

11. Enhancing Spoken Vocabulary Performance in Children with Autism in a Multimedia-supported Context

LAU, Fai Kim, catoichw@hkucc.hku.hk

YUEN, H.K. Allan, hkyuen@hkucc.hku.hk

LIAN, M.G. John, jmlian@hkucc.hku.hk

Abstract. Adopting a cognitive perspective of information processing theory in multimedia learning, this study attempts to explore how much progress children with autism with limited speech make in their verbal vocabulary acquisition via a tailor-made multimedia software. These children's speech difference than their typically developed counterparts is assumed an outcome of delayed development in the ability of retrieving appropriate information in their working memory from their long term memory instead of their receptive language capability. This is expected to help these students with the media acting as an external memory to fill the gap and prospective findings may assist professionals in such fields as education, cognitive psychology, information and communication technology, and neuropsychology as well in further investigation in these areas as contributing factors to autistic spectrum disorder (ASD) and learning models for ASD students.

With an ABA design of single-subject multiple-case with the design experiment approach, five children, whose parents are native Cantonese speakers, from 8 to 14 in their chronological age in a special school have been selected to participate in this investigation of 15-session 35 minutes each. Their performance in the four aspects of language, that is, phonological, semantic, syntactic, and pragmatics, will be examined. In order to obtain a relatively reliable and valid result, a pilot study on preliminary data in three different settings is being conducted. With similar or the same characteristics like those in main study, two kids each with language age of 4 to 5 in these settings, that is, a voluntary association catering for children with learning, another special school than the participating school, and the participating school.

Keywords: language – children with autism, design experiments, representational tools, learning disability, informal learning settings – children

1. Introduction

This paper is intended to explain the structure and design of this tailor-made multimedia software. The contents and vocabularies are based on the curricula in listening and speaking of three special schools with students with autism spectrum disorders in Hong Kong. Topics of these curricula include: [Theme 1] self-understanding, common utensils, water and fire, environmental protection, transportation, careers and professions; [Theme 2] our school, our community, nice kids, clothing, prevention better than cure, and mass media; [Theme 3] happy family, food and nutrition, food and beverage sites, festivals, shopping sites, and common tools. Three topics will be selected from the list above and will be structured in a 1 topic-2/3 lessons mode; but the number of interventions (lessons) is corresponding to number of baseline sessions each student will be involved. Regarding the assessment tool, this is a self-devised assessment tool which is under construction with reference to such tools as Hong Kong Cantonese Receptive Vocabulary Test, CREVT, CELF-R, EVT, EOWPVT-R, PPVT-III, ROWPVT-R, and TOLD-P

2. Structure and Design of the Multimedia Software

2.1 Theoretical Framework

Basing on the ideas and findings of Robert E. Kozma and his associates (1987, 1991, 1992) and Richard E. Mayer (2001), and on the concept of information processing (IP) being a joint product of information theory and computer sciences (Alessi and Trollip, 2001), this study is going to argue how IP demonstrates its specific characteristics and contributions to the progress of vocabulary learning (Massaro and Cowan, 1993) in students with autism spectrum disorders.

Designed from the constructivist IP perspective, instead of a literal interpretation (Mayer, 1996), this kind of learning tool for children with autism shown in Figure 1 below graphically expresses its role and function in the process of the interaction between the learner with autism as a processor and humanized multimedia program and computer technology in the learning ecology, a concept of design experiment's supporters (for example, Cobb, *et al.*, 2003). In this learning process, automaticity and interactivity, two key features of computer-based multimedia program, help students with autism develop their spoken vocabularies with the guidance of the teacher or facilitator.

Theoretically incorporated the application of information processing theory to speech formulation in human learning (Levitt, 1989) with Kozma and Mayer's multimedia learning theory, symbol system of which multimedia presentation is a crucially essential part, and procedure system displaying a variety of processing qualities (Kozma, 1991) are

able to bridge the gap in language learning in children with autistic spectrum disorders when working memory attempts to retrieve relevant or corresponding visual and audio information from the long term memory (Bird, *et al.*, 2004) as those typically developed do.

