Smart Model of Augmented Reality in Teaching Using Hand Signals Makaton Among Down Syndrome Student

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Abstract: Makaton is a means of communication involving the use of symbols or images, movements or hand signs, facial expressions as well as specific speech for the down syndrome groups in assisting the development of language and communication skills. In addition to less intellectual capacity, children with Down syndrome have limited of concentration. This aspect is very challenging for the teaching of learning among children suffering from down syndrome, including the teaching of the Makaton signal language. Therefore, there should be a method of teaching and learning of Makaton to the down syndrome to suit their ability. The purpose of this study was to facilitate the use of Augmented Reality (AR) in the teaching of hand-held makings in the lower-level Down syndrome suffering children. Based on the 8 basic features of the language of hand signaling against the child's syndrome down as a guideline. An overview of teachers and parents' perceptions on the use of software and integration of AR in pedagogical instructional handbooks and surveys on student perceptions about their use in acquiring learning skills and for living a daily life was conducted based on the specific objective of the study. Case study research design was applied using survey, observation and interview methods as the main instrument of the study. By applying the concept of direct instruction (direct instruction), an analysis framework will be carried out. The results of the study were modules for Down Syndrome suffering children from the age range of 7 to 13 years old.

Keywords: *Makaton, Down Syndrome and Augmented Reality*

1. Introduction

Down Syndrome was named after Dr. John Langdon Down, a British physician who originally classified the condition in 1862 and in turn, manages to identify the symptoms and features of the disease by further analyzing the massive and meager differences in the structure of the body. The sufferer's intellectual disability and abnormal growth pattern tend to differentiate them from other, normal children (Hulme & MacKenzie,1992; Bower & Hayes, 1994). Down Syndrome is a hereditary symptom caused by an additional chromosome on the 21st chromosomal pair in a particular cell, causing it to also be called the trisomy 21 disorder. Children who are diagnosed with the disorder will have inherited a distinctive bodily feature and a host of other health issues (Puteri Roslina,2016). Down Syndrome could be diagnosed using a blood test to identify the presence of an extra chromosome in the 21st chromosome pair. The tests could also be performed during pregnancy using the aforementioned blood test, ultrasound check up and amniotic fluid analysis. Children who suffer from

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Down Syndrome will have a delay in all aspects of development which consists of social, cognitive and physical development as well as problems with learning, sight, heart and speech (Asma,2015).

Sign language is a form of communication commonly used by the hearing impaired by using hand, body and lip motion to convey information as a form of communication (Renawati,2017). Sign language is heavily utilized by a vast majority of the disabled community in Malaysia as it would enable to express their thoughts, feelings, et cetera (Syar Meeze,2017). The Makaton Sign Language utilizes symbols, pictures, actions, hand gestures and facial expressions (Shahrul Affendi,2016). The words that are classified in the first and second level are rather simple vocabularies that connotes simple needs such as 'eat', 'drink' and 'toilet' as well as simple familial salutations such as 'father', 'mother', 'brother' and 'sister' while the higher tiered words require a much more complex vocabulary such as 'big', 'small', 'name' and so forth (Sheedy & Duffy,2009).

The advancement of Information Technology had given rise to concept of Augmented Reality (AR) technology, which is defined by its capability to combine virtual object in two or three dimensions (Lia Kamelia,2015). Due to the immense challenge of using the Makaton sign language in a learning and teaching environment, the utilization of AR serves as a good incentive for communication between teachers and students with Down Syndrome as well students with family members by using simple and coherent symbols (Shahrul Affendi,2017). This is because Down Syndrome sufferers will display erratic emotion as they long to live a normal life without needing sympathy from normal people and without social gaps (Zuriahwati,2012).

