

Proposal for Development of Teaching Methodology and Accessibility Tool for Professional Qualification of Visual and Mobility Impaired People

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Abstract

According to 2000 Cense, there are approximately 24.5 million people in Brazil who have some kind of deficiency, where the visually and mobility impaired are the majority. The government actions are mainly taken toward to basic education, so not many advanced education programs are destined to impaired people. Although some specialized institutions usually offer several technical courses, they are considered basic-level, and don't prepare them to get more qualified jobs. On the other hand, the number of corporations that offer jobs to them is reduced. Our institution NCE/UFRJ has been developing accessibility tools since 1993, which provides access to information through, but not only, the Internet. Based on this context, NCE/UFRJ has created the Projeto Habilitar, which main goals are to provide intermediate to high-level courses in both administrative and technical areas for impaired people, to develop a teaching methodology and to develop or upgrade accessibility tools to be used in future courses and by other institutions as well. The strategy applied to start this project was to deploy a pilot course. The course chosen is called Cisco Networking Academy Program, implemented by Cisco Systems Inc., the biggest corporation in networking technology of the world.

Keywords: Deficiency, Digital Inclusion, Special Teaching, Technical Qualifying, Development of Technology for Impaired People.

1. Impaired People's Scenario in Brazil

According to 2000 Cense [1] performed by Instituto Brasileiro de Geografia e Estatística (IBGE) and summarized on Table 1, approximately 24.5 million people in Brazil have some kind of impairment, which corresponds to 14.5% of entire population [8]. In Table 2 [1], we can observe that the number of the visual impaired is quite high, around 9.8 %, followed by the mobility impaired (4.6%).

Table 1: Total of impaired people in Brazil.

Brazilian Population (2000)	169799170	100%
Total of impaired people	24537984	14.5%

The social ascension of most part of impaired people in Brazil is limited by low incomes, very restricted access to education and inadequate public policies concerning social development. This significant contingent stays away from job market, as most of them do not have any professional skills [9]. One of the main reasons for this scenario is

public and private teaching Institutions not has a policy to create and maintain professional qualifying programs for impaired people.

Organizations around the world are getting more concerned about social responsibility, and Brazil is included in this list. [10] However, while developed countries have implemented several funding support programs through their social responsible organizations, in our country the scenario is far from an ideal one. In the nineties, these actions started to get more effective through the hard work of Organizations Non-Governmental (ONG's), research institutes and organizations concerned about this issue. In fact, the huge social inequality promotes more importance to organizations' social responsibility. In general, the society expects that organizations play a new role in the development process: they be new agents of a new culture and promote a social change, in order to build a better society.

Table 2: Total by impairment category.

Mental impairment (permanent)	2848684	1.7%
Visual impairment	16573937	9.8%
Not able to see anything	159824	0.1%
Very Restricted vision (permanent)	2398472	1.4%
Restricted vision (permanent)	14015641	8.3%
Mobility impairment	7879601	4.6%
Not able to walk or take steps	588201	0.3%
Very restricted walking or taking steps (permanent)	1799917	1.1%
Restricted walking or taking steps (permanent)	5491482	3.2%
Hearing impairment	5750809	3.4%
Not able to hear anything	176067	0.1%
Very restricted hearing (permanent)	860889	0.5%
Restricted hearing (permanent)	4713854	2.8%
Quadriplegic, paraplegic or hemiplegics (permanent)	955287	0.6%

What concerns about having job opportunities to impaired people, most of the organizations usually hire them just because there is a law, which obliges them to do it [2]. Nevertheless, more than hire just because the law demands, the insertion of impaired people in these companies can become very attractive from the company's point of view, and at the same time it converges to societies craving [12]. A way of justifying the employment of impaired people is characterizing them, economically speaking, as an unexplored productive resource, that if is technologically oriented, can reach great performance. Researches show that workers with have some kind of impairment generally gets high levels of productivity, attendance and devotion [13]. Hiring impaired people is also beneficial for organizations' image that from this moment on is known as "good employer". It also promotes a humanization process, which reflects on their employees and customers. On the other hand, organizations that discriminates impaired people tend to be considered as non-socially responsible, becoming the "last alternative" to get a job not only for people with no impairments, but also for impaired people.

