

SUPPORT OF A SPECIAL STUDENT USING ASSISTIVE TECHNOLOGIES IN A REGULAR SCHOOL

PERSPECTIVES FROM A REHABILITATION ENGINEER PROFESSIONAL

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Abstract — This article describes the integration in the regular school of a special student (AG) from 1st grade till now (7th grade) focusing assistive technology support. It will be presented the technological solutions proposed for each school year, as well as the strategies adopted in educational context. The difficulties that have aroused will also be described.

Through the analysis and discussion of this case we intend to contribute to the identification of problems concerning integration of assistive technologies in regular schools. We'll also point out some support mechanisms and tools that could diminish these difficulties.

I. INTRODUCTION

The Salamanca Statement [7], proclaimed by 88 countries and 25 international organizations, promotes the integration of students with special needs in the regular education (Inclusive Education or Education for All). To achieve this goal these students should be assisted with different mechanisms, some of which technology based.

AG is a child with cerebral palsy that has some motor difficulties and is finishing the 1^o year of the middle education (7^o grade) in a regular school. At the cognitive level AG reveals no difficulties, however sometimes can get tired performing more demanding activities (e.g. evaluation tests). For locomotion support he uses a walker and an electric wheelchair. At the manipulation level AG has some difficulties that affect the quality of his handwriting.

Having in consideration the AG motor situation and foreseeing some difficulties in the accomplishment of important school activities (e.g. handwriting), the Assistive Technologies Assessment Team of the Centro de Paralisia Cerebral de Beja (CPCB) (Cerebral Palsy Center of Beja) proposed the

acquisition of a laptop computer and introduced AG to computer use.

II. AG IN THE PRIMARY EDUCATION

A. Computer Training

In the school year of 2000/2001, when AG was entering the 1st grade of primary education, he started being followed by the CPCB team in computer use. The main goal of this training was teaching AG technological competences that allowed him to use the computer in a classroom context as an alternative to handwriting.

In this period the student acquired competences about basic computer use: turning the computer on and off, starting programs, as well as mouse and keyboard training. Later he learned how to use a word processing program and how to organize documents in a computer disk.

With respect to mouse training AG learned the basic operations: mouse movement, click, double click and dragging. For the development of these trainings the team used various programs such as "Letters and Numbers" with the "Cake Crush" activity (Figure 1).

At the same time AG also trained keyboard use. Initially he played simple games which gradually



Figure 1 – Mouse movement training with “Cake Crush” activity.

The author wants to thank to AG and his family, to the Assistive Technologies Assessment Team of CPCB, as well as to our students Luís Alexandre, Hugo Laibaças and Emanuel José for their collaboration in this work.



Figure 2 – Training typing speed with “Letter Drill” activity.

introduced him to this device. One of these programs was the snake game, in which AG controlled a snake that couldn't crash against obstacles in computer screen. The snake was controlled with the cursor keys, and so, AG was compelled to have fast reactions in the keyboard, increasing this way his familiarity with the device.

Fast keyboard typing depends on movement automaticity [1]. To increase this automaticity the team worked with a computer program for keyboard training called “Animated Beginning Typing” from Flix Shareware, and available at <http://www.flixprod.com/typing.html>. One of the most used activities was the "Letter Drill" game which requested AG typing in 20 isolated letters (Figure 2). The letters could be limited to a well defined set (ASDFJKL, RTYUEIGH, CVBNM or WXOQZP) for more specific trainings, or just be any letter from the keyboard.

Table I: AG performance typing in 20 isolated letters in a "Letter Drill" program.

	Time	Errors	wpm
ASDFJKL	1:21	1,2	3,0
RTYUEIGH	1:13	1,2	2,7
CVBNM	1:11	0,8	3,5
WXOQZP	1:15	1,0	3,2
All (6 sessions only)	1:15	1,0	3,4

In the end of the activity the software supplied a report containing the number of errors, elapsed time and words per minute (wpm) estimative. Table I presents the results of 9 sessions using this program during 2000/2001 school year, when AG was attending the 1^a grade.

