

Smart Interactive Comprehensive Learning Aid: Practical Application of Bruner's Theories in Primary Education

H.K.T.C. Halloluwa, A.P. Kaushalya, P.K.B.P.S. Bandara, K.D.S. Yapa, S. S. Sumanadasa

Abstract— Smart Interactive Comprehensive Learning Aid (SICLA) is learning and teaching aid, implemented based on Bruner's theory on the development of the children (1996), in education. The main objective is to provide an automated interactive learning tool for children who can learn and acquire knowledge with minimum teacher support. According to the Bruner's theory, for effective teaching and learning can be done through three modes of representation: enactive representation (action based), iconic representation (image based), and symbolic representation (language based) and that is the main focus for this automated tool.

This interactive solution focuses mainly the development of language skills, enactive skills and cognitive skills of a child through some software based activities. Activities selected carefully by focusing above underline skill and the level of knowledge that the child has and the age child is in. Therefore the selected activities leads to acquire new knowledge within interactive environment and the performance of the child evaluate with the aid of intelligent components of the software application. Some of the activities includes are the Letter identifier by object tracking, speech capturing, story builder and a smart story board, memory activities and innovative object designing. The implemented solution capable of expanding to capture new knowledge of parent/ teacher and that can be acquired by the child with or without their support. Advanced neural network techniques help to capture child knowledge and evaluate them with the constructive feedbacks in the execution time.

One of the key intentions of this automated tool is to deliver a user friendly automated learning tool grounded with proven effective teaching techniques in affordable cost.

Index Terms— Bruner's Theory, Virtualization, Primary Education, Phonics, Neural networks, performance Evaluation, Reading and Writing Practice, Story Building

1 INTRODUCTION

One of the critical problems in education sector particularly in Sri Lanka is inadequate qualified teachers for primary education [1]. This situation is more critical in rural areas in Sri Lanka [2]. Furthermore not only in rural areas, within the city areas or suburbs in Colombo, some schools other than popular well-known schools still suffering shortage of qualified teachers [3]. This problem is more crucial in language education. It has been identified that there are so many primary schools which ceased conducting language class due to unavailability of single qualified teacher to educate grade 1 and 2 students [4]. Present teaching-learning approach in primary education in Sri Lanka is usually teacher-centered, instructive teaching approach. Together with large number of students teacher conduct class and give activities. The results of the student's performances or the feedbacks received by the students mostly the following week. Also the lessons are taught by the speed of the average student, so the children who are slow at learning will face in difficulties and rare chance of getting second chance to re-try the activity again.

In literature there are so many researched carried out to find out effective teaching approached particularly in primary education [5, 6]

Among them one reputed theory on education and psychology is Bruner's theory (1966) [7, 8].

In his research on the development of education in children, Bruner proposed three modes of representation. [9]

- Enactive representation (action based)
- Iconic representation (image based)
- Symbolic representation (language based)

In the enactive stage, child will be able to identify the objects in the real world and to perform physical tasks by his own. It involves encoding action based information and storing it in our memory.

In the iconic stage, information is stored visually in the form of images. When presented with new information, it is sometimes more helpful to people to have a diagram.

In the symbolic stage, knowledge is stored primarily as words, mathematical symbols and other symbol systems. [9]

This approach is proven in different stages in education and achieved success in many instances. This research is focused how IT technology can be utilized to embrace above theory hence the child can study in novel interactive learning environment.

- All the authors except Sujani Sumanadasa are currently pursuing Bsc degree program in Information technology in Sri Lanka Institute of information technology, Sri Lanka, E-mail: hkthilina@gmail.com
- Sujani Sumanadasa is the supervisor for the research in Sri Lanka Institute of information technology, Sri Lanka, E-mail: sujani.s@slit.lk

There are various products in the market which provides some solutions to use IT for primary education though it is not directly associated with Bruner's theory. Some of those use Websites, Software, TV programs and Videos.

The major limitations that the study identified are as follows.

1. Too complex

Most of the softwares and websites are too complex for the child to operate alone since child cannot operate the key board and mouse alone. Therefore the child will need a considerable amount of assistance from an adult to handle the application.

