	Paper ID																	
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
Background		/		/				/		/		/	/					/
Arabic Linguistic Features			/	/	/	/				/	/		/	/	/	/		/
Learning Strategy		/	/	/				/		/	/	/	/		/		/	
Learning Hierarchy				/	/			/		/	/		/	/	/		/	/

Table 5
Arabic language learning elements guidelines for game-based Arabic language learning for dyslexic students

Elements	(Code)	Guidelines
Background	(B#1)	Game-based Arabic learning for dyslexic children design should incorporate interaction context and cultural characteristics
	(B#2)	Game design should consider dyslexic children's prior skills in the Arabic language and learning styles
	(B#3)	Game design should consider the background of dyslexic children
Arabic Linguistic Features	(ALF#1)	The Arabic font used should be heavy and bold letter base/bottom to resemble different letter heights and form
	(ALF#2)	Expose all the distinct shapes of Arabic letters as it is distinguished by their several orthographic forms, depending on their location in the word
	(ALF#3)	Use a variety of colours or sizes to distinguish additional Arabic patterns, the dots and their positions, and long vowels
Learning Strategy	(LS#1)	Games for dyslexic children are suitable using the phonetic method
	(LS#2)	Arabic language learning games for dyslexic children are suitable for using the storytelling method
	(LS#3)	Arabic language learning games for dyslexic children suitable for using frequently used words (syar'iah sentences)
	(LS#4)	Arabic language learning games for dyslexic children are suitable using the multi-sensory visual, auditory, and kinaesthetic tactile (VAKT) method

	(LS#5)	Arabic language learning games for dyslexic children are suitable using the Barton reading program method
	(LS#6)	Arabic language learning games for dyslexic children are suitable using the symbol method as communication (semiotic)
	(LS#7)	Language learning games for dyslexic children need to involve auditory activities
	(LS#8)	Language learning games for dyslexic children need to involve visual activities
	(LS#19)	Language learning games for dyslexic children need to involve kinaesthetic activities
	(LS#10)	Arabic learning games for dyslexic children need to combine all learning methods suitable for dyslexic children
	(LS#11)	Game design should consider the learning style of dyslexic children
	(LS#12)	Piaget's constructivist learning theory is a suitable learning theory for dyslexic children
Learning Hierarchy	(LH#1)	Arabic learning games can help dyslexic children pronounce words in Arabic correctly
	(LH#2)	This game needs to be applied with skills to identify the different letters in the Arabic language
	(LH#3)	Arabic language learning games need to contain Elements that can increase the level of mental ability of dyslexic children
	(LH#4)	Arabic learning games can help dyslexic children build words based on *hijaiyah* letters
	(LH#5)	Arabic language learning games can help dyslexic children distinguish *hija'iyah* letters
	(LH#6)	Arabic language learning games need to be designed according to the ability level of dyslexic children
	(LH#7)	Arabic learning games for dyslexic children need to start by introducing symbols in Arabic
	(LH#8)	Arabic language learning games for dyslexic children should start by introducing *hija'iyah* letters followed by word building and finally building sentences
	(LH#9)	A video simulating the pronunciation of *makhraj* and *hija'iyah* letters in the Arabic language learning game helps dyslexic children to pronounce Arabic letters and words correctly
	(LH#10)	Arabic language learning games for dyslexic children need to follow the level of difficulty based on the ability level of dyslexic children

3.2 Fuzzy Delphi Method (FDM)

This section consists of the results from the Fuzzy Delphi method (FDM) analysis and evaluation. FDM is used to evaluate the importance and ranking of each element retrieved from the previous systematic literature review (SLR) outcome. A total of 6 experts were involved in this evaluation, which are 3 experts in Arabic language education and 3 dyslexia teachers.

3.2.1 Background

Table 6 summarises the expert consensus and recommendations for the background of Arabic language learning components for game-based Arabic language learning for dyslexic students. According to the Table 6 above, all elements were acknowledged by the experts. The table also displays the ranking for each of the 3 items chosen. According to the analysis, the significance of each item for background components in Arabic language learning is assessed based on experts' consensus and opinion. The elements are ranked in the following order:

i) Game design should consider the dyslexic children's prior skills in the Arabic language and learning styles
ii) Game design should consider the background of dyslexic children

iii) Game-based Arabic learning for dyslexic children design should incorporate interaction context and cultural characteristics.

