Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 27 (2014) 19 – 27

Procedia Computer Science

5th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion, DSAI 2013

Teaching music to blind children: new strategies for teaching through interactive use of Musibraille software

José Antonio Borges[a], Dolores Tomé[b]*

[a]*Instituto Tércio Pacitti, Universidade Federal do Rio de Janeiro, Brazil*
[b]*Universidade do Porto, Portugal*

Abstract

This paper presents a methodology for teaching music to blind children, based on the interaction with the Musibraille software, to which specific functions were added so it can support the activities of basic music education. The main activities and related functions are described and illustrated. Some essential project characteristics are also quickly shown, especially to explain the big changes it has produced in the role of Braille Music and in the music education of blind people in Brazil.

Selection and peer-review under responsibility of the Scientific Programme Committee of the 5th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion (DSAI 2013).

Keywords: Assistive technology, Braille Music, Blind children education

1. On the difficulties about music teaching to blind children

Music study became recently a compulsory subject in elementary schools in Brazil[1], aiming to provide children with their first deep contacts with the musical universe. This subject addresses three main themes:

* Corresponding author. Tel.: +55-21-2598-3339; fax: +55-21-2270-8554.
E-mail address: antonio2@nce.ufrj.br

1877-0509
Selection and peer-review under responsibility of the Scientific Programme Committee of the 5th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion (DSAI 2013).
doi:10.1016/j.procs.2014.02.004

- Contact with various types of musical manifestation, including various styles and musical expression related to Classical Music and Brazilian folklore.
- Overview of some properties of sound and music: frequency (treble and bass), duration (short and long), intensity (strong and weak), timbre (characteristics that differentiate the musical notes of each instrument), tempo (fast and slow), notions of form (pieces of music), rhythmic cells, etc..
- Notions about transcription of notes and major musical elements in conventional notation.[2]

A special case is related to music teaching for blind children, where the two first themes are quite easy to work, but when we try to teach music writing, some big challenges arise. The technique traditionally used by blind people to write and read music is known as Braille Music, a tactile transcription technique invented in the nineteenth century[3]. This technique is quite effective for people with visual impairments, as it enables the transcription of any conventional musical score, shortly and with small expense of paper, and reading musical transcriptions at great speed, only by touch.

However, hardly any elementary school teacher has a minimum knowledge about this technique. As a consequence, when the subject taught is related to writing and reading of conventional music, a blind student attending to an inclusive classroom is restricted to oral explanations, and as a consequence, its interaction with colleagues in educational activities is greatly impaired, fact described with almost no change from quite old texts[4] until recently, as reported in researches like[5]. It's a common place in the literature to use different strategies when teaching when blind and non-blind are put to learn together, leading to an undesirable dichotomy between Braille writing and conventional musical writing.

On other hand, some hints in[6] suggest a possible alternative approach:

> *"Children who are visually impaired learn music in much the same way they learn other material---with special tools and technology. ... With the right tools, visually impaired children have the same potential and ability as other children to develop their talents and engage in musical creativity."*

In other words, technology would be the key. However, the use of computer programs to teach music to blind children is not so easy, not only due to lack of accessibility of almost all educational programs, generally poorly designed and usually based on the intensive use of the mouse. Sure, there are some music edition programs with good accessibility for the blind or adapted for their use (e.g. Braille Music Editor), but in this case, the reverse occurs: non blind students are segregated or unmotivated by its not so intuitive interface.

It's interesting to notice that even in countries with big cultural development, music education to blind students, when performed outside the environment of specialized schools, is also recognized as a challenge. As stated by[7]

> *"Overwhelmed by what seems to be required, but unable to locate suitable resources, the teacher may still try to do the right thing despite having virtually no tools."*

With this in mind, it would be very interesting to develop an suitable methodology for integrated education of blind and sighted people, in a teaching perspective that would provide better understanding of music theory both for blind and non-blind students. The idea is to teach music using Braille Music techniques as they are fully accessible to blind students working together with conventional writing, with both writing models being exercised the same computer program.

This paper describes a methodological approach to teach music in inclusive classes with strong use of computers new inclusive educational features introduced in the Musibraille Software. In section 2, the basics of Braille Music are shown as it is fundamental to understand the rest of the paper. In section 3 some ideas to teach Braille Music are shown, with particular emphasis to computer technology. In section 4, the Musibraille project, is briefly described. In section 5 the methodology is presented in the form of activities that are executed with the support of Musibraille. Finally, some results and conclusions are shown in section 6.

