PAYKAREH
Journal of Art Faculty, Shahid Chamran University of Ahvaz
Comparison of Visual Features in Iranian and Non-Iranian Applications Based on Visual Perception of 6- and 7-Year-OldChildren
Volume 10 Issue 26. Page 15-29
15

Original Research Article

Faezeh Taheri [1] Fahimeh MohamadDoust [2]
Received: 17 December 2021 Revised:14 April 2022 Accepted: 9 May 2022

DOI: 10.22055/PYK.2022.17482 **URL:** paykareh.scu.ac.ir/article_17482.html

How to cite this article: Taheri, F, & MohamadDoust, F. (2022). Comparison of Visual Features in Iranian and Non-Iranian Applications Based on Visual Perception of 6- and 7-Year-OldChildren. *Paykareh*, 10 (26), pp. 15-29.

The Persian translation of this article is published in the same issue with the following title
مقایسه ویژگی‌های بصری در اپلیکیشن‌های ایرانی و غیرایرانی بر اساس ادراک بصری کودکان ۶ و ۷ سال

Comparison of Visual Features in Iranian and Non-Iranian Applications Based on Visual Perception of 6- and 7-Year-OldChildren*

Abstract

Problem Definition: Technology is fundamental in human life in various areas, especially education. In recent years, due to the growth of technology and capabilities in digital media, cyberspace has become the most widely used media among children. Therefore, the designers' attention to selecting visual elements appropriate to the physical and perceptual features of children and creating a distinction in the design for children and adults reduces the visual pressure of inappropriate design for children and strengthens children's perceptions as well as their level of interaction with the new media.

Objective: The aim is to identify visual elements appropriate to children's perception in designing educational applications for 6- and 7-year-old children.

Research Method: The dominant method in this research is synthetic-analytic. Visual elements tailored to the perceptions of 6- and 7-year-old children have been extracted through online search and library studies. These elements were discovered and extracted as leading indicators in 80 Iranian and non-Iranian applications. According to their implementation in the studied applications, those elements appropriate to children's visual perception have been introduced.

Results: The investigation results showed that the applied visual elements are appropriate for children's visual perception. Visual qualities are used to create peace of mind and mental readiness to understand educational concepts. In organizing the applications, visual stress has been avoided, which is consistent with the perceptual characteristics of children. This article is extracted from the master's thesis entitled "Review of math education applications for children 6- to 8-year-old children."

Keywords

Visual Perception, Visual Elements, Visual Qualities, Children, Educational Application

1. Corresponding Author, Department of Visual Communication and Illustration, Faculty of Visual Arts, University of Arts, Tehran, Iran. Email: Faeze.tahery@yahoo.com.
2. Department of Visual Communication and Illustration, Faculty of Visual Arts, University of Arts, Tehran, Iran.

*This article is extracted from the second author's master's thesis in visual communication at Tehran University of the Arts, entitled "Study of mathematics education applications for 6- to 8-year-old children", supervised by the corresponding author.

Introduction

Applications[1], as a digital achievement, are a kind of functional, small-scale, diverse, and accessible software that is designed according to the needs and age of the audience. These products are designed and established according to the target community's needs, capabilities, limitations, and visual perception characteristics (namely, the user). Many applications are provided for children for various educational and entertainment purposes in today's world, accepting the belief that "children live in a purely visual world and imagine everything they hear as figures in their minds" (Alipour, Sheikhzadeh, & Dahar, 2013, p. 75). It is essential to pay attention to these programs' contextual and visual content. "The Internet and the Web can greatly benefit our children," said Neville Holmes, "But, willingly or unwillingly, it can be the source of many of the world's children's problems" (Neville Holmes, 2002, P. 51). In the design of applications, also known as user interface design[2], design systems and ready-made kits are very common, usually designed on a large scale for widely used platforms, including predefined suggestions used by designers. Attention to the physical and perceptual abilities of the target community is important even in designing systems as particular frameworks in the field of the user interface for children and can be effective in visual macro-policies that provide suggestions to their visual perception to designers in this field. The main question of this research is, "what are the visual features appropriate to visual perception in designing educational applications for 6- and 7-year-old children?" The target sample group in this study is the most popular math education apps for 6- and 7-year-old children. Visual abilities and visual perception in this age group have reached an almost constant state of development. Since they have not yet mastered the reading skill or have not learned it, this group can communicate through images. Examining these applications can provide helpful information about the visual range and signals children perceive. This study extracted visual indicators and elements consistent with children's perceptions. The same indicators analyzed the studied applications, including 70 non-Iranian and 10 Iranian applications. Then, the presence of indicators in the applications was investigated and compared. Studies of the educational methods of children and adolescents in recent decades have developed an attitude called "digital offspring", theorizing that the current generation, despite the strong connection with the electronic elements and media, needs to follow and benefit from a different educational system compared to previous generations. This generation needs different ways and tools to process, store, and use the appropriate information for their everyday media (Prensky, 2001, p. 3).