2. Literature Review

2.1 Down Syndrome

Every human being that was born into the world are special in their own unique ways. Every couple in the world all hope and yearn for a healthy offspring from a physical and mental viewpoint, especially those couples who had been longing for a child for a long time. But they cannot contest God's will that they were to be blessed with a child suffering from Down Syndrome. According to a 2013 Utusan Online article, The Down Syndrome Association of Malaysia estimated that 50,000 individuals suffers from Down Syndrome, with an estimation of one case per 800 births. The disorder is often linked with learning difficulties, delayed physical development, facial disfigurement as well as early stages in muscular defect (Patricia & Winders, 2014). Due to a lack of knowledge in identifying the symptoms of Down Syndrome, parents would often face an immeasurable amount of challenges and dilemma, and could even cause a deterioration in relationship between parents and sufferers. Down Syndrome is a chromosomal defect caused by addition of another genetic material on the 21st chromosome whether it be partial or in its entirety (Kumin,2003).

Down Syndrome could be characterized as a physical and mental disorder that was caused by an abnormality in the development of chromosomes (Ili Zarifah,2014). The exact reasoning why a person could inherit an extra chromosome could not be pinpointed, but it tends to happen to aging mothers where in a mother within the 35-year-old age group would have a 1 in 400 rate of carrying a child with Down Syndrome which increases exponentially to a 1 in 30 by the time the mother reaches the 45-year age group.

2.2 Makaton Hand Sign Language

Sign language is a method of communication that utilizes hand, body and lip motion to convey information and meaning of the utterances and is widely used by the hearing impaired in Malaysia. The

Makaton sign language involves the usage of simple symbols and is currently being implemented for Down syndrome sufferers due to its appropriateness with their relatively slow level of development, motion and utterances when compared to other children (Ramlah,2016). It is developed to support the oral language as the signs and symbols aids in communication. With the utilization of the Makaton Sign Language, both children and adults could communicate easily as the symbols could be used as hints to the words that are being uttered, and is invaluable for the speech impaired (Razhiyah,2005).

This makes the Makaton sign Language immensely flexible as it is capable of being personalized according to the person's needs and level of proficiency. According to a writing by Sheedy and Duffy (2009); Dunst, Meter and Hamby (2011), these advancements could only be used in the context of teachers in a Western classroom, as the discussion regarding sign language and Down Syndrome in Malaysia is immensely limited in the context of speech development and the Makaton Sign Language method of teaching in general.

2.3 Augmented Reality (AR)

The teaching profession's involvement with the ever advancing world of technology would mean that the teaching and learning programmer had implemented the usage of technology in classrooms. According to Norabeerah Saforrudin, (2012), the usage of technology as a learning and teaching aid would enable students, especially the upcoming Generation Z, to be immensely proficient in the usage of technology. This is further proven by the fact that the Education Minister of Malaysia had accepted the usage of ICT as a media of teaching with teachers serving as facilitators of change beginning in 2010 (Lim, 2010).

Therefore, the presence of a particular technology such as augmented reality (AR) must be studied in order to recognize its potential that would enable it to be invaluable in the field of education. It must also be studied in order for it to be implemented into the layout of the education system, especially in Teaching and Learning Activities which would utilize the Makaton sign Language to enable teachers to attract students' attention during a T&L session, which in turn, would be implemented into the students' daily lives. AR has also been proven to be particularly beneficial with the creation of the MagicBook, a project developed (Billinghurst, Kato & Poupyrev, 2001). However, AR that interacts via 3D imagery is more capable of instilling a deeper understanding regarding complex content caused by an easy interface and a topic that could be actively explored by students and would also motivate and engage students, on top of supporting immersive learning and being able to reach the objective of acquiring communication skill (McKenzie & Darnell, 2004).