Organizations that have employed impaired people noticed that the business environment has improved substantially, as it allows them to characterize with more precision the social structure of the communities they want to be part of. Generally, the insertion of impaired people in the work environment does not require critical changes. It requires only alterations in work turns and some modifications in the facilities or in the equipment.

Even so, the absorption of them by the job market in Brazil is quite low, and most of the time lower than what is demanded by law. One of the explanations for this scenario is that they are not able to get the jobs offered due to their lack of skills. Additionally, the traditional teaching institutions for impaired people do not offer a proper education for professional ascension, as they are just concerned in providing basic courses to this community. Even when these high-level professional courses are offered, or the accessibility tools are not effective, or are underutilized. According to this scenario, we can conclude that Brazilian impaired people do not have professional

skills, and as a consequence do not have conditions to compete for a job in equal conditions with people with no impairments. Thus, it is necessary to implement professional qualifying programs that propitiate to them an opportunity to get a job, not only for obtaining an income, but also to have a career, giving them a chance to redeem their citizenship.

2. Motivation for Projeto Habilitar's creation

The Núcleo de Computação Eletrônica of Universidade Federal do Rio de Janeiro (NCE/UFRJ), has developing, since 1993, teaching and researching activities to visually and mobility-impaired people [3]. This work is focused basically on tool development that can provide to them access to information, promoting to them a perspective of social integration. Two of the developed tools deserve distinction; DOSVOX [4], software which uses voice synthesis to transmit to the visually impaired what is displayed on computer's screen, and MOTRIX [5], software which provide access to computer through voice commands spoken by the mobility impaired. This and other tools are being adopted nationwide, as they are distributed freely by NCE/UFRJ through Internet. A Spanish version of DOSVOX was released recently, and is also available for America Latina community. As the commercial tools that provides similar features are very expensive, and as the mobility and visually impaired generally have very low incomes, the free download of these tools provides to them the chance to have access to the computer, and consequently, to the Internet.

The Projeto Habilitar [6], created by NCE/UFRJ on march 2003, has as a main goal the professional qualifying of impaired people, not only through the offering of technical and administrative courses, but also helping them to ingress the job market, establishing partnerships with public and private institutions or organizations. The first step toward the job market is obtaining an internship, and the following one is to be hired.

3. Projeto Habilitar's initial phase

Before starting any activity related to this Project, it was established that it is going to embrace just the visually and mobility impaired community, once our institution has a large experience with these two kinds of impairment. It has also been defined that the course to be offered to this community would be separated in two categories; technical and administrative. In technical area the following courses were selected; Technical in Computer Networking, JAVA programmer and Webmaster, while in administrative area the courses were Library Assistant and Administration Assistant.

In principle, these courses could be offered with no difficulties, once all of them were already implemented, and, in our case, as we work in a university, we wouldn't have any problems to find qualified instructors. However, there is an issue; these courses should be offered to them in the same way they are implemented to people with no impairments? They have to contain the same material, but for sure, they have to be implemented using different methodologies and teaching tools. When we think about this, we concluded we didn't have full-qualified instructors for this task.

Thinking about this issue, we have decided to start the Project with one single course, a pilot course, having as its main goal to develop teaching methodology and to use/develop accessibility tools which could be adopted in future courses and in other teaching institutions as well. We have chosen a technical course in computer networking, as NCE/UFRJ has a qualified staff in Computer Networking with large experience in teaching, research and consultant services, and also for being the Center of Coordination of Quality and Teaching in Brazil of a qualifying program in networking called Cisco Networking Academy Program from Cisco Systems Inc [3]. Another strong motivation was the support that Cisco do Brasil Ltda and Cisco Systems Inc decided to give to this Project, like internship offers to students of this course and the rewarding and participation of the best students in the installation of the networking infrastructure during the Cisco Systems Inc's annual event, Networkers 2003.

This course is divided in four modules, each one with 80-hour minimum. Classes occurred twice a week with 4-hour duration. It consists of a theoretical part and a practical one, which must be performed in a laboratory properly built. All course material is accessed through Web. The student's evaluation is done through multiple-choice exams that should be taken online. For modules 2, 3 and 4, there are practical exams to be done in the laboratory. Speaking in educational issues, the course material was not designed to be used by people with impairments.

A pilot class was composed of 12 students, being 6 visually impaired (4 with no vision and 2 with sub-normal vision) and 6 mobility impaired (with different levels of quadriplegia), in order to capacitate them in a highly recognizable profession and make possible the development of a teaching methodology, and verify the needs for developing or adapting supporting tools to teaching activities. As the course goes by, analysis and studies are

conducted about the use and adequacy of the tools and the methodology applied to impaired people and to the instructors involved in the teaching activities.

The whole experience acquired in this pilot class will serve as a framework in the implementation of other courses and in the dissemination to other teaching institutions that want to be engaged in Projeto Habilitar.

4. Tools and methodology development

To start up course was necessary to select a team that could work directly with the pilot class students. Two instructors, one assistant, one pedagogue and one psychologist should compose this team initially. It would be perfect if the team had previous experience in teaching impaired people, but, as this was not the case, we had to build the whole teaching methodology from the scratch, supported only by the technical expertise of the participant professionals.

Although we have in our institution staff a considerable number of qualified professionals to teach this course, it was quite difficult to get adhesions, as most of them were afraid in having contact with impaired people. In spite of that, we were able to get a reduced number of instructors who engaged themselves into the Project. Regarding the assistants, it was also hard, but we could get two at least. The assistant is the key in the classroom, once his main task is giving support to the instructor in practical activities, and to interact directly with the students concerning accessibility tools adaptation and utilization. A pedagogue was summoned to work with us in order to orientate the instructors in terms of didactics and teaching methodology.

The psychologist's task is to provide emotional support to instructors and assistants, once they don't have any previous experience with students with impairments, as most of them need psychological support, not only to deal with the impairment, but also to face the society again, as many of them have lived for quite some time away from social conviviality.

As our class is composed of students with two types of impairment, it was necessary to make a previous analysis to distribute them efficiently into the classroom. We opted to divide them into groups of two students, each one composed of one visually impaired and one mobility impaired. Two factors contributed to make such decision; firstly we believed that the interaction between students with distinct impairments would proportionate a mutual understanding of each other's difficulties, where one student can help the other one to overcome his impairments. Secondly, as the visually impaired have a better education, they could help the mobility impaired teaching.

Summarizing, the mobility impaired would contribute with their vision and the visually impaired with their mobility and knowledge. Till the present moment this disposition in classroom has obtained excellent results. The social conviviality inside and outside classroom has helped to experience exchange and previous resolution of questions, establishing a high level of interaction among them.

As this classroom has different levels of education, it was decided to initiate it with short duration course in Windows platform. The purpose of this initial training was to analyze if the tools already developed would serve to the students' needs, and the final result was positive. In fact, the tools provided access to the computer, e as a consequence, to Internet.

As the course goes by, two teaching methodologies need to be developed concomitantly, each one related to a certain type of impairment. The integration of both is going to be done during the course. The instructor is in charge to find a better way of explanation for both impairments.

An important issue to worry about that is common to both impairments is students' incapacity to make class notes. It is crucial that practical activities being performed very often into the classroom, through the running of applications or through labs exercises. In that way, the theory and the practice can be combined, making the classes less tedious.

In mobility impaired case, the instructor and the assistant has to explored, as much as they can, his visual capacity. It is true that some mobility-impaired students have some movements in their superior members, but they are not coordinated, what makes tasks as building and installation of equipments really impossible. Thus, the instructor has to prepare the student, in the network course context, to manage these tasks and to be able to identity connection and communication problems using his vision and the accessibility tools.

A common procedure adopted by instructors in conventional classes is to write most of the important information down in the blackboard without saying anything. This kind of practice can't be used in a classroom with visually impaired students. Everything that is being presented into this classroom, that is, new information or equipments, has to be described with as many details as possible, so the visually impaired can understand what is going on.

Another usual mistake is to ask the visually impaired if he is seeing what is written in the blackboard, or in our case, if he is seeing some equipment that is being presented. This kind of question should be avoided, but if this kind of situation happens, the instructor must be prepared to student's reaction, and do not feel bad about it. The instructor and the assistant should explore the tactile capacity of the visually impaired student. The handling of cables,

connectors and networking equipment like NICs (Network Interface Cards), routers and switches should be explored as much as possible.

It was observed during some classes that, as the visually impaired students do not have access to figures and graphics contained in course material, this fact was really compromising their understanding about the course's content. To overcome this problem, we have decided to adopt other forms of figure representation.

