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A computer–supported learning platform for pupils with cognitive disabilities

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Abstract

Although there is no doubt that computers are highly capable to provide pupils with cognitive disabilities in learning we observe an immense lack of professional learning software for this target group. On the one hand, there are products designed by special education teachers with a high level of instructional design. But these products are usually at a low technical level, unflexible and adapted for the special situation they are designed for. On the other hand there are loads of colourful animated commercial products, but with absence of any instructional quality. In our project we want to overcome these problems by developing a learning platform for this special target group in an interdisciplinary group based on participatory design principles.

1 Introduction

"Technology as a teaching tool immediately, profoundly, and positively impacted the education of individuals with mental retardation ... The introduction of the computer as a teaching tool ... can be viewed as the greatest agent of change ... for individuals with mental retardation." [4]. This euphoric description is representative for the appraisal of the use of computers in schools for students with cognitive disabilities. A Computer can be used as an effective learning tool to support the acquisition of basic learning skills [2]. In addition the work with this medium supports the increase of self–determination, of independence, and integration skills [11] and allows for "positive changes in inter– and intrapersonal relationships, sensory abilities and cognitive capabilities, communication skills, motor performance, self–maintenance, leisure, and productively." [7].

Bearing this in mind we would expect to find a great many of ICT in schools for students with cognitive disabilities. But far from it ICT is still playing an underpart in the continuum of learning media. Apparently there is a gap between the described potential of ICT on the one side and its marginal importance in schools on the other side. Hence, the motivation of our project was to solve

this contradiction by designing a multi media learning platform for pupils with cognitive disabilities.

2 Development process

The main objective for the realisation of the computer learning platform software is to integrate the computer into daily teaching and learning practice supporting pupils in exiting learning procedures without redefining well suited pedagogic methods. In our project we realised the approach of participatory design [1] bringing together teachers for children with cognitive disability, computer scientists and psychologists. Their complementary expertise led to a description of how the needs for a software environment for pupils with cognitive disability should be implemented in an innovative software environment.

With both, regular meetings of the core group and frequent direct contact between software developers and teachers it is guaranteed that there are short cycles of the four phases:

1. design and description,
2. implementation
3. evaluation in schools
4. feedback which leads back to a redesign phase.

An important role in this process is given to the project's Wiki[1] where downloads are provided for internal software testing but also prototypes for evaluation through interested teachers from outside. The Wiki also contains the software manual and every user of the software prototype is invited to participate in writing the manual, giving evaluation results via an electronic form or just report bugs.

3 Learning Platform

The software development in LMMP is done using FreeStyler [2], a platform and tool environment to facilitate (co–)constructive activities. It offers an optional shared workspace environment allowing the co–learners to synchronously and jointly elaborate external representations or solve tasks based on *visual languages* [8] in which some objects have a specified domain–related functionality and semantics, enabling the system to provide e.g. special tools, means of analysis or domain–related support.

The capability of FreeStyler has been proven in several projects with primary and secondary schools [6]. We have decided to developed our learning modules as visual languages to benefit from the potentials of FreeStyler. To provide an easy access for both, teachers and learners, FreeStyler will be embedded into a special desktop for pupils and be enhanced with assistants for technical unexperienced teachers.

[1] http://www.lmmp-bw.de/wiki

3.1 Learning Modules

Currently, we are working on five different modules which are in different phases of the development process. Depending on their development status the modules are either available for public or group–internal download.

Puzzle With this module, digitalised images can be automatically divided into a variable number of pieces which are randomly arranged in the workspace. Beside the puzzle pieces there is a target area where the puzzle should be solved in which can be configured to be either a plain frame or contain a watermark of the original image. In the next step puzzle–pieces with different shapes will be provided.

Word construction kit This module offers the possibility to "write" words either by bringing letters or syllables into the right order or arrange already known letters to words. A detailed description is given in 3.1.1.

Word–picture assignment The teacher can easily prepare tasks where pupils have to assign words to pictures. This module is the starting point and technical basis for further modules for assignment tasks. For a detailed description see 3.1.2.

Math–box The math box enables the teacher to design a rich variety of tasks for numeracy. At the moment it provides tasks for adding numbers to results till 10 or 20 but will be enhanced soon after an internal testing phase has been finished. Furthermore the design is discussed with experts for the didactics of mathematics. The feedback will be taken into account for a careful revision before the module will be available in the public download area.

Picture story This module is still under development, although a very first prototype is already available for the projects core group. The teacher can create stories by using pictures or images, enrich them with text and/or sound and optional spoken text which must be currently voice recorded. In a later version we will implement a text-to-speech system which will read out text and comments the teacher types in.

In this paper, we will exemplify two of these modules.

3.1.1 Word construction kit

From the observations of several lessons we elaborated the design patterns for the implementation of the word construction kit. Writing words for pupils with cognitive disabilities means either bringing letters of a word represented by a picture into the right order or constructing the word from a set of already learned letters. In the first prototype we implemented both ways of writing. The teachers could select from a range of pictures and drag them into the workspace where they are expanded to a task (Figure 1).