3. Framework

3.1 Observation

This research uses non participant observation. This observation is not an observation that allows developers to break away from what is happening thus making it appropriate to examine the management process and get a real picture of a situation. Given the focus of research is to study the management process, then this type of observation is appropriate so that the management process is not interrupted (Ahlam, 2016). The observation was conducted for 2 months in a typical school. Researchers obtain permission from the school's supervisors and principals before starting the data collection process. Attention is given to classes that accommodate pupils of suffering from Down syndrome between 7 and 12 years old. Researchers attend school every day and sit in class starting from first, second, and third classes in sequence. The

position of the researcher is placed behind the classroom and there is no interruption during the daily learning process (Suraya Bai, 2012). The researchers only observe the behavior of pupils and teachers, acceptance of pupils, and the teaching methods used by teachers during the learning and teaching of the subjects in the Makaton format (Nur Hasanah, 2014). All these observations are recorded in the form of daily notes, photos, and video recording to be analyzed. Observation studies will take place before and after involving AR in the use of a Makaton hand sign language. This process is recorded using the video camera and the reading period of each pupil imitates the signal obtained and recorded through the duration of the video recording.

3.2 Interview

Interviews are conducted on teachers teaching in special schools and parents. This interview was conducted individually after the completion of the school session to measure the level of achievement of the students before and after introducing the use of AR technology application in the teaching of the language of the hand-to-hand Makaton among students of lower level down syndrome.

Based on the theories, principles, and description of the overall research, the researcher would present the proposal of the allocated framework involving the visualization technique for learning involving the eight elements of the Makaton sign language as described by the figure below:
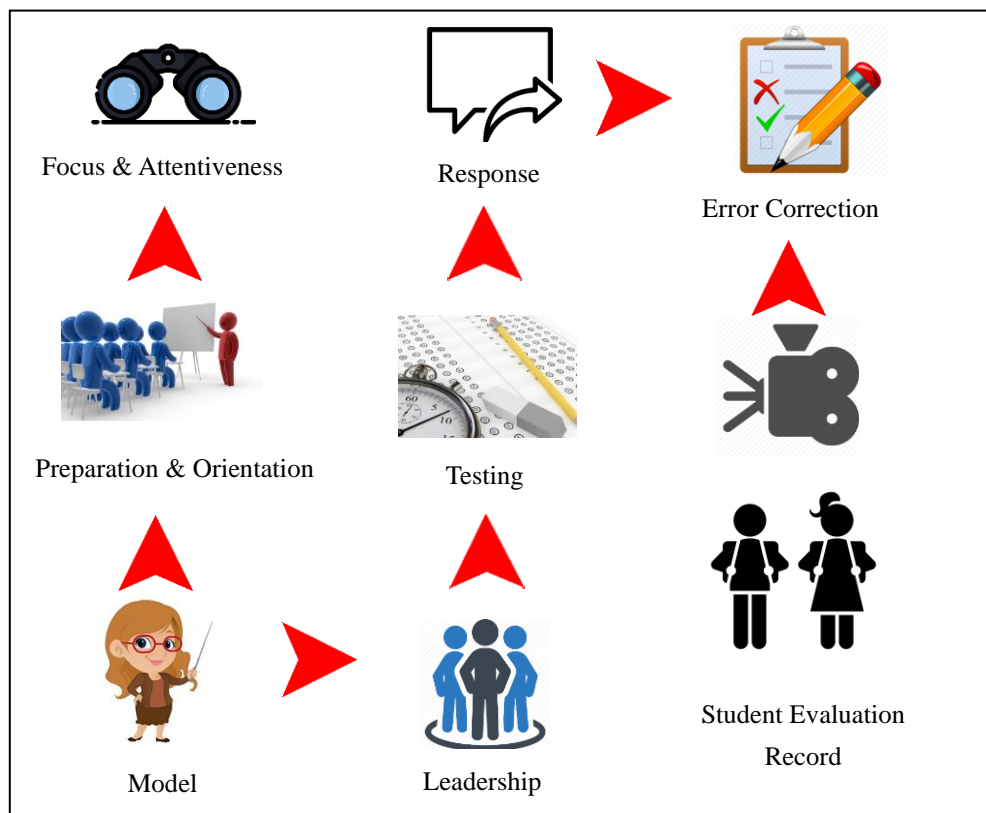

Figure 1. Elements for the Makaton Sign Language for children with Down syndrome

3.2.1 Focus and Attentiveness

Focus and attentiveness plays an important role for a teacher to retain their students with down syndrome's sense of focus to learn the Makaton sign language as a daily communication language. This could be done by attracting the student's attention by projecting live images and the students would in turn, give their fullest attention.