2. Teaching Music to blind student in inclusive classes: from Braille notes to computer programs

The notes and their duration are the most important components in Braille Music, and Louis Braille organized their coding on a 6 dots (2x3) matrix based on a simple rule: the 4 upper dots represent the note, the 2 lower dots, represent the duration, leading to a basic notation that can be taught in minutes. However, in a set of seven interviews taken with some Braille Music teachers in Brazil, we discovered all of them tend to focus the whole Braille cell not on its formation rule, so teaching a big amount of 6 dots symbols, when compared to the 4 x 2 approach.

While this could be seen as superfluous, it obliges the student to memorize a big amount of symbols (28) just in the beginning. It is not adequate in an inclusive class, where notes and rhythm are taught separately and then tied, leading to the preference of an alternative approach, introduced by one of the authors (Dolores Tomé) in its master thesis.

On the other hand, since the methods are grounded in the principles of "music in ink reading", many challenges to be faced by learners of Braille Music notation are not covered. There are some intriguing differences: Braille doesn't use staves or clefs and the height of the notes is defined by signals octave. The score is presented horizontally, as a text, and the vertical relationships between the parties and notes (music present in ink) are inferred by the reader. All this is really not difficult to learn but scares the sighted teacher, who is trained in conventional music notation.

Another important difference is the reading procedure as emphasized by[8], who describes the technique typically employed by Braille Music readers. Generally, the individual reads a certain number of music information and must retain the excerpt read in memory before playing. This establishes two levels of performance by the reader: the identification of each character read and the use of particular strategies to keep the set of information in memory.

In the world scenario, computers changed the way that blind musicians relate to the music. There are two approaches, both favored by intensive use screen reader or adaptive programs: first the blind musician uses sequencer programs to create musical arrangements, recording by direct playing in music synthesizers, without writing scores; in the second approach, they use computer music editors, normally operated by sighted people, to write musical scores. In both cases, it is not trivial to use the products, and the training involved requires large knowledge on the operating screen readers and adaptive programs, which in most cases are lacking of accessibility. For example, scoring programs are highly visual, and there are only a few that can be used by a blind person[9].

Among the programs that can be used, we can cite Dancing Dots, a Braille Music translator, which can convert files from MIDI and Music XML files that can be exported from standard software like Finale and Sibelius into Braille. These programs have utilities that allow that print music may also be scanned so allowing it to be converted to Braille effortless. But because of the visual properties of music and problems with alignment, it is often the case that a blind person will need sighted help before music which is scanned can be made readable in Braille. Another interesting option is the Italian program Braille Music Editor (BME) that can edit scores directly or imported from Finale. All these products are, unfortunately, too expensive, for most blind.

In Brazil the differences between Braille Music notation and Conventional Music notation till recently lead to many teachers refusing to teach to blind students. Even if a blind person was clearly talented, he would probably not find a good reception in Conservatories and major music schools[10].

The use of computers by blind people began in 1994 via the Dosvox Project[12], who used a particular approach adequate to the cultural profile of this country to digitally include more than 60.000 blind users from 1994 to 2013. Nowadays many of those users could, at least theoretically have access to computer music technology, not only with Dosvox but with other tools like Jaws and NVDA. However, it doesn't happen, and the reason for this is the price of the software, the lack of accessibility and the inexistence of specialized teachers. There are a few exceptions, with almost all blind musicians directed to the production of popular music and vignettes via a sequencer program (Sonar, operated together with Jaws).

This situation begin to change as the Musibraille Project was introduced, producing a critical mass of teachers interested (and apt) to teach music writing to blind people using computers.

