Facilitating Learning in Children with Autism using Hybrid Visual Cognitive (HVC) Learning System

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Abstract

Education has been identified as a relative cure for children with autism. However teachers have found the educating task daunting and challenging due to the inattention in learning tasks and differences in style of learning amongst them. Children with autism are generally categorized as visual learners and different studies have utilized this skill to develop software learning systems to assist these children in self-help skills, social skills and others. In recent studies, visual learning applications developed for a particular child with autism might not be useful for another child within the same age range and spectrum due to their different interest in style of learning and visual cognitive ability. There are quite a number of visual learning applications for these children but none of these learning applications cater for their variation in visual cognition and learning ability. In this study, we proposed a Hybrid Visual Cognitive (HVC) Framework that is based on an instructional design model, multimedia cognitive learning theory and learning style. The proposed framework could serve as a guide for software developers in developing a learning system for children with autism of different visual interest. In order to evaluate the HVC framework it was applied in developing a Hybrid Visual Cognitive (HVC) learning system for children with autism specifically for learning verses of the Quran due to lack of guidance for software developers on the components necessary for this category of children in gaining their attention in learning. According Whetherby & Prizant (2000), there are three categories of behavioral pattern in children with Autism Spectrum Disorder, they are: hyporeactive, hyperactive and mixed pattern. The category of hyporeactive pattern of behavior requires high sensory input to keep them calmer and attentive. Hyperactive pattern requires low sensory input to keep them calmer and attentive and mixed pattern could require high or low at different point in time. Hence, children with autism who display hypoactive pattern of behavior require stimulating learning environment in order to be calm and attentive.

The knowledge of Quran is essential for Muslims as it serve as a means of communicating with God. The Quran is in text format. This format can easily be learnt by typical children but children with autism cannot manage on the text alone. Therefore, providing them with the platform that supports their interest in learning the verse from the Quran will be required. The objective of this study is to propose a learning system using Hybrid Visual Cognitive (HVC) framework to assist developers in developing software learning system with suitable elements especially for children with autism. Teaching children with autism create challenges for teachers during learning task. However, children with autism have been identified as visual learners (Grandin, 2006) but the degree of the visual inputs that can maintain the attention of the children with autism varies (Dunn & Dunn, 1992).

In the proposed learning system, different thematic areas of visuals were identified and presented to the learners in order to gain their interest in learning task. An HVC
learning system prototype was developed to teach verses of
the Quran to children with autism in order to maintain their
attention on the recitation as well as the text. The
contribution of this study is to provide guide to software
developers in developing an adaptive learning tool and
provides teachers with a flexible learning tool to manage
different learners with autism.

Hence, this paper discusses the experimental study of
Hybrid Visual Cognitive (HVC) learning system based on
HVC framework in teaching verses of the Quran to children
with autism. Other sections of this paper are section 2
which explained the related framework, section 3 gives the
general overview of the framework, section 4 provides the
implementation of the framework by developing a learning
prototype system, section 5 provides the evaluation of the
prototype and section 6 provides the result, while section 7
conclusion of the study.

2. Related Work

According to the study conducted by Doyle (2011), Reach
and Teach framework was used in teaching children with
autism on how to respond to a social interaction. The
methods of presentation style used were: animations, video,
audio and text. The findings of this study indicated that
90% of the children preferred animation, 40% preferred
video and none of the student preferred text or audio. This
study considered the incorporation of the mediums disliked
by the children (text and audio) into the medium they
preferred as a way of empowering their weakness using
their strength.

3. Framework Overview

The Hybrid Visual Cognitive (HVC) framework depicted in
the Figure 3.1 below is based on the four basic components
of instructional model which emphasize on the Leaners,
Objectives, Method and Evaluation (Morrison, Ross,
Kemp, & Kalman, 2010). These four components are the
basic components of instructional designs. However, other
components could be added based on the needs of the
learners. The guide for each phase of the framework is
provided in the subsequent sections.

3.1 Identify Learners

Profiling the learners serve as the first phase of the
framework. This involves the general characteristic of the
learners such as age, prior knowledge, special interest and
other characteristics that can affect learning.