If the figure has a more descriptive feature, it was converted to a text format and be available afterwards to the students through Internet. Another option very effective was the figure representation into maquettes. This approach made possible to them, for example, to recognize and understand the several networking topologies. That kind of representation replaced the one using the Braille method, what would imply the use of a high cost special printer [3]. For maquettes construction we opted to use low cost and easy to obtain materials, which could produce the best final result. Some of the material used was paper, thin ropes, shirt buttons, and glue, cardboard and wooden sticks. The kind of material utilized is just a suggestion, and some others can be used like lollipop sticks to replace thin ropes and bottle tops replacing shirt buttons. The maquettes construction did not use any specific technique, once their elaboration depends on instructor and assistant's creativity and the available material. However, standardization must be established in regular courses, to avoid comprehension issues.

In our pilot class, for example, every time we had to build a maquette about a physical network topology we used a thin rope to represent the medium connecting the network equipment and cardboards from different sizes to represent distinct equipment like PCs, hubs, switches and routers. To start building the maquette we have firstly to print, in a paper the equipment that are part of the network topology, in a size that could provide a good spatial "vision" through touching. Then we cut the thin ropes according the connection's size that could be flat lines and "ray-shaped" ones. Thin ropes were then glued in paper where the links were defined, and care was taken to not use ropes longer than the links sizes, because on each extremity there is network equipment represented by the cardboards. Care also must be taken to not leave relief differences between ropes and nodes (equipments) [3]. We still get support from a visually impaired teaching institution to print, in Braille, the maquettes legends.

All the figures representation (text or maquette) was submitted to visually impaired students' approval before being used in the classroom as a supporting material by them. This procedure is primordial to avoid wrong interpretations. The result has been surprisingly good, as it helps the students to consolidate the theoretical content presented in the classroom, and the mobility-impaired students already use it as a complementary studying material.

This course from Cisco Systems Inc. was not designed for impaired students; so, it was not possible, till recently, their participation, and that's why we were motivated to not only make adaptations to the course material, but also to develop a whole tools' kit which could provide to them access to it.

To read the courses content through the Web, we use DOSVOX for the visually impaired and MOTRIX for the mobility ones. MONIT32, a screen reader that takes part from DOSVOX package, was used by visually impaired students to take the online (multiple-choice) exams. The instructor or assistant (with no visual impairments) helps them to make a previous place demarcation where the question's stem will be positioned and the options to be selected. It is important that this exam be configured to present just one question per page, to not jeopardize the demarcation. This operation is one of the few ones that need instructor/assistant's help, as MONIT32 is not completed adapted to these type of exams. Although they need this initial help to start the exams, they are able to take the exams all by themselves. The mobility-impaired students use MOTRIX to take the same exams, and the exams can present more than one question per page.

As this course contents a wide variety of practical activities in laboratory, it was developed specific tools for the visually impaired, although they can also be used by the mobility ones in a modified version. These tools serve to help them to understand what happens into the network, and to configure network equipment like routers and switches.

To capture network packets, we developed VOXDUMP that is a friendly interface with a voice synthesizer to use WINDUMP, public domain software for packets capturing. This software has a whole set of parameters and capturing combinations, so, to not get things too complicated at the beginning, we implemented just, in this first version, the most common capturing options and present them in a simpler form to the visually impaired. The objective is they do not have to worry about order or format parameters.

For being a technical course in networking, most part of it is dedicated to routers and switches configuration. TELNETVOX, a program from DOSVOX package, to provide to the visually impaired access to computers locally and remotely was successfully modified to configure these network equipment.

In this course there is a lot of mathematic calculation, for example, the conversion from decimal numeric base to binary numeric base and the division of a network address in subnet, which requires pencil and paper. This kind of activity should be presented very carefully, once impaired students do not have physical skills to perform it. Thinking on this matter, we developed a base conversion calculator in two versions, one for each type of

impairment, called CALCBASE, as the Windows calculator does not satisfy impaired students' needs. In visually impaired's case, voice is used to inform the base conversion operation's result.

For dividing a network address into subnets was developed VOXCALC, where voice is also used to teach students how to make network address divisions. This tool has a version, which is operated by voice to be used by the mobility-impaired students. Both tools have been very effective to consolidate student's knowledge, although its utilization be only to help them to learn how to perform these calculations, and should not be used as a replacement for ratiocination.