Research Method

The present study is applied research, and the data set is quantitative. It should be noted that in quantitative research, the content analysis method is used. Since, in the first place, the identification of frequently used visual elements in children's applications is considered, quantitative content analysis has been used in the present study. Thus, 70 non-Iranian applications and 10 Iranian applications on mathematics education for 6- and 7-year-old children were purposefully selected, and five pages of each were viewed and reviewed to identify commonly used visual elements. It should be noted that in this study, the focus is on the examination of visual indicators to use image-based results as a common language. In this case, all the children's communication happens through the image, and there is no place for written communication. Samples have been selected according to the age of users and the number of downloads in the two marketplaces as the primary sources of downloads on a global and Iranian scale (Two examples of analyses performed aiming at introducing

the method of visual inspection are presented in the text and for the rest of the samples, only the results are announced in the relevant tables). The background information of the research is also presented in the section related to children's visual perception by reviewing written and electronic sources. The extracted indicators are examined in 70 Iranian and 10 non-Iranian applications, and their frequency and use in the design of these applications are reviewed. The statistical population includes 70 non-Iranian mathematics education programs and 10 Iranian programs for 6 and 7 years, selected by purposive sampling on two websites (Cafe Bazaar and Google Play). The method of selection is choosing the programs with the most downloads.

Research Background

Among the sources in this research area, the book entitled "Art and Visual Perception: A Psychology of the Creative Eye" by Arnheim can be mentioned, which focuses on visual perception based on Gestalt theory as a branch of psychology. In this book, visual elements and qualities are introduced and studied as inseparable aspects in the formation of sensory perception and meaning-based interactions. Also, the book entitled "Reading Images: The Grammar of Visual Design" by "Kress and Leeuwen" is helpful in visual arts and visual perception. In addition, the book entitled "Design Elements: Form and Space" by "Puhalla" is one of the most up-to-date and reliable sources in the field of visual elements and qualities. The book entitled "Varieties of Visual Experience" by "Feldman" deals with different types of engagements with visual works. Also, regarding the books related to art and illustration for children, the following topics can be mentioned, which are valuable resources in the field of children's visual perception; "Children's Painting and Its Concepts" by " Ferraris" discusses children's preferences in creating images and establishing visual communication. Also, the books entitled "Introduction to Children's Book Illustrations" and "Arranging and Adjusting Children's Books" by "Ebrahimi" have provided tips on creating images for children and helped illustrators in this field get acquainted with the intricacy of work with this group of audiences. The book "Understanding Motor Development: Infants, Children, Adolescents, Adults" by "L Gallahue, C Ozmun" deals with the development and formation of perception in children at different ages. Due to many books in this field, only a few are mentioned as examples in this section, and then several dissertations and articles on similar topics are mentioned. "Pourhossein, Lavasani, and EnsaniMehr," in their paper entitled "Study of the memory evolution and visual perception in children," have examined perception in children. "Fattahi," in an article entitled "A look at children's group painting," focuses on how children use visual elements in paintings and create a visual expression using their images by them. In his article entitled "The place of composition in the illustration of children and adolescent books", "Mahan" has introduced and studied the practical components of creating functional compositions for children. "Salehi" (2016), in a dissertation entitled "Comparison of the appearance of Iranian and non-Iranian children's educational websites", examines and identifies the strengths and weaknesses in the design of Iranian children's educational websites in comparison with similar non-Iranian examples. It shows that the principles of designing the appearance of children's websites in Iranian samples are much less than non-Iranian samples. The mentioned study is somewhat similar to the present study in terms of attention to the visual aspects of the children's website. The main focus is on the general audience and the type of media.