To cope with the task the pupils have to drag the letters to the correct position in the template. To facilitate an easy usage of the software the letter only needs to overlap more then 50% with the correct position to be accepted as the result and snap into the final position. This first prototype was tested in

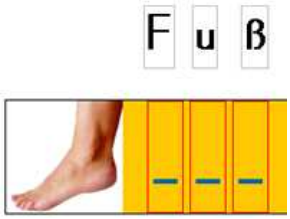

Figure 1: First prototype of a writing task

the classroom and the feedback from the teachers together with a "wish list" for further features has been taken into account for the next release.

The current final version includes a lot of features and options: shadowed solution preview, write from left to right only, free arrangement of letters, capitals only, permute solving letters, sound when wrong letter is dropped over field, visual/acoustic feedback when task is solved correctly, coloured letters, different letter size, arrange letters horizontal or vertical. Figure 2 shows an example with two tasks, one now using coloured letters, permuting the letters and offer a shadowed preview of the solution for very low attaining pupils and the other using syllables. The words assigned to the pictures are stored within the JPEG

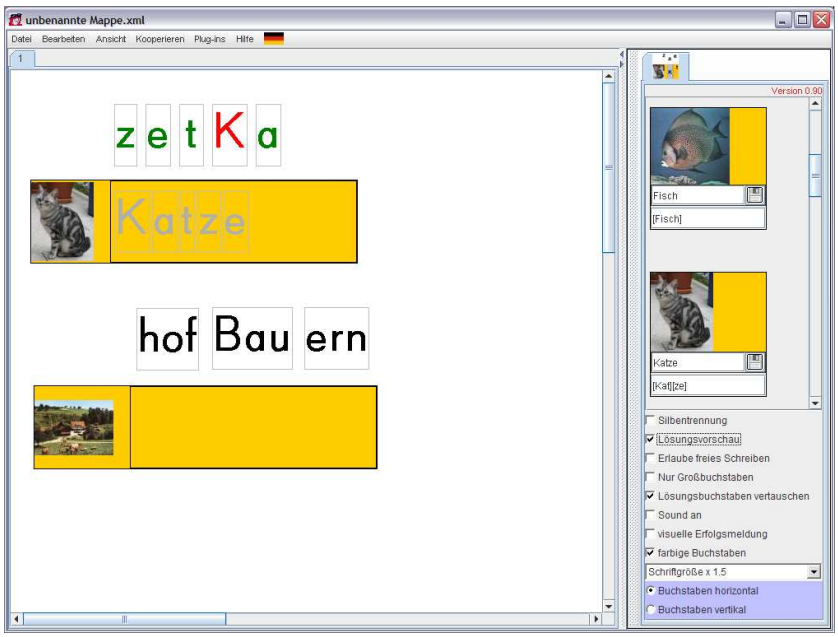

Figure 2: The current version of the word construction kit now offering also syllable based writing.

file and can be easily changed. Furthermore a parser has be implemented to automatically divide words into syllables and offer a further option.

Teachers from schools for pupils with cognitive disabilities are sometimes using phoneme tables to enable higher capable pupils to freely write words. This follows the *reading through writing* approach used in primary schools [9]. Since cognitive abilities particularly of high capable pupils should be fostered we will resume ideas and experiences made in an European research project with primary schools [10] and enhance the word construction kit with a text-to-speech synthesis to give the pupils the possibility to write words by arranging letters freely and listen to the result. In case of positive findings in a further step intelligent feedback could be added following the approach described in [5].

3.1.2 Word–picture assignment

In a preliminary survey teachers from schools for pupils with cognitive disabilities have been asked which kind of tasks they would like to have supported the most by the computer. The evaluation of the questionnaires showed that most of the tasks the teachers described can be put down to mapping tasks where one or more objects have to be assigned to a target object. We identified two main clusters for the assignment task. In the first, words have to be assigned to pictures and in the second, pictures have to be assigned to other pictures or special positions on a background. Figure 3 shows a word to picture assignment.