3.2 Learning Objective

The second phase is “Learning Objective”. The objective of
learning should be in line with the prior knowledge of the
learners and simple to understand. “Learning theory” and
“The Learning style” serve as corroborating phases for the
learning objective phase in order to guide the style of
content presentation and their level of assimilation.
Children with autism have the impairment in theory of
mind; therefore they find it difficult to connect different
ideas together as a whole. Considering their learning
cognitive, the use of simple illustrations should be
considered in the content of the objective. More so,
learning style is imperative in any act of learning and
different children with autism have different interest in the
style of learning. Some children prefer

3.3 Learning Method

The third phase of the framework is “Learning Method”.
This phase involves the medium of presenting the learning
content to the learners. This phase is supported with the
Learning Strategy phase where motivation and memory
were given consideration. Children with autism have
strength in some skills such as visual processing and rote memory while some of their weaknesses are attention in task and audio processing. Hence, this study emphasized the use of their strengths in order to work on their weaknesses. Teaching the verses from the Quran involves text and audio, these two were embedded in two visual presentation styles; Representational and Decorative. The representational style has the humanoid animation, transitional animation and video while the decorative has the abstract animation adapting the visual sensation in sensory room.

3.4 Formative Evaluation

The final phase is the “Evaluation”. The evaluation considered in this framework is formative where learning method phase is tested with the learner before the final design. The need to involve learners in the development of a learning system specifically for children with special interest gives a better learning outcome.

4. Implementation of the HVC Framework

The Hybrid Visual Cognitive learning system is a computer based system that consists of four different visual themes which were identified during the preliminary study. These visual themes are humanoid animation, Abstract animation, Transitional image and Video. The main page of the learning system is shown in figure 4.1. The application is used by the trainer with the learners where the option of the desired verse is selected, the number of times it can be repeated and the visual style preferred by the learner.

When the desired verse of surah al-fatihah (first chapter of the Quran) is selected, then the desired number of times for repetition is selected and finally the style of presentation is selected and the recitation screen is displayed as seen the figure 4.2. While other links can easily be navigated from the top links.

In order to praise the learner for watching there is a reward page with “dummy face” to praise them for a job well done and notifying them that they have completed a task as shown in figure 4.3.

5. Evaluation

Three participants were used for this study for the period of 5 weeks where the sessions were videotaped. The participants were Nasir, Imtiaz and Atika who were confirmed as children with autism based on a doctor’s report and direct observations.
5.1 Procedure

The participants attend the same Islamic school and the duration of their class session is 2 hours where 1 hour is used for theoretical learning and the remaining 1 hour is for practical sessions. During the first hour of the session we used the learning system with the participants and took the sessions were videotaped for the purpose of further analysis of their attentional behavior during learning with different style of presentation.

5.2 Coding and Reliability

The analysis of the video data taken during the learning sessions were done using Nvivo a qualitative software analysis tool. The video was divided into chunks of 60 seconds and a total of 50 chunks of the video (3000 seconds) were analyzed. The attentional behaviors of the learners were coded. During the open analysis of the learners’ behavior, the value of 1 was used to represent the each behavior observed and each behavior was coded once in each chunk of the video. The general behaviors coded from the video were categorized into on task and off task as shown below.

Inter observer reliability was done on 25 percent of the coding which were sparsely selected. The reliability coefficient was calculated to be 0.96 based on the agreement and disagreement on the coding for attentional distribution of the participants.

<table>
<thead>
<tr>
<th>Codes</th>
<th>Categories (Off task)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coff 1.</td>
<td>Irrelevant comment</td>
<td>When the child mentions what is not in the content of learning</td>
</tr>
<tr>
<td>Coff 2</td>
<td>Look away</td>
<td>When the child looks away and not pay attention to the screen nor trainer</td>
</tr>
<tr>
<td>Coff 3</td>
<td>Play</td>
<td>Playing with another object</td>
</tr>
<tr>
<td>Coff 4</td>
<td>Walk away</td>
<td>When the learner leaves the learning scene</td>
</tr>
</tbody>
</table>

Table 2

* (Con = On task category, Coff = Off task category)

6. Result

The average of the frequencies of the learners’ behavior was calculated by dividing the total frequency of behavior by the total number of chunks of video for each participant and each presentation style for both off task and on task behaviors.
7. Conclusion

According to the charts given in figure 6.1 and figure 6.2, each of the participants showed different attentional behavior for different style of presentation. Hence providing a learning system using the HVC framework for children with autism will attract different learners and creating an adaptive learning for different learners.

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9. References


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