Children's perception of visual elements and qualities

Visual communication and the basis for forming a visual work are associated with visual elements and qualities. These elements play an essential role in both the creation and perception of the work, and at different ages, the level of understanding and communication with them is different. However, a large amount of visual perception is usually formed at five to six years and then develops (Lark-Horowitz, Lewis, & Luca, 2018, p. 87). In this research, the quality of children's perception and relationship with visual elements and qualities have been examined and presented separately for each case in the following section.

Dot: The dot is the most basic visual element, and children in their early paintings at the age of 4 to 6 usually use the dot in their drawings in a meaningful way. Their interest in realism increases as they get older, and their attention to the dot's shape increases (Kellogg, 1976, p. 12).

Line: By about 3 to 4 years old, the child understands line movement better and shapes such as rectangles, triangles, and semicircles. As a result, the child is ready to enter the visual stage. The process of understanding shapes in children is done by drawing horizontal and vertical lines and gradually round, spiral, and circular shapes (Fattahi, 2005, p. 92).

Shape: In fact, children gain visual understanding of shape by being familiar with real and tangible shapes, with the excitement of discovering intuition, and on the other hand, by understanding mathematical concepts, they understand the visual dimensions of shapes (Luccio, 2019, p. 27). Seven-year-old children use surface and shape in their drawing; however, the forms are far from logical dimensions, and they use color relatively freely on the surface of the drawn shape (EnsaniMehr, Pourhossein, & GholamAli Lavasani, 2019, p. 351).

Form: Children 's interest, in reality, causes them to tend to 3D images, even though they are not able to draw them at an early age (Kellogg, 1976, p. 62).

Space: In fact, spatial perception is the ability to identify the position of objects and their status in space. Spatial communication is the understanding of the depth and geographical orientation (Nobahar & Shojaei, 2016, p. 34).

Color: From a psychological point of view, to analyze and conclude children's perception of colors, their age must be considered a criterion because there is a parallel relationship between the color and the child's emotional life and developmental process in different eras. The child of about three to six years old is under the influence of internal pressures, has a great interest in color, and prioritizes color over shape. But as he gets older, he prefers shape to color. At a younger age, the child uses colors more vividly; However, in the path of development and education in school, he uses cold and less harsh colors and has started the logical cognition stage (Oliviero Ferraris, 2019, pp. 100-102). According to research, children are more interested in blue, red, purple, and orange and less inclined to brown and gray (Taylor & Dee, 2011, p. 8). The three stages of using color are the decorative use of color, the realistic use of color, and the advanced use of color. In the first stage, the child uses the color only for its own sake and for the pleasure it brings, which lasts until the beginning of the schematic period of about 3 or 4 years old. In the second stage, which begins at the age of 6, the child develops an interest in realism in using color. At this stage, color is of secondary importance. The shape becomes more critical because first, they draw the shape and then fill the inside of the shape with color. In the third stage, when children use more advanced colors, they move in the direction of realism, with the difference that they increase the variety of colors in reality (Lark-Horowitz et all, 2018, pp. 113-114).

Texture: Children need opportunities to work at different texture levels and discover their suggested methods for textures found in nature. Because through familiarity with the texture, they can express their emotions well, and in understanding the educational cases, they can sensitize their memory to the emotions they receive from the texture to establish a mental connection with the educational issues (Murphy & Hussey, 1999, p.10).

Rhythm: Children are significantly influenced by natural rhythms. When they reach the training stage, they experience a change in the visual rhythm of perception and learning. Sudden changes in rhythm can be harmful, and the child must be prepared to learn by creating peace of mind so that he does not change his natural rhythm very much. In general, in children's education at the age of 6 to 8, a decreasing rhythm is more appropriate so that the child can distance himself from his natural rhythm, which includes an overview and reduces the accuracy in visual perception (Kellogg, 1976, p. 89).

Composition: Children know the components of their painting; however, they cannot form a single visual unit from several related components and present a meaningful whole of them. The child is more inclined to fill in the blank space on the page, but at about 4 or 5 years old, he takes an essential step toward composition using the baseline. This line is sometimes drawn at the bottom of the page. Around the age of 7 or 8, the child accepts the concept of composition well and tries to represent a whole unit. However, he still presents his painting with minor organization (Lark-Horowitz et all, 2018, pp. 82-83).