Table 6
Overview of the results of expert consensus on background component

Code*	Triangular Fuzzy Numbers		Fuzzy Evaluation Process				Experts' Consensus	Elements ACCEPTED	Ranking
	Threshold Value, *d*	Percentage of Experts' Agreement, %	m_1	m_2	m_3	Fuzzy Score *(A)*			
(B#1)	0.103	90.0%	0.800	0.940	0.990	0.910	ACCEPTED	0.910	3
(B#2)	0.064	100.0%	0.840	0.970	1.000	0.937	ACCEPTED	0.937	1
(B#3)	0.103	90.0%	0.800	0.940	0.990	0.910	ACCEPTED	0.910	2

*Please refer to Table 5

3.2.2 Arabic linguistic features

Table 7 summarises the expert consensus and recommendations for Arabic linguistic Features of Arabic language learning components for game-based Arabic language learning for dyslexic students.

Table 7
Overview of the results of expert consensus on Arabic linguistic features component

Code*	Triangular Fuzzy Numbers		Fuzzy Evaluation Process				Experts' Consensus	Elements ACCEPTED	Ranking
	Threshold Value, *d*	Percentage of Experts' Agreement, %	m_1	m_2	m_3	Fuzzy Score *(A)*			
(ALF#1)	0.042	100.0%	0.867	0.983	1.000	0.950	ACCEPTED	0.950	1
(ALF#2)	0.042	100.0%	0.867	0.983	1.000	0.950	ACCEPTED	0.950	1
(ALF#3)	0.042	100.0%	0.867	0.983	1.000	0.950	ACCEPTED	0.950	1

*Please refer to Table 5

According to the Table 7 above, all elements were accepted by the experts. The table also displays the ranking for each of the 3 items chosen. According to the analysis, the significance of each item for the Arabic language features components in Arabic language learning is assessed based on experts' consensus and opinion. The elements were ranked in the following order:

i) The Arabic font used should be heavy and bold letter base/bottom to resemble different letter heights and form.
ii) Expose all the distinct shapes of Arabic letters as it is distinguished by their several orthographic forms, which vary depending on its location in the word.
iii) Use variety of colour or sizes to distinguish additional Arabic patterns, the dots and their positions, and long vowels.

3.2.3 Learning strategy

Table 8 summarises the expert consensus and recommendations for the learning strategy of Arabic language learning components for game-based Arabic language learning for dyslexic students. The Element(s) in red box represents the value of the agreement that was not agreed upon by the experts.

Table 8
Overview of the results of expert consensus on the learning strategy component

Code*	Triangular Fuzzy Numbers		Fuzzy Evaluation Process						
	Threshold Value, *d*	Percentage of Experts' Agreement, %	m_1	m_2	m_3	Fuzzy Score *(A)*	Experts' Consensus	Elements ACCEPTED	Ranking
(LS#1)	0.068	100.0%	0.767	0.933	1.000	0.900	ACCEPTED	0.900	8
(LS#2)	0.293	83.3%	0.667	0.817	0.900	0.794	ACCEPTED	0.794	10
(LS#3)	0.122	83.3%	0.800	0.933	0.983	0.906	ACCEPTED	0.906	4
(LS#4)	0.042	100.00%	0.867	0.983	1.000	0.950	ACCEPTED	0.950	1
(LS#5)	0.102	100.00%	0.733	0.900	0.983	0.872	ACCEPTED	0.872	9
(LS#6)	0.367	33.33%	0.517	0.683	0.817	0.672	REJECTED	0.672	12
(LS#7)	0.122	83.33%	0.800	0.933	0.983	0.906	ACCEPTED	0.906	4
(LS#8)	0.122	83.33%	0.800	0.933	0.983	0.906	ACCEPTED	0.906	4
(LS#19)	0.122	83.33%	0.800	0.933	0.983	0.906	ACCEPTED	0.906	4
(LS#10)	0.042	100.00%	0.867	0.983	1.000	0.950	ACCEPTED	0.950	1
(LS#11)	0.042	100.00%	0.867	0.983	1.000	0.950	ACCEPTED	0.950	1
(LS#12)	0.394	83.33%	0.683	0.800	0.850	0.778	ACCEPTED	0.778	11

