CASE STUDY: PRACTICAL EXPERIENCE OF A TECHNICAL QUALIFYING PROJECT TO VISUALLY AND MOBILITY IMPAIRED USING ACCESSIBILITY TOOLS

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ABSTRACT
According to 2000 Census, around 24.5 million people in Brazil have some kind of deficiency, where the visually and mobility impaired are the majority. Some education programs have been destined to impaired people, but in general, they are considered basic-level programs, once the government has not taken actions toward to advanced education. Some specialized institutions usually offer several technical courses, but they don’t prepare them to get more qualified jobs. On the other hand, the number of corporations that offer jobs to them is reduced. NCE/UFRJ, our institution, has been developing accessibility tools for the visually impaired since 1993, and for the mobility impaired since 2003. These tools provide access to information, promoting a social integration perspective. Based on this scenario, NCE/UFRJ has created a program named Projeto Habilitar (Habilitar Project). We have two main objectives in this project; to offer from intermediate to high-level courses in both administrative and technical areas for visually and mobility impaired and to develop a teaching methodology, upgrading or developing accessibility tools to be used in future courses and by other institutions as well. The strategy adopted to initiate this project was selecting a course not designed to impaired people and adequate it to them. A course from Cisco Networking Academy Program, implemented by Cisco Systems Inc., the world’s biggest corporation in networking technology, was chosen to be a pilot course.

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

1. SCENARIO OF DEFICIENCY IN BRAZIL
In Brazil, according to the Census 2000 [1] performed by Instituto Brasileiro de Geografia e Estatística (IBGE), there are approximately 24.5 million people who have some kind of deficiency. This corresponds to 14.5% of the entire population [8], where visually impaired people is the majority, around 9.8% of population, followed by 4.6% of mobility impaired.

The social ascension for most of impaired people in Brazil is limited by very low incomes, a restricted access to formal education and inappropriate public policies to the social development. Most of them nowadays cannot find a place in the labor market as they are not able to acquire professional skills [9]. One main factor leading to this scenario is an absence of policies, which encourage public and private institutions to implement qualifying programs for impaired people in.

Nowadays, enterprise social responsibility is an issue of great importance in the world, especially in Brazil [10]. However, while developed countries have several programs led by socially responsible companies, the actual situation in Brazil is below the desired level. In our country, these actions were
gathered way in the nineties, through some Non-Governmental Organizations, research institutes and companies moved by this issue. In fact, the high level of social inequality in Brazil gives to enterprise social responsibility a more significant importance. Brazilian society, in a certain way, expects that companies play a new role in the process of social development: that they be the agents of a new culture and the fomenters of a social change, in order to build a better society.

What concerns about job opportunities to impaired people, most of the companies give them work because there is a legislation, which obliges them to do that [2]. However, 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 at the same time that it converges to societies craving [12]. One economical way of justifying the employment of impaired people is they can be characterized as an unexplored productive resource, that if is technologically oriented, can reach a great performance. Researches demonstrate that workers with some kind of deficiency generally get high levels of productivity, attendance and devotion [13]. Give an opportunity to them also improves the company’s image, that from this moment on is known not only as a “good employer”, but also as a promoter of a humanization process that reflects directly on their employees and customers. On the other hand, companies which do not take these actions tend to be considered as non-socially responsible, becoming the “last option” to get a job, not only for impaired people, but also for people with no deficiencies. Furthermore, these companies get a negative image by the customers.

Several companies that have employed impaired people admit that it was a good deal to hire them, once it improved the business environment, allowing them to mirror with more precision the social structure of the communities they want to serve. The insertion of impaired people in a work environment generally does not require many alterations in work turns and just some modifications in the facilities and/or in the equipments.

However, the number of people with deficiencies hired by companies in Brazil is still below the desired level. One of the explanations for it is that the kind of job offered cannot absorb them as they do not have required skills. This causes a dead-end, as traditional institutions that support impaired people, do not provide conditions to get a professional ascension, because most of them are just concerned to offer basic-level courses to their community. Even when they offer higher level qualifying courses, the accessibility tools do not work, or they are not well applied.

Based on this picture, we can conclude that the Brazilian scenario consists of impaired people with inappropriate professional skills. As a consequence, they have no conditions to compete for a job with people with no deficiencies. Our society needs the deployment of programs of professional qualifying that can give to them an opportunity to ingress into the labor market, not only to obtain an income, but also to have a career, allowing them to redeem their citizenship.

