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作品編號 130011

參展科別 行為與社會科學

作品名稱 Improving Communication for the Visually
Impaired Through an Innovative Arabic
Writing System

得獎獎項 一等獎

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作者照片



Project Abstract

Visual impairment is a major global health problem. In 2017, WHO estimated that there were 253 million people worldwide with this ailment. According to the journal of the American Medical association, the prevalence of visual impairment in the Saudi population is 9.3%. Learning Braille by families of students with visual impairments remains a major obstacle, which precipitates several communication issues. Moreover, difficulties for the students themselves lie in learning braille with languages that include diacritical marks; consequently, affecting their academic progress. My main objective of this project is to help improving life quality of these individuals, and the focus is to advance their social productivity and adaptation. This was accomplished through creating a new simpler Arabic writing system using geometrical shapes. As a part of this project, fifteen participants with visual impairments were interviewed and tried this new writing system; two of them are adults between 25 and 40 years old while the rest are students from 9 to 17 years old. Additionally, 100 participants with visual impairments completed a survey. The data showed that students learned this system in two hours in comparison with students that mastered braille in a few months. This shows that this system is easier to learn and subsequently saves time and effort. The most important value added to this project is that diacritical marks were combined with the alphabet, thereby considerably reducing book sizes compared to Braille-written books. This project presents a novel system that helps people with visual impairments to increase their confidence and independence.

Introduction

Background Information

a. Arabic Braille

More than two billion people speak Arabic, which is the fifth most spoken language in the world 9. The Arabic language consists of 28 letters and diacritical marks. Diacritical marks play a huge role in the meaning of many Arabic words.

Miss Lovell, an English missionary, worked on Arabic Braille in the 1870's 7**Fig. 1.** The Arabic Braille was unified in the 1950's, and was first used in Saudi Arabia in October 2002. Diacritical marks are written as completely new letters in Arabic Braille as shown in **Fig. 2.** However, diacritical marks in the writing have to be included above or under the letters to be reflected in pronouncing these letters.

b. The Arabic Braille Alphabet System

The Arabic Braille alphabet is divided into three subsystems: The alphabet letters, short vowels, the *madd*(~), and the *hamza*(ء).

Short vowels extend the horizontal length next to the letter when written above the word.

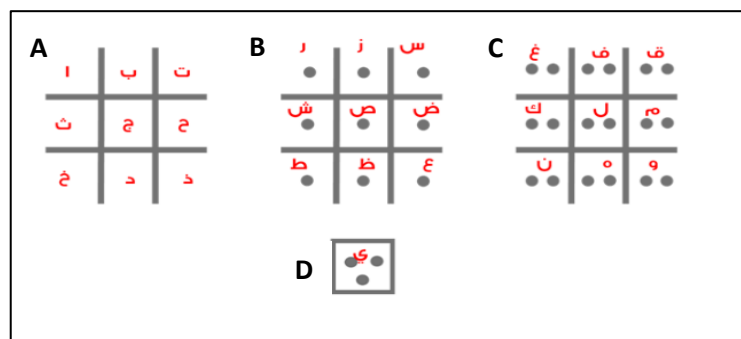
Writing diacritical marks in the original Braille doesnot create any inconvenience in terms of added writing space, while converting the diacritical marks into Arabic required them to be written as completely new letters7. This led to the creation of an easier writing system that focuses on the simple use of diacritical marks by following a geometrical pattern.

Visual impairment is the complete or near complete loss of the sensual perception of visible light. The care of blind people is considered as one of the main priorities in the development of people with special needs. Health statistics in the kingdom of Saudi Arabia in 2008 indicates that the percentage of blind people in the country is 9.1%, which means that the number of blind people is 159 thousand person, and the number of visually impaired people is 400 thousand person. Another study showed that 253 million people in the world live with vision impairment: 36 million are blind and 217 million have moderate to severe vision impairment. Which makes blind people an integral part of the society; this is in a way that all blind people have to participate in any movement that may help the nation improve or develop and share their creative solutions as effective as normal people in all aspects of educational and social life. The loss of vision entails confronting some social and educational difficulties. It was found that some of the blind students in

[illegible]

Geometric Design:

The Arabic alphabet consists of 28 letters. As shown figure 1, 3 sets of 9-quadrant-grids are used to represent the different letters. They are divided into 3 grids, which are used recurrently with the only difference being, the absence or presence of one or two dots within the shapes. As seen in the figure below, the letters are divided into 3 groups, and the 9 basic shapes are used in all three, with different uses of dots each time.