*Please refer to Table 5

According to the Table 8 above, 11 elements were accepted by the experts and only 1 element was rejected. The table also displays the ranking for each of the 12 elements chosen. Although LS#12 resulted with a higher Threshold (*d*) value than 0.2, it is still accepted as the percentage of experts' agreement and fuzzy score managed to meet the conditions of the FDM item acceptance. However, 3 items with the same score are placed first, and 4 items are ranked fourth. According to the analysis, the significance of each item for learning strategy components in Arabic language learning is assessed based on experts' consensus and opinion. The elements are ranked in the following order:

i) The Arabic language learning games for dyslexic children are suitable using the multi-sensory visual, auditory, and kinaesthetic tactile (VAKT) method.
ii) Arabic learning games for dyslexic children need to combine all learning methods suitable for dyslexic children.
iii) Game design should consider the learning style of dyslexic children.
iv) Arabic language learning games for dyslexic children suitable for using frequently used words (*syar'iah* sentences).
v) Language learning games for dyslexic children need to involve auditory activities.
vi) Language learning games for dyslexic children need to involve visual activities.
vii) Language learning games for dyslexic children need to involve kinaesthetic activities.
viii) Games for dyslexic children are suitable using the phonetic method.
ix) Arabic language learning games for dyslexic children are suitable using the Barton reading program method.
x) Arabic language learning games for dyslexic children are suitable using the storytelling method.
xi) Piaget's constructivist learning theory is a suitable learning.

3.2.4 Learning hierarchy

Table 9 summarises the expert consensus and recommendations for the learning hierarchy of Arabic language learning components for game-based Arabic language learning for dyslexic students. According to the Table 9 above, all elements were accepted by the experts. The table also displays the ranking for each of the 10 elements chosen. According to the analysis, the significance of each

item for learning hierarchy components in Arabic language learning is assessed based on experts' consensus and opinion. The elements are ranked in the following order:

i) Arabic language learning games for dyslexic children need to follow the level of difficulty based on the ability level of dyslexic children.
ii) Arabic language learning games need to contain Elements that can increase the level of mental ability of dyslexic children.
iii) Arabic language learning games can help dyslexic children distinguish *Hija'iyah* letters.
iv) Arabic language learning games need to be designed according to the ability level of dyslexic children.
v) Arabic learning games for dyslexic children need to start by introducing symbols in Arabic.
vi) Arabic language learning games for dyslexic children should start by introducing *Hija'iyyah* letters, followed by word building and finally building sentences.
vii) A video simulating the pronunciation of *Makhraj* and *Hija'iyah* letters in the Arabic language learning game helps dyslexic children to pronounce Arabic letters and words correctly.
viii) This game needs to be applied with skills to identify the different letters in the Arabic language.
ix) Arabic learning games can help dyslexic children pronounce words in Arabic correctly.
x) Arabic learning games can help dyslexic children build words based on *Hija'iyah* letters.

Table 9
Overview of the results of expert consensus on learning hierarchy component

Code*	Triangular Fuzzy Numbers		Fuzzy Evaluation Process				Experts' Consensus	Elements ACCEPTED	Ranking
	Threshold Value, (*d*)	Percentage of Experts' Agreement, %	m_1	m_2	m_3	Fuzzy Score *(A)*			
(LH#1)	0.122	83.3%	0.800	0.933	0.983	0.906	ACCEPTED	0.906	9
(LH#2)	0.109	83.3%	0.833	0.950	0.983	0.922	ACCEPTED	0.922	8
(LH#3)	0.068	100.0%	0.833	0.967	1.000	0.933	ACCEPTED	0.933	2
(LH#4)	0.122	83.33%	0.800	0.933	0.983	0.906	ACCEPTED	0.906	9
(LH#5)	0.068	100.00%	0.833	0.967	1.000	0.933	ACCEPTED	0.933	2
(LH#6)	0.068	100.00%	0.833	0.967	1.000	0.933	ACCEPTED	0.933	2
(LH#7)	0.068	100.00%	0.833	0.967	1.000	0.933	ACCEPTED	0.933	2
(LH#8)	0.068	100.00%	0.833	0.967	1.000	0.933	ACCEPTED	0.933	2
(LH#9)	0.068	100.00%	0.833	0.967	1.000	0.933	ACCEPTED	0.933	2
(LH#10)	0.042	100.00%	0.867	0.983	1.000	0.950	ACCEPTED	0.950	1

*Please refer to Table 5

4. Conclusions

Although previous research findings show that game-based language learning in Arabic for dyslexic students is effective, there are still defects, issues, and challenges that must be addressed and overcome. Game-based learning is a form of learning tool that incorporates motivation, fun, and education. It is one of the educational aids that may be used in a variety of ways and for a variety of goals, especially when combined with appropriate guidelines, frameworks, systems, and expertise in the chosen subject. Hence, this study takes the initiative to focus on game-based learning; Arabic language; and dyslexia learning.

The findings from the 18 papers selected highlighted 4 main components which are background, Arabic linguistic features, learning strategy, and learning hierarchy. All the systematic literature

review (SLR) papers retrieved are deemed to be reliable as they qualify for the required marks. The results are then evaluated using the Fuzzy Delphi method (FDM) to analyse the importance of items based on experts' opinions and consensus.

As a result, all the elements were accepted except for 1, which is 'Arabic language learning games for dyslexic children are suitable using the symbol method as communication (semiotic)'. The selected elements include, but are not restricted to: the usage and consideration of dyslexic students' prior skills and learning style; the usage of fonts; appropriate learning methods; and the level of difficulty accustomed to the dyslexic students. The study's combined conclusions give a comprehensive and cohesive set of guidelines that can shape the design and development of game-based Arabic language learning for dyslexic children, encompassing the insights and views of both empirical research and expert opinion.

To conclude, design features and elements must be thoroughly addressed and evaluated to produce successful game-based Arabic language learning for dyslexic students. The findings of the study can guide future research to investigate the impact of game-based Arabic language for dyslexic students on language learning gains and user experience, as well as the guidelines' accessibility and practicability across diverse contexts and groups.

Acknowledgement
This research was funded by a grant from Ministry of Higher Education of Malaysia which is The Fundamental Research Grant Scheme (FRGS Grant) under the title of A Framework of Game-Based Arabic Language Learning for Dyslexic Children with the code of FRGS/1/2020/WAB10/KUIS/02/1.

References

[1] Casañ-Pitarch, Ricardo. "An approach to digital game-based learning: Video-games principles and applications in foreign language learning." Journal of Language Teaching and Research (Online) 9, no. 6 (2018): 1147-1159. https://doi.org/10.17507/jltr.0906.04
[2] So, Hyo-Jeong, and Minhwi Seo. "A systematic literature review of game-based learning and gamification research in Asia: The synthesized findings and research gap." Routledge international handbook of schools and schooling in Asia (2018). https://doi.org/10.4324/9781315694382-37
[3] Yusoff, Mohd Alwee, and Mohamad Azrien Mohamed Adnan. "Bahasa Arab sebagai bahasa ilmudan peradaban: Satu kajian dari sudut keistimewaannya." Jurnal Usuluddin 27 (2008): 157-167.
[4] El Kah, Anoual, and Abdelhak Lakhouaja. "Developing effective educative games for Arabic children primarily dyslexics." Education and Information Technologies 23, no. 6 (2018): 2911-2930. https://doi.org/10.1007/s10639-018-9750-2
[5] Al Rowais, Fadwa, Mike Wald, and Gary Wills. "An Arabic framework for dyslexia training tools." (2013): 63-68.
[6] Aljojo, Nahla, Asmaa Munshi, Wfaa Almukadi, Anhar Hossain, Noran Omar, Bashair Aqel, Shahad Almhuemli, Fatma Asirri, and Areej Alshamasi. "Arabic Alphabetic Puzzle Game Using Eye Tracking and Chatbot for Dyslexia." International journal of interactive mobile technologies 12, no. 5 (2018). https://doi.org/10.3991/ijim.v12i5.8957
[7] Haladjian, Juan, Daniel Richter, Paul Muntean, Damir Ismailovic, and Bernd Brügge. "A Framework for the Creation of Mobile Educational Games for Dyslexic Children." International Association for Development of the Information Society (2013).
[8] B. Kitchenham, 'Guidelines for performing systematic literature reviews in software engineering', Technical report, Ver. 2.3 EBSE Technical Report. EB
[9] Kitchenham, Barbara, O. Pearl Brereton, David Budgen, Mark Turner, John Bailey, and Stephen Linkman. "Systematic literature reviews in software engineering–a systematic literature review." Information and software technology 51, no. 1 (2009): 7-15.https://doi.org/10.1016/j.infsof.2008.09.009
[10] Kitchenham, Barbara. "Procedures for performing systematic reviews." Keele, UK, Keele University 33, no. 2004 (2004): 1-26.
[11] Kitchenham, Barbara, and Stuart Charters. "Guidelines for performing systematic literature reviews in software engineering." (2007): 1051.