5. Projeto Habilitar's Important Issues

At the beginning of this project, we had some problems, which had to be solved. Accessibility was the first issue and it was completely bypassed through the total remodeling of NCE/UFRJ facilities to allow the access of the wheel chairs. Access ramps were built, restrooms were adapted and side access reformed.

NCE/UFRJ mounted for this project a lab containing one PC for each student, multimedia kits for DOSVOX and MOTRIX utilization, network equipments like routers, switches and hubs, and every developed/adapted tool to be used during the course. NCE/UFRJ also offers coffee break for students.

The transportation of mobility-impaired students from their homes to NCE/UFRJ was an obstacle to be solved before the course's start. As this Project does not have financial support to provide it, was necessary to establish a partnership with a public bus company. One bus from this company was totally adapted to make their transportation, assuring their participation in the course.

It has been very difficult to get instructor's adhesions for this Project, but the ones who got involved has done a great job. In fact, there was no instructor with previous experience in teaching impaired students, and as consequence, most of them did not know how to behavior professionally in front of the students. There were a certain number of invited instructors who refused to participate in this Project. However, the ones who decided to get involved suffered of "emotional sickness", headaches, sleeping problems, among other symptoms.

The absence of a psychological support for students, instructors and assistants in this pilot class is a problem, in a certain way, minimized by instructors, assistants and students dedication. However, this issue has to be solved soon for the next and more stressing modules.

6. Conclusion

At the present moment, the pilot class has been finishing the module 2, and we think that on September 2004 the fourth modules will be completed. The academic performance of this class has been above the expected level for a pilot experience, as we can observe on Figures 1 and 2 [7], showing that the methods and tools developed so far have been adequate and effective. From a qualitative point of view, the grades obtained in evaluations has been excellent when compared to a non-impaired students class during the same time and using the same team of instructors.

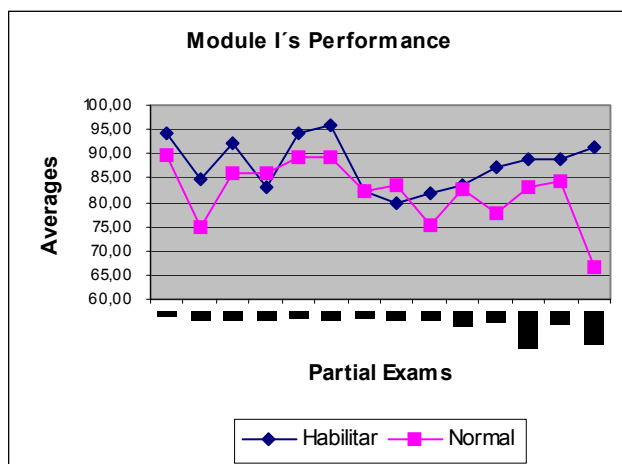


Figure 1 – Average grade obtained from final and partial exams of module I.

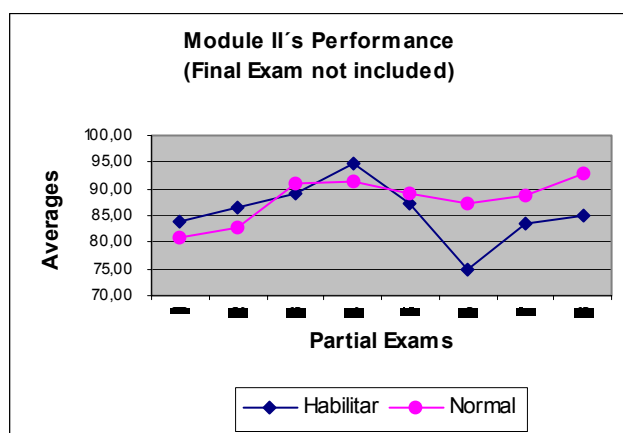


Figure 2 – Average grade obtained from partial exams of module II.

Analyzing the pilot class behavior according to the graphics displayed on Figures 1 and 2 above, we noticed a lower performance of non-impaired students class (“Normal”), in module I, in the final exam. That is happened because 3 students didn’t take the final exam.

In module II, we can observe a lower performance of Habilitar’s students, in partial exams 6, 7 and 8. That was caused by absence of one student that was ill during these exams period.

If we do not take these facts into consideration, we can conclude that Habilitar’s class performance is superior to Normal class in module I and quite similar on module II.

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