The first group: It starts from the letter (ا) and ends with the letter (ذ) and it is the only group that does not contain any dots in the middle of the shapes. (Figure 1.a)

The second group: It starts from the letter (ر) and ends with the letter (خ). It uses the same shapes as the first group but contains one dot inside of the squares, and that's because if **Figure 1** forgot the shape of any letter, e.g. a beginner learning this new system for example, the letter would be easily recognized by remembering the pattern of the letters. (Figure 1.b)

The third group: it starts with the letter (ع) and ends with the letter (و), which has the same shape as the first two groups, but what distinguishes it is the presence of two dots inside of its letters. (Figure 1.c)

The 28th letter (ي): The last letter in the alphabet is the only letter that has no set, and it has three dots. (Figure 1.d)

Diacritical marks: They have different geometrical shapes from the letters' shapes. The geometrical shapes are written in small forms above the letters in

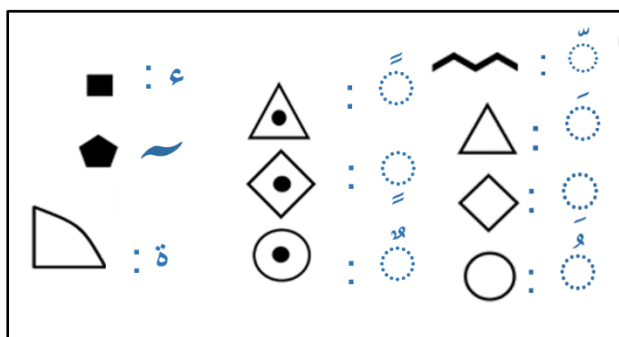


Figure 2

contrast to Braille, which the marks are written as new letters. (figure 2)

Project Problem and Aim

Loss of sight entails many educational difficulties such as the difficulty parents and teachers face with Braille, and social problems which affect the academic achievements of students with visual impairments (1). This project aims to provide better care for these individuals, within the educational environment, and increase their inclusion, productivity and adaptation in society, by creating a new simpler writing system using geometrical shapes. A big inconvenience emerges from the fact that diacritical marks are written as completely new letters in braille, which makes their books huge, which is solved in the new system.

Experimental Techniques and Methods

- The first stage:
 1. Two identical boards that measure (29 x 50 x 0.4 cm) will contain the writing system's key.
 2. A third board that measure (30.5 x 50 x 0.4 cm) will contain a simple sentence formed by three words.
 3. The two boards will be made of tenuous cork, and the letters will be in thick foam sheets, so that it is prominent on the cork, and that is comfortable for the participant to feel.
 4. A questionnaire will be distributed first, and it will include questions about how well the participants master braille, and what difficulties did they face

in the process. It also includes some questions about their beliefs in an innovative system other than braille.

5. The mechanism of the writing system will be explained to all participants, and the time spent in the process will be calculated.
6. Then the understanding of the participants will be evaluated and tested by giving them a three-word sentence, which is (Ahmad ate the apple) while time is calculated. (figure 3)

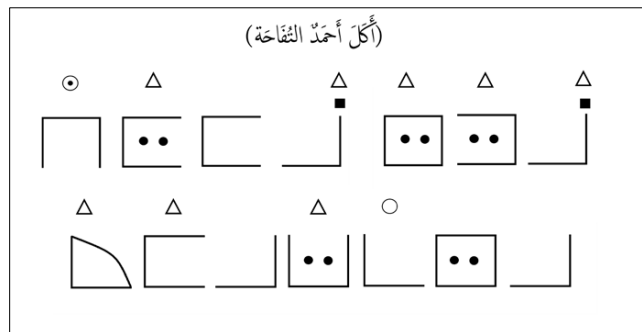


Figure 3

7. Then a second questionnaire will be distributed; it will include questions about their opinion on the innovative writing system in general, and what they think should be improved.
 8. The time took to learn the innovative writing system will be compared to the time none visually impaired people took to learn braille, and that to prove that the writing system take less time to learn.
- The second stage:
An electronic survey will be conducted on 100 qualified people whose questions are about the difficulties they faced and the time spent, and that to measure the size of the problem on the lives of visually impaired people.
 - It is expected from the experiment that this writing system would take less time to learn in comparison with braille, and would be easier to memorize

Results

- The mean time taken to learn Braille (346.3 minutes) is 10 times the mean time taken to learn the new writing system (33.27 minutes). This result indicates that the new writing system will save time and effort for visually impaired individuals.
- According to the survey completed by the participants, the new writing system was perceived to be easier. After all, they indicated that it takes less time and effort to learn and master the new writing system.
- The new writing system was also found to be easier to understand by these individuals' families. This implies that the new writing system helps improve the life quality of visually impaired individuals.
- The new writing system takes less space to write due to writing the diacritical marks above the letters. Consequently, the size of printed books can be significantly reduced through this writing system.
- All participants mastered the new writing system in less than an hour. Additionally, they were able to read the three-word sentence shown in less than 10 minutes.