2. CREATING PROJETO HABILITAR

The Núcleo de Computação Eletrônica da Universidade Federal do Rio de Janeiro (NCE/UFRJ), has achieving, since 1993, research and teaching activities to visually impaired, and since 2003, to the mobility impaired [3]. This work has been focused basically on the development of tools, which can provide to them access to information, promoting a perspective of social integration. One of the developed tools that deserve distinction is DOSVOX [4], software that uses voice synthesis to show to the visually impaired what is displayed on the screen. Another one is MOTRIX [5], software that provides access to the computer through voice commands spoken by the mobility impaired. These tools have been fully adopted nation-wide, once they are distributed for free around the country through the Internet. A first Spanish version of these softwares called MEXVOX was recently developed, and it is being distributed to the Latin America also through the Internet.

The reason for the free distribution of these tools is that most of impaired people do not have conditions to purchase such softwares, and the commercial tools that exist in the market nowadays have a very high cost.

Projeto Habilitar [6], created by NCE/UFRJ in March of 2003, has as a main objective the professional qualifying of impaired people. It provides that not only through courses in administrative and technical areas, but also in getting them a place in the labor market, establishing partnerships with public and private
institutions. The first step toward the labor market is obtaining an apprenticeship and the next one is hiring them.

3. INITIATING PROJETO HABILITAR

Before initiate any activity in Projeto Habilitar, it was defined that it would firstly comprehend just the community of visually and mobility impaired, as our institution already have expertise with these two kinds of deficiency. It was also established that the courses being offered to this community would be divided in two categories: technical and administrative. The technical courses selected to be part of the project are technical in computer networking, JAVA programmer and Webmaster, while in the administrative area the courses chosen are the Library Assistant and Administrative Assistant.

In a certain way, these courses could be offered without any problems, once they are already implemented to people with no deficiencies in our university. However, there is a question that must be asked: would be these courses offered to impaired people in the same way they are applied to people with no deficiencies? For sure they have to consist of the same content, but we cannot say the same about the teaching methodology and the accessibility tools. When we thought about this issue, we concluded that we did not have qualified instructors to teach these courses.

Taking all these into account, we have decided to initiate our project with a pilot course, a laboratory that had as the main objective to develop a teaching methodology and use/develop accessibility tools, which could be adopted in future courses, and be disseminate to other teaching institutions.

We have decided to start the project choosing a technical course in computer networking as NCE/UFRJ has a computer networking professional team with great expertise in teaching, research and consultant services. Another reason is because NCE/UFRJ is the Coordination of Quality and Teaching of a qualifying program in networking called Cisco Networking Academy Program from Cisco Systems Inc [3]. A strong incentive was also the support that Cisco do Brasil Ltda and Cisco Systems Inc decided to give to Projeto Habilitar. They offered apprenticeship to the students of the course, and the participation and rewarding of the best students in the installation of the networking infrastructure of a networking international event of Cisco Systems Inc, Networkers 2003.

The course is divided in four modules, each one with 80-hours duration, and the classes occurred twice a week with 4-hours duration. It consists of a theoretical and practical part that has to be performed in an adequate lab. All material is accessible via Web. The student’s evaluation is done through multiple-choice exams, which should be taken online, and depending what module the student is doing, there will be also a practical exam to be realized in a lab. In educational terms, the course material was not designed for being used by impaired people. Thus, it would be required to make some adjustments in this course in order to adapt it to them, besides the implementation of accessibility tools and the development of teaching methodology.

A pilot class was composed of 12 students, being 6 visually impaired (4 with no vision and 2 with sub-normal vision) and 6 seriously mobility impaired (with different levels of deficiency). The goal of this pilot class is to qualify them in a highly recognizable profession in the labor market, make possible the development of a teaching methodology, and verify the needs of development or adaptation of supporting tools to teaching activities. Analysis and studies related to the use and adjustment of these tools and the applied methodologies to impaired people and to the instructors involved in the teaching activity has been conducted during the course.

All the experience acquired in this pilot class will serve as a landmark in the implementation of other courses and in the dissemination to other institutions that wish to take part of the project.
3.1 Teaching methodology

To start this pilot course was necessary to select a team that could work directly with the students. Two instructors, one monitor, one pedagogue and one psychologist composed this team initially. The ideal situation would be if the whole team had previous experience to deal with impaired people, but as this was not our case, we had to build a whole new teaching methodology only sustained by the technical experience of people involved.

