Assistive Training to Improve Motor Skills of Dyspraxia persons

Dr.K.PONMOZHI
Assistant Professor
Department Of Computer Applications
Kalasalingam Academy of Research and Education
Krishnankoil, Tamil Nadu, India

***Abstract*— Assistive technology helps physically challenged persons in many a ways. These technologies can also be used to improve motor skills of a person in a way of designing gaming applications. Motor skills are influenced by cognitive ability of the persons too. Improvement in eye and hand coordination is essential among others to do the daily life without others support. In this paper a simple application which improves eye and hand coordination is designed. Dragging and dropping of objects in four directions is designed.**

The influence of practice and assistance in picking up and dragging are measured by conducting three sessions of play. Participants with varying IQ levels and age were selected to evaluate the influence. In Session I participants are asked to play the game without assistance, In session II participants are asked to play the game with assistance. Before conducting session III 50% of participants are made to practice the game for 5 times. Session III is conducted to measure the influence of practice.

Task completion time, Number of correct drag and drops, time taken to complete a screen are measured. It is identified that there is 30% improvement in the performance of the participants while playing the game with assistance, also 40% improvement after practice.

Keywords—motor skills, assistive technology, disabled, Gaming for assistance.

I. INTRODUCTION

Technology eases the life of people in many a way. It is a boon to the disabled persons as it makes things many impossible things to possible [1]. Overall development of any country should include the growth of disabled persons too which is also an essential factor to ensure sustainable development. Disability in any form for that matter will isolate the persons from others. Assistive technologies come in handy to improve the life of disabled in many a ways, for instances they are used to (i) stimulate some kind of activities [2-4], (ii) provide improved and safe learning [5],[6] (iii) customized learning by providing different difficulty levels[7-9] (iv) provide repeated personalized learning activities [10],[11].

Many a time the assistive technologies are having limited access because of financial and technical constraints. To get more benefits out of assistive technology, applications designed for privileged people should be user-centered, and can be operated or used in all environments. It should be acceptable by caregivers and therapist [6].

Measures such as strengthening the (i) shoulder muscles (ii) trunk muscles (iii) left and right coordination (iv) hand movements (v) improving balance and cognitive skills will improve motor coordination[12].

Motor skills are influenced by various mental activates such as remembering things, also ability to learn new information. Human beings ability to perform the problem solving and learning activates are termed as cognitive skills [25]. Other skills such as memory, insight, orientation, giving attention and organizing activates are comes under cognitive skills.

Problems in cognitive skills will affect day today activities such as communication, mobility. To improve this, various tasks which involves different movements, in different position also in varying environment[13] should be designed and used.

Tasks such as [14]: (i) noise identification (ii) pointing shapes and identifying colors (ii) counting (iv) practicing alphabets will help in improving cognitive skills.

This paper discusses the application designed with tasks such as identifying shapes, picking the correct shapes and dropping, remembering the directions which will improve eye and hand coordination.

II. OVERVIEW

Gaming application designed in this paper aimed to improve the motor coordination by using gestures like drag and drop, and also to improve cognitive skills reasoning such as shape identification is used. The tasks used are matching shapes and a medium level difficult sequence of gestures introduced for selection. 20 dyspraxia children were selected for analyzing the usage of the application developed.

Indian adaptation of Wechsler's intelligence scale for children [21] the Malin's Intelligence test [20] proposed and adapted for Indian children is used to measure the IQ level of the participants.

Details of the participants is shown in Table 1.

TABLE I. PARTICIPANTS DETAILS

Number of Participants	Participant's Age	Gender	IQ level
20	Mean = 14, Std. Deviation = 5.2	Male = 10 Female = 10	Mean =42 Std. Deviation = 11

III. RELATED WORK

Application development based on Gesture interactions is facilitated by development of many motion tracking technologies. To track the motion of human body parts they provide software tools for instance Kinect,

To name a few Nuitrack, motionbuilder etc. are technologies that promotes the creation of gesture based applications. By using these technologies we can detect facial expressions [7], interventions for cognitive based applications [19], eye-hand coordination[18], and Whole body interactions[22] are used in applications such as SensoryPaint [22].

In the area of therapeutic assistance [14], educational applications, social interactions especially for kids are geared up now a day.

Learning of new information happens through interaction between body and the environment [15]. As stated by Embodied cognition theory there is an influence of body in the actions and reactions of mind, the mind is not only connected to the body but that the body influences the mind [16]. Interactions with environment in the way of training will influence cognitive developments too. Embodied learning has its role in human-computer interaction [17] field also, to create better assistive devices.