[12] Masrop, Noor Azli Mohamed, Hafawati Ishak, Ghazali Zainuddin, Siti Rosilawati Ramlan, Muhammad Sabri Sahrir, and Harwati Hashim. "Digital games-based language learning for Arabic literacy remedial." Creative Education 10, no. 12 (2019): 3213.https://doi.org/10.4236/ce.2019.1012245

[13] Kitchenham, Barbara, Rialette Pretorius, David Budgen, O. Pearl Brereton, Mark Turner, Mahmood Niazi, and Stephen Linkman. "Systematic literature reviews in software engineering–a tertiary study." Information and software technology 52, no. 8 (2010): 792-805. https://doi.org/10.1016/j.infsof.2010.03.006

[14] Mohd Ridhuan, M. J., S. Saedah, H. Zaharah, M. N. Nurulrabihah, and S. Arifin. "Pengenalan asas kaedah Fuzzy Delphi dalam penyelidikan rekabentuk pembangunan." Minda Intelek Agency (2014).

[15] Siraj, Saedah, Abd Razak Zakaria, Norlidah Alias, Dorothy Dewitt, Ponnei Kannan, and Jeyanthy Ganapathy. "Future projection on patriotism among school students using Delphi technique." Creative Education 3, no. 06 (2012): 1053. https://doi.org/10.4236/ce.2012.326158

[16] McMillan, Sara S., Michelle King, and Mary P. Tully. "How to use the nominal group and Delphi techniques." International journal of clinical pharmacy 38 (2016): 655-662. https://doi.org/10.1007/s11096-016-0257-x

[17] Clayton, Mark J. "Delphi: a technique to harness expert opinion for critical decision-making tasks in education." Educational psychology 17, no. 4 (1997): 373-386. https://doi.org/10.1080/0144341970170401

[18] Mohd, J. M. R., and M. N. Noh. "Kepelbagaian Metodologi dalam Penyelidikan Reka Bentuk dan Pembangunan (Izra Noh, Ed.;)." Qaisar Prestige Resources (2020).

[19] Sensuse, Dana Indra, Betty Purwandari, and Puji Rahayu. "Defining e-Portofolio Factor for Competency Certification using Fuzzy Delphi Method." Turkish Online Journal of Educational Technology-TOJET 17, no. 2 (2018): 25-33.

[20] Hsieh, Ting-Ya, Shih-Tong Lu, and Gwo-Hshiung Tzeng. "Fuzzy MCDM approach for planning and design tenders selection in public office buildings." International journal of project management 22, no. 7 (2004): 573-584. https://doi.org/10.1016/j.ijproman.2004.01.002

[21] Abdullah, Jamelah Bibi, and S. I. M. Yusof. "A Fuzzy Delphi method–developing high-performance leadership standard for Malaysian school leaders." Journal of Education and Social Sciences 9, no. 2 (2018): 1-10.

[22] Ishak, Siti Hafawati, Noor Azli Mohamed Masrop, and Ghazali Zainuddin. "Educational Software for Dyslexic Children: A Systematic Literature Review." Malaysian Journal of Information and Communication Technology (MyJICT) (2021): 16-33. https://doi.org/10.53840/myjict6-1-40

[23] Alsswey, Ahmed, Fuad Ali El-Qirem, and Mohammed Hassan Al Tarawneh. "Dyslexic Arabic Students in the Arab Countries: A Systematic Review of Assistive Technology Progress and Recommendations." International Journal of Early Childhood Special Education 13, no. 1 (2021). https://doi.org/10.9756/INT-JECSE/V13I1.211014

[24] Benmarrakchi, FatimaEzzahra, Jamal El Kafi, Ali Elhore, and Sara Haie. "Exploring the use of the ICT in supporting dyslexic students' preferred learning styles: A preliminary evaluation." Education and Information Technologies 22 (2017): 2939-2957.https://doi.org/10.1007/s10639-016-9551-4