3.2.2 Preparation and Orientation

Preparation and Orientation must be done by the teacher as it would grant them an early exposure regarding their teaching subjects and methodology before applying it to their students. Teachers would introduce the content of the Makaton sign language in a category of family, objects, fruits, body parts, the weather, numbers, alphabets, et cetera to the students. The introduction serves as a traditional method of self-preparation before utilizing AR related tools and technologies.

3.2.3 Model

Model is a demonstration done by the teacher in front of their students as part of a dictation. The teacher would start demonstrating each aspect of the Makaton Sign Language that will be taught later on. However, each learning aids must be prepared by the teacher or the assistant for student management beforehand. The teacher will show a picture card while uttering the words and hand motion that word represent the subject in the card repeatedly until the student could identify the card when the teacher shows the card all by themselves.

3.2.4 Leadership

It is a requirement for a teacher to be able to lead the class as they are instrumental in the students' capability to be able to receive the lesson far more effectively. The teacher will instruct their students to mimic the signals taught. At this stage, the teacher will observe the signals made by the students and must simultaneously identify the mistakes made by their students.

3.2.5 Testing

Tests are made to observe the overall proficiency of students regarding topics they had learned. The teacher would start questioning their students following the completion of a learning session and the students will be questioned regarding the signals that they had just mastered. The inquired sign language will be chosen at random involving tabs with animation. The teacher would show the animation and the students will answer it.

3.2.6 Response

Response is highly invaluable for children with Down syndrome as it would motivate the students to keep remembering what the teacher had taught them. The teacher will give a response following the aforementioned tests, and would usually comprise of compliments while the students who got it wrong will have to rectify the error immediately whilst the teacher will repeat the questions until the students get it right. This due to the fact that children with down syndrome are more vulnerable emotionally and does not function like other children.

3.2.7 Error Correction

The involvement of the AR technology provides both teacher and students the opportunity to further enhance their understanding and approach with the Makaton Sign Language as well as understanding the errors made far more effectively. The teacher would hold the students' hands and perform proper movements that would denote the proper meaning by referring to the screen tab.

3.2.8 Student Evaluation Record

The teacher could make a conclusion with the involvement of AR in integrating the Makaton Sign Language toward students with down syndrome in

order to test the students' capabilities with the help of technology as a learning aid. It would also aid teachers or students' caretaker to communicate with students if their utterances do not convey adequate meaning with teachers, peers or even family members. The change in students' outlook and behavior could be used as an initiative to use the Makaton Sign Language as the standard language among students with Down Syndrome.

4. Research Studies

According to the finding, there were indeed several studies in the market for AR-CARE. The many different purposes and features were listed in table 1.

FEATURE	TYPE OF MATERIAL LEARNING		
	AR-CARE	*Makaton Pic*	*Speech Viewer 3*
Technological Approach	/		/
3D Entertainment	/		
Easy Estimation	/		
Availability	/	/	
Attention Grabbing Properties	/		/

Table 1. Difference of AR-CARE

4.1 Makaton Pic
The Makaton Pic is a teaching aid that has been in existence for quite a while where it involves the usage picture card. The students are expected to provide their answers based on their understanding of the picture to the teacher. This is a traditional method that proves to be quite detrimental for students with low attention span as an inert object could cause boredom. This could cause a multitude of unwanted incidents due to the fact that Down syndrome sufferers tend to have erratic behavior.

4.2 Speech Viewer 3
Speech Viewer 3 is an innovation that employs five multimedia elements to provide variants in terms of technological innovation. Speech Viewer 3 only involves voice and language software that allows converting conversations and sounds into graphics. Interesting graphic engagement that shows how to learn the language of Makaton's hand gestures. If this software only displays graphs on the computer screen used to attract interest or attention to the target group of elementary students it is likely that elementary students quickly lose focus because the main characteristics or characteristics of elementary students are their innate capability to quickly lose focus.

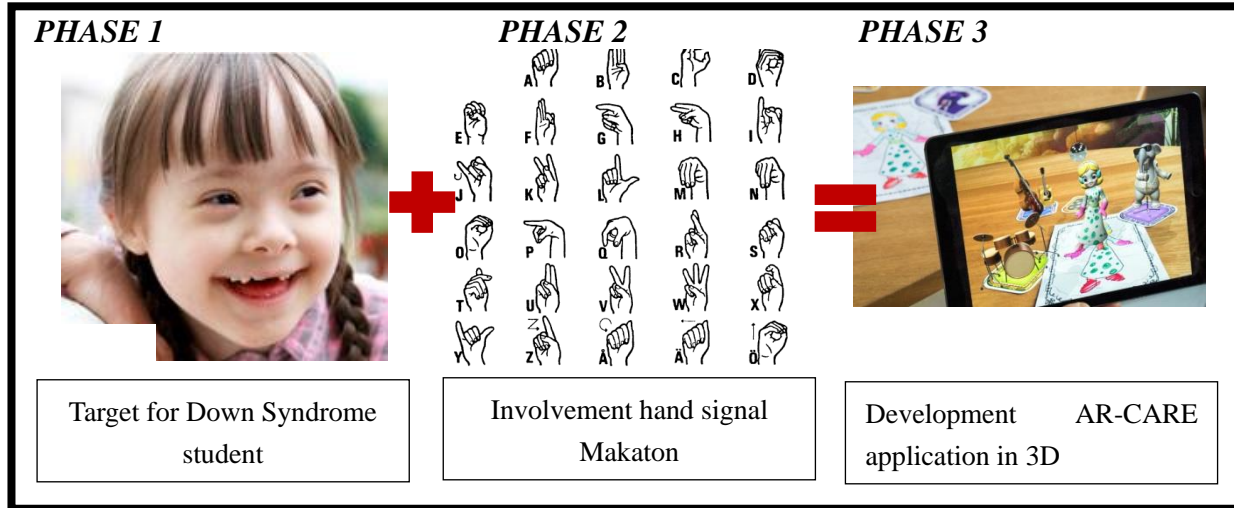**5. Design Structure**

5.1 AR-Care

Figure 2. AR-CARE development structure

AR-CARE's application development structure is a teaching aid that involves the use of technology such as information communication technologies (ICT) as a teaching medium in helping teachers as teaching aids and assisting students as learning aids (Ang, 2016). Therefore, the presence of a technology like augmented reality (AR) should identify the potential that it can really benefit education. AR is a technology that combines virtual objects into the realm of reality and users can interact with those virtual objects in real time. It is proven to attract and entertain elementary school students with moving 3D images.

3D entertainment is an image moving on the tab screen that can move 360 degrees. In addition, it is easy to estimate (Ellin & Dwi Fransiska, 2017). Sign language is a sign language, using signs, symbols and utterances to help people communicate. Signs are used, with speech, in the order of words spoken. It helps provide additional clues about what someone is saying. Using signs can help the person who does not speak or someone who suffers from his speech impediment. Using symbols can help someone with limited speech and those who cannot, or choose not to communicate using sign language.

AR-CARE's application is an easily accessible application for anyone with a smart phone to make it easier for students or families to learn sign languages. In addition, it can grab the students' attention to see them and their students as they complement the moving image with combinations of cheerful and attractive colors can to enhance the interest of elementary students (Manuri & Sanna, 2016). In fact, before developing this application, the researcher observed the habit of elementary children, which we established earlier as in need of guidance, for two months. AR-CARE's decidedly active nature make students feeling joyful as it allows them to play while studying (Prita Haryani,2017).