Direction: Children usually have difficulty understanding directions. By the age of three to four, they have a problem drawing geometric shapes such as squares and circles. However, they realize the difference between a curved and a straight line at four (Oliviero Ferraris, 2019, pp. 60-61). The preschool child still does not pay attention to the direction. But while engaging in activities related to readiness for school, he becomes familiar with directions (Lark-Horowitz et all, 2018, pp. 80-81).

Movement: Visual movement also has a unique role in the child's visual perception, both in visual compositions of shapes and in motion pictures or animations. From the age of 3, children become accustomed to perceiving the element of movement in images. Their visual perception is relatively ready around the age of 5 to 6. Movement in the child's mind is a stream of consciousness and acceptance of the arrangement in the various images and begins at the age of 6 to 8 years (Clutten, 2009, p. 4).

Proportion: At the age of 3 to 5, what they have in mind about proportions and have logically understood, do not interfere with their work while painting because, at this time, they follow the dynamism of their feelings and beliefs. However, as the child gets older, the world of his paintings becomes closer to reality in terms of proportions, and he tries to draw proportions like an adult, although the degree of success depends on his skill and ability (Lark-Horowitz et all, 2018, pp. 78-79).

Harmony and Contrast: Children understand the concept of contrast well and use it effectively. With their experience, they use warm and cold colors, vivid and muted colors, and apply the proper degree of color brightness and darkness to create effects in the way of contrast (Murphy & Hussey, 1999, p. 82).

Balance and Symmetry: Young children around the age of four can compare unbalanced situations with low, lower, and the lowest concepts. In general, it can be said that the development of mathematical concepts among children occurs even before the start of school (Arizi Samani, Kavousian & Kadivar, 2004, p. 50). Recent findings suggest that children better understand proportion and consider the concept of balance in the same way

(Kellogg, 1976, p. 23). A summary of the findings related to children's visual perception is presented in Table 1.

Table 1. Perceptions of visual elements in 6- and 7-year-old children. Source: Authors.

Visual Elements	Children's perceptual range
Dot	Understanding every tiny form as a dot
Line	Having an interest in understanding curved lines
Shape	Dealing freely with shapes and easier understanding of organic shapes
Form	Perception by touching the form
Space	Perception of space as a whole
Color	Tendency to warm and emotions-based colors
Texture	Perception through touch and sensory communication with the texture and creating order in the child's mind
Rhythm	General and natural understanding of rhythm and logical understanding of visual details
Movement	Perception of movement with relative deviation from image attention (lack of focus on movement)
Direction	Inattention to the direction due to attention to the shape itself and the horizontal direction
Balance	Understanding balance inspired by instinct and emotion, interest in symmetrical balance, and creating balance in visual elements
Proportion	Tendency to be realistic in observing the proportion of components to each other inspired by emotions, and a balancing approach between the application of elements
Scale	Ignoring the actual size
Contrast and Harmony	General understanding of form harmony

Visual investigation of educational programs

Visual analysis has been done for the first five pages in 80 educational applications, and to introduce how to analyze the applications, two examples of the analysis are presented in summary form (Iranian application "Kids Math" and American application "ABC Mouse").

1. Review of the Iranian application "Kids Math": The program " Kids Math" was produced by "Armik" company in 2016 and is known as the most popular program among mathematics education programs in Iran, with more than twenty thousand downloads. The program focuses its educational goals on content production for preschool and elementary school. In the following section, the analysis of the elements and qualities used in this program is introduced. In the end, the results are summarized in Table 2. The images and visual analysis of the first five pages are presented in Figures. 1 to 3.

Figure 1. First, second and third pages. Source: Kids Math application. Source: Authors.

Figure 2. Fourth and fifth pages. Source: Kids Math application. Source: Authors.