[25] Minoofam, Seyyed Amir Hadi, Azam Bastanfard, and Mohammad Reza Keyvanpour. "RALF: an adaptive reinforcement learning framework for teaching dyslexic students." Multimedia Tools and Applications 81, no. 5 (2022): 6389-6412.https://doi.org/10.1007/s11042-021-11806-y

[26] Saeed, Aliza, Khubaib Amjad Alam, Awais Azam, Maria Khalid, and Osama Tauni. "Game-based interventions as support for learning difficulties and knowledge enhancement in patients with Dyslexia: A systematic literature review." Information and Knowledge in Internet of Things (2022): 79-97. https://doi.org/10.1007/978-3-030-75123-4_4

[27] Salih, Mohamad Adib Mohamad, Rosmila Abdul-Kahar, W. A. M. W. Zahari, Halimi Mohd Khalid, and Kartini Abdul Rahim. "Strengthening Jawi writing for Dyslexia students through online games-analysis of E-Jawi games online in Malaysia." Journal of Education and Human Development 4, no. 2 (2015): 147-151. https://doi.org/10.15640/jehd.v4n2a17

[28] Allafi, Randa, Ibrahim Alzahrani, and Paul Newbury. "Measuring the impact of developing a game-based mobile application to increase reading skills level for dyslexic students at primary schools in Saudi Arabia." In INTED2022 Proceedings, pp. 10552-10559. IATED, 2022. https://doi.org/10.21125/inted.2022.2790

[29] Ishak, Siti Hafawati, Noor Azli Mohamed Masrop, Ghazali Zainuddin, M. S. B. Sahrir, and Sarifah Nurhanum Syed Sahuri. "Game user interface criteria for dyslexic children." In 3rd International Innovation, Technology & Research Exhibition and Conference, pp. 1-4. 2021.

[30] Shohieb, Samaa M., Abd Elghaffar M. Elhady, Abdelrahman Mohsen, Abdelrahman Elbossaty, Eiad Rotab, Hajar Abdelmonem, Naira Elsaeed et al. "Let's Play a Game! Serious Games for Arabic Children with Dictation Difficulties." In Entertainment Computing–ICEC 2020: 19th IFIP TC 14 International Conference, ICEC 2020, Xi'an, China, November 10–13, 2020, Proceedings 19, pp. 77-89. Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-65736-9_6

[31] Al-Dawsari, Hadeel Mohammed, and Robert Hendley. "Understanding the needs of Arab learners with dyslexia for adaptive systems." In 35th International BCS Human-Computer Interaction Conference, pp. 1-10. BCS Learning & Development, 2022. https://doi.org/10.14236/ewic/HCI2022.13

[32] Taileb, Mounira, Reem Al-Saggaf, Amal Al-Ghamdi, Maha Al-Zebaidi, and Sultana Al-Sahafi. "YUSR: Speech recognition software for dyslexics." In Design, User Experience, and Usability. Health, Learning, Playing, Cultural, and Cross-Cultural User Experience: Second International Conference, DUXU 2013, Held as Part of HCI International 2013, Las Vegas, NV, USA, July 21-26, 2013, Proceedings, Part II 2, pp. 296-303. Springer Berlin Heidelberg, 2013. https://doi.org/10.1007/978-3-642-39241-2_33

[33] Aldabaybah, Balqees, and Shaidah Jusoh. "Usability features for Arabic assistive technology for dyslexia." In 2018 9th IEEE control and system graduate research colloquium (ICSGRC), pp. 223-228. IEEE, 2018. https://doi.org/10.1109/ICSGRC.2018.8657536

[34] El Kah, Anoual. "Computer-assisted learning language for learning disabilities in the Arabic language: Diagnosis, training and assistance." Unpublished doctoral dissertation). Al Akhawayn University, Ifrane (2019).

[35] Benmarrakchi, Fatimaezzahra, Jamal El Kafi, and Ali Elhore. "Communication technology for users with specific learning disabilities." Procedia Computer Science 110 (2017): 258-265. https://doi.org/10.1016/j.procs.2017.06.093

[36] Allafi, Randa Saad, and Paul Newbury. "Importance of assistive mobile applications for Dyslexic students in Saudi Arabia." International Journal of Teaching, Education and Learning 7, no. 1 (2021): 01-12. https://doi.org/10.20319/pijtel.2021.53.0112