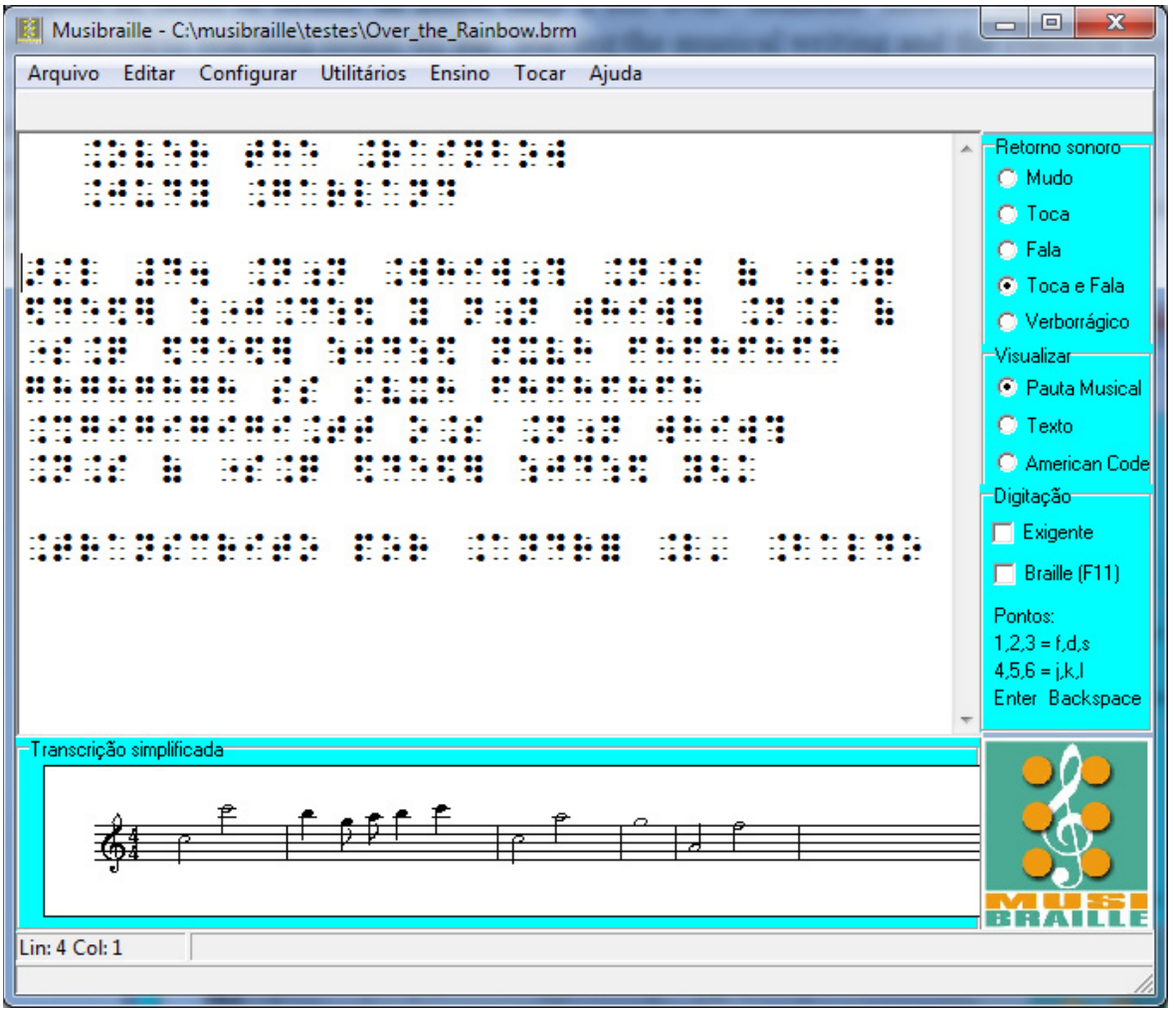

Fig. 1. Musibraille Music Editor – main window

3. The Musibraille system, the central part of the methodology

Before knowing the details of the methodology, it is important to know the Musibraille project and the Musibraille software because they are foundations that allow new methodologies to be applied and disseminated.

The Musibraille project started in 2009 aiming to facilitate the training of professional music education of blind students at undergraduate level in music courses of major Federal Universities of Brazil. As stated previously, in these courses, it is common for music teachers not to have knowledge of Braille Music, so refusing to teach blind students, thinking that those students wouldn't be able to read musical scores effectively.

The situation at that time showed also a big decline in the use of Braille (and consequently of Braille Music) in the country, due to the increasing use of recorders and computers[11]. To illustrate this decline on Braille Music in Brazil, in 1954 there were 19 teachers of this subject in Instituto Benjamin Constant, one of the reference centers for the education of blind in Brazil. In 2008, only 2 left over! Students' interest was also very small and, finally, they also surrendered to teaching music by ear, leaving the musical writing and the classical music training aside.

