### INTERACTIVE MULTIMEDIA LEARNING FOR CHILDREN WITH COMMUNICATION DIFFICULTIES USING THE MAKATON METHOD

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#### Abstract

The Makaton Vocabulary Development Project is a widely used communication system designed for individuals with speech and communication disabilities. It enables educators to teach students how to communicate alternatively through selection and combination of visual representations, symbols, words, gestures and sounds. Our analysis has indicated various difficulties that arise in the manual application of the above system, as customisation to individual student-needs is needed, presenting a complex and time-consuming task for the educator. This paper presents the development of a novel communication environment that permits students to use the Makaton method through an open media-rich, adaptable easily extendable interactive multimedia application. The environment is tested in two focus groups and the results and observations are discussed. The method of knowledge-base extension is presented, targeting the development of an internet-based virtual learning environment for special needs.

#### Introduction

This study aims to enhance existing learning methods for individuals with communication disabilities with the development of state of the art multimedia technologies. The end result of this work is a fully functional interactive audiovisual environment that may be utilised by educators and parents as a teaching aid for selected curriculum-based notions in schools and home environments. Individual knowledge components are organised and presented appropriately through a media-rich game-like environment, which was designed according to the latest learning standards and specific student-based requirements. This work is part of a wider attempt to implement a novel computer-aided adaptive-learning methodology, covering specific educational needs, employ routine procedures for constructive and interactive learning.

In our research we target children with Down syndrome at primary-school level that already utilise an alternative communication method in the learning process (Bird, 1993, 1999; Tien, 1997). Typical problems encountered that necessitate the use of an alternative communication method include the following factors: reduced short-term audiovisual memory followed by visual, acoustical and movement disabilities; difficulty in establishing and retaining skills that require repetitive learning methods; composite tasks that require a specific order to be

followed are usually hard to implement as often students find difficult to follow the required order. Another important observed behavior is the student's denial to take part in new activities that are not engaging. These characteristics permit the application of interactive-multimedia technologies in this area of communication and learning. On the other hand, as Szuprowicz, Fetterman and Gupta demonstrated through their experiments (Fluckiger, 1995), humans remember 20 percent of what they see, 30 percent of what they hear and this increases to 50 percent for audiovisual presentation. Interaction through constructive examples increases the result to 80 percent. We believe that the above observations also stand for students with communication disabilities, where interactive multimedia technology may be utilised to motivate them into learning and enhance their content-absorbsion and overall understanding. We have selected to use the MAKATON method (Charity, 2008), already employed manually in the majority of students with the above learning difficulties.

## **Empowering the Makaton Method using Interactive Multimedia**

Realisation of the interactive multimedia application involves analysis of a number of intermediate stages in the learning process. Initially, the Makaton Vocabulary Development Project was reviewed as a process both in theory and in practice. This involved filming of the learning process in class, which was subsequently used for internal reference between the educators and the developers. This proved particularly important as it revealed certain characteristics that the system had to cover. This includes customised repetition upon student-failure to identify the correct answer, as under this system the wrong answer may be selected accidentally. Observation of the user in action permitted the learning process to be viewed from the user perspective, enabling the end-system to cover specific userrequirements and demands while it enabled multimedia developers to appreciate the complexity of parameters that govern whether the method will be adopted and used or rejected by the student.



Figure 1: Left: Content positioning; Right: gender selection

The results of this first analysis are used in Human-Computer Interface system design. The characteristic setup of the working environment employed to introduce a term is shown in Figure 1 left. The text within each block describes the position of the multimedia data. Numbering is used to indicate the order of appearance of the terms. The underlying strategy involves learning through repetition of the same term, while each appearing element complements the notion of the term. Then the actor instructs the student to select the appropriate use of the term, and finally the term is used in practice to demonstrate student understanding. This is completed without altering the locations of each object, enabling easier visual memorisation of the notions. The interface is designed with the use of clear and neutral colours on purpose, permitting the student to concentrate on the task in hand. Selecting the gender and name of the student beforehand as shown in Figure 1 right, instructs the system to adapt by applying boy or girl-only videos and sounds through the learning process, resulting in a personalised learning environment. Names not already included in the multimedia database may be recorded by the end-system, permitting further sophistication to be achieved.