Limited infrastructure and facilities like electricity, internet access, devices for accessing and using applications and assistive devices are the de-motivator of wide spread acceptance of the assistive devices and applications. Developing countries like India usage of assistive devices is very less due to the above mentioned factors.

Low schooling attainment and poverty due to disability is evident in many developing countries has been identified by the study conducted in 14 countries by World Bank [23]. One among the cause is expensive technology and unavailability of reusable devices in many persons also foe many applications.

For an application to be usable it should be (i) affordable (ii) possibility of customization for many users (iii) accessible through many devices.

This study and application development bear these factors in mind and developed the application using python a freeware and can be accessed through varying type of devices.

IV. APPLICATION DESIGN

A. Design overview

Similar shape matching, counting number of similar shapes, dragging a specific shape and dropping in the destination, Alphabet symbols for matching are the concepts used in the application. These techniques will improve motor skills, memory, learning skills. Implicitly the participants will also be familiar with directional or spatial aspects too.

Application is designed to address the issues such as (i) personalized accessing i.e. the level of difficulty can be adjusted as needed by the participants. This will show different screens and difficult combination of selection (ii) Adaptable accessing (i.e). can be accessed using any kind of devices such as laptop, smart phones etc. It also allows users to interact with any type of devices such as touch screen, mouse.

There are three tasks in this application. (i) One is for matching the shapes. Five different shapes are used for identification. Same colored objects are used for initial screen and color and number of different shapes are introduced gradually. Figure 1 shows the initial screen of task 1. Figure 2 shows the last screen of task 2.

Figure 1: Screen 1 of task 1

Figure 1: Screen 10 of task 1

(ii).Dragging a specific shaped object and dropping it in to matched object, in this difficulty level increased gradually by introducing colored objects, and destination in different directions. Initial screen is shown in figure 3. The direction information is shown as a hint Figure 4 shows screen with directional assistance of task2.