A new teach methodology, based on concepts explored by the master thesis of one of the authors (Dolores Tomé) and using particular software (Musibraille), was then established. This was the first software in the Portuguese language for transcribing music to Braille.

Fig. 1 shows a Braille score created with Musibraille, also showing a transcript in simplified conventional music notation, which serves as the reference for the transcriber.

The creation of a Braille score can be done by direct Braille input from the keyboard or automatic transcription from a MusicXML standard format file, which can be produced by conventional music editing programs. Musibraille has also a built-in dictionary that eases search and transcription of Braille music symbols, and some other facilities for conventional and Braille printing. Musibraille is available free of charge via the Internet. More details about this software can be found in[13].

By 2012, spite of having many facilities to easily create Braille scores, including a very practical dictionary, and some other utilities, Musibraille was not taught like a music teaching environment for beginners. However, during the 15 courses we applied in Brazil, we noticed that blind and non blind students frequently cooperate, and learn together, as the accessibility of the software is very good (including a built in specialized screen reader). Some of these students were young, and were able to experiment with them many ideas related to music education, like perception of notes, intervals, duration, rhythm and so one, and this gave us a good feeling of a certain number of functions that would be interesting. This contact helped us to define a set of new functions for the program, together with methodological ideas about how they should be used in music education.

4. A new methodology for the integrated music teaching for blind and sighted students

We describe now the functions we implemented, suggesting how its use was thought. We tried to help from the initial contact with dots writing, necessary so non-blind students feel comfortable to interact, to simple editing functions that prepares the student as to become apt to use the Musibraille program main functions.

The following steps correspond to a teaching sequence, not a sequence on time. The time can vary from minutes to several days depending on the previous experience of students in Braille or in its capacity to absorb or its interest. The training is done like playing educational games, in which blind and sighted share the same environment, based on the methodology of Braille writing, but this should not be explicitly stated.

a) Exploring the Braille dots

Teaching begins presenting (orally) the six points of the Braille cell, numbering them from 1 to 6 on a column basis. Then we associate three fingers of the left hand and 3 from right to Braille dots, as it was a Perkins Braille Typewriter keyboard.

Musibraille is then started and the "Learning Braille Dots" function called, as shown in Fig. 2. This function tells the number of the point when the finger reaches corresponds to FDS and JKL keys. The dots of the cell are “on” when the finger presses, “off” when the finger is removed.

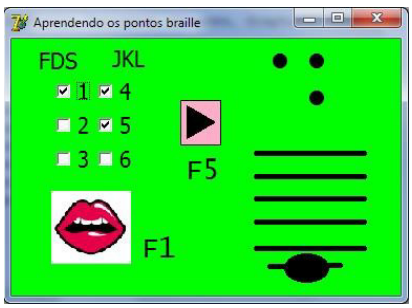

Fig. 2 – Learning Braille Dots Function

b) Learning letters

This same program function allows talking dots numbers, or the corresponding letters or the name of the notes. Although the program know all the names of letters in Braille, during training we should only type the letters A through J (even A to C not being used to represent music notes). As in usual typing Braille programs, this program tells the name of the key only when the person removes his fingers.

c) Learning music notes

This is a game, where the objective is to play up to 7 notes in sequence. The game is played in 10 phases. The game plays the sound but also shows the drawing in conventional notation and Braille. The notes are typed in Braille or ink. In the case of Braille, the letters to represent each music note (D, E, F, G, H, I, J). In case of ink the American notation is used (C, D, E, F, G, A, B), and that it is important not to be confused during the "game"!

The program also has options to speak the name of the note, play the note or sing.

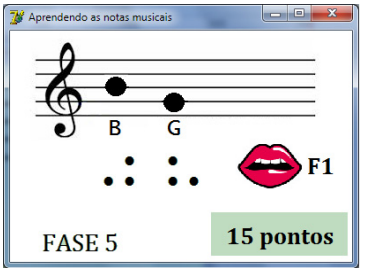

Fig. 3 – Learning music notes

d) Discovering timbre

We inform the student that there are several musical instruments available. The student then selects an instrument within the program, then plays notes (pressing the upper 4 Braille dots) to realize the difference in timbre.

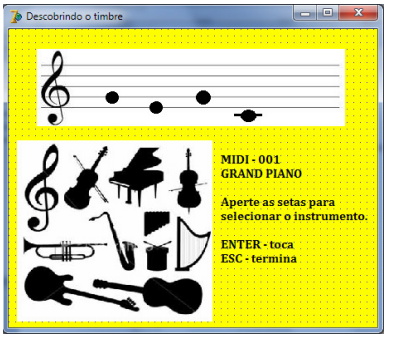

Fig. 4 – Discovering timbres

e) Identification of music notes

The teacher produces a little dictation, playing just two notes: Do and the Sol. He repeatedly asks that students to type the corresponding note on the "Braille keyboard". Then he produces sequences of 2, 3 and 4 of these same

notes, Do and Sol, asking the students to repeat. As progress continues, the same activity is extended, with each new activity encompassing more and more notes.

f) Learning how to play a piano keyboard, by simulation

The "mini keyboard" function is enabled. This function, shown in Fig. 5, showing a small keyboard (from DO to SI), which can be played with the mouse or typing the keys ZXCVBNM, being also accepted the typing in Perkins' style. Many kinds of exercises are possible here, including both the simple recognition of notes, and playing simple melodies in real time.

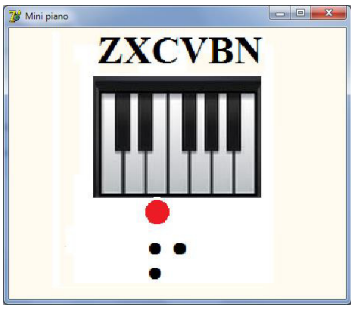

Fig. 5 – Mini keyboard function

g) Recognition of high and low notes.

The "mini keyboard" function can also represent a keyboard with two octaves, the keys being associated to ZXCVBVM and QWERTYU. The student must recognize if a given note belongs to the first or second octave. After this we should use the Perkins' typing to indicate the pitch, then the note, using initially 5th and 6th octaves and then other octaves. The program has the ability of speaking the name, playing or singing a note.

h) Drum Voice Recognition and playing

The "mini drum" function , shown in Fig. 6, associates some keys to drum sounds (kick, snare, cymbals, etc.). The student is provoked to recognize these sounds and play simple sequences produced by the teacher, possibly also with real instruments, if available.

This function also has facilities for playing rhythms and recording drum sequences in real time. The teacher has then several possibilities here, depending on the interest of the students.

Fig. 6 – Mini drum function

i) Rhythmic recognition

The most important function, essential for the perception of how music is written is the production and perception of a sequence with eighth, quarter , half and whole notes. For this, we use combinations of keys S and L (the same used in Braille to indicate rhythms – dots 3 and 6). When these "dots" are triggered an organ sound is produced, with equivalent duration.

This function also allows the entry and record rhythms, which can then be played back with the sound of drums. Optionally the sound can follow a metronome that accompanies this reproduction being also possible to select timing alternatives.

j) recognition of musical sounds with rhythm and rests

The "pianette", shown in Fig. 7, is the most complex. You can also activate the production of sound using real midi instruments, connected externally to the computer. This functions is close to real music data entry, and allows the blind student to explore many options, independently or not of other students. For sake of simplicity the facilities available will not be described in this text.

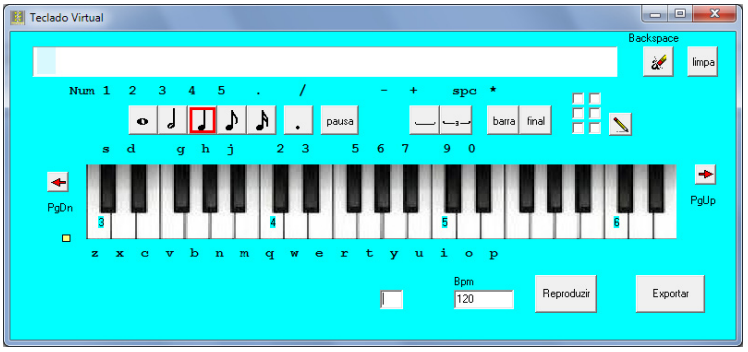

Fig. 7 – the "Pianette" function

Finally, it is important to note that this set of functions represents a methodologic starting point, and may be used by the teacher in many different ways. We must also reaffirm that we will be building additional functions aimed to support music education as the methodology evolves, as new ideas are presented by the teachers who apply it.

5. Conclusion

As previously shown, the Musibraille now incorporates the functions aimed to teach children, so enabling that many interesting educational experiments and approaches can be performed. Our intention is to incorporate facilities with educational purposes.

