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Learning Vocabulary for Children with Autism Using Augmented Reality AR

From Development to Evaluation

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Introduction

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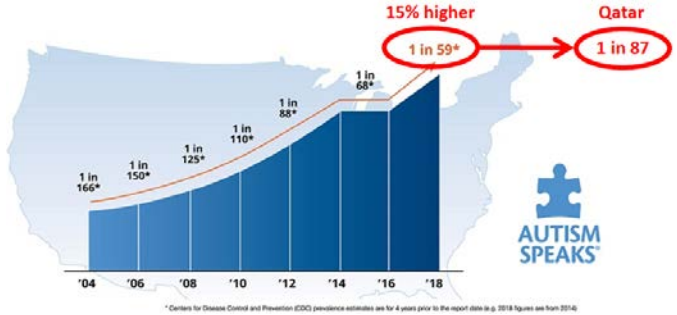
Autism Spectrum Disorder (ASD)

- Neurological disorder
- Social communication
- Repetitive/restricted behavior

- The use of technology (computer, smartphone, tablet, etc.) based interventions (TBIs) has increased. Several review papers that have been written over last 10 years.

- One of the common problems:
  - ✓ Read text
  - ✗ Interpret meaning of text
    - Visual learners
    - Prefer reading on technology than book



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Autism Spectrum Disorder (ASD)

- Teaching children with ASD:
  - Specialized teaching methods
  - Specialized teaching strategies

✅ ASD games by Typical children
❌ Typical children games by ASD

- Each child with ASD is different, Bosseler and Massaro (2003) have suggested that each TBI should be tested with an individual to determine if the solution is feasible for an individual or not

  - Delayed generalization from computer to a natural environment

Autism Spectrum Disorder (ASD)

- For generalization: virtual reality (VR), augmented reality (AR), and mixed reality (MR) has increased
- mobile AR apps are expected to dominate the market by 2022 in comparison to VR (Merel, 2018)
- AR for ASD has increased from 2010: social skills, daily living skills, attention, cognitive skills, communication

Method

Building on our existing research

- Developed a serious game prototype in Kuala Lumpur (KL) Malaysia.
- Requirements gathering from center for ASD based in KL.
- Instructional content: 209 vocabulary items among 11 categories (fruits, animals, birds, etc.)
- Prototype was improved based on the feedback of the teaching staff and experts
- Prototype evaluation: five mild children with ASD
- Result: Improvement in the children from the baseline to the intervention and maintenance.

- Considering the usefulness of MARVoc and its underutilization for the vocabulary learning among children with ASD, this paper presents a requirement gathering, an initial version of MARVoc prototype, and its evaluation with the teaching staff working at centers for ASD in Qatar.

Overall method

- A mixed-methods approach was used with the teaching staff working at centers for ASD in Doha, Qatar, providing to gather the needs of children with ASD.
  - Semi-structured interviews were conducted with the teaching staff
  - Use cases were developed based on the requirements gathered from the teaching staff
- Use cases were modified based on the comments of the teaching staff.
- Initial version of the prototype.
- Updated version based on feedback from the teaching staff working at two centers for ASD.

Semi structured interviews

- Qualitative study with the teaching staff was to identify:
  - Technologies used
  - Instructional content taught
  - Performance assessment
  - Difficulties faced by the children
  - Instruction methods used

- Two centers based in Doha, Qatar: 27 interviews

- Survey form to gather opinions in terms of difficulties faced, instruction methods, and strategies used based on a 5-points Likert scale (strongly disagree to strongly agree.)

Use Case

Learning the English Alphabet, Words and Construction of Short Phrases/Sentences

- To learn a letter
  - A child picks one card at a time to learn: “A” to “Z” or “a” to “z”
  - Scan a card
  - Augment 3D uppercase and a lowercase letter
  - Listen to the sound of the selected letter

- To learn construction of a three-letter or four-letter Consonant Vowel Consonant (CVC) word:
  - Scan a card
  - If correct word is formed:
    - Augmented representation of the object
    - Pronunciation of the word
  - If incorrect word is formed:
    - Motivate and help in correcting specific letters

Functionalities

- Mixed-mode letters: 26 letter cards that show uppercase and lowercase

- Three-letter and four-letter CVC words that can have a visual representation:
  - CVC words beginning with ‘A’ or ‘a’
  - CVC words beginning with ‘E’ or ‘e’
  - CVC words beginning with ‘I’ or ‘i’
  - CVC words beginning with ‘O’ or ‘o’
  - CVC words beginning with ‘U’ or ‘u’

Functionalities

- Learning
  - Mixed-mode letters
  - CVC words

- Activity:
  - Construct three-letter or four-letter words of your choice.
  - Construct three-letter or four-letter words starting with a given letter.
  - Construct three-letter or four-letter words ending with a given letter.
  - Construct three-letter or four-letter words that contain a given letter.