2. Require Internet access

Most of the applications available are web based and to use them, it is needed to have high capacity internet connection. However in Sri Lankan context it is a barrier as the internet connection is not much wide spread and bearable.

3. Teaching Techniques are outdated

According to the modern syllabus, all the English language classes should be conducted using Phonics techniques and none of the above is doing that.

4. Do not interact with the child

When teaching how to write letters, most of these systems need the user to download papers. So the system cannot evaluate the performance of the child.

Smart Interactive Comprehensive Learning Aid (SICLA) is developed and hence it overcomes most of the above limitations of the existing systems while intending to give better education for the children in Sri Lanka.

SICLA is a standalone application which follows the Bruner's theory of cognitive development. Bruner introduced the ideas of "readiness for learning" and spiral curriculum. Bruner believed that any subject could be taught at any stage of development in a way that fit the child's cognitive abilities. [9]

According to the Bruner, none of these stages are age specific to the learner [8]. However in our model we implement and developed the solution focusing only children in age 3-8 where they lay solid foundation in second language (English) learning. Since the country is facing serious problem in English education due to the shortage of qualified teachers, this research is focused how IT can effectively utilize to find a solution to develop English education.

SICLA follows this Bruner's theory when creating the activities for children. SICLA has been divided in to three major modules called Activity Room, Class Room and the Story Room which are responsible to improve the enactive skills, language skills and the cognitive skills as Bruner said.

SICLA also uses the modern teaching methodology called Phonics. Phonics is a method for teaching speakers of English to read and write. [10] By using phonics, instead of having to memorize thousands of words, child need only to learn the sounds of the language with phonics and how to use them in order to improve their language skills.

SICLA has been implemented as a game to get the attention of a child and to make it more interactive and self-motivated. Child can interact with this system by using a simple graphical tablet and a microphone. This graphics tablet allows the child to practice letter writing and to do many other activities and child may not need any extra training to operate the device because it looks like a book. So the child can use this application with a minimum assistance of an adult (See figure 1).



Figure 1: graphics tablet

2 METHODOLOGY

SICLA consist of three major modules which concentrate on developing enactive skills, language skills and cognitive skills.

1. Enactive representation - Activity Room
2. Iconic representation - Class Room
3. Symbolic representation - Story Room

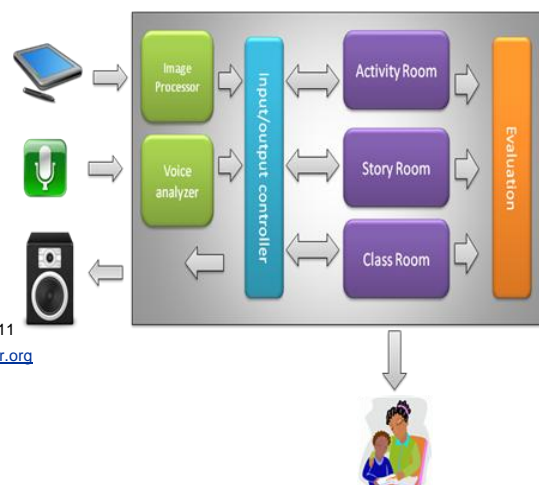


Figure 2: System Diagram

2.1 ENACTIVE REPRESENTATION (ACTION BASED)

According to the Bruner's theory, the first stage of the intellectual development should be the developing enactive (action based) skills. To accomplish that goal, we use the Activity Room.

The Activity Room allows the child to learn by doing simple activities.



Figure 3: Color and Shape Identifier

SICLA provides children the opportunity to learn the basic colors and shapes in an interesting way using two activities. Once child click on a balloon they can learn the particular color.

In order to learn a shape, child has to drag and drop a shape in to a matching shape. By performing these actions, child can get a good understanding about the colors and shapes.



Figure 4: Draw Shapes

Once child identify the shapes, the system allows child to draw those shapes on the canvas using the pen. It gives the child the opportunity to experience how to draw shapes.

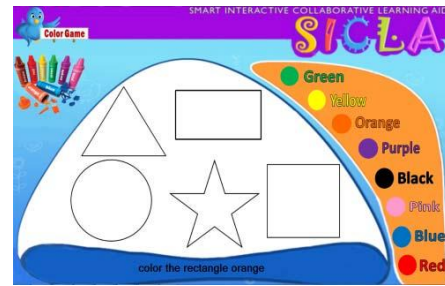


Figure 5: Color game

Once the child is familiarized with the shapes and the colors, system provides an opportunity to apply the knowledge in this color game. This module is evaluating the child's knowledge gain through previous modules.



Figure 6: Designer

The Designer module allows the child to create real world objects from the given set of shapes. This module allows child to learn that the real world objects are created with the shapes by performing some actions.



Figure 7: Memory Game

In this activity child has to memorize what he saw in the video and say it. It provides an action based and image based learning environment to the child to improve their memorizing capabilities and it uses voice capturing techniques.

2.2 SYMBOLIC REPRESENTATION (LANGUAGE BASED)

The Class Room is responsible for improving the language (symbolic representation) skills of the child. In this symbolic stage, the system allows child to store the knowledge as symbols and words. Class Room contains five sub modules called,



Figure 8: Alphabet Reading

In this module, system allows child to identify letters in the alphabet using its symbol and how to pronounce it according to the Phonics methodology.



Figure 9: Words Reading

When child is familiarized with the alphabet, then the system is providing the opportunity to apply the knowledge by giving some words. This is evaluating whether the child can identify the letters and pronounce them correctly using voice capturing techniques. This will make the child a better reader in the future.

Since the system keep track of the development of the child, parent or the teacher can see the child's progress and can provide necessary guidelines for areas of improvements.

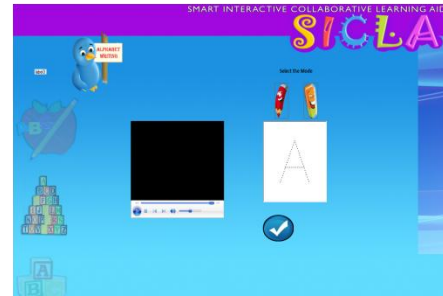


Figure 10: Alphabet Writing

When child can identify the letters in the alphabet, from the next step system allows the child to learn how to write those letters.



Figure 11: Fill in the Blanks

As the last step of symbolic stage, system provides some language related activities to the child. Here the child should identify the missing letter.

SICLA uses advanced neural networking solution to track child's performance and provide constructive feedback on runtime. Once the child draw (or write) the letter system reads the child's work and evaluated against existing knowledge. This feature is unique and hence the SICLA is different from most of the other applications.



Figure 12: Dictation

This module is also a language related activity which applies the language based education in Bruner's theory and it also uses advanced neural networking solution to track child's performance and provide constructive feedback on runtime.

2.3 ICONIC REPRESENTATION (IMAGE BASED)

According to the Bruner another representation mode in development of children is the iconic (image based) representation. To address that iconic representation mode, SICLA provides a Story Room to the child.

The Story Room is there to improve the child's cognitive skills with the use of images. The Story Room contains two sub modules which applies Bruner's theory.



Figure 13: Story Builder

In the Story Builder module first the system is narrating the story. Child has to listen to it and watch the images carefully. In the next step, the system gives a set of images related to that story and child has to place them in the correct order to create the story. To do this activity child has to understand the images. So this module provides an image based learning environment to the child to improve their listening and the understanding skills.



Figure 14: Story Narrator

In this module, the child is given a set of images. By looking at these images child should build his own story. So it provides an image based learning environment to improve the child's creative skills and it uses voice capturing techniques.

We have successfully built the Smart Interactive Comprehensive Learning Aid (SICLA).

3 CONCLUSION AND FUTURE WORK

The research project, SICLA mainly focuses on educating the children in 3-8 years. The child can educate themselves with minimum supervision of a teacher. Therefore the system contains fewer words, more pictures, animations in an eye catching environment.

SICLA follows Bruner's theory of cognitive development and uses Phonics methodology to assure that the child gains a good education.

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