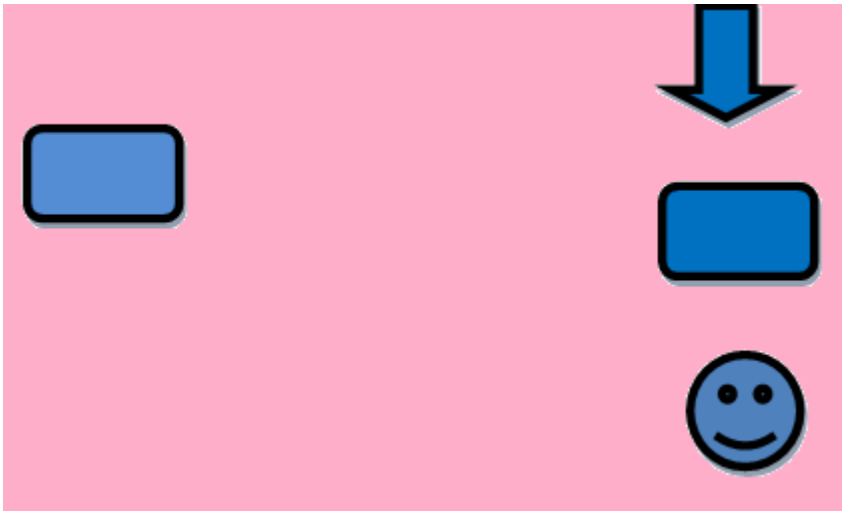

Figure 3: Screen 1 of task 2

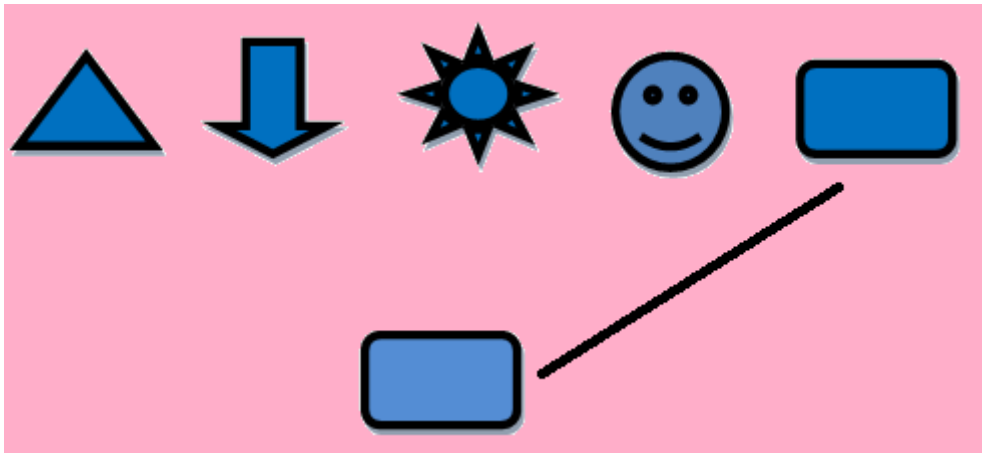

Figure 4: Screen with assistance in task 2

(iii) Remembering Alphabets, and counting is the third task to improve memory. For each task 10 screen are used. First screen shows with only three alphabets which is shown in figure 5, gradually the number of alphabets are increased. Final screen of the task is shown in figure 6.

Figure 5: First Screen of task 3

Figure 6: Screen 8 of task 3

Audio Visual feedback for the participants is given to motivate the performance.

B. Evaluation

First session of play is conducted with assistance. Assistance is given in verbal form by default. In case the participant needs voice assistance they have to press the audio button. Third session is used to compute the influence of the practice. Half the number of participants is permitted to practice the play form 5 times. Time taken to complete single screens and the total time taken to complete the entire session are compared with second session. Before starting the both the sessions instruction for the play and level selection options, game winning situation will be given. Every screen's completion time in both sessions will be calculated. Total time taken for the entire session, the screen for which assistance required, and number of screens for which assistance required are calculated.

C. Result

Individual Participants performance is measured. Influence of assistance is measure by comparing the time taken to complete the entire session I & II. Figure 7 shows participant's performance in Session I and session II.

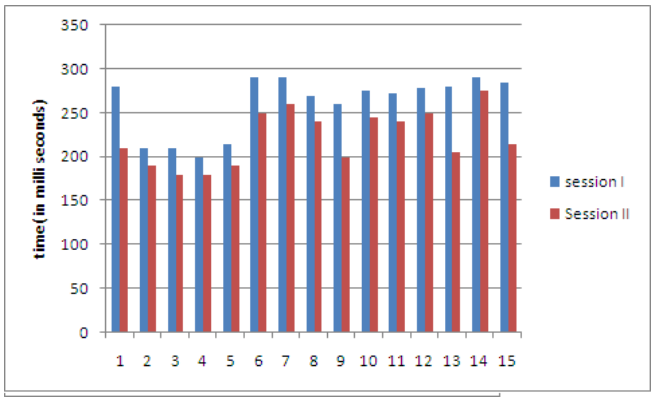

Figure 7: Completion time of task 1

(i) Influence of practice

This has been measured by comparing the time take to complete every screen in session III by participants taken practice and those who do not taken practice are compared. 50% of participants are asked to practice the same set of screens and difficulty level for 5 times. A test was conducted for both the participants who were practiced the game and non-practiced participants. Time taken to complete the screen by practiced participants is less upto 35% compared to others. For shape finding they find it easier than alphabets. Comparison of practice is shown in figure 8.

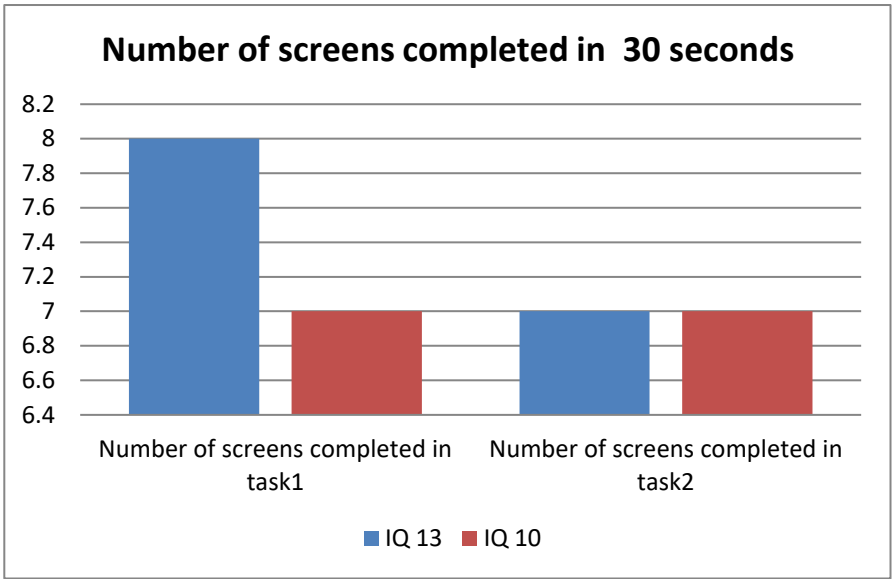

Figure 8: Comparisons of practiced and non-practiced participants

(ii) Influence of Assistance

Number of screens completed with assistance and number of screens completed without assistance are compared for every participant. Figure 9 shows the completion time of session I and II. It is evident that participants complete the task faster with assistance. Participants with IQ level higher than the others completed screens without assistance faster than others.