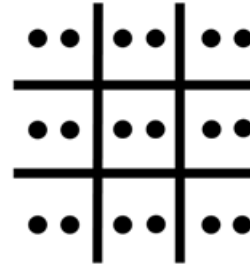
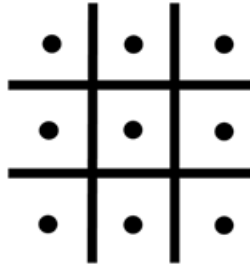
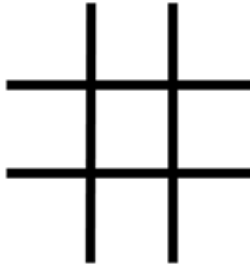
Conclusion

In conclusion, this new writing system was shown to be easier to learn as it takes less time and effort for visually impaired individuals to learn it compared to Braille (p-value is 0.00001). The results also suggest that the writing system takes less space than Braille when used to write Arabic.

The new writing system will potentially help individuals with visual impairments to enhance the communication between them and others. Furthermore, it can improve their adaptation, life quality, and social productivity. Additionally, the new writing system will potentially help individuals with visual impairments by reducing the sizes of their printed books due to combining diacritical marks with letters.

Application

- The innovative writing system can be applied to any language (Exp. Syriac, Hebrew, and Korean) regardless of its use of diacritics.
- It can be easily taught to teachers working in schools with visually impaired students.
- The innovative writing system can be incorporated into advanced scientific subjects such as math and science.
- It can be well utilized in public places to guide individuals with visual impairments. (e.g. bathrooms, elevators, etc.)
-
- The new writing system was also found to be easier to understand by these individuals' families. This implies that the new writing system helps improve the life quality of visually impaired individuals.
- The new writing system takes less space to write due to writing the diacritical marks above the letters. Consequently, the size of printed books can be significantly reduced through this writing system.
- Apply the innovative writing system to a small wireless keyboard. All three 9-quadrant grids can be optimized into one set that contains all 28 letters with separate dots inside. This keyboard will be more practical for visually impaired individuals. To use the keyboard, the user will have to press the shape representing the desired letter. To choose any letter from the first group, he must press the corresponding shape without pressing the dots; to use letters from the second group, he must press the shape and one dot, etc...6.



الهمزة: ■

المد: ◆

التاء المربوطة: ◡



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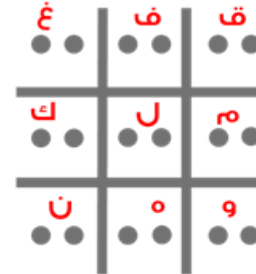
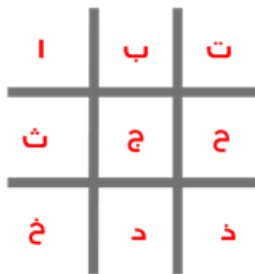
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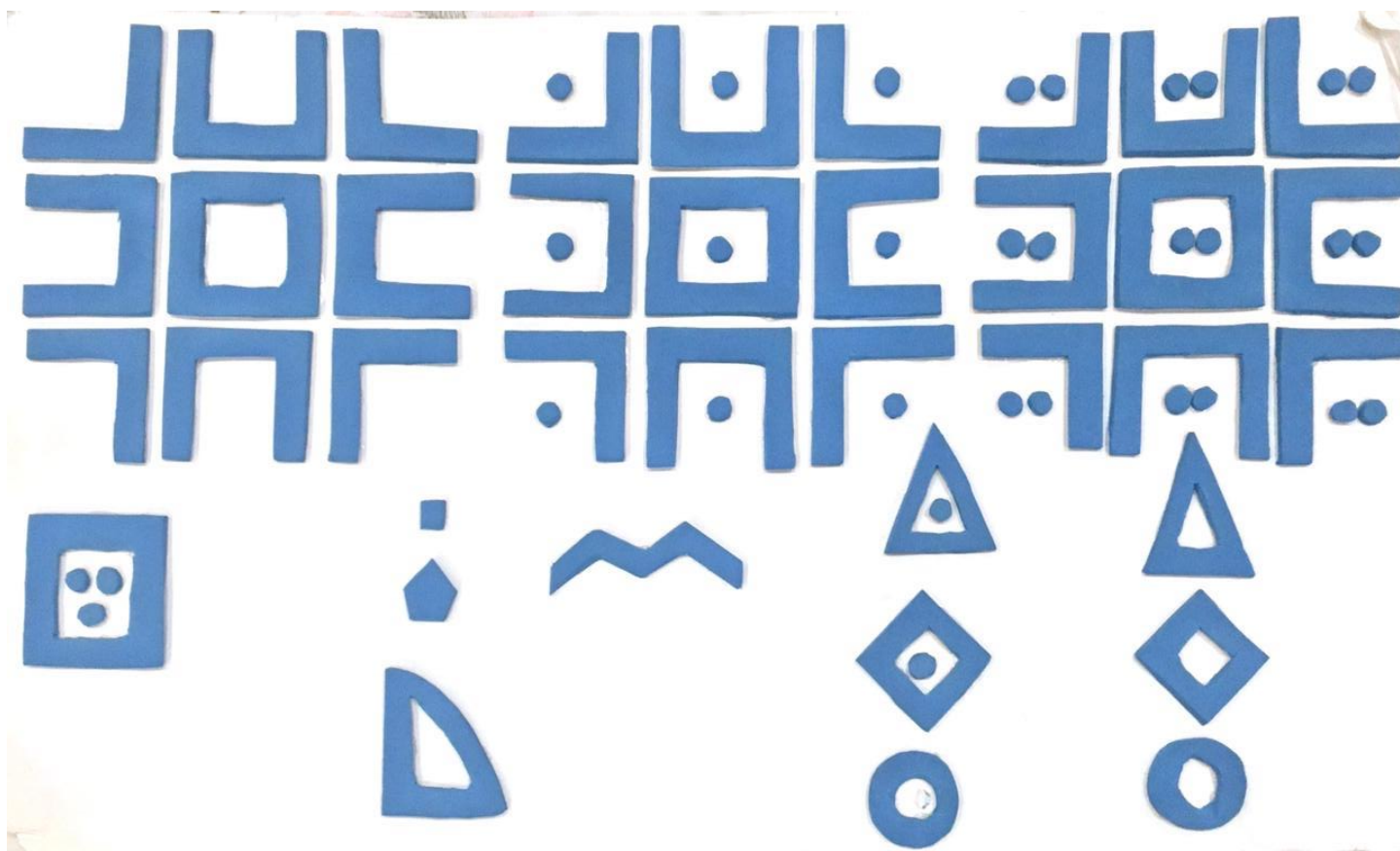
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Attachments





The First Step

- Survey 1 was distributed to 100 visually impaired participants. It included questions such as:
 - a. How well they mastered Arabic Braille.
 - b. Difficulties they faced in the process.
 - c. A question to understand their acceptance regarding an new writing system other than Arabic Braille.
- The same survey was given to 15 participants without visual impairments.

The Second Step

- 15 participants from the 100 used in the first step were randomly chosen as the experimental group.
- The 15 without visual impairment from step 1 were used as a control group.
- The new system was explained to the experimental group, while Arabic Braille was explained to the control group.
- Then, the understanding of the participants was tested by a three-word sentence (“Ahmad ate the apple.”, in Arabic), while time used to read it was calculated.

The Third Step

- Survey 2 was distributed to the 15 visually impaired participants who were included in the experiment (step 2). It included questions such as:
 - a. Their opinions on the new writing system.
 - b. What they think should be improved.
- Time taken to learn the new writing system was compared to the time non-visually impaired people took to learn Arabic Braille.
- Participants’ social flexibility was rated from one to ten based on their communication skills during the experiment.

Sample	Case (Visually impaired/ without visual impairments)	Age	Gender	Social flex.
Experimental sample	Visually impaired	17	F	9
	Visually impaired	43	F	10
	Visually impaired	16	F	9
	Visually impaired	40	F	10
	Visually impaired	8	M	7
	Visually impaired	12	F	6.5
	Visually impaired	12	M	6
	Visually impaired	16	F	10
	Visually impaired	8	F	9.5
	Visually impaired	8	M	9
	Visually impaired	9	F	9.5
	Visually impaired	9	M	10
	Visually impaired	9	F	10
	Visually impaired	6	M	9.75
	Visually impaired	6	F	9
Control sample	Without visual impairments	14	F	8.75
	Without visual impairments	15	F	8.5
	Without visual impairments	14	F	6
	Without visual impairments	47	F	7.75
	Without visual impairments	12	F	8.5
	Without visual impairments	9	F	10
	Without visual impairments	9	F	9.5
	Without visual	9		5

Control sample	impairments		F	
	Without visual impairments	12	F	7
	Without visual impairments	6	F	9
	Without visual impairments	6	F	5.75
	Without visual impairments	6	F	10
	Without visual impairments	12	F	8
	Without visual impairments	15	F	9
	Without visual impairments	15	F	9
	Without visual impairments	14	F	6
	Without visual impairments	47	F	7.75
	Without visual impairments	12	F	8.5
	Without visual impairments	9	F	10

(Ahmad ate the apple)
using Arabic braille writing system

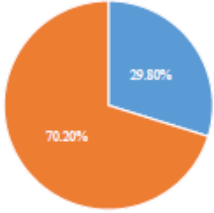
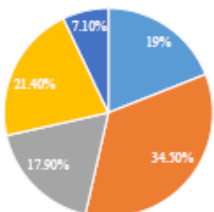
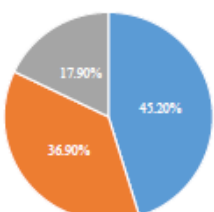
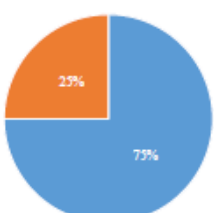
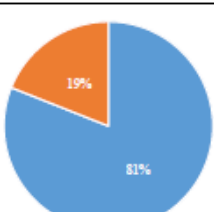
أَكَلَ أَحْمَدُ التُّفَاحَةَ

(Ahmad ate the apple)
using the novel writing system

أَكَلَ أَحْمَدُ التُّفَاحَةَ

1. Survey's Data

Table (1) : Results of the survey completed by 100 with visual impairments

Questions	Graphs	Key
Braille system was easy to learn		- Disagree - Agree
How much time took you to learn Braille?		- One year - Few month - It took me a long time to learn - I don't remember - I don't know or use Braille
Do you face any challenges in using Braille? (especially in Arabic)		- Yes, diacritical marks is written as new letter in Braille - no, I do not use diacritical marks - Braille's is hard anyways
Do you believe in the idea of creating a innovative writing system other than Braille?		- Yes, I believe in creating a new writing system - No, I do not
Do you agree that crating a innovative system can solve communication problems?		- Yes, I agree - No, I disagree

2. Experiment's Data

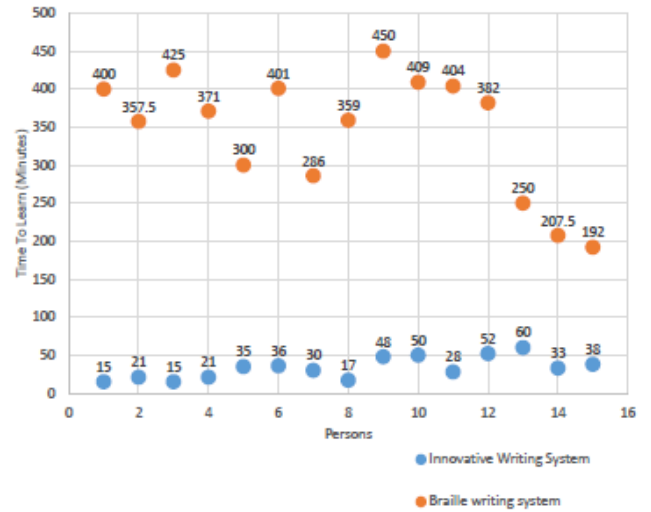


Fig 12. Time taken to learn Arabic Braille compared to the time took to learn the new system