Figure 2: Filming setup for camera, lights and actor

The overall project idea for the development of an extendable system involves a series of standards that permit further user-driven extension of its capabilities. In that respect, widely available equipment may be utilised to capture, edit and embed new notions to the system. Figure 2 shows a diagram taken from the developer's guide that is used to depict the setting for filming. Filming was performed using a handheld digital camera positioned vertically, in order to permit additional examples to be added by the educators, without noticeable change in video quality or video editing. Scene lighting involved the use of two sidelights positioned at a 45-degree angle and a neutrally coloured background wall. The actor is placed at a certain distance from the wall to reduce the shading effect. This setting is considered ideal for home-based filming, and basic video-editing tools may subsequently be utilised to isolate the appropriate video sequences. Care is taken to allow sufficient time, approximately 2 seconds, before and after the notion is presented. Audio is captured in the same manner, using the video camera and then exporting only the audio channel. On the technical side the propriety

"Adobe Director 11" multimedia-authoring environment was used to develop the system.

Actors of young age were selected to demonstrate the use of terms and notions. It was observed that focus group members reacted more positively to instructions given by persons of similar age and look. The filming process involved multiple repetitions. At each stage the actor was instructed by professional educators in order to accurately perform the gestures and appropriate pronunciation, resulting in a sound overall outcome with clear educational value.

### Development of the Environment Based on the Learning Process

An important end-system objective was to achieve full-functionality for the MAKATON method, which aided by technology may reduce the complexity for the educator perspective, while it may prove appealing and rewarding for the student. These aspects were consider during the system-design, for the selection of the platform and were ultimately mapped into the prototype and testing versions.

In terms of system design, a number of factors have been considered based on the above requirements. The interface functionality was separated from the userinterface design and aesthetics. Particular locations and maximum screen-size limits have been set for each data stream, enabling various user-selectable backgrounds to be superimposed to enrich the presentation aesthetics. This is done by imposing a user-designed image at the top layer of the presentation that is automatically applied throughout the presentation environment. This feature has been successfully used to create image-borders and add depth to the environment. Note here that although animated backgrounds are supported, they are not recommended for use by students with Down syndrome as they may disorientate their attention away from content-videos and animation.

The use of a multimedia database for the underlying streams and the fully featured "Lingo" programming language supported under the authoring environment has permitted stream re-programming. As mentioned earlier, the educators are able to record their own video and audio streams that may directly be used to adjust special learning requirements. It has been observed that in most cases minor customisation is needed. For example, most times it is only necessary to record the name of the student, and a series of "rewarding" statements. The latest version of the environment supports direct recording through a standard microphone, updating directly the database with the appropriate information.

A prototype has been developed at the initial stages of the research, which was used for testing. Its functionality involves a number of discrete stages that are described below. The first step involves the presentation of the information that needs to be communicated. The system reveals the information according to the order shown in Figure 1 left. First the photograph is presented, followed by the video, the MAKATON symbol and finally the word. At each stage the information name is repeated synchronously. The second step involves the learning process where the student is asked to show, locate and identify the information through alternative representations of the same notion. All answers at this stage are correct, and upon selection they disappear and the user is rewarded every time. The third step involves the repetition of the notion by the student, until it is sufficiently accurate. The fourth and final step involves the examination of the use of term, where the student has to identify the correct photo, symbol and word, as instructed by the actor. The system recognises erroneous responses and adopts its feedback accordingly. If the student fails this test, then the system re-starts presenting again the information from the beginning. The first three stages are described above are summarised in Figure 3 below.

Figure 3: Three steps of the learning process



Figure 4 presents the final examination stages where the student is instructed to select the correct representation within four choices. The presentation environment is programmed to adjust the response according to each selection. One wrong choice informs the user to be "more careful". Second and third choices follow alternative strategies. If the majority of answers across all representations are wrong, then the system concludes that more attention is needed, instructing the learning module to be repeated. Alternatively the appropriate internal score is stored on the database for the particular user, enabling the educator to inspect the progress even when the student uses the system unattended.





# **Results and Observations**

The system has been used in two focus groups using alternative knowledge representations at the same class-level. A set of ten notions was split into two random groups of five and each group was taught five knowledge-units through the new system and five in the traditional way. Evaluation of the learning process revealed that the audiovisual environment was more engaging than the traditional teaching method and students were keener to use it as from their perspective it was perceived as a game. Although the overall speed of learning was not greatly affected, the quality of learning was significantly improved. In that sense students were able to describe and use new notions with increased confidence, something that was not observed in the focus group that used the manual application of the method.

In terms of ease of use, students did not immediately understand what they had to do with the system. This difficulty was overcome by presentation of system-use by the educators. This was only necessary to be performed once, as since the initial use students could use the system unassisted. Children were particularly happy to use the interactive application, particularly as they were able to interact alone with the software. System-personalisation and direct name referencing was surprisingly efficient and engaging for the users. Students that viewed actors to call them using their first names were more attracted by the system.

From the teacher perspective, increased student-concentration was observed to the task in hand, which resulted in faster learning and minimal interruption and breaks, when compared to traditional teaching methods. In general, use of the interactive software resulted in the fact that the system was recording student progress and was preparing the material automatically. This feature aided the process as it reduced the work that had to be completed before the class. In that respect students could complete a larger number of learning units. Educators suggested that another possible use of the system was to use the system even at home enabling parents with proper training to aid their children in teaching new notions.

### **Additional Functionality for Makaton**

Enabling additional functionality is one of the main objectives. The use of the Adobe Director authoring environment permits the presentation to be exported over the Internet through Shockwave technology (Schmitt, 1997). Extended programmability is supported through the "Lingo" programming language, which is backward compatible with previous versions, enabling ready-made code to be included, furnishing the system with advanced functionality (Li Ze-Nian, 2005). Typical examples of interactive functionality may be implemented through these tools is described in the literature (Avril, 2003; Deliyannis & Webster, 2002; Dillenbourg, 2000; Dutton & Loader, 2002; e-Learning, 2005; Scanlon, Jones, Barnard, Thompson, & Calder, 2000), without excluding advanced learning-based examples that involve the use of Internet-based technologies for learning new notions using exploratory learning (Deliyannis, 2007).

On the downside, system expandability is currently supported for a finite number of terms. We are currently working on the development of a web-based database that educators may utilise to store new educational units and access those of interest. This possibility renders extendable to those with little technical knowledge, while enabling more proficient users to share their examples with the rest of the community.

#### Conclusion

The use of an interactive multimedia environment utilising animation/sound and engaging activities has resulted in the development of a useful teaching tool for students with communication difficulties. Although the learning process is aided more in terms of the quality of understanding and less on the speed of learning, this is an issue that needs further examination as the produced system is also designed for extracurricular learning, by parents who possess the necessary educational skills. We believe that extension of interactivity from the perspective of the educator is a significant issue, as it may introduce a system that through the use of separate user-accounts may aid to accurately record the learning curve for each student. In addition the existing system implementation may be used as a basis for new e-learning methodologies, featuring knowledge-units that may be combined to a single web-based system. Finally, the teaching methods supported under this implementation may be enriched externally, offering increased interactivity and customised activities particularly designed for each student. Typical examples include the development of games with educational aims, while measuring/improving the speed of response and skill development.

#### References

- Avril, M. L. (2003). The interaction between primary teachers' perceptions of ICT and their pedagogy. *Education and Information Technologies*, 8(4), 313–326.
- Bird, B. S. (1993). Teaching children with Down syndrome to read. *Down Syndrome Research and Practice*, 1.
- Bird, B. S. (1999). Improving the speech and language skills of children and teenagers with Down syndrome. *Down Syndrome News and Update*, 1(3), 111–128.
- Charity, T. M. (2008). MAKATON website. Retrieved April 14, 2008, from http://www.makaton.org/
- Deliyannis, I. (2007). *Exploratory learning using social software*. Paper presented at the Cognition and Exploratory Learning in the Digital Age (CELDA), Algarve, Portugal.
- Deliyannis, I., & Webster, M. F. (2002). WWW delivery of graph-based, multi-level multimedia systems: Interaction over scientific, industrial and educational data. Paper presented at the IADIS Int. Conf. WWW/Internet 2002, Lisbon Portugal.

- Dillenbourg, P. (2000). *Virtual learning environments*. Paper presented at the Learning in the new Millenium: Building new education strategies for schools.
- Dutton, W. H., & Loader, B. D. (2002). *New media in higher education and learning*. London: Routledge.
- e-Learning. (2005). *eLearning: People and technology*. Retrieved May 10, 2005, from http://europa.eu.int/information\_society/eeurope/2005/all\_about/ elearning/index en.htm#eLearning:%20People%20and%20Technology
- Fluckiger, F. (1995). Understanding networked multimedia applications and technology. Prentice Hall.
- Li Ze-Nian, D. M. (2005). Fundamentals of multimedia: AND Macromedia Director Mx 2004, training from the source. Pearson Higher Education.
- Scanlon, E., Jones, A., Barnard, J., Thompson, J., & Calder, J. (2000). Evaluating information and communication technologies for learning. *Educational Technology* & Society, 3(4).
- Schmitt, B. (1997). *Shockwave studio: Designing multimedia for the Web*: O'Reilly and Associates.
- Tien, B. (1997). Effective teaching strategies for successful Inclusion. A focus on Down Syndrome. Calgary, Canada.