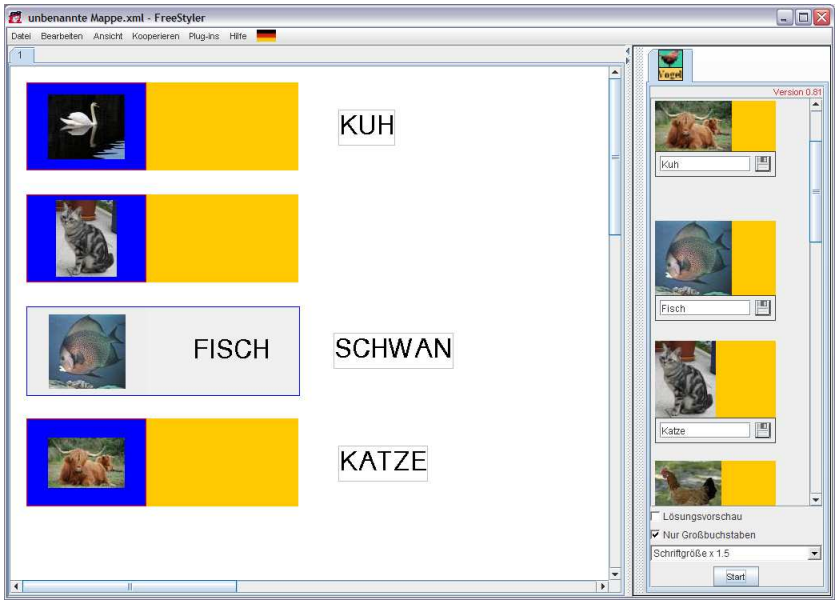

Figure 3: Example of a picture–word assignment task in teachers' preparation mode

The teacher can select the pictures and assign target words. Again he can change the font size, use capital letters only and optionally enable a shadowed preview of the solution.

3.2 Desktop

Pupils being unwatched while working on the computer are always at risk of distract themselves from the task they should solve. Since they outmatch particular teachers with low computer skills they can start surfing the web or playing computer games. On the other hand, teachers are often fearing that they will not get enough information about the task solving process from the pupils.

To lead the pupils while using LMMP and to provide the teacher to enable only those functionality pupils shall be allowed to use, we follow the ideas of a computer integrated classroom (cf. [3]) and develop a special desktop which covers the standard system desktop. Here, pupils will find their individual tasks and internal and external functionalities (e.g. printing) and applications (e.g. a web browser) they are allowed to use. Figure 4 shows the prototype of the pupils desktop with three individual tasks (icons on the left side), an opened worksheet which can be printed by a mouse click on the printer icon (upper left corner).

4 First experiences and outlook

First experiences of teachers and pupils using the software have been very positive. We observed that the modules could be easily adapted by the teacher to meet the different needs of the pupils. Hence, the pupils were very motivated

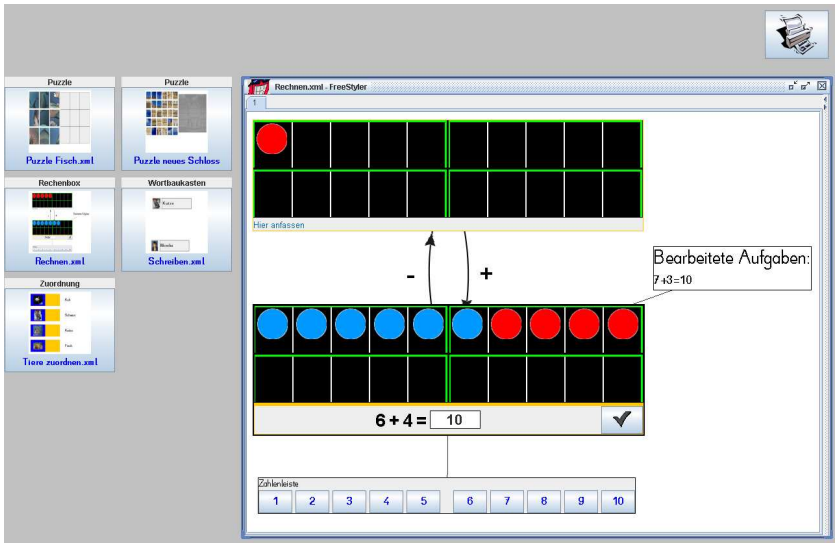

Figure 4: Example of a numeracy task on the pupils desktop

and worked with the software effectively. Although assistants have not been implemented yet, after a short introduction most teachers were able to design their own exercises with the software. Through this, a seamless connection between the traditional learning and the software could be established.

Together with teachers we want to enhance existing modules and generate new oncs to cover most of the contents and methods of schools for cognitive disabled children. Furthermore we will offer access to a learning object repository (LOR) to provide easy exchange of material by teachers.

To support the teachers designing tasks in an easy manner we will implement assistants where the teacher will be guided though the process of designing a task and configure it for the individual needs of pupils. Thereby, we will guarantee that even teachers with no experience in using computers can make use of the whole potentials of the learning platform.

The desktop will be further elaborated to the needs of the heterogeneous target group. In this context we intend to design templates for pupils from different age groups.

To provide pupils in working self–directed as much as possible (depending on their cognitive abilities) help and feedback mechanisms ("intelligent agents") will be designed and implemented and the teacher will be enabled to make use of automated, action–based analysis facilities, e.g. by post–processing detailed log–files already provided by FreeStyler.

Finally the software shall be adapted to support special needs of and hardware for disabled pupils. In a last step we will investigate whether the learning platform might be of interest for other types of schools, e.g. primary schools.

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