Functionalities

- Activities are timed
- Child can create as many words as possible
- When a child constructs any word:
  - Correct word: Interact with the visual object associated with the word
  - Incorrect word: Motivate them to construct another word

- At the end of the activity:
  - Show constructed words and status (correct or incorrect)
  - Badges for all the correct words
  - Collect as many badges as possible.

MARVoc Prototype

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MARVoc Prototype

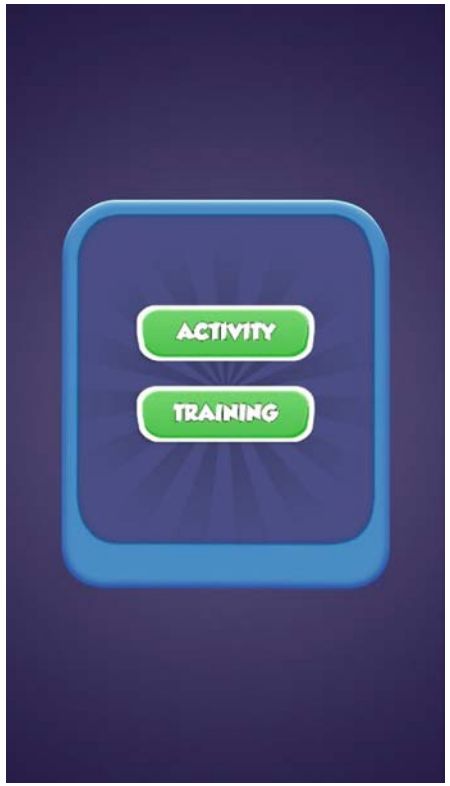

Fig. 1. The first screen to choose an activity or learning

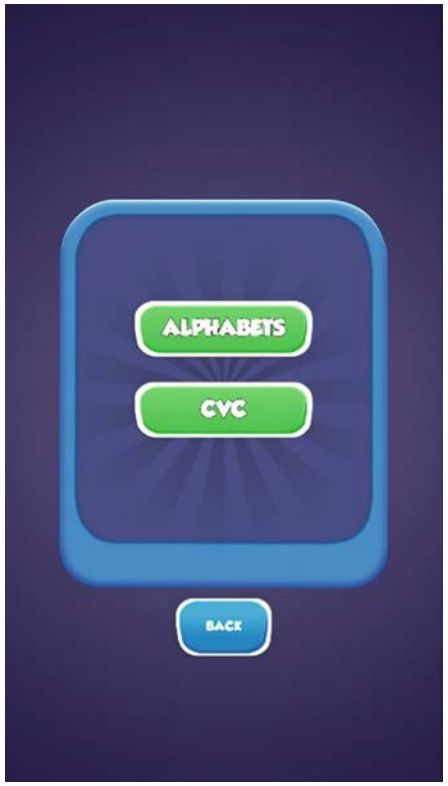

Fig. 2. Second screen to learn alphabets or CVC words

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MARVoc Prototype

Fig. 3. Third screen to choose an option to learn or take part in an activity

Fig. 4. Fourth screen to select a letter to learn or for an activity

MARVoc Prototype

Fig. 5. Fifth screen to construct a three-letter CVC word as a part of the learning or an activity

Fig. 6. An example of a marker used in the MARVoc

Feedback

- The font face is inconsistent
- The background is inconsistent
- Animation of rotating lines in the background may be distracting
  Connectivity of the back button on screens is incorrect.
- When a user clicks on the close button of the dialog box, the instructions disappear
- A child may not know what does “B” in a curved rounded rectangle indicates?

Fig. 5. Fifth screen to construct a three-letter CVC word as a part of the learning or an activity

Conclusion

Conclusion

- Mobile augmented reality app for the vocabulary learning of children with ASD (MARVoc)
- Localized requirements for the MARVoc: semi-structured interviews from the teaching staff working at two centers based in Doha, Qatar.
- One of the two use cases was finalized and improved for the prototype.
- Demo of initial version of the prototype to the teachers
- The feedback was taken from the staff, and MARVoc was updated.
- MARVoc is being improved to include Arabic language

References

- Bosseler, A., & Massaro, D. W. (2003). Development and evaluation of a computer-animated tutor for vocabulary and language learning in children with autism. J Autism Dev Disord, 33(6), 653-672.
- Merel, T. (2018). Ubiquitous AR to dominate focused VR by 2022. Retrieved from https://techcrunch.com/2018/01/25/ubiquitous-ar-to-dominate-focused-vr-by-2022/

Thank You

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