

# MUS4VIP PROJECT

## Final Report – Public Part





## Project information

Project acronym:	Mus4VIP
Project title:	Music for Visually Impaired People/ Mus4VIP
Project number:	530990-LLP-1-2012-1-IT-KA3-KA3MP
Sub-programme or KA:	KA3
Project website:	<a href="http://www.mus4vip.org">www.mus4vip.org</a>
Reporting period:	From 01/11/2012 To 28/02/2015
Report version:	1
Date of preparation:	25/04/2015
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This project has been funded with support from the European Commission.



Education and Culture DG

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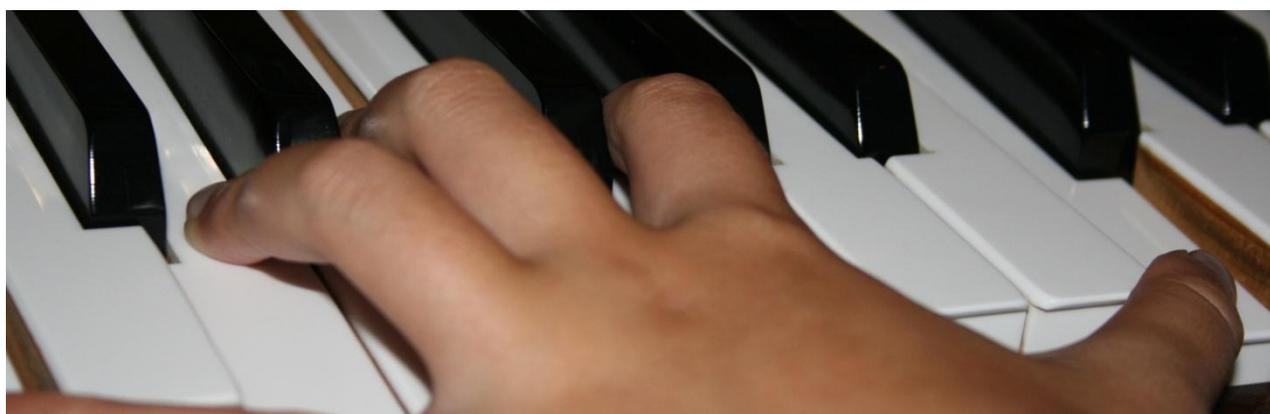
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## Executive summary

This document is intended for wider public communication, which is as important as communication in scientific contexts. After a section concerning the background and motivations of the project, we present a short overview of the proposed solutions, and finally our outcomes and plans for the future. Special attention has been devoted to contribution to European policies.

After the paragraph on background and motivations, we offer a short description of the main problems concerning music studies by blind persons of all ages. We outline the current situation and we indicate the main difficulties faced by a blind individual, both in special and in mainstream schools, in learning music not just by ear, but through direct and personal access to music scores, without external assistance.

Next we give a short overview of recent perspectives opened up by IT technologies, in the framework of specific European projects. Finally, we present the main objectives of the Mus4VIP projects, outcomes, plans for the future, how the project contributes to European policies in the domain of education, culture and equal opportunities.





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## 1. Project objectives.

The main goal of "Mus4VIP" is to close the gap between Braille music and its non-sighted users.

This goal was achieved by designing, developing and testing a new didactical methodology, capable of exploiting the new software, in an integrated educational context.

The project is also address the fragmentation in this area; this approach brings together different groups working in different countries. The project has developed a learning pathway that will promote wider adoption of Braille Music by encouraging its integration within mainstream environments.

The Mus4VIP project includes the creation of a web portal that offers teachers of blind music students methods of working, guides and didactic solutions to take full advantage of information technology.

### 1.1 Background and motivations

Although music is the only form of art totally accessible to blind people, only a very limited number of blind individuals have access to music literacy, but music literacy is indispensable for music studies and can be considered a formal written language. Braille music notation is the traditional method that allows a blind person to read and write music scores. In other words, a blind person is able to learn and compose music using the Braille notation, although with a greater mental and physical effort than his sighted peers.

Nevertheless, in the last 40 years, music studies have dramatically declined among the blind, owing to the difficulty in finding appropriately trained teachers in mainstream schools.

The main reason for this is the gulf between common music notation and Braille music notation. Indeed, while common music notation is able to represent the main musical elements in an intuitive manner, a Braille score is more like a town

with no windows and no signs, so that the reader finds every single element on his way, but is not able to get an overview of the page.



This distance between the two kinds of music notation has several negative implications, which discourage blind people from learning music in a formal way:

a) it requires well trained teachers;

b) transcription into Braille music is both time-consuming and expensive;

Furthermore, since Braille is based on tactile reading, the blind music student is generally obliged to separate reading and playing. In other words, blind musicians, with the exception of singers, are obliged to read a fragment first, before being able to play it. This represents a significant challenge, especially for beginners.

## 1.2 The current situation

Nowadays, the vast majority of blind musicians memorise their scores using different strategies, based either on learning by ear, or on verbal description of the score.



In other words, the beginner listens to the teacher playing the first studies, or to a professional recording, and he or she imitates the teacher first, and afterwards learns the score from memory (Learning by ear).

Alternatively, especially for more complex pieces, the student has a friend, often a parent, who either directly, or in a recording, describes what he or she sees on the music page, one element after another. This takes time and very hard mental effort both for the sighted reader and for the blind student (“Spoken Music”).

Despite the difficulties in using the above mentioned strategies, in different combinations, some blind musicians nonetheless manage to achieve astonishing results.



## 2. Project Approach

### 2.1 Proposed solutions

Our experience in the field of education, and of music teaching, suggests that, rather than jettisoning currently adopted solutions, which, although very labour intensive, produce some results, it is worthwhile looking at their positive aspects.

New perspectives offered by IT technologies, in particular the combination of different sensory channels in a flexible way, as well as our experience of more than 15 years, has enabled us to develop an innovative solution, based on all the strengths of current solutions, i.e. Braille, learning by ear, spoken music.

Specifically, the blind student is able to choose any combinations of: a) Braille display (paperless Braille); b) Braille printer (paper Braille), c) sound, that is to say, listening to the notes; d) verbal description (spoken music).

It must be added here that the Braille music score, originally a city with no windows and no signs, is processed by our software in such a way that it becomes a well-structured database, where the blind student can move and navigate in different ways, such as note after note, bar after bar, part after part, etc. In short, he can act as a visitor to a city with a very accurate map in his hand, able to move towards a precise location, or to explore a given surrounding. He can walk or run, jump or stop as long as he likes.

This was the result of several different European projects, e.g. Play2, Ebrass, Contrapunctus.

Our new challenge now is to develop effective didactical strategies, along with appropriate tools, aiming at establishing and disseminating an innovative method for teaching music to blind students, both in special and in mainstream schools.

## 2.2 Project Approach

Our approach is based on two general principles:

- a) Learning by doing is more effective than just learning by listening;
- b) Learning to read and to write music is very similar to learning to understand a non-native language you speak every day. The big difference with music is that in most cases the student is able constantly to monitor his work by listening to what he/she is writing.

Our approach therefore can be considered as interactive learning, where the two sensory channels make up an integrated system of trials and errors, under constant monitoring by the student himself.

Mus4VIP therefore seeks to overcome learning, understanding and memorisation problems by exploiting the best available resources, both in terms of the functioning senses (touch and hearing), and the best possible use of existing technology based on these two senses.



## 2.3 Project outcomes & results

The outcome of this will be to promote Braille music literacy, because hearing and touch will support each other in the complex process of deciphering and comprehending music as a language.

In particular, the project:

- Has developed an educational methodology that will attract students and support teachers in the field of accessible music.
- Offer the opportunity to develop training materials in a collaborative way, taking into account knowledge and understanding of the cultural differences between the various participating countries (each country has developed its own local Braille language, with small, but significant differences; the project consider this aspect, by collecting and systematically organizing the differences between countries).
- Help young visually impaired students to develop a more attractive and accessible method for studying music, bearing in mind what an important contribution music can make to an individual's intellectual and psychological development.
- Help new generations of teachers, teaching assistants and lecturers to acquire specific basic skills in the area of accessible music, by offering them powerful resources and workplace opportunities, both in special schools and in institutions devoted to training the visually impaired.
- Has develop, test and disseminate new teaching models in the areas of Braille music theory, reading and writing, based on the use of new technologies.
- Has created a collaborative process among schools at the European level, aimed at improving both basic training and services for music teachers and other categories of people working in schools, such as teaching assistants for visually impaired students. The purpose of this collaboration is to exchange experience, with a view to developing new teaching strategies

aimed at improving music teaching quality and the use of Braille both in schools and special institutes, particularly in those classes with one or more visually impaired students.

- Has develop a guide to the use of available computer tools that meet the training needs of teachers at primary, secondary schools of theoretical and practical subjects in music conservatories and music high-schools, considering the conditions of each participating country in terms of school integration and education provided by special institutes.
- Dialogue with projects and networks that operate on the same themes.
- Improve the quality and European dimension of training for teachers of visually impaired students;
- Promote the development of contents, services, pedagogical solutions and innovative practices based on IT in the field of permanent learning.
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## 2.4 Overview of results achieved

The Mus4VIP consortium has developed and realised the following products:

### 1. A web portal for distance learning.

A web portal [www.music4vip.org](http://www.music4vip.org) for publication of lessons that can also be used as a form of distance learning.

It includes versions in 4 languages: English, Italian, Polish and French

### 2. Music theory handbook, containing all examples and notational elements in the BMML format. As for the format and the contents of the units, on the basis of data collected through interaction with users and

teachers, it was necessary to devote special attention to the young blind students who face the Braille system and its music theory for the first time. This has brought us to create a new specific teaching aid, whose main purpose is to acquaint the young student with both some features of his/her PC (especially useful for the next phase of the study) and the peculiar concepts of Braille music notation which do not correspond with common music notation. The original book has been enriched by a special section called “stay in tune”. This section aims at ensuring that the blind student “keeps in step” with his sighted peers. The section contains all the special information and instructions concerning Braille music notation, following the different topics dealt with in the corresponding chapter. Testing and exercises accompany each chapter. Relief tables ensure that the blind student understands specific terms and concepts belonging to common notation, which have no application in Braille notation, i.e. stave, clef, etc.

### **3. Inclusive acoustic Manual with examples in relief ready for Braille embossing.**

This manual was not planned in the original project and it has been added, because at the beginning of the project, after several contacts with the users, some common problems were pointed out. The users complained of a complete lack of Braille material on acoustics. Currently there is no systematic tactile material available representing the most acoustic common concepts, such as waveforms. The deliverable was created in order to offer relief pictures of some examples of acoustics images that have been simplified and made available in order to be downloaded and embossed using a Braille relief printer or a Tiger graphic relief printer.

The handbook is realised in 4 languages (English, Italian, Polish and French).

#### 4. Development of a music program (called Braille Music Learning)

The project realised a new interactive piece of software with the following main functionalities:

- 1) handle music text using a simulation of Perkins Brailler (a very popular aid for Braille writing);
- 2) work with the traditional alphanumeric text;
- 3) Have the screen readers able to pronounce the lessons' text
- 4) Output of audible notes and examples that are part of the lesson
- 5) Synchronization with the script by the projects realised with the Jaws screen reader.

A specific lesson deals with introduction to this piece of software, and it includes a test and verification module. The program and script for "JAWS" screen-reader are available free of charge and can be downloaded from the project portal. The program interface is realised in 4 languages (English, Italian, Polish and French).

#### 5. Teaching units.

The original number of 16 has been enlarged as follows:

**8 lessons for children are contained** in the Braille Music Learning software, to be read with the BML program. The 8 lessons can be downloaded along with the BML program here:

[http://www.music4vip.org/braille\\_music\\_learning](http://www.music4vip.org/braille_music_learning)

The 8 lessons have been realized in 4 languages (English, Italian, Polish and French)

**21 Teaching units.** In order to offer the teachers some concrete examples about how they could, in future, create didactic units for their training activities, exploiting the computer tools, several didactic units for different tools and different levels of competence have been created. These didactic

units have served as models for all the teachers that participated in the trial phase. On the basis of such models, the teachers were asked to realize similar didactic units and to prepare the lessons for their students using the BME2 program and the Braille music texts from the graphic music program Finale that is used by sighted musicians. The conversion have been done using the conversion portal service. There are currently 22 tutorials divided by instrument: Piano tutorials, Singing tutorials, Trumpet tutorials and 3 about Learning Braille music notation

The 25 didactic units are realized in 4 languages (English, Italian, Polish and French).

- 6. Videos for teachers.** We have produced 7 videos dealing with: Braille, music and Braille, communication for blind people, ear training and a presentation “how a blind musician can read and write music using Braille Music Editor”.
  1. The Braille system (in English, Italian, Polish and French)
  2. Communication and blind people (in English, Italian, Polish and French)
  3. Hearing and its role in communication as compared with other senses (in English, Italian, Polish and French)
  4. The music and musical education for blind students. Why study music.. (in English, Italian, Polish and French)
  5. Writing Braille music (in English, Italian, Polish and French)
  6. The computer aids for music (in English, Italian, Polish and French)
  7. BME2: How can a blind person access and make music without an external help (in English)

### **7. Database of Braille symbols available on our project portal**

The portal includes a database of all the Braille music symbols for an easy and quick consultation by the music teachers and students. We know that it is really difficult to remember several hundreds of existing music symbols and therefore this tool offers an immediate and quick service. The user are able to type a given sequence of Braille symbols which form a music element and obtain all the relative correspondences, including a short description of each symbol in different contexts - that is for different instruments.

This service is realised in English.

### **8. Database of music glossary**

A set of elements of Western classical music is listed in the alphabetical order in a glossary, including some music examples. The glossary can be used by music teachers providing them with an opportunity to find the required terms and also some music examples in English.

*This service is realized in English*



## **9. Online activation of two conversion programs for automatic transcription of music from MusicXML and Lilypond to Braille BMML**

The following modules can be activated on line by the user.

### **MusicXML (also version 3.0) to BMML converter**

This is a really useful and important service for all those teachers who wish to produce Braille music scores starting from a traditional electronic format score. This tool facilitates the production of scores, examples and Braille exercises also for those who have only a poor knowledge of Braille music syntax.

The user is asked to upload the file in a traditional format and then save the corresponding version in Braille Format. The service is offered for free and is completely automatic and will make obsolete the expensive current manual services of Braille scores transcription.

As described above a conversion module was created not only for the conversion of MusicXML 2.0 to Braille, but also for the conversion of MusicXML 3.0 to Braille. This second activity is in addition to the original plan.

### **BMML to MusicXML converter**

It should be noted that this deliverable was not expected in the original project but it has been added as a further activity. The service offers the opposite conversion process compared to the previous one allowing all the blind musicians to exchange their work originally written in Braille with their sighted colleagues. The service consists of a conversion program from the electronic BMML Braille Music Format to a new format compatible with hundreds of commercial music editors used by sighted musicians. The program is available to be used online.

*This conversion service is realised in English, French, Italian and Polish*

### **Lilypond to BMML converter**

It is a conversion program from the Lilypond to the Braille format.

LilyPond is a compiled system: it is run on a text file describing the music. The resulting output is viewed on-screen or printed. In some ways, LilyPond is more similar to a programming language than to a graphical score editing software.

LilyPond is written and edited by volunteers. It is distributed by the GNU General public License and the GNU Free Documentation Licence that allows everybody to modify the program. On the Internet you can find thousands of scores and LilyPond is very useful for blind people in order to provide Braille format scores (visit the website of Mutopia).

This service offers the possibility to convert a Lilypond format score into a BMML format. Unfortunately, there are many dialects in Lilypond and therefore it focuses the attention only on a pre-defined model.

*This conversion service is realised in English, French, Italian and Polish*

## **10. Tutorial for XML and MIDI.**

**In addition to what was originally planned, the UT2J partner has produced 2 tutorials as described below:**

- 1) How to prepare an easy piece of music for piano, a typical example of the early years of study. Bach: "Minuet in G major, BWV Anh. 114, from the Notebook for Anna Magdalena"
- 2) How to get Braille music from Midi.

The two tutorials are realized in the 4 consortium languages

In addition to the services of the mus4vip.org portal the project realised the following activities:

**11. Develop supporting materials for the pilot phase**

**12. Practical pilot course and experimentation activity**

of the solutions and services provided by the portal.

**13. Evaluation and Quality Assurance**

Realise a document of the Evaluation plan (all the stages, the elements, the protocols, the questionnaires and the documents related to the assessment phase)

**14. Evaluation of the training activities.**

Thanks to the information gathered by some of the questionnaires we reported the users' satisfaction rating and collected reports on the evaluation of the online conversion system of the portal carried out by some users.

**15. Dissemination activity**

We have made every effort to draw benefit from every means of communication that is compatible with our knowledge, competencies, abilities and within our resources. In particular our consortium organized / participated in 58 events, including Publications / media, Newspaper, Newsletter, Seminars, Conferences, Workshops, Technical meetings, Fairs. Some very promising contacts have been activated with institutions outside Europe (Brazil, Japan). A very prudential estimation would show that 800 thousand persons have received information about our project at least once during the whole project life.

## **16. Exploitation of results**

The purpose of this document is to outline the steps to be taken to ensure that the work of the project can continue and remain relevant after the project ends.

### 3. Partnership

All of the Mus4VIP project partners are organisations with a strong European presence in supporting visually impaired people: this trigger greater cohesion and integration in Europe.

In particular, the Mus4VIP consortium consists of associations representing users, music schools specialised in teaching the blind, who have reached very high quality levels in the domain of music teaching, e-learning, music psychology, electronic music archiving, interactive editing (European Project Musicnetwork), accessible solutions in the domain of music (Play2, Contrapunctus).

The following is a brief description of each of the consortium partners

#### **Conservatorio Statale di Musica di Padova “Cesare Pollini”.**

(<http://www.conservatoriopollini.it/>) The tradition of teaching music in Padua dates back to the Renaissance. In 1577 the "Accademia degli Elevati" was founded with the purpose of "training instrumentalists and singers". In the years that followed the teaching of Music took place in the university, until, in 1878, the Conservatory was founded. The Conservatory has a strong tradition of teaching music Braille.

#### **EKMS - Edwin Kowalik Music Society**

([www.idn.org.pl/towmuz](http://www.idn.org.pl/towmuz))

The Edwin Kowalik Music Society is a non-governