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Game-Based Arabic Language Learning (GBALL) Visual Element Design Guideline for Dyslexic Children

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

[1] Fakulti Mutimedia kreatif dan Komputeran, Kolej Universiti Islam Antarabangsa Selangor, Malaysia
[2] Fakulti Pengajian Peradaban Islam, Kolej Universiti Islam Antarabangsa Selangor, Malaysia
[3] Faculty of Major Language Studies, Islamic Science University of Malaysia (USIM), Nilai, Negeri Sembilan, Malaysia
[4] International Islamic University Malaysia (IIUM), Gombak, Selangor, Malaysia

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ABSTRACT

Dyslexia is a common learning disability that affects a significant number of children in Arabic-speaking countries. It is known that game-based learning has shown promising results in helping dyslexic children improve their language skills. However, there is a lack of comprehensive guidelines for designing Game-Based Arabic Language Learning (GBALL) programs for dyslexic children. Hence, this paper aims to identify and synthesize existing guidelines and recommendations for designing the visual elements of a GBALL application for dyslexic children. Systematic literature reviews and the Fuzzy Delphi technique were employed to acquire the list of guidelines and recommendations. A total of ten expert consents were obtained via the Fuzzy Delphi technique to evaluate the proposed guideline. They are comprised of three experts in the Arabic language, three experts in dyslexia, and four experts in multimedia. As a result, 26 guidelines are identified and classified into three main categories proposed as a guideline for visual element design. The output of this study proposes a set of design guidelines for the visual elements of a GBALL application for dyslexic children. These are analyzed through a Systematic Literature Review (SLR) and confirmed by the experts via the Fuzzy Delphi technique.

1. Introduction

Dyslexia is a neurological disorder affecting a child's reading, writing, and spelling ability. Approximately 10-15% of the world's population has dyslexia [1]. In Arabic-speaking countries, dyslexia is a prevalent learning disability that affects many children [2]. Note that dyslexic children often struggle with language-related tasks such as reading, writing, and spelling [3]. These difficulties can have a negative impact on their academic performance and self-esteem [1]. Therefore, game-based learning has emerged as a promising approach to help dyslexic children improve their language skills. Holmes [4] emphasizes the potential benefits of game-based learning for children with dyslexia,

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

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while El Kah and Lakhouaja [5] state that games offer an effective and exciting learning experience, especially when they incorporate multisensory features. However, there is a lack of comprehensive guidelines for designing Game-Based Arabic Language Learning (GBALL) programs for dyslexic children [3,6,7].

Arabic is one of the official languages of the United Nations, and it holds significance for over 1.2 billion non-Arabic Muslims who use it for prayer sermons and formal reading and writing. Educated Arabs also adopt it for international and national news broadcasts [8]. Additionally, the recitation of Quranic verses during Muslim prayers emphasizes the importance of learning to read the Quran [9]. In Malaysia, where Arabic was introduced years ago, there is concern about the level of mastery among Malaysians. Learning Arabic is considered an essential religious duty for Malay Muslims, but many students find it challenging [10]. Research in Malaysia is lacking when it comes to understanding the difficulties dyslexic Muslim children may face in reading the Holy Quran and learning other Islamic principles, which are primarily in Arabic [9,10].

To address this issue, it is necessary to identify suitable teaching techniques and tools that can motivate and encourage dyslexic students to engage in learning the Arabic language. Unfortunately, there is still a lack of research specifically focusing on game-based Arabic language learning with visual elements, tailored for children with dyslexia. Most existing efforts have concentrated on supporting blind or visually impaired users, and primary data analysis related to dyslexia is limited. [6,11,12].

This paper identifies and synthesizes existing guidelines and recommendations for designing GBALL applications for dyslexic children. The review also aims to provide practical recommendations for developing effective GBALL programs that are engaging, accessible, and equip the specific needs of dyslexic children.

2. Methodology

Systematic literature reviews and the Fuzzy Delphi technique were employed to acquire the list of guidelines and recommendations Figure 1.

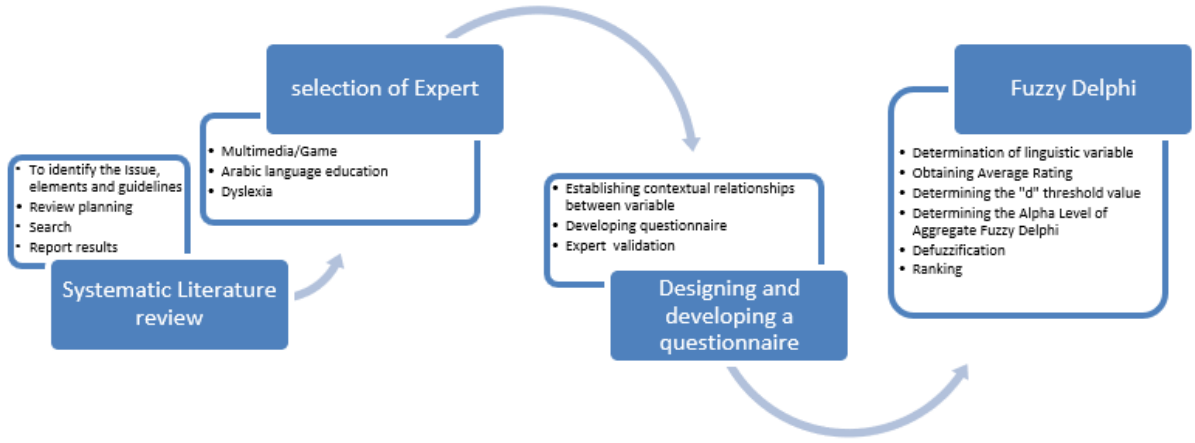

Fig. 1. Research methodology

2.1 Systematic Literature Reviews (SLR)

To identify the themes and issues related to visual elements design guidelines in GBALL for dyslexic students, a systematic literature review was conducted following the recommendations by Kitchenham [13]. The following steps were taken to develop the literature review:

i) Planning the review
   a) Ask the question and sub-questions of the review
   b) Definition of preliminary categories of analysis

ii) Search
   a) Define the sources of the literature search
   b) Define the inclusion and exclusion criteria of the literature
   c) Define the search criteria
   d) Search for literature
   e) Selection of literature

iii) Analysis of literature
   a) Reading of the selected literature
   b) Data extraction and coding

iv) Results report
   a) Interpretation of results
   b) Generation of the review report

2.1.1 Quality assessment

The evaluation of every SLR was conducted based on four Quality Assessment (QA) questions that were adapted according to the recommendation of Kitchenham [14]. The four questions used for the evaluation are:

QA1: Was the literature search likely to have identified all relevant studies?
QA2: Are the assessments of the quality and validity of the studies reliable?
QA3: Does the study provide details or guidelines on Game-Based Arabic Language Learning (GBALL) for dyslexic children?
QA4: Do the findings fulfill the research objective?

Table 1 demonstrates how the questions were assessed and categorized. In determining the scores, a value of 1 was assigned to responses marked as "Yes," 0.5 to "Partially," and 0 to "No/Unknown." These scores serve as a measure of the articles' quality and address the research inquiries.

Table 1
The specifics regarding the questions used to evaluate the quality

Scoring Question	Yes (Y) = 1	Partly (P) = 0.5	No (N)/Unknown = 0
QA1	The authors either conducted searches across four or more digital libraries, employing supplementary search algorithms, or identified and referenced all relevant journals in the field.	The authors accessed up to two digital libraries or a minimal assortment of journals.	The authors accessed up to two digital libraries or a minimal assortment of journals.
QA2	The authors explicitly outlined the criteria for assessing quality and retrieved them from each primary study.	The research question encompasses quality concerns as an integral component.	No detailed evaluation of individual primary studies' quality has been undertaken.
QA3	The study comprehensively explained the elements and guidelines involved in GBALL for dyslexic children.	The study may have only briefly summarized the elements or guidelines in GBALL for dyslexic children or may have presented an incomplete overview.	The study may have omitted discussing the elements or guidelines in GBALL for dyslexic children.
QA4	The study aligns with and directly addresses the research objective, which is stated clearly.	The findings of the study are closely tied to the research objective that is clearly stated.	The findings are ambiguous and not easily deducible.

2.2 Fuzzy Delphi Technique

To evaluate the guideline, the researcher used ten field experts through the Fuzzy Delphi technique from Kaufman & Gupta [15] and Ridhuan [16]. The Fuzzy Delphi technique was chosen because it was the appropriate technique for obtaining expert consent in deciding what to include in visual elements guidelines for GBALL for dyslexic children. Note that the main objective of the Fuzzy Delphi technique is to obtain a high-level response from the experts toward the problems given. There are seven steps in data analysis for Fuzzy Delphi, according to Sensuse *et al.,* [17]:

i) Step 1: Selection of Experts
A group of experts assessed the evaluation criteria's significance concerning the factors measured by linguistic variables. To achieve this, researchers can use multiple techniques, such as scientific seminars or workshops, inviting experts to participate, meeting identified experts in person, or disseminating information online via emails to experts who specialize in the relevant fields. In this study, the researchers have chosen to meet with the identified experts in person to facilitate discussion and explanation of any concerns. A total of ten experts with more than five years of experience were selected from the field of Arabic learning (three experts), game-based learning (four experts), and dyslexia (three experts).

ii) Step 2: Determination of Linguistic Variables
In this process, all linguistic variables are transformed into triangular fuzzy integers. Additionally, the conversion of linguistic variables includes the addition of fuzzy numbers. The linguistic scale utilized in this study is comparable to the Likert scale, except that it employs fuzzy triangular triangles as a basis for fuzzy numbering. Consequently, each response is represented by three fuzzy values demonstrating expert opinions (expert opinion fuzziness).

iii) Step 3: Getting Average Rating
Once the researcher receives a response from the assigned specialist, it is necessary to convert all Likert scale responses to a fuzzy scale. It is achieved by computing the average response of each fuzzy number, a process commonly referred to as fuzzy averaging. It is expressed in formula (1), where:

$$M = \frac{\sum_{i}^{n}=1mi}{n} \quad (1)$$

iv) Step 4: Determining Threshold "*d*" value
The method used determines the value of the threshold "*d*", which is crucial in determining the level of agreement among specialists during the evaluation process [18]. For example, the formula employed to calculate the distance between each fuzzy number $m = (m_1, m_2, m_3)$ and $n = (n_1, n_2, n_3)$ depends on the threshold value. According to Cheng and Lin [19], a threshold value of 0.2 or lower indicates expert agreement. Additionally, for each item, the overall agreement or group consensus should exceed 75%; otherwise, a second round of evaluation should be conducted [16].

v) Step 5: Identify the Alpha Level of Aggregate of Fuzzy Assessments
Once an expert agreement has been reached, the alpha aggregate level of fuzzy assessment is determined by adding the fuzzy numbers for each item. To demonstrate expert agreement, it was established beforehand that a consensus of 75% is required [17]. Therefore, if the level of agreement among experts is below 75%, the procedure should be repeated to ensure that the experts reach at least 75% consensus. The process of computing and determining fuzzy values is as follows: $A_{max} = / (m_1 + 2m_2 + m_3)$.

vi) Step 6: Defuzzication
The objective of this analysis is to determine the fuzzy score (*A*) for an element. To meet the third criterion, the value of the fuzzy score (*A*) should be greater than or equal to the median value (α-cut value) of 0.5, indicating that a group of experts has reached an agreement on the element [20]. Consequently, the value of fuzzy scores (*A*) can be utilized to determine the priority of an element based on the experts' opinions. The formula for calculating the fuzzy score (*A*) is as follows: $A = (1/3) * (m_1 + m_2 + m_3)$.

vii) Step 7: Ranking
The element that holds the most significant position is determined based on the defuzzification value and the level of agreement among experts, with the highest value element being selected [20].

3. Results and Findings

3.1 Results of Systematic Literature Reviews (SLR)

This section discusses the results obtained from the SLR study. In this study, the researchers attempted to systematically analyze the current literature on the visual elements guidelines of GBALL for dyslexic children. Altogether, 18 publications related to the topic were chosen from the databases, revealing three elements: color, layout, and formatting.

3.1.1 Data extraction

The papers retrieved are then calculated based on the quality assessment questions. The average quality scores for studies each year are shown in Table 2.

Table 2
Details and quality assessment scores of the papers retrieved

ID	Title	Author	Year	Q1	Q2	Q3	Q4	Total score
S1	Educational Software for Dyslexic Children: A Systematic Literature Review	[21]	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	[22]	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	[23]	2017	1	1	1	1	4
S4	RALF: an adaptive reinforcement learning framework for teaching dyslexic students	[24]	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	[25]	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	[26]	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	[27]	2022	1	1	0	1	3
S8	An Approach to Digital Game-Based Learning: Video-Games Principles and Applications in Foreign Language Learning	[28]	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	[5]	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	[32]	2013	1	1	1	1	4
S14	YUSR: Speech Recognition Software for Dyslexics	[33]	2013	1	1	0.5	1	3.5
S15	Usability Features for Arabic Assistive Technology for Dyslexia	[34]	2018	1	1	1	1	4
S16	Computer-Assisted Learning Language for Learning Disabilities in The Arabic Language: Diagnosis, Training, and Assistance		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

3.1.1 Elements and Design guideline from SLR

Table 3 summarizes the analysis results for the visual elements of GBALL for dyslexic children. Meanwhile, the design guidelines are summarized in Table 4.

Table 3
Summary matrix of the visual elements of GBALL for dyslexic children

Elements	Paper ID																	
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
Color	/		/	/		/			/	/	/	/	/	/	/	/	/	/
Layout			/	/		/			/	/			/		/	/	/	/
Formatting	/		/	/			/		/	/			/		/	/	/	/

Table 4
The visual elements guidelines for GBALL for dyslexic children

Elements	(Guideline code) Guidelines	
Color	(color #1)	Background and text colors in game-based language learning for dyslexic children should not be too bright
	(color #2)	The contrast color of the background and text in game-based language learning for dyslexic children should not be too high.
	(color #3)	The use of patterns or pictures as a background in game-based language learning for dyslexic children should be avoided
	(color #4)	Cream colors or soft pastel colors are suitable for the background of game-based language learning for dyslexic children
	(color #5)	The freedom to choose text and background colors, font types, and sizes in game-based language learning for dyslexic children will significantly impact dyslexic children's reading accuracy.
	(color #6)	The use of secondary or tertiary colors is more suitable for dyslexic children's games
	(color #7)	Game interfaces with too many colors in game-based language learning can confuse and distract dyslexic children
	(color #8)	The use of soft colors to highlight important content from long texts in game-based language learning is suitable for dyslexic children
	(color #9)	The use of green and red/pink colors should be avoided in game-based language learning for dyslexic children
	(color #10)	Menu buttons should use a few basic colors to avoid confusion among dyslexic children
Layout	(layout #1)	The use of left-aligned text without justification is suitable for game-based language learning for dyslexic children
	(layout #2)	Avoid the use of multiple columns in game-based language learning for dyslexic children
	(layout #3)	Lines should not be too long (recommended 60 to 70 characters) in game-based language learning for dyslexic children
	(layout #4)	Game-based language learning that contains long texts need to be broken into several sub-headings
	(layout #5)	Table of content should be included in game-based language learning for dyslexic children
	(layout #6)	The use of line markers can improve the focus of dyslexic children
	(layout #7)	The use of reading rulers can enhance the focus of dyslexic children
Formatting	(format #1)	The use of 1.5 line spacing in the game is suitable for dyslexic children
	(format #2)	Bold text is suitable for emphasizing important content in game-based language learning for dyslexic children
	(format #3)	The use of colored text is suitable to emphasize the important content of game-based language learning for dyslexic children
	(format #4)	Italic text is not ideal for highlighting important content in games for dyslexic children.
	(format #5)	Underlined text is not suitable for emphasizing important content in the game for dyslexic children
	(format #6)	Non-serif fonts (San Serif) are suitable to use in game-based language learning for dyslexic children

(format #7)	Font with a heavy base and bolder looking, the resembling letters differ in height and form, capitals bolder, and the spacing between the letters enhanced are suitable for dyslexic children
(format #8)	Small letters can help make it easier for dyslexic children to read the material in the language-learning game
(format #9)	The appropriate font size in games for dyslexic children is 14pt to 16pt (depending on the size of the smartphone)

3.2 Fuzzy Delphi Technique

This section discusses the results of the Fuzzy Delphi technique used to evaluate the proposed guideline. In this study, the ten experts directly involved are three experts in the Arabic language, three experts in dyslexia, and four experts in multimedia.

3.2.1 Color

Table 5 summarizes the final findings of experts' consensus and recommendations on color element guidelines for GBALL for dyslexic children. The value of the agreement not agreed upon by the expert is indicated by the element(s) in red. A total of ten experts were selected as respondents for this questionnaire, which are; three experts in Arabic language learning, three dyslexia teachers, two psychologists, and four multimedia for dyslexia experts.

Table 5
Summarizes the final findings of experts' consensus on color element guidelines

#	Guideline Code*	Conditions for *Triangular Fuzzy Numbers*		Conditions for *Fuzzy Evaluation Process*				Experts' Consensus	Elements ACCEPTED	Ranking
		Threshold Value, d	Percentage of Experts' Agreement, %	m1	m2	m3	Fuzzy Score *(A)*			
1	Color #1	0.409	30.0%	0.590	0.730	0.820	0.713	REJECTED	0.713	6
2	Color #2	0.388	50.0%	0.550	0.700	0.810	0.687	REJECTED	0.687	8
3	Color #3	0.174	90.0%	0.780	0.910	0.960	0.883	ACCEPTED	0.883	1
4	Color #4	0.336	40.00%	0.630	0.770	0.860	0.753	REJECTED	0.753	5
5	Color #5	0.211	90.00%	0.720	0.870	0.940	0.843	TERIMA	0.843	3
6	Color#6	0.378	60.00%	0.530	0.690	0.810	0.677	REJECTED	0.677	9
7	Color #7	0.128	100.00%	0.760	0.910	0.980	0.883	ACCEPTED	0.883	2
8	Color #8	0.390	60.00%	0.570	0.720	0.820	0.703	REJECTED	0.703	7
9	Color #9	0.301	60.00%	0.490	0.660	0.810	0.653	REJECTED	0.653	10
10	Color #10	0.169	100.00%	0.660	0.830	0.950	0.813	ACCEPTED	0.813	4

*Please refer to Table 4

The experts accepted four items, while six items from the elements were rejected, as stated in Table 5 above. The table also presents the ranking for all the items selected out of ten. According to the analysis, the importance of each item for color components in guidelines for dyslexic children is determined based on experts' consensus and opinion. The ranking of the items is as follows (Figure 2).

i) Using patterns or pictures as a background in game-based language learning for dyslexic children should be avoided.
ii) Game interfaces with too many colors in game-based language learning can confuse and distract dyslexic children.

iii) The freedom to choose text and background colors, font types, and sizes in game-based language learning for dyslexic children will significantly impact dyslexic children's reading accuracy.
iv) Menu buttons should use basic colors to avoid confusion among dyslexic children.

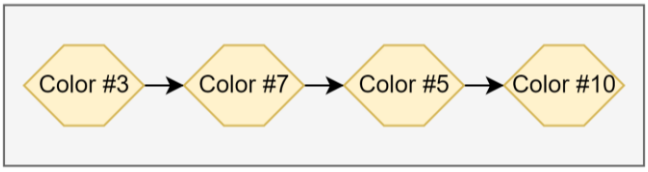

Fig. 2. Color components guidelines

3.2.2 Layout

Table 6 summarizes the final findings of experts' consensus and recommendations on layout element guidelines for GBALL for dyslexic children. The value of the agreement not agreed upon by the expert is indicated by the element(s) in red. A total of ten experts were selected as respondents for this questionnaire, which are; three experts in Arabic language learning, three dyslexia teachers, two psychologists, and four multimedia for dyslexia experts.

Table 6
Summarizes the final findings of experts' consensus on layout element guidelines

#	Guideline Code*	Conditions for *Triangular Fuzzy Numbers*		Conditions for *Fuzzy Evaluation Process*				Experts' Consensus	Elements ACCEPTED	Ranking
		Threshold Value, d	Percentage of Experts' Agreement, %	m1	m2	m3	Fuzzy Score *(A)*			
1	Layout#1	0.399	30.0%	0.510	0.670	0.790	0.657	REJECTED	0.657	7
2	Layout#2	0.249	90.0%	0.690	0.840	0.920	0.817	ACCEPTED	0.817	6
3	Layout#3	0.181	90.0%	0.740	0.890	0.950	0.860	ACCEPTED	0.860	5
4	Layout#4	0.103	90.00%	0.800	0.940	0.990	0.910	ACCEPTED	0.910	1
5	Layout#5	0.174	90.00%	0.780	0.910	0.960	0.883	ACCEPTED	0.883	3
6	Layout#6	0.103	90.00%	0.800	0.940	0.990	0.910	ACCEPTED	0.910	1
7	Layout#7	0.166	90.00%	0.740	0.890	0.960	0.863	ACCEPTED	0.863	4

*Please refer to Table 4

The experts accepted six items, while only one item from the elements was rejected, as exhibited in Table 6 above. However, two items scored the same, sharing the same rank. The table also presents the ranking for all the items selected out of seven. According to the analysis, the importance of each item for layout components in guidelines for dyslexic children is determined based on experts' consensus and opinion. The ranking of the items is as follows (Figure 3):

i) Game-based language learning containing long texts must be broken into several sub-headings.
ii) The use of line markers can improve the focus of dyslexic children.
iii) A table of content should be included in game-based language learning for dyslexic children.
iv) The use of reading rulers can enhance the focus of dyslexic children.
v) Lines should not be too long (recommended 60 to 70 characters) in game-based language learning for dyslexic children.
vi) Avoid the use of multiple columns in game-based language learning for dyslexic children.

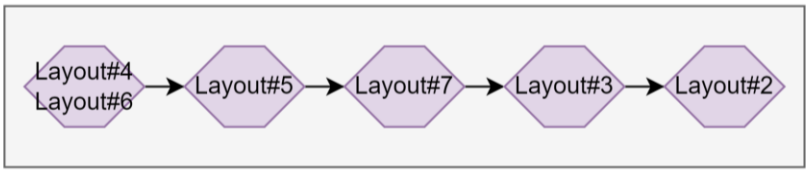

Fig. 3. Layout components guidelines

3.2.3 Formatting

Table 7 summarizes the final findings for formatting elements guidelines for dyslexic children subjected to experts' consensus and recommendations. The value of the agreement not agreed upon by the expert is indicated by the element(s) in red. A total of ten experts were selected as respondents for this questionnaire, which are; three experts in Arabic language learning, three dyslexia teachers, two psychologists, and four multimedia for dyslexia experts.

Table 7
Summarizes the final findings of experts' consensus on formatting element

#	Guideline Code*	Conditions for *Triangular Fuzzy Numbers*		Conditions for *Fuzzy Evaluation Process*				Experts' Consensus	Elements ACCEPTED	Ranking
		Threshold Value, d	Percentage of Experts' Agreement, %	m1	m2	m3	Fuzzy Score *(A)*			
1	Format#1	0.128	100.0%	0.760	0.910	0.980	0.883	ACCEPTED	0.883	5
2	Format#2	0.132	100.0%	0.780	0.920	0.980	0.893	ACCEPTED	0.893	2
3	Format#3	0.132	100.0%	0.780	0.920	0.980	0.893	ACCEPTED	0.893	2
4	Format#4	0.166	90.00%	0.740	0.890	0.960	0.863	ACCEPTED	0.863	7
5	Format#5	0.310	80.00%	0.630	0.780	0.880	0.763	ACCEPTED	0.763	8
6	Format#6	0.073	100.00%	0.820	0.960	1.000	0.927	ACCEPTED	0.927	1
7	Format#7	0.141	90.00%	0.780	0.920	0.970	0.890	ACCEPTED	0.890	4
8	Format#8	0.370	30.00%	0.610	0.750	0.840	0.733	REJECTED	0.733	9
9	Format#9	0.118	100.00%	0.740	0.900	0.980	0.873	ACCEPTED	0.873	6

*Please refer to Table 4

Nine items were accepted by the experts, while only one item from the elements was rejected, as stated in Table 7 above. However, two items scored the same, sharing the same rank. The table also demonstrates the ranking for all the selected items. According to the analysis, the importance of each item for formatting components in guidelines for dyslexic children is determined based on experts' consensus and opinion. The ranking of the items is as follows (Figure 4):

i) Non-serif fonts (San Serif) are suitable to use in game-based language learning for dyslexic children.
ii) Bold text is suitable for emphasizing important content in game-based language learning for dyslexic children.
iii) Using colored text is suitable to emphasize the important content of game-based language learning for dyslexic children.
iv) Font with a heavy base and bolder looking, the resembling letters differ in height and form, capitals bolder, and enhanced spacing between the letters are suitable for dyslexic children.
v) The use of 1.5 line spacing in the game suits dyslexic children.

vi) The appropriate font size in games for dyslexic children is 14pt to 16pt (depending on the smartphone size).
vii) Italic text is not suitable for emphasizing important content in games for dyslexic children.
viii) Underlined text is unsuitable for highlighting important game content for dyslexic children.

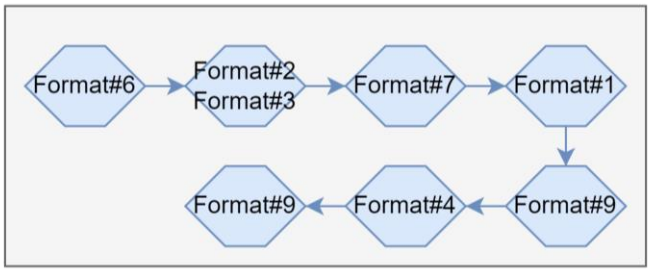

Fig. 4. Formating components guidelines

4. Conclusions

Using SLR, we examined the existing literature on GBALL applications in terms of visual elements guidelines for dyslexic children. A panel of experts was consulted using the Fuzzy Delphi technique to evaluate the guidelines. The following discussion presents the key findings and their implications for the application's design.

The SLR revealed a relatively limited number of studies investigating GBALL interventions for dyslexic children. Other than that, the SLR identified several key visual elements consistently recommended in the literature, including font size and style, formatting, color scheme, and layout.

4.1 Expert agreement

The expert consensus in the research has provided valuable recommendations for game-based language learning for dyslexic children. It is recommended to avoid using patterns or pictures as a background, as it can be distracting.

On the other hand, the freedom to choose text and background colors, font types, and sizes can significantly impact dyslexic children's reading accuracy. However, it is suggested that game interfaces with too many colors can confuse and distract dyslexic children.

Left-aligned text without justification is deemed suitable for game-based language learning for dyslexic children. Multiple columns should be avoided, and lines should not be too long, preferably between 60 to 70 characters. Long texts should be broken into several sub-headings, and a table of content should be included in game-based language learning.

To improve the focus of dyslexic children, line markers and reading rulers can be used. It is also recommended to use 1.5 line spacing in the game. Bold and colored text is suitable for emphasizing important content, while italic and underlined text is unsuitable for dyslexic children.

Non-serif fonts, specifically San Serif, are suggested for use in game-based language learning for dyslexic children. Apart from that, fonts with a heavy base and bolder-looking letters, where the resembling letters differ in height and form, capitals are bolder, and the spacing between the letters is enhanced, are also appropriate.

Lastly, the appropriate font size in games for dyslexic children is 14pt to 16pt, depending on the smartphone size. These recommendations can help in creating functional game-based language learning for dyslexic children.

4.2 Expert Disagreement

The experts who participated in the research reached a consensus on several guidelines. However, there were also some areas where there was disagreement. Among these was the use of background and text colors in games, with some experts recommending that bright colors be avoided and others suggesting that the contrast color between the background and text not be too high. Additionally, some experts recommended using cream or soft pastel colors as a suitable background, while others suggested using secondary or tertiary colors.

There was also consensus among the experts that soft colors should be applied to highlight important content from long texts in game-based language learning for dyslexic children. Nevertheless, there was disagreement on using green and red/pink colors in games. Some experts recommended avoiding these colors, while others did not.

Finally, the experts proposed that using small letters in the language learning game will make some learning materials easier for dyslexic children to read. Overall, although there was agreement on many aspects of the visual elements guidelines, there were also areas of disagreement among the experts.

4.3 Implications of the Findings

This SLR and expert evaluation suggest that visual elements guidelines can be essential in designing GBALL applications for dyslexic children. Nonetheless, it is vital to note that the effectiveness of these visual elements may vary depending on individual learners' specific needs and preferences. Therefore, designers must consider learners' diverse needs and preferences when implementing visual elements guidelines in their applications.

4.3 Limitations of the Study

This review had several limitations that should be acknowledged. First, the studies included in the review were limited to those published in English, which may have excluded relevant research published in other languages. Additionally, the quality and rigor of the studies varied, which may have impacted the generalizability of the findings. The expert panel was limited to a specific geographic region, limiting the generalizability of the results to other cultural contexts. Other than that, the study did not consider other factors, such as sound and interactivity, which may also impact the effectiveness of game-based language learning applications.

4.3 Future Implications for Research

Future research should consider the limitations of this study and explore the effectiveness of visual elements guidelines for game-based language learning applications in different cultural and linguistic contexts. Additionally, future studies could consider the impact of other factors, such as sound and interactivity, on the learning experience of dyslexic children.

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