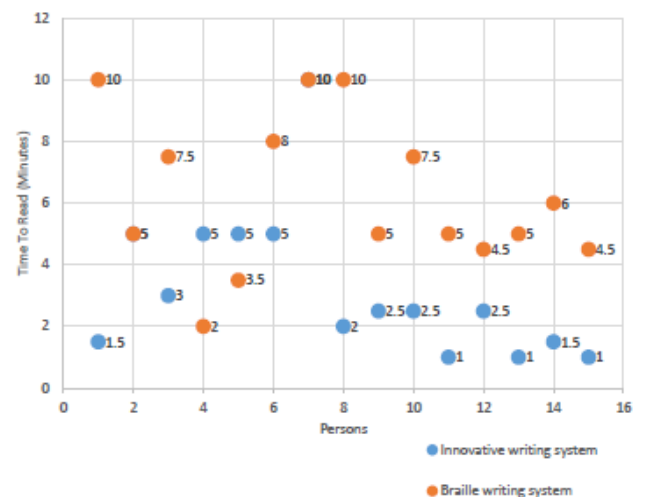
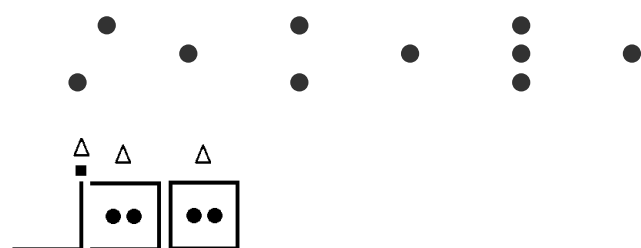


Fig 13. Time taken to read a three-word sentence in Arabic Braille and the new writing system

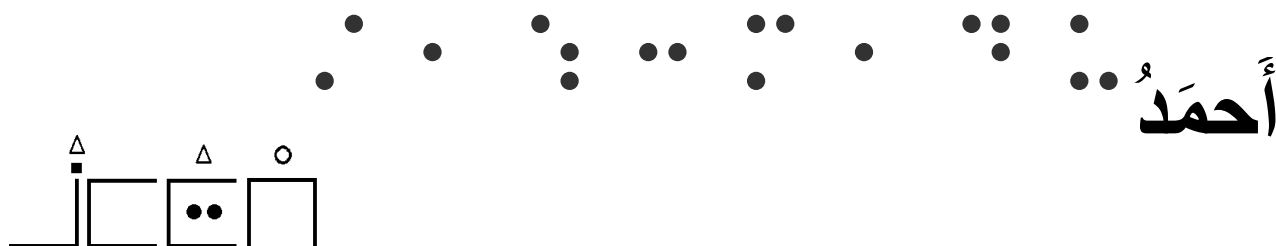
	Table (2): Descriptive Statistics Results of the Experiment		
	Group	Mean	Std. deviation
Time to learn the innovative writing system	Experimental sample	33.27 minutes	N/ A
Time to read a sentence using the innovative writing system	Experimental sample	3.4 minutes	N/ A
Time to learn Braille writing system	Control sample	346.3 minutes	N/ A
Time to read a sentence using Braille system	Control sample	6.6 minutes	N/ A
Age	Experimental sample	14..6	11.49
	Control sample	11.67	3.18
Social flexibility	Experimental sample	8.95	1.35
	Control sample	8.12	1.54

Comparison between Braille and the new system in space

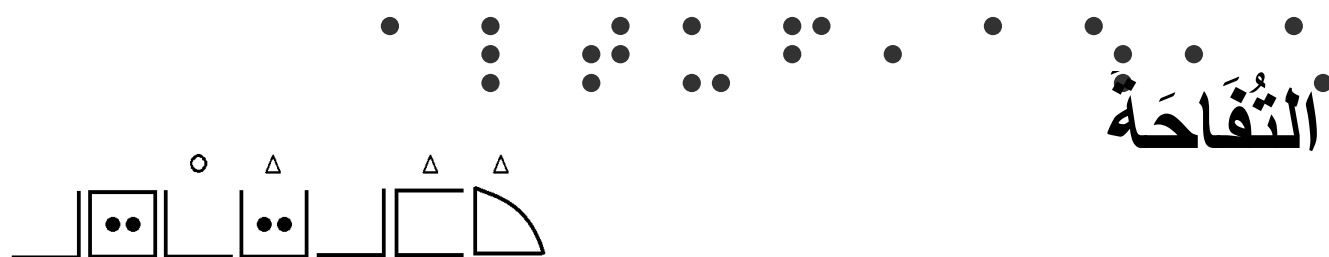
“Ahmad ate the apple”



أَكَلَ



أَحْمَدُ



التُّفَّاحَةُ

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This study aimed to develop a new writing system to improve communication in visually impaired individuals. The study demonstrated a faster learning rate and acceptance rate for the users compared to the current writing system. However, a relative weakness of this study is that it does not compare the variables concerning the current system versus the newly developed system systematically or control some possible confounders. Overall, it provides practical utility to improve communication in visually impaired populations using Arabic and similar language systems.