Although we have in our institution a lot of capable instructors who could be engaged themselves in this project, it was very hard to get adhesions, as most of them were afraid to have some kind of contact with impaired people. In spite of that, we have got our two instructors. As time went by, we could count on more instructors, but even so, the number was not very high. The same situation happened to find a monitor that could work with the students, but we were also successful in our search. This monitor represents an essential part of the team, as he/she has the role to help the instructor in all theoretical and practical classes, and to interact directly with the students in order to keep up with how they are dealing with the accessibility tools. The monitor can give to the instructor an important feedback about adaptation or development of new tools. One pedagogue was summoned to work with us in order to guide the instructors in what concerns the didactics and the teaching methodology.

The psychologist would give emotional support to the instructors and the monitor, once they were not used to deal with people with deficiencies, and also to the students, as most of them need psychological support not only to face the deficiency, but also to face the society. Many of them have lived apart from the social conviviality. Unfortunately, till the present moment we could not get this kind of support.

As students in this class have two kinds of deficiency, it was necessary to make a previous study to how distribute them into the classroom. We have opted in dividing them into groups of two students, each one consisting of one visually impaired and one mobility impaired. Two were the factors that contributed to such decision; the first one is that we believed the interaction between them would provide a mutual knowledge of each other’s difficulties; so one student could help the other to overcome the group’s deficiencies. Another factor was that, as the visually impaired students have more education than the mobility impaired, this could contribute positively to teach the mobility impaired.

To sum it up, the mobility impaired would contribute with his vision, and the visually impaired would contribute with his mobility and with his knowledge. This system of distribution has been proving to work wonderfully till the present moment. The social conviviality inside and outside the classroom has also been very efficient to exchange of experiences and the previous resolution of questions causing a high level of interaction between them.

As the students in our class has different levels of education, it was decided to initiate it with a short time training in Windows platform, as the softwares DOSVOX and MOTRIX were designed to work on it. Besides that, a DOSVOX version has been developed to run on a Linux platform called CURUMIN. A first version is being released, and spite of DOSVOX runs on it without any problems, in the Linux system it runs slower.

This training in Windows platform had the purpose to analyze if the accessibility tools already developed would serve to students’ needs, and the result obtained was positive. In fact, the tools provide to them access to the computer, and as a consequence, to Internet.

To give a start and continuity to this course was necessary to develop two teaching methodologies simultaneously, each one related to a certain kind of deficiency. The integration of them would occur during the course. The instructor has to find the best way of explanation for each type of deficiency.

One characteristic that should take into account in this class and common to both deficiencies is the incapacity of students in making class notes. It is important, from time to time, that practical activities be performed in the classroom, in order to combine theory and practice to provide a better understanding of the concepts, and at the same time make the classes less tedious.

In mobility impaired’s case, the instructor and the monitor must have explored his visual capacity as much as possible. Even when some of them have some mobility in their superior members, these cannot be considered coordinate movements, making impossible to them to execute tasks related to build and installation of equipments. However, it is also an instructor’s task to qualify them, in the networking
environment, according to their limitations, to be able to supervise this kind of work and to identify connection and communication problems using their vision and accessibility tools.

A normal procedure used by the instructors in conventional classes is using the blackboard to write information without speaking a word while he does it. This kind of practice could never be adopted in a classroom with the visually impaired. Everything to be presented in the class involving writing should be described as much detailed as possible using voice, so the visually impaired can understand what is going on.

Another common practice used by the instructor is asking the visually impaired if they see what is written in the blackboard, or more specially in our case, if he is seeing some equipment that is being presented in the classroom. A question like that should be avoided, but if this happens, the instructor must be prepared for the student’s reaction, and do not feel bad about it. The instructor and the monitor should explore as much as they can, the tactile capacity of the visually impaired. The handling of the cables, connectors and network equipment like network interface cards, routers and switches should be extensively explored.

It was observed during some classes that as the visually impaired could not have access to the figures contained in the material, this was compromising their understanding of the course’s content, and for that reason it was decided to adopt some ways of representing it to them.

In case figures have more descriptive types, they are described as text, and sends to the students through email. Another efficient way of representing it is their conversion into maquettes. This approach has made possible for the visually impaired to recognize and understand the current networking topologies. It came as a replacement to the Braille method, which would imply in the utilization of a high value cost equipment [3]. The Figure 1 shows an example of one of the maquettes built for this course.

To build those models we have chosen materials of low cost, very easy to obtain and that could provide the desirable result. We are using paper sheets, thin ropes, shirt buttons, glue, cardboard and wooden sticks. The material used is just a suggestion, and can be replaced by other ones, like using lollipop sticks instead of ropes and bottle caps in the place of buttons. The elaboration of the maquettes is not based in any building technique, as the way the they are developed depends on the instructor/monitor’s creativity and the available material. However, some kind of standardization must be established in order to disseminate this know-how in another courses, and avoid the occurrence of comprehension problems.

In our pilot class, for example, to build a networking physical topology, we have chosen a thin rope to represent the physical media between the equipments and buttons of different sizes to show the different equipments. For the construction of these models we first print the networking topology figures in a paper size that could make it easier to glue the distinct materials on it, and at the same time to provide a good spatial “vision” through touch. After that, we cut the thin ropes according to the size of the links that can vary between flat lines and circumferences. Then we glue these ropes where the physical media is represented, and be careful to not have hopefuls longer than the physical media, as at the end of each rope there is the buttons representing the nodes. Careful must be taken to not have difference of salience between the ropes and the nodes [3]. Cardboards of different sizes are glued in the paper in order to differentiate the several types of equipments like PCs, switches and hubs. We still got some support of a visually impaired institution to print, in Braille, legends to be added in those maquettes.

All the figures converted to text and represented by maquettes were submitted to student’s evaluation before being used in the classroom. This procedure is essential to avoid comprehension problems. The result has been surprisingly good, once these two kinds of representation have been helping them a lot in the course to consolidate the theoretical knowledge presented in the classes. Although these materials has been prepared
for the visually impaired, they have not been useful just for them, but also to the mobility impaired, that are using it as support material for study.

3.2 Tools development

As this Cisco’s course is not designed to be attended by impaired people, there was the necessity to not only make an adaptation of the course’s material, in order to provide a better understanding of the content, but also to develop several tools that could offer to the students access to this information.

For the reading of the material, through Web, DOSVOX was used by the visually impaired, and MOTRIX for the mobility impaired. The MONIT32, a full screen reader member of DOSVOX package, was used for the accomplishment of the theoretical on-line exams by the visually impaired. With an instructor's or monitor’s help, with no deficiencies, the visually impaired makes a previous demarcation of the places where the statement of the question will be positioned and the options to be selected. It is important that the exam is configured in way to present one question by page, so that the demarcation can be made correctly. This operation is one of few that need intervention of a monitor by virtue of MONIT32 not to be totally adapted for Cisco Academy on-line exams. Although such intervention happens, the visually impaired make the exams alone. The mobility impaired use MOTRIX to accomplish the exams. In the case of MOTRIX, the exams can present more than a question by page.

As the course contains a wide variety of practical laboratories, specific tools were developed for the visually impaired, although they can also be used for the mobility impaired in a modified version. These tools have as a main goal to aid in the perception of what it happens in the network, as well as in the configuration of networking equipment like routers and switches.

To capture packets in the network, VOXDUMP was developed. It is actually a user-friendly interface, using voice synthesis, coupled to software of public domain for packet capturing named WINDUMP. As in that software several capturing parameters combinations exist, we opted to implement, in this first version, the most common capture options and to present them in a more simplified way to the visually impaired, so that they did not have to worry with neither order nor format of parameters.

As this course has the objective to qualify network technicians’, great part is dedicated to routers and switches configuration. There is an application named TELNETVOX, part of DOSVOX’s package, that is used for the visually impaired to access remote computer systems. In order to provide to them remote access to the router, some adaptations to TELNETVOX were necessary. Tests in order to remotely access the switches have been conducting, so the next step is to have a TELNETVOX version that also works for switches.

During the course some calculations are required that, in principle, use pencil and paper, like the conversion of decimal numbers into binary ones and the division of a network address into subnets. This kind of activity should be introduced carefully, once the students do not have the writing ability. Thus, to facilitate the comprehension of these subjects, a base conversion calculator was developed in two versions. CALCBASE was developed in two versions, each one appropriate to a certain type of deficiency, once the Windows Calculator does not fit to impaired’s requirements. In the case of visually impaired, voice is used to inform what actions are taken in the application.

For the division of a network address in subnets, VOXCALC was developed. It works in the same way as CALCBASE, where the application reports what is being done through voice synthesis. Another version of this tool was developed in order to be used by the mobility impaired as well. They perform the calculation using voice commands that are passed to the application. Both tools have been very efficient to consolidate the students’ knowledge, although their utilization is just to help learning, not as a replacement for the ratiocination.
4. DIFFICULTIES

We had some problems at the beginning of this Project that was solved. Accessibility was the first one that was bypassed through the complete remodeling of NCE/UFRJ facilities to provide access to the wheel chairs. Access ramps were built, restrooms adapted and side access reformed.

The laboratory to be used in the course was completely mounted by NCE/UFRJ. It consists of one PC for each student, multimedia kits for the utilization of DOSVOX and MOTRIX software and all the networking equipment required like routers, switches and hubs. NCE/UFRJ also provides coffee break for the students.

The transportation for the mobility impaired from their homes to NCE/UFRJ was also an obstacle to be solved to initiate the course. As our Project does not have any resources to provide this transport, a partnership with a public bus company was established. A bus from this company was totally adapted for the mobility impaired transportation, and, as a consequence, the participation of them in the course was guaranteed.

The support supplied by the instructors to the Project, especially because we have no external financial support, has been essential to its progress, once it has been very difficult to get new adhesions. In fact, none of them had a previous experience in teaching impaired people, and consequently, most of them did not know how to behave, professionally speaking, in front of students. Amongst the instructors who were invited to engage to the Project, there were some of them who refused to participate, as the others who accepted the challenge suffered of “emotional sickness”, headache, sleeping problems, and other symptoms who caused uneasiness of body.

The lack of psychological support for both the instructors and students in this pilot class was a problem, in a certain way minimized by instructors’, monitors’ and students’ dedication. However, to continue this course, this problem must be resolved.

5. CONCLUSION

At the present moment the pilot class has already finished modules 1 and 2. The students are doing a kind of retooling course named Bridge Course for these modules, as new versions of them were released recently. They are going to start the module 3, in the new version, at the beginning of February, and probably on July 2005 they will complete module 4.

Table 1. Grade Average of Module 1 partial and final exams.

<table>
<thead>
<tr>
<th>Module 1 Performance</th>
<th>60.00</th>
<th>65.00</th>
<th>70.00</th>
<th>75.00</th>
<th>80.00</th>
<th>85.00</th>
<th>90.00</th>
<th>95.00</th>
<th>100.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Exams</td>
<td>Habilitar</td>
<td>Normal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Grade Average of Module 2 partial exams.

<table>
<thead>
<tr>
<th>Module 2 Performance (Final Exam not included)</th>
<th>70.00</th>
<th>75.00</th>
<th>80.00</th>
<th>85.00</th>
<th>90.00</th>
<th>95.00</th>
<th>100.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Exams Averages</td>
<td>Habilitar</td>
<td>Normal</td>
<td></td>
<td></td>
<td></td>
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The academic performance of that group has been above the expected level for a pilot experience, as we can observe in Tables 1 and 2 [7], demonstrating that the methods and tools developed until the present moment have been appropriate and effective. Of a qualitative point of view, the grades obtained in the
evaluations have been excellent when compared with a class with no deficiencies in the same period and using the same instructors.

Analyzing the behavior of the pilot class showing in Tables 2 and 3, we noticed a low performance of group with no deficiencies, in module 1, in the final exam. This result was because 3 students have not accomplished the exams for several reasons.

In module 2, a low performance of Habilitar class is observed, in partial exams 6, 7 and 8. This happened because the absence of a student, caused by health problems, during the exams.

If we do not take these situations into account, we can notice that the performance of Habilitar class is superior to the class with no deficiencies in module 1 and quite similar in module 2.

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To all pilot class instructors, our congratulations for their courage to be part of such ambitious experience.

On behalf of the Universidade Federal do Rio de Janeiro and all technical-administrative-researchers staff of NCE/UFRJ, we are thankful to pilot class students for joining this project. The dedication, the character, the community sense, and most of all, the courage of each one to face this challenge gave to this project a soul.

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