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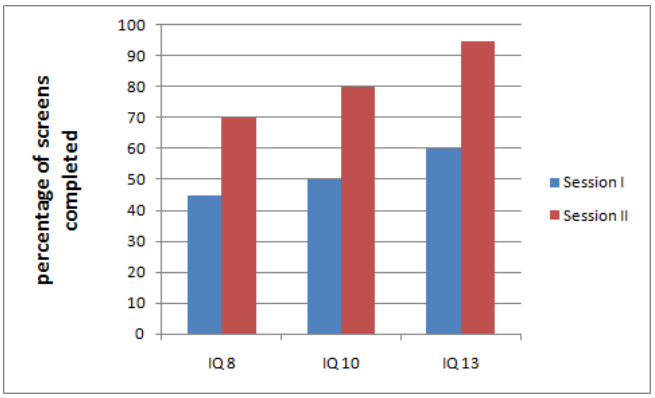

Figure 9: completion time

Total time taken to complete a session and total number of screens and the screens actually completed are calculated. Task 1 is based on shapes, where as in task two it is a combination of count, direction, color along with shape mapping. Figure 10 shows the number screens completed in task1 and task2. There is less number screen completion in task 2 because of the difficulty level.

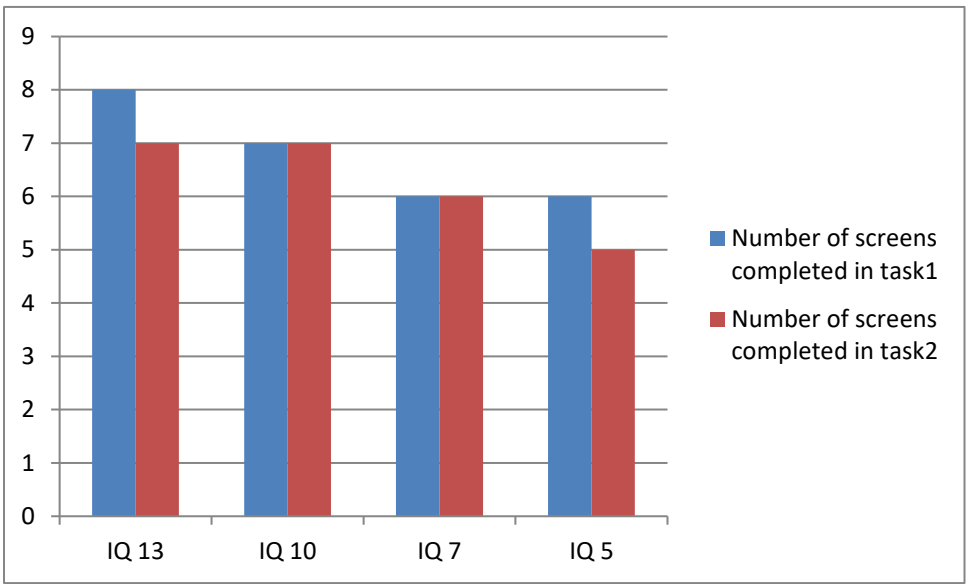

Figure 10: number of screens completed in task 1 and task2

Conclusion

Lack in Cognitive and motor skills among children make them feel aloof and they cannot mingle with people. By practice, children with these two issues can improve their skills. So, we developed an application to improve these skills and through experiments we ensured that through practice and assistance, these people can also move along with the society within a stipulated period of time.

While evaluating, it is found that the participants felt difficulty in doing two things simultaneously i.e. the time taken to match same color shapes is easier for them than to match shapes with varying color. This component also varies depending upon assistance. In future, we plan to analyze the impact of color in recognition, female and male performance variations if any.

In Alphabet counting there is a slight difficulty because there are two activities involved one is remembering the alphabet, also the count. Simultaneous tasks needs even more practice. By designing games and make the students practice will help them.

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