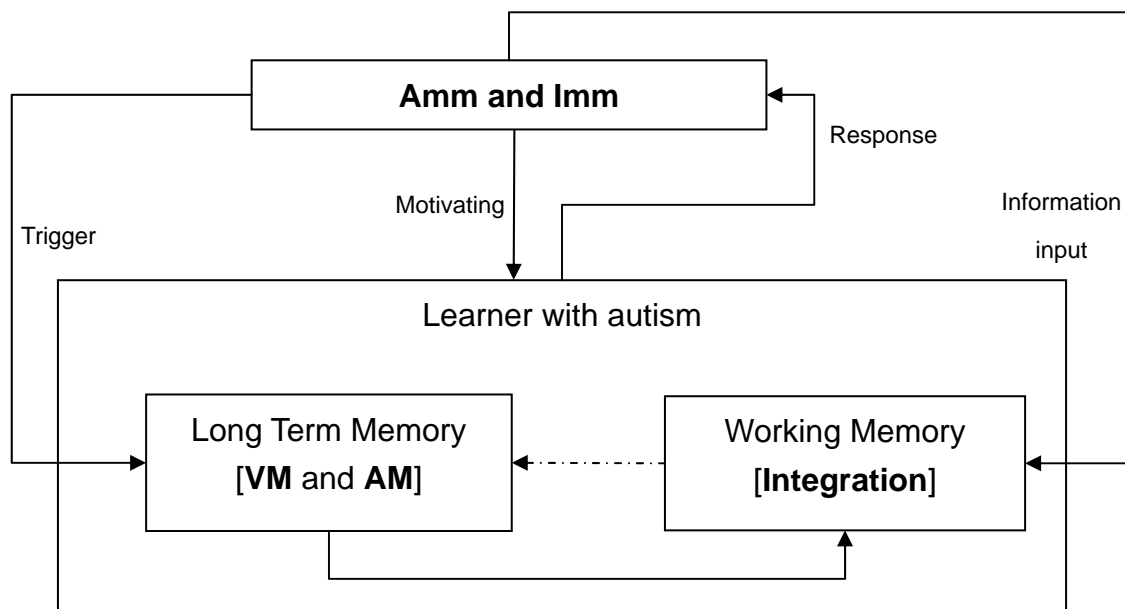


Figure 1 Interaction between learner with autism as processor and multimedia as external memory. Bold letters are key concepts. Amm=Automaticity of multimedia, Imm=Interactivity of multimedia, VM=Visual memory, AM=Audio memory. Broken line indicates incomplete transmission of information

First, visual and audio information in the tool is input to the short term memory (working memory), the area matching both input information from the external memory, that is, the computer-based multimedia program serving as a supplementary device for leaning in students with autism, and an existing set of information in long term memory.

At the same time, the multimedia program triggers a transfer of this existing information in long term memory to the working memory for integration, after which the integrated set of information will be sent back to long term memory for permanent storage.

Due to the characteristics of visual capacity in the child with autism, s/he is expected to get motivation to respond verbally simultaneously when the integrated information is being sent back to long term memory, and such response may be recorded, stored in the external memory, and retrieved next time.

Similar to H. Lee Swanson's (1987) argument that this framework might contribute to the understanding of children with learning disabilities, information processing theory is likely to be able to uncover some common processing procedures among children with autistic spectrum disorders, and it further provides "a tentative framework for the selection of subgroups" (Swanson, 1987, p. 159) within that spectrum. Such sub-grouping, accounting for individual differences among learners with autism in terms of their combination of different abilities and/or deficits, is able to help both teachers and students who are autistic in the process of knowledge acquisition and construction.

On the other hand, research studies based on information processing framework about the changes of mental processes, in Swanson's (1987) terminology, hemispheric processing, in the learning in students with autism may further disclose neurological deficiencies in the students with learning disabilities. Such clarification is a good means "to capture [human] ability group differences" (Swanson, 1987, p. 163).

Multimedia technology with a facilitator (Biklen, 1990, 1993) providing physical and emotional support is assumed not only likely to motivate the child and speed up the acquisition of spoken words in childhood autism, but also it would disclose more means to accelerating the learning progress in typically developing children of similar biological age as those students in this study. An even wider gap is expected between these two groups of children if both groups are engaged in multimedia learning, owing to the fact that the impairment in the working memory of students with autism may cause them to "connect incorrect bits of information in memory" (Pierangelo and Giuliani, 2002, p. 234). With this kind of understanding about learning difficulties, however, on one hand, typically developing children with similar problems may be helped achieve better integration in the working memory; on the other, such group of typically developing students may strengthen their retrieval power of the working memory so that their ability to understand other components in the learning ecology would be improved and even maximized, and may remove certain obstacles to effective modelling like what are performed in other typically developing children.

By and large, this framework is able to supplement students with autism in vocabulary learning but also to reveal possible neurobiological impairment causing problems in the process of information retrieval in interpersonal communication. That suggests further elaboration in and integration with neurosciences in future investigation.

2.2 Concise introduction to the content of the learning tool

The content in this piece of software is composed of three parts: Front Page which consists of a Main Page and a Login Page for individual students; Curriculum, and

Assessment in which there are 4 online tests (Figure 2). For both curriculum and assessment, four areas related to language learning from the perspective of information processing perspective serve as guidelines of the design of this multimedia learning tool. They include receptive ability, comprehension power, organization ability, and desire of learning and communication, which will be integrated with the learning styles and individual differences among students with autism and will be demonstrated in some key features in this software.

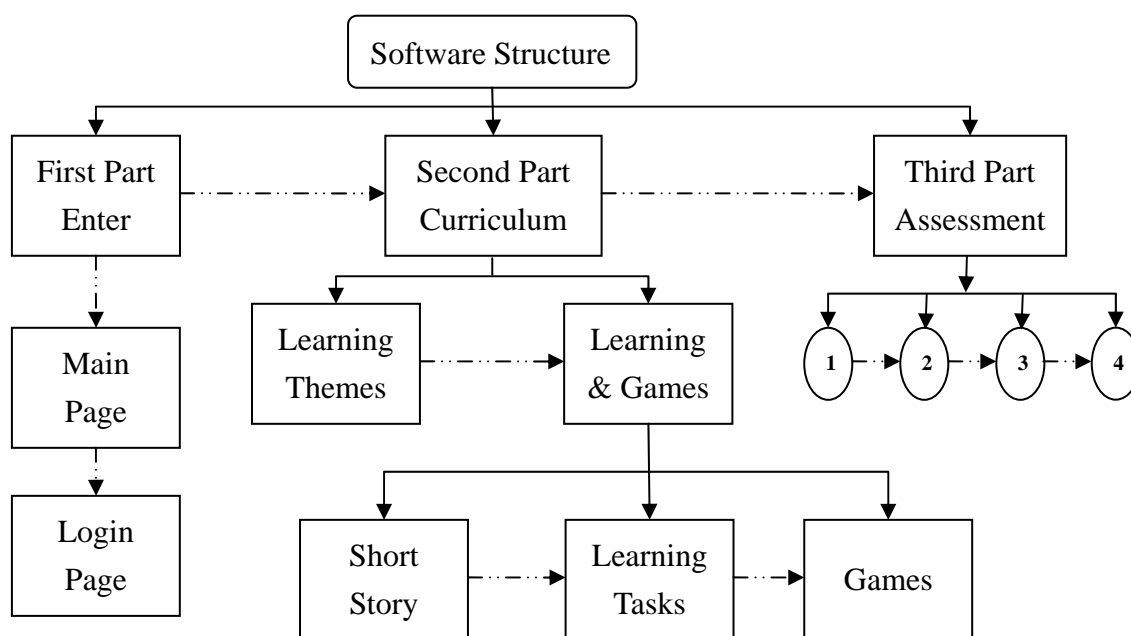


Figure 2 A simple graphical representation of the structure of the multimedia software.