In spite of requesting isolated letters the "Letter Drill" game allowed us to obtain a typing speed estimative - 3.4 wpm. This value would be lower if complete words were requested, since word writing is more difficult isolated letters writing, however the reduced vocabulary of a 1st year child didn't allowed prompting words. The typing speed estimative was comparable to handwriting speed of students in the same year of AG, which is around 2.4 wpm [1].

B. Computer in Class

However, AG handwriting was getting better and so laptop use was not very frequent in the classroom. At this time AG only worked a morning per week with the laptop.

In the following years we assisted to a decrease in computer use in the classroom because student handwriting quality was enough to handle the educational requests at that school level.

Among the reasons for the reduction of computer use in the classroom we can point out the following ones: (1) The idea that AG handwriting would keep getting better; (2) A teacher replacement that affected negatively the continuity of previous work; (3) Teachers lack of knowledge using computers in educational contexts; (4) Lack of school resources for dealing with technology demands of special students.

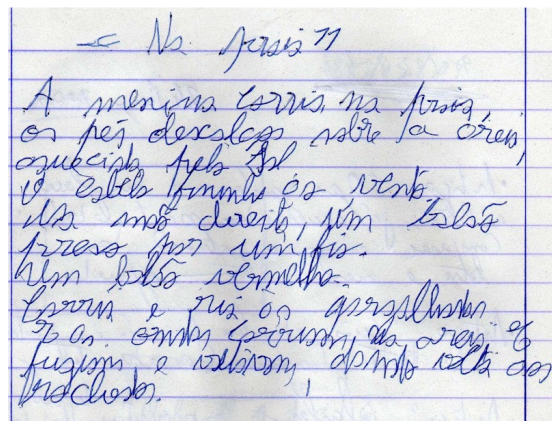


Figura 3 – AG handwriting in 2004.



Graph 1 – Writing speed for handwriting and computer.

II. AG IN THE MIDDLE EDUCATION

When entering the middle education AG could maintain handwriting speeds similar to his colleagues but with some legibility problems (Figure 3). Experiences reducing the writing speed didn't improved legibility. This problem was getting more serious because AG was starting the 5th grade (school year 2004/2005), with several disciplines and teachers, who would have more difficulty in understanding AG handwriting. Thus, before initiating the 2005/2006 school year, new efforts were developed to find a solution that allowed AG to write in the computer with a speed comparable to handwriting.

As a starting point we compared speed and errors for AG handwriting and computer writing. At the time of these experiments AG was in summer holidays and so we asked him to write a text every day during two weeks. Each day AG selected a text from the Internet, about a subject of his interest, with at least 30 lines, half of which would be hand written and the other half typed in the computer. Graph 1 shows speed results for these two writing modalities (the missing values are due to data loss). Through the graph we can verify that AG averaged a 8.8 wpm and 8.27 wpm speed for handwriting and computer writing respectively (values very close to each other). Studies refer speeds of 10.4 wpm with respect to children in the same school grade [1]. The differences in speed between AG and other children of the same age were not significant. However the legibility was indeed a problem.

Thus, in the beginning of the 2005/2006 school year, we established a plan for a gradual integration of the computer in the classroom. This plan was composed of three stages, to be implemented gradually: (1) Doing homework in the computer for two disciplines, Mathematics and Nature Science; (2) Use of the computer in classroom, one time per week, for Mathematics and Nature Science, and simultaneously doing homework in the computer for all other

disciplines; (3) Use of the computer in classroom and at home for all disciplines; (4) Adoption of writing acceleration techniques.

AG was told to use the MS Word for computer writing. Each activity, as for example the worksheet resolution, would have to be stored in a different file and assigned a name containing information about the exercise book (e.g. Mat56.doc for the solution of an exercise from the Mathematics book, page 56). Various folders were created in AG computer disk, each one for a different discipline. For mathematics it was suggested the Ms Equation Editor because it allows an easy integration with Ms Word. In respect to other more infantile programs it has the advantage of being a tool that would fulfil AG future needs.

Because it is nearly impossible to identify all the technological needs required by all disciplines we knew our solution was a starting point that should be extended according to AG and teachers feedback.

Difficulties using the computer in classroom context occurred again. Computer use was just verified for Mathematics and Natural Sciences and at most for some homework labour in other disciplines. The factors that we consider being in the origin of the difficulties are very similar to the ones detected in previous years: (1) Excessive confidence on AG handwriting progression; (2) Teachers lack of knowledge using computers in educational contexts; (3) Deficient background support for teachers; (4) Communication difficulties between professionals.

A. Excessive confidence on AG handwriting progression

One of the problems remained to be the excess of confidence in the improvements of manual dexterity of AG. In fact those improvements did happen, as we can verify in Figure 4. However we think that even in these cases, where a positive evolution is expected, an alternative approach should exist to be used as a plan B.

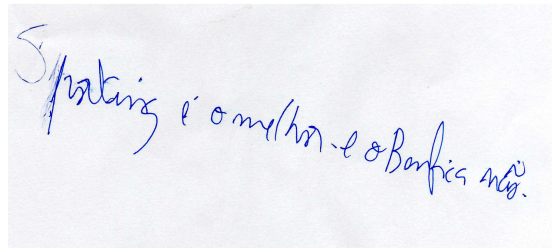


Figure 4 - AG handwriting in 2007.

B. Teachers lack of knowledge using computers in educational contexts

Teachers with technological knowledge and technology motivated reacted positively to the challenge, sending inclusively assignments by email, while other teachers, less motivated for the technologies, did not tried simple tasks like homework resolution using the computer.

The lack of knowledge can sometimes transform a simple educational solution, as writing answers in a Ms Word document, something complex and difficult to integrate in day-by-day functioning of a class. A study about school teachers as computer users, reported that due to a certain number of factors (e.g. lack of formation, lack of technical support) teachers feel many difficulties in the effective use of technologies in educative contexts [6].

The integration of students with special needs, whose success depends on an efficient use of these technologies, demands that all teachers (class teachers and special teachers) have adequate technological competences. As each situation requires different technological solutions it is extremely important that teachers participate actively in the solution improvement.

C. Deficient background support for teachers

The integration of a student with special needs in a regular school is a complex task that requires efforts from different institutions and professionals. Complex cases, the ones that require more advanced technological solutions, still lack the necessary support mechanisms to be really successful.

AG was followed up since the beginning by the Assistive Technologies Assessment Team from CPCB in order to prepare the student to an adequate integration in regular education. However we are conscientious that in Portugal these teams are not yet ready to respond to cases that require the use of advanced technological solutions. For such rehabilitation engineer elements should be included in these teams.

In great measure the proposed solutions had been possible due to the contribution of the Escola Superior de Tecnologia e Gestão de Beja (ESTIG) (High School of Technology and Management of Beja). Despite of being desirable the cooperation between institutions this interventions shouldn't rely solely on external engineering efforts because contributions from external sources are always limited. It is important that institutions like CPCB can integrate

rehabilitation engineering elements into its team so that they can contribute for an adequate response to these cases. It is also important the presence of Rehabilitation Engineering Technician, with practical knowledge about electronics, mechanics, materials, and computer software and hardware, to implement the solutions with the Rehabilitation Engineer. The Assistive Technologies Assessment Team from CPCB has hired one of these technicians.

Beyond the existence of this specialized team, that is responsible for proposing a technological solution for the integration of the child, as well to monitor the solution adequacy, the class teacher needs pedagogical support from more experienced teachers in this problematic. Teachers may be helped in the classroom, or simply get some background support, otherwise they may feel unsupported and incapable of dealing with the situation [3]. It would be important that schools promote teacher formation in assistive technologies in order to create a school team capable of actively participate in these interventions.

New education policies defend turning Special Schools into Resource Centers [4]. A good application of this idea should reinforce the background support needed by teachers of special students.

In all the cases school must assure the technological solution maintenance and repairing. This support must be effective and fast enough, otherwise the system may stop working, and the child integration may be compromised.

Portuguese Government has already understood the importance of computer systems maintenance in schools and therefore created the Information and Communication Technologies School Coordinator [2]. However our experience working with schools shows that the resources allocated to this service are not yet enough.

D. Communication difficulties between professionals

Nowadays, schools do not possess the adequate mechanisms to support the integration of students that require advanced technological solutions. In the previous section we pointed out the main faults at this level. The lack of well established mechanisms obviously makes the coordination and distribution of responsibilities between professionals very difficult. An important step for the resolution of this problem would be the description of the technological solution in the individual educative plan of the student. It would act as a compromise between all parts. To assure the feasibility of this plan schools and other

institution should be supplied with the proper resources. This measure has already been adopted in other countries with very positive results [5].

III. THE NEXT SCHOOL YEAR

AG keeps increasing the quality and speed of his handwriting as well as computer writing. Recent measurements of the performance (July of 2007) indicate writing speeds of 10.7 wpm and 11.4 wpm respectively (in 2005 the average of these values were 8.7 wpm and 8.8 wpm respectively).

However, it's difficult to anticipate student reactions to new school demands in the future, and therefore we should continue developing a technological solution the student can use any time he needs.

Next year AG should use a mixed solution for writing, where handwriting and computer writing levels of use will be tuned according to the student needs. In the next years the solution may be based essentially on handwriting, but as long as the student progresses on his studies the solution may become more computer based.

To facilitate the implementation of the solution the team will propose to the school an implementation methodology.

D. Implementation Methodology

Currently schools and its professionals do not have all the resources needed for a proper integration of special students. The methodology proposed takes this reality into account and for this reason suggests a step by step implementation of the solution.

Last year a similar methodology was delineated, however, because of not having been documented, due to the inexistence a legal framework that favours its implementation, and because of school difficulties responding to this kind of technological challenges, the practical results were very limited. However the collected experience contributed significantly for the definition of the proposed methodology.

The legal framework should not suffer significant changes in the short-term and therefore we consider important the existence of a methodology document that describes the implementation scheduling, including evaluation moments, the tools to use, as well as the responsibilities of each intervention element.

The methodology will allow a gradual knowledge of the solution by the intervening elements. It will also



Figura 5 – Smart-Board

favour the solution integration with teachers current work methods. The evaluation moments will allow difficulties reporting and hence solution adjustments to take place.

In this methodology we propose starting using the computer in less critical tasks, for instance homework task, and in a limited disciplines set – only two. Later these tasks should be extended to other disciplines. After analysis of the results more critical tasks could be tried (e.g. note taking in classes).

D. Technological Tools

In the base solution the student will have to use the Ms Word for computer writing and Ms Equation Editor for mathematics writing. A document management scheme similar to the one already described will be adopted.

The school manuals and exercises books available in digital format (pdf) will be requested. In the next years it would be important that manuals selection had into account the existence or not of a digital version.

For the student to develop some writing activities in the manual we are studying some tools that can edit pdf files, including Adobe 8 Acrobat Creator. In cases where a digital version of the book does not exist the student must develop the activities with Ms Word referencing the book page in the filename as already discussed.

For certain classes or specific areas, like music, geometry, sport, among others, specific software that includes the desired contents must be identified. Due to contents specificity this selection must be carried out by AG school teachers.

Use of these tools should not mimic the original tasks like they were being carried out in the traditional support (e.g. paper). This approach may become very

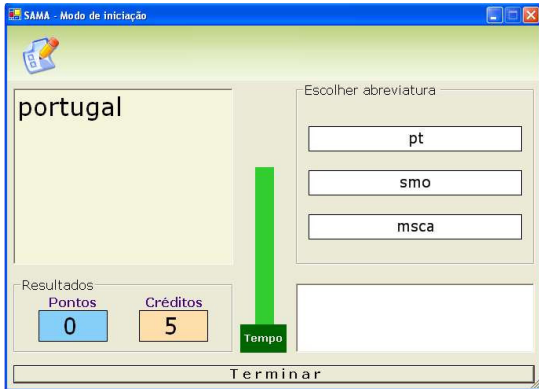


Figura 6 – Game for abbreviation memorization (level 1).

inefficient and frustrating because paper and computer are completely different information supports. The primary concern should be the activities goals, not the way activities are carried out.

For AG to write down class notes it is not enough to simply increase the student typing speed. It is also important that teachers take into account the fact that a student is taking notes with a computer. Teachers can use many strategies to help AG in note taking: (1) Book referencing for difficult note taking material (e.g. diagrams); (2) Supplying copies of difficult note taking material to the student; (3) Using acetates and a video-projector instead of a traditional school board. At the end of the class all notes can be photocopied and made available to the student; (4) Digital photography of class board contents; (5) Use of a smart board. At the end of the class all notes can be printed and made available to the student.

The existence of a Smart Board (Figure 5) in the school would facilitate greatly the process of note

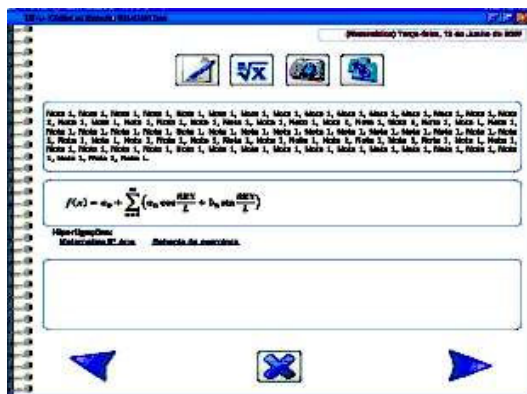


Figure 7 – Non-functional prototype of CE-e (Caderno Escolar Electrónico) (Electronic Scholar Notebook)

taking to AG, as well as to other special students, because it would allow printing all the teacher notes to paper or saving them to a document file. Currently the prices of some of these boards became very affordable. These boards work with a computer and a video-projector.

The effectiveness of each of these tools will have to be measured to allow some adjustments or even replacement of inadequate tools.

As a result of this work some new tools are being developed by our laboratory in order to help AG and other children with similar needs in school. These tools may not be ready in the beginning of next school year and therefore the base solution shouldn't rely on it.

The first of these tools is based on the Portuguese augmentative alternative communication system "Eugénio - the Génio of the Words" (<http://www.l2f.inesc-id.pt/~lco/eugenio>). Currently we are creating different abbreviations sets, measuring its efficacy and testing the memorization easiness of each one. The selected abbreviations set will be tried by AG for writing acceleration.

The objective of the second tool being developed is abbreviation memorization support. This tool is a computer game that asks the correct abbreviation for a given word or word sequence (Figure 6). This game has two levels of difficulty. In the first level the player selects the abbreviation from three possible choices. In the second level he must write the abbreviation without any type of aid. The game monitors the number of correct and wrong answers along the training sessions.

The third tool is being developed to facilitate note taking, the accomplishment of written works in the computer and management of all the produced documents. It should constitute an effective alternative to the traditional scholar note book and so we name it Caderno Escolar Electrónico (CE-e) (Electronic Scholar Notebook) Figure 7 shows part of a non-functional prototype for this application.

IV. CONCLUSIONS

The process of integration of a student with special needs in a regular school is a complex task that requires the concentration of efforts from different institutions and professionals.

Technology can assist special students in their integration in regular schools but schools and other organizations are not yet prepared to make this work.

With the presentation of AG case we tried to identify some of the problems that may be responsible for these difficulties.

Based on our experience we also pointed out some solutions that can attenuate these problems.

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