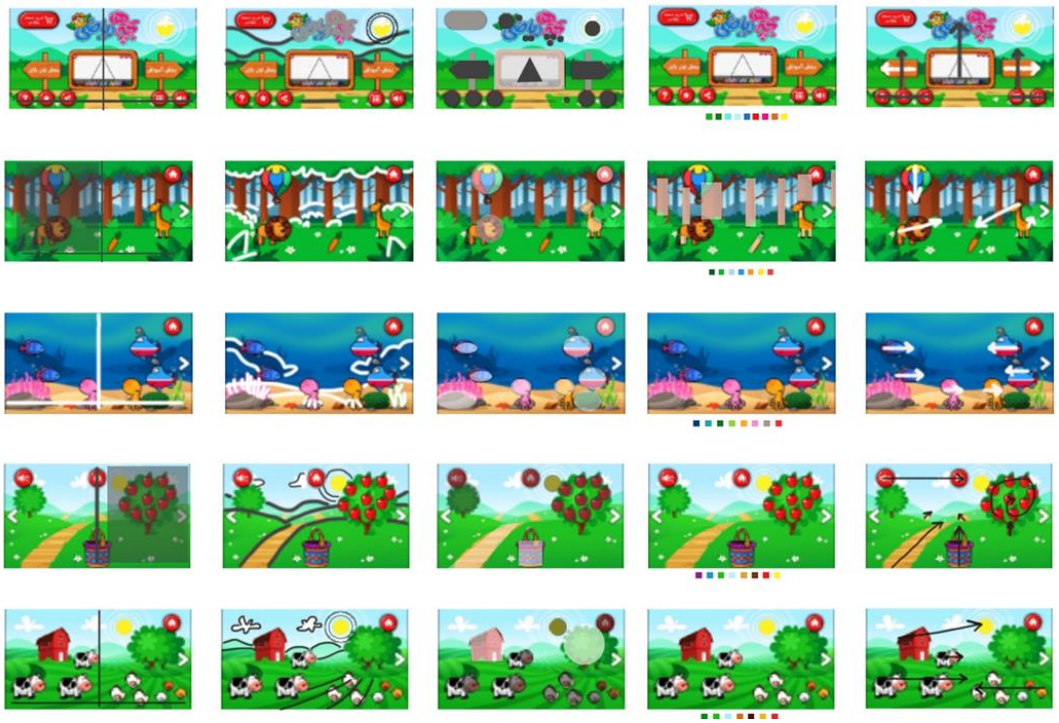

Figure 3. Example of Iranian application analysis: type of lines, shapes, balance and symmetry, harmony, color, direction in line with eye movement. Source: Authors.

Table 2. Examining the visual elements in the "Kids Math" program. Source: Authors

Visual elements/qualities			Pages					Frequent
			1	2	3	4	5	
Dot	Geometric	Circle	✓	✓	✓	✓	✓	✓
		Square						
		Triangle						
Line	Straight	Vertical		✓				
		Horizontal		✓				
		Diagonal						
	Curve		✓		✓	✓	✓	
	Zig Zag							
	Mono-Line		✓	✓	✓	✓	✓	✓
	Non-Mono-Line							

Visual elements/qualities				Pages					Frequent
				1	2	3	4	5	
Shape	Geometric	Circle		✓	✓	✓	✓	✓	✓
		Square		✓		✓			
		Triangle		✓					
	Combined			✓	✓	✓	✓	✓	✓
	Organic			✓	✓	✓	✓	✓	✓
Form	Geometric	Spherical					✓		
		Cube		✓					
	Combined			✓					
	Organic				✓	✓	✓	✓	✓
Color	Primary	Yellow		✓	✓	✓		✓	
		Red		✓	✓	✓	✓	✓	✓
		Blue		✓	✓		✓		
	Neutral	White		✓	✓	✓	✓	✓	✓
		Black		✓	✓	✓	✓	✓	
		Gray		✓			✓	✓	
	Combined	Secondary	Green	✓	✓	✓	✓	✓	✓
			Purple			✓			
			Orange	✓	✓	✓	✓	✓	✓
		Tint		✓	✓	✓	✓	✓	✓
		Lively			✓	✓	✓	✓	
Texture	Natural								
	Geometric			✓	✓	✓	✓	✓	✓
Rhythm	Regular			✓			✓		✓
	Alternating					✓			
	Progressive								
	Flowing				✓			✓	✓
Direction & Movement	Right to Left								
	Horizontal			✓	✓		✓	✓	✓
	Vertical					✓			
Display Script	Dot Form	Circle		✓			✓		✓
		Square							
	Weight	Thin							
		Normal					✓		
		Thick		✓			✓		✓
	Character Contour	Mono-line					✓		✓
		Non-Mono-line		✓					✓
	Proportion of elements			✓					
	Negative space			✓					✓
	Color contrast of typeface			✓					✓
Textual Script	Dot Form	Circle		✓					✓
		Square		✓					✓
	Weight	Thin							
		Normal		✓					✓
		Thick							
	Character Contour	Mono-line		✓					✓
		Non-Mono-line							
	Proportion of elements			✓					✓
	Negative space			✓					✓
	Color contrast of typeface			✓					✓
Balance	Symmetrical			✓	✓	✓	✓	✓	✓
	Asymmetrical								

Visual elements/qualities			Pages					Frequent
			1	2	3	4	5	
Proportion	Proportionate		✓	✓	✓	✓	✓	✓
	Disproportionate		✓	✓		✓		
Harmony & Contrast	Harmony	Form	✓	✓	✓	✓	✓	✓
		Color	✓	✓	✓	✓	✓	✓
	Contrast	Form						
		Color						

2. "**ABC Mouse" Program:** This program is an American learning program that includes reading math, art, music, and more for 2- to 8-year-old children, produced in 2014 and supervised by teachers and education experts from "Age of Learning, Inc.". This program has more than 10,000 exciting learning activities for children of all levels of education and has been downloaded more than 10 million times. The figures of the first five pages are presented in Figures 4 & 5. The visual analysis of the pages is provided in Figure 6, and the results of the analysis and data are presented in Table 4.

Figure 4. First, second, and third pages of "ABC Mouse" application. Source: Authors.

Figure 5. Fourth and Fifth pages of "ABC Mouse" application. Source: Authors.

PAYKAREH
Journal of Art Faculty, Shahid Chamran University of Ahvaz
Comparison of Visual Features in Iranian and Non-Iranian Applications Based on Visual Perception of 6- and 7-Year-OldChildren
Volume 10 Issue 26. Page 15-29

Figure 6. Example of American application analysis: type of lines, shapes, balance and symmetry, harmony, color, direction, in line with the eye movement. Source: Authors

Table 3. Examining the visual elements/qualities in the "ABC Mouse" program. Source: Authors.

Visual elements/qualities			Pages					Frequent
			1	2	3	4	5	
Dot	Geometric	Circle	✓	✓	✓	✓	✓	✓
		Square	✓					
		Triangle						
Line	Straight	Vertical						
		Horizontal						
		Diagonal						
	Curve							
	Zig Zag		✓					✓
	Mono-line		✓					✓
	Non-Mono-line			✓				✓
Shape	Geometric	Circle	✓	✓				
		Square		✓	✓	✓	✓	✓
		Triangle		✓		✓	✓	
	Combined		✓	✓				
	Organic		✓		✓	✓	✓	✓
Form	Geometric	Spherical			✓			
		Cube			✓		✓	
	Combined		✓					
	Organic		✓	✓	✓	✓	✓	✓
Color	Primary	Yellow	✓	✓	✓	✓	✓	✓

PAYKAREH
Journal of Art Faculty, Shahid Chamran University of Ahvaz
Comparison of Visual Features in Iranian and Non-Iranian Applications Based on Visual Perception of 6- and 7-Year-OldChildren
Volume 10 Issue 26. Page 15-29

Visual elements/qualities				Pages					Frequent
				1	2	3	4	5	
		Red		✓	✓	✓	✓	✓	✓
		Blue		✓	✓	✓	✓	✓	✓
	Neutral	White		✓	✓	✓	✓	✓	✓
		Black		✓	✓	✓	✓	✓	
		Gray		✓			✓	✓	
	Combined	Secondary	Green	✓	✓	✓	✓	✓	✓
			Purple	✓	✓	✓	✓	✓	✓
			Orange	✓	✓	✓	✓	✓	✓
		Tint		✓	✓	✓	✓	✓	✓
		Lively		✓	✓	✓	✓		
Texture	Natural			✓	✓	✓	✓	✓	✓
	Geometric			✓	✓	✓	✓	✓	✓
Rhythm	Regular					✓	✓	✓	✓
	Alternating			✓					
	Progressive								
	Flowing				✓				
Direction & Movement	Right to Left			✓	✓				
	Left to Right				✓				
	Horizontal					✓	✓	✓	✓
	Vertical								
Display Script	Dot Form	Circle		✓			✓		✓
		Square							
	Weight	Thin							
		Normal					✓		
		Thick		✓			✓		✓
	Character Contour	Mono-line					✓		✓
		Non-Mono-line		✓					✓
	Proportion of elements			✓					
	Negative space			✓			✓		✓
	Color contrast of typeface			✓			✓		✓
Textual Script	Dot Form	Circle		✓	✓	✓	✓	✓	✓
		Square							
	Weight	Thin		✓	✓	✓	✓	✓	✓
		Normal		✓	✓	✓	✓	✓	✓
		Thick							
	Character Contour	Mono-line		✓	✓	✓	✓	✓	✓
		Non-Mono-line							
	Proportion of elements								
	Negative space			✓	✓	✓	✓	✓	✓
	Color contrast of typeface			✓	✓	✓	✓	✓	✓
Balance	Symmetrical					✓	✓	✓	✓
	Asymmetrical			✓	✓				
Proportion	Proportionate			✓		✓	✓	✓	✓
	Disproportionate				✓				
Harmony & Contrast	Harmony	Form		✓	✓	✓		✓	✓
		Color		✓	✓		✓	✓	✓
	Contrast	Form					✓		
		Color				✓			

The analysis of statistical population applications is reviewed and extracted in the same order as presented in the two sample applications (See Tables 2 & 3). The results of this analysis are presented in Table 4 and are comparable in Iranian and non-Iranian groups.

Table 3. Comparison of visual elements / qualities in 80 Iranian and non-Iranian applications. Source: Authors.

Visual elements/qualities				Frequent in 10 Iranian applications	Frequent in 70 non-Iranian application
Dot	Geometric	Circle		✓	✓
		Square			
		Triangle			
Line	Straight	Vertical			
		Horizontal			
		Diagonal			
	Curve			✓	✓
	Zig Zag				
	Mono-line			✓	✓
	Non-Mono-line				
Shape	Geometric	Circle		✓	
		Square			
		Triangle			
	Combined				✓
	Organic				
Form	Geometric	Spherical			
		Cube			
	Combined				
	Organic			✓	✓
Color	Primary	Yellow			
		Red			
		Blue			✓
	Neutral	White		✓	
		Black			
		Gray			
	Combined	Secondary	Green		
			Purple		
			Orange		
		Tint			
		Lively			
Texture	Natural				
	Geometric			✓	✓
Rhythm	Regular			✓	✓
	Alternating				
	Progressive				
	Flowing				
Direction & Movement	Right to Left				
	Left to Right				
	Horizontal			✓	✓
	Vertical				
Display Script	Dot Form	Circle		✓	✓
		Square			
	Weight	Thin			
		Normal		✓	
		Thick		✓	✓
	Character Contour	Mono-line		✓	✓
		Non-Mono-line			

Visual elements/qualities			Frequent in 10 Iranian applications	Frequent in 70 non-Iranian application
	Proportion of elements			
	Negative space		✓	✓
	Color contrast of typeface		✓	
Textual Script	Dot Form	Circle	✓	✓
		Square		
	Weight	Thin	✓	
		Normal		✓
		Thick		
	Character Contour	Mono-line	✓	✓
		Non-Mono-line		
	Proportion of elements			
	Negative space			✓
	Color contrast of typeface		✓	
Balance	Symmetrical		✓	✓
	Asymmetrical			
Proportion	Proportionate to the page		✓	✓
	Proportionate to other elements			
	Close to the reality			
	Disproportionate to the reality			
Harmony & Contrast	Harmony	Form	✓	✓
		Color	✓	✓
	Contrast	Form		
		Color		

Conclusion

In this section, the visual elements and features that were primarily observed in the applications (the result of a qualitative and quantitative analysis of the applications) have been adapted to how children perceive these features. Children's perception and visual preferences are presented in the first part of this research and as an abstract in Table 1 (Iranian and non-Iranian interdisciplinary studies and sources have been the primary sources in this section). Curved and circular lines and shapes have been used, aiming to create a kind of flexibility in the design. Also, combined and organic shapes and organic forms are in line with children's visual perception of soft and curved forms and organic shapes. According to the findings, children are more strongly associated with warm colors. Still, the color variation in the studied applications is high and is not limited to warm or cold colors. Even the presence of light and cool colors in applications can be observed. In the Iranian program, the most used colors are green and red, while in foreign programs, colors such as blue and green are used more. The types of textures (natural and geometric) are well used in their place, and natural textures affect the child by establishing sensory communication; and on the other hand, geometric textures, by creating order in the child's mind, prepare him to understand educational concepts. The strong presence of geometric textures in the design of applications is in line with children's visual perception of texture.
Rhythm as its regular and alternating form is used frequently. According to children's perceptual abilities, rhythm can create a logical understanding of visual details to align with educational goals. The horizontal direction, right-to-left direction, and vice versa are predominant in applications. Children's perceptions are based more on horizontal movement than on vertical movement. Educational materials can also be transferred to the child using visual elements and in line with the horizontal movement and direction. The text has been

examined more from the perspective of the predominant form used in them, and readability is not considered. Due to the audience's age group, the texts are often curved, corresponding to the children's better visual perception of the curved forms. With all the variety that can be observed in the use of forms and colors in most applications, the element of harmony in form, color, and size prevails over the element of contrast. Children prefer images that have less visual intensity and better understand form harmony. The quality of the balance in its symmetrical type is more used, which brings balance to the frame. The proportions are closer to the real world, and there is not much exaggeration in the proportions of the elements in the frame. A soothing space in the composition, which is the result of more harmony, balance, and proportion in the frame, and at the same time dynamic, resulting from the variety of visual elements, can contribute to the quality of the child's visual perception. In general, it can be said that most of the visual elements used in designing applications are mainly consistent with children's perceptual abilities. In visual qualities, it is crucial to maintain tranquility and create a pleasant visual atmosphere free from visual tension and turbulence, which is entirely consistent with children's visual perception. The images appropriate to the children's perceptual abilities are produced with such selections, and their aesthetics are well preserved. The child also increases the desire to communicate with the images of the application.

Appendix

1. It is a computer program designed to carry out a specific task, other than one relating to the operation of the computer itself, typically to be used by end users.. Word processors, media players, and accounting software are examples. Applications may be bundled with computer and its system software or published separately and may be coded as proprietary projects (https://en.wikipedia.org).
2. User interface design (UI) is a process that designers use to create interfaces in software or computing devices that focus on appearance or style. The goal of designers is to create relationships that are easy and enjoyable for users. User interface design refers to graphical user interfaces (https://www.interaction-design.org/literature/topics/ui-design).

References

- Alipour, R., Sheikhzadeh, M., & Dahar, A. (2013). A Study of Illustrations of Preschool Children's Pictorial Books in Iran, *Peykareh, 2* (3), pp. 69-80.
- Arizi Samani, H., Kavousian, J., & Kadivar, P. (2004) "reliability and validation of the mathematical competence scale of Utrecht children in preschool and elementary school students in Isfahan", *Quarterly Journal of Educational Innovations, 3(9),* pp. 65-49.
- Clutten, S. C. (2009). *The development of a visual perception test for learners in the foundation phase*(Thesis of Master of education). University of South Africa.
- EnsaniMehr, N., Pourhossein, R., & GholamAli Lavasani, M. (2019). Development of visual perception and projection in children. *Journal of Iranian Psychologists, 15(60),* PP. 353- 345.
- Fattahi, Z. (2005). A look at children's group painting. *Tandis, (59),* P. 8.
- Kellogg, R. (1976). *Analysing Children's Art, Palo Alto*. CAL: National Press Books.
- Kramer, P & Hinojosa, J. (2010). *Frames of reference for pediatric occupational therapy*. hiladelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.
- Lark-Horowitz, B., Lewis, H., & Luca, M. (2018). *Understanding children's art for better teaching* (F. Sahib Qalam & M. Arab (Marzban), Trans.). Tehran: Nazar Publishing.
- Luccio, Riccardo. (2019). Perceptual Simplicity: The True Role of Prägnanz and Occam. Geshtalt Theory, 41(3), pp. 263–276.
- Mahan, I., (2009). The status of composition in the illustration of children and adolescent books. *Monthly Book: Children and Adolescents, (139-138),* PP. 86-80.

- Murphy, T & Hussey, C. (1999). *Visual Arts: Arts Education Teacher Guidelines*. Dublin: Published by The Stationery Office.
- Neville Holmes, W. (2002). The net, the web, and the children. *Advances in Computers*, (55), PP. 49-85.
- Nobahar, M., & Shojaei, A. (2016). Occupational therapy interventions in visual perception disorders. *Journal of Exceptional Education, 16(5)*, pp. 37 - 31.
- Oliviero Ferraris, A. (2019). *Children's painting and its concepts* (A. Sarafan, Trans.). Tehran: Dastan.
- Prensky, M. (2001). Digital Immigrants, Digital Natives. *On the Horizon*, 9(5), pp. 1–6.
- Taylor, L. & Dee, J. (2011). Psychology of colors (color therapy). (M. Ganji, Trans.). Tehran: Khaneye Ketab Publications.