AR-CARE is an AR-based 3D app that is designed to serve as a teaching tool for teachers to implement communication methods that involve language of handwriting signals to facilitate down syndrome

students to communicate in everyday life. By employing advanced, sophisticated technology (Fidler, Lawson & Hodapp, 2003). AR-CARE 3D application allows educators to facilitate learning and implementing technology in learning for down syndrome students. In addition, it is an entertainment material used in the 21st century learning in the classroom, thus making it easy for students and teachers to gain the 21st century skills (Amanat Menteri Pendidikan Tinggi, 2018). 21st century skills include complex problem solving, creativity, human management, emotional intelligence as the primary source of developing AR-CARE applications to serve as a teaching tool as well as everyday use for down syndrome students with special needs down syndrome to be capable of confronting and even interact with normal students. In fact, there will be no significant gap between technologies for usage between by both normal and special needs down

syndrome students.

Additionally, it is also slowly but surely changing the way learning with elementary students in Malaysia as it still maintains a traditional way of involving elementary school technology materials. Special needs down syndrome are no longer excluded by different means of communication as the existence of the AR-CARE applications of down syndrome students feel themselves valued (Gabrial Grayson, 2013). As well as indirectly the family could also use this application to indirectly change the other people's viewpoint by emphasizing kindness and not regard special needs down syndrome people as a burden. In fact, implementing to new methods is a challenge in of itself as it requires patience and confidence to change the future of education for down syndrome students.
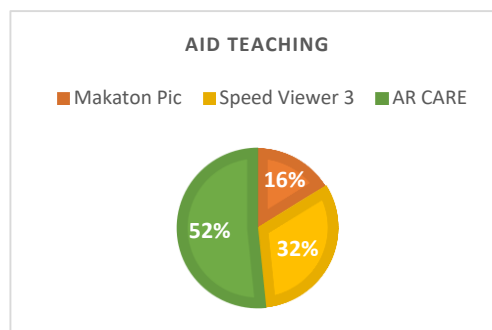
6. Result

Table 2. Percentage of engagement teaching aids.

According to our findings, Makaton Pic could only attract the attention of students 16% of the time. Although it utilizes the usage of eye-popping graphics, it proves to be a temporary solution as it may result in loss of focus only using inert, graphic pieces. While the use of skills "Makaton pic" this is only fully centered on by the teacher.

If one were to compare between "Makaton pic" and "speed viewer 3" it is being clear that the use of

technology is growing rapidly because of the use of speed viewer 3 is an active graphical display on a computer screen with engagement of computer in learning.

The effectiveness "Speed viewer 3" against Makaton hand sign language could be measured as much as 32%. "Speed viewer 3" is the use of multimedia elements by engaging in graphics that are displayed on the computer screen. It proves problematic,

however, as it led to usage of the "Makaton pic" being combined with "speed viewer 3", thus negating the advancement made with the Speed Viewer 3 and causes teachers to still implement traditional learning methods. Therefore, the use of AR technology can be implemented and improved upon as a classroom teaching aid for the use with down syndrome children and as way to counter aforementioned problem.

In the engagement AR for as a teaching aid for the target children down syndrome for disclosure to children down syndrome with the latest learning technology to redefine the learning space from traditional to modern to realign the appropriate tech-space and appropriate heutagogy

7. Conclusion

In conclusion, the teaching and learning of the Makaton Sign Language among children suffering from Down syndrome must be done face-to-face as it is easier for individual interaction and to fully gauge the students' comprehension and mastery of what is taught (Lily Haslina, 2004). The teaching and learning of the sign language consists of eight main elements, and are capable of an effective lesson among students with Down syndrome. Due to their inherent skill at emulating their teacher and peers, the absorption of the Language can be done without much interference. Based on the study's utilization of data previously recorded in the field of mass virtual reality, mass augmented reality in the field of education, and the advantages of mass augmented reality, the researcher finds that the augmented reality technology has a massive potential in enriching the field of education (Grace, 2017).

Acknowledgment

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