—————> = Represents structural relationship between two units, - - - - ->
 = Represents procedural relationship between two units

Since individuals with autism spectrum disorders are considered visually-directed and concrete-minded, this multimedia software is designed in such a way that concrete objects accompanied with texts or vocabularies especially are being adopted. Besides, simple layout (3a in Figure 3) is used as children with autism are mostly likely distracted and too easily pay over attention to one particular point or object when facing complicated background whether in case of showing single object (3b in Figure 3) or asking students to make choice between two objects (3c in Figure 3).





Figure 3 Samples of layout and graphics used in the software

Sources:

3a – www.vocabulary.co.il

3b – iLongman.com Interactive Learning software (Kindergarten)

3c – Laureate Learning Systems Demo CD

Another function that simple layout and concrete graphics plays in the learning in students with autism is to strengthen their desire to learn and communicate and to help develop their receptive and comprehension capacity to a greater extent. In order to achieve this even better, students will be asked to do some painting like Figure 4 below.

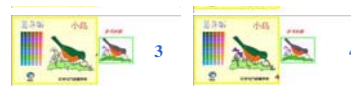
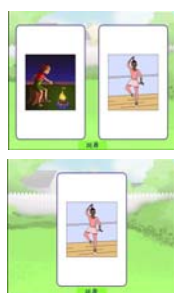


Figure 4 Painting task to strengthen students' ability of receptive and comprehension, and their desire to learn and communicate

Source: Hong Chi Morninglight School, Tuen

Mun <http://www.hctmml.edu.hk/>

Learning Tasks (5...cont.)



- 2 items of similar nature with action
- Students drag a picture to the box below when hear a voice and see the corresponding text
- Reward, verbal or materialistic if correct
- If incorrect, encourage students to try again
- **RECORD** and **STORE** student's verbal response to the chosen item

Figure 5 Audio recording for improving students' retrieval capacity
Source: Laureate Learning Systems Demo CD



Three other means to help students with autism change their learning behavior include a sharp focus on a theme and/or item, repetition of the learning behavior, and audio recording of their speech, if any. This is why the action of “RECORD and STORE” is repeated throughout the entire curricular activities (Figure 5). The “STORE” function is expected to help students retrieve relevant audio data of a particular vocabulary in following sessions from the database in the computer which serves as an external memory to bridge the gap in language learning in these kids who are diagnosed autistic.

Repetition also occurs in different types of learning tasks and playing games which is also believed to enhance students' motivation and interests in learning as well as their retrieval power. For example, a student with autism learns how to say “Bird” (Cantonese). The sequence of learning tasks may be like the following.

1. Single object with text and sound
2. Painting
3. Picking up the “Bird” between two moving objects
4. Clicking the target object among four objects
5. Dragging the “Bird” between two similar and static objects)
6. Dragging the “Bird” between two similar objects with action



The last two tasks are to help students relate the target object to, say, quantifier and verb. This is expected to assist them to consolidate their foundation of sentence building in verbal format (6a in Figure 6). Students are also offered other two ways to develop the four areas abovementioned that playing games and learning are integrated in some tasks (6a and 6b in Figure 6), and that level of difficulties is a means to arouse their desire in participation in learning activities (Figure 7).