In the first Musibraille courses, the prerequisite to use the software was the basic knowledge of conventional music theory. However, there were always a small number of people who knew nothing about music, specially blind people. So these people were separated from the group and differentiated training was given, always performed by one of us (Antonio Borges), using early versions of the methodology we have shown in this paper.

Among those who received this special training we highlight the presence of a few blind adolescents. It was just these teens who most influenced the definition of technical and pedagogical changes in the software Musibraille, perhaps because they accept and operate with greater ease the computer along with accessibility tools (which was

not a prerequisite for the course). We can say that preliminary experiments produced a very encouraging result: almost all people with low knowledge in music, with to whom we applied this methodology during Musibraille courses (circa 35 people) achieved a minimum level of knowledge that allowed them to complete their course, which would be impossible without this action.

The foundations that have enabled the creation of this methodology are extensions Musibraille the program, but one should not think that the main objective is the formation of new blind or sighted Braille music transcribers! The main idea is that during the initial period of learning, blind and sighted people can comfortably share a "interesting computational toy ", which brings underlying pedagogical advantages, being applicable to different audiences.

The Musibraille Project is the structure that will disseminate nationwide the proposals and methodological ideas contained in this paper, ensuring they are widely distributed throughout the country. It is our hope that the human network that has been created, interconnecting Musibraille users and teachers, will be able to support these ideas, allowing that quality inclusive music education for blind children quickly become reality across the country. The future of this research involves the evaluation of this technology and methodology to disseminate Braille Music education in Portuguese language countries in Africa, subject of a doctoral thesis of one of the authors (Dolores Tomé).

References

1. Kaiado, K. and Laplaine, A.: The Inclusive Education program: the right to diversity – an analysis from the point of view of administrators of a hub municipality. *Educação e Pesquisa* vol.35 nº2. São Paulo, Brazil (2009)
2. Mateiro, T.: Education of music teachers: A study of the Brazilian higher education programs. *International Journal of Music Education*, 29(1), pp. 45-71. (2011)
3. Marsan, C.: *Louis Braille: A Brief Overview*. Association Valentin Haüy, Paris, France (2009)
4. Zeeuw, A.M.: Teaching College Music Theory Classes That Include Blind Students – College Music Symposium – vol. no. 2 – 1977 - online at http://www.jstor.org/stable/40373893
5. Bonilha, F., *Leitura musical na ponta dos dedos: caminhos e desafios do ensino de musicografia Braille na perspectiva de alunos e professores*. Master in Music Thesis (in portuguese) - Universidade de Campinas, Brazil (2006)
6. Sessoms, G. - How to Teach Music to Visually Impaired Children - online at http://www.livestrong.com/article/225097-how-to-teach-music-to-visually-impaired-children/
7. Smaligo, M. = Resources for Helping Blind Music Students - *Future Reflections* - Spring 1999, Vol. 18 No. 1 online at https://nfb.org/images/nfb/publications/fr/fr18/issue1/f180105.htm
8. Boyer, A.S. - "Rehearsal and Recognition of Braille Music Melodies by Skilled and Less Skilled Braille Decoders." *Journal of Visual Impairment and Blindness* (Nov/Dec. 1997): 593-5.
9. Elsea, P. - Technology and the Blind Musician – 1999 – online at ftp://arts.ucsc.edu/pub/ems/accessibility/Tech&BlindMus.pdf
10. Borges, J. A., Tomé, D.,: The Musibraille Project - *World Congress Braille21 - Innovations in Braille in the 21st Century*. Leipzig, German (2011)
11. Borges, J. A.: *Do Braille ao Dosvox – diferenças nas vidas dos cegos brasileiros*. PhD in Computer Engineering Thesis (in portuguese). COPPE/UFRJ, Rio de Janeiro, Brazil (2009), online at http://teses2.ufrj.br/Teses/COPPE_D/JoseAntonioDosSantosBorges.pdf
12. Borges, J.A.: *Dosvox – a personal perspective* – text submitted to the Lawler Awards – 2006. Online at http://intervox.nce.ufrj.br/dosvox/textos/lawlerText.doc
13. Borges, J.A, Tomé, D, - The Musibraille Project - Enabling the Inclusion of Blind Students in Music Courses - *International Conference on Computers Helping People with Special Needs (ICCHP) 2012* - Lecture Notes in Computer Science Volume 7382, 2012, pp 100-107