Learning Tasks (6)

- Blocks of numbers = vocabulary learning (7.1)
- Blocks of letters = Sentence building (7.1)
- Words used in the sentence are those in the blocks of numbers
- In sentence building, students are asked to orderly put the words to form a meaning sentence (7.2)
- RECORD and STORE student's verbal response
- If students do not know how to put words in sequence, they can choose vocabulary learning
- Successful tries are recorded for their report in the assessment


Game (3)

- Press "Learning" to go back "Learning Task" if desired
- Press "Play" for the matching game in 1
- Select "Animal", for example, and press "Start" to play the game in 2
- Both button with "Start" or "Back" and the icons next to them are of same functions

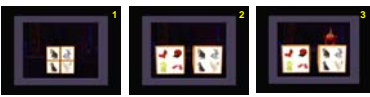
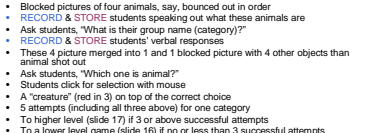
Figure 6 Sentence building to help students develop their pragmatic use and an example of integration of learning with games Sources: 6a –Jump Start Learning System Demo CD; 6b – www.vocabulary.co.il

Learning Tasks (4)



- Four different objects with words each shown on the board
- The target object with corresponding word shown below the board
- The "elephant" at right-hand corner speak out a word
- Students move their mouse to one of the four pictures
- Encourage students repeat the phonology of the word
- RECORD and STORE student's verbal response
- Numbers 1, 2, and 3 indicate level of difficulty
- Successful tries are automatically recorded

Game (4)

- Blocked pictures of four animals, say, bounced out in order
- RECORD & STORE students speaking out what these animals are
- Ask students, "What is their group name (category)?"
- RECORD & STORE: students' verbal responses
- These 4 picture merged into 1 and 1 blocked picture with 4 other objects than animal shot out
- Ask students, "Which one is animal?"
- Students click for selection with mouse
- A "creature" (red in 3) on top of the correct choice
- 5 attempts (including all three above) for one category
- To higher level (slide 17) if 3 or above successful attempts
- To a lower level game (slide 16) if no or less than 3 successful attempts

Figure 7 Level of difficulties to arouse students' interest Sources: 7a – Jump Start Learning System Demo CD 7b - Laureate Learning Systems Demo CD


Reinforcement maybe considered as a function of repetition in learning tasks and in playing games also helps students with autism learn and consolidate the concept of category like that shown in 7b and Figure 8.

Game (4...cont. 1)



- Robot bounced out and 4 pictures of animals, say, shown on the whiteboards
- Background narrator asks, "These are all animals. Robot now wants a duck. Please pick it for him"
- Students click the duck with mouse
- Ask students, "What is this?" when Robot points at the duck at the cupboard he is standing on
- RECORD & STORE students' verbal responses
- In 2, a new cupboard shot out pushing the one with blurred duck one step forward and repeat the Q & A sequence above again until four pictures have been asked
- Then narrator asks, "What is their group name (category)?"
- RECORD & STORE students' verbal responses
- 5 attempts
- If 3 or above attempts successful, to a higher level (slide 15) with same category

Game (4...cont. 2)



- 1 is introduction including explaining the rules and methods of playing this game
- Students drag figures to the round buttons and speak out their names in 2
- RECORD & STORE students' verbal responses
- Ask students, "What is their group name (category)?"
- RECORD & STORE students' verbal responses
- 1 point for 1 correct drag; 1 more point for 1 correct phonology; 1 additional point for correct group naming (categorization)
- 3 with voice appears when all 3 actions correct
- Modified 3 with voice appears if only 1 or 2 actions correct
- Timer and number of successful counts at the right-hand corner
- 5 attempts
- Different rewards for different achievement

Figure 8 Helping students develop concept of category

Sources: 8a – Laureate Learning Systems Demo CD; 8b – Hong Chi Morninglight School, Tuen Mun

Despite criticisms on the theory of information processing (Mayer, 1996; Swanson, 1987), this researcher is convinced that it is able to help students with autism change their learning behaviour and develop their speech ability. Based on the concepts of those scholars mentioned in preceding paragraphs, this researcher constructs a multimedia learning tool specifically for those kids with autistic features. This is fully understood some hidden weaknesses that should be tackled in future investigation. For an important part of this study, the assessment tool will be explained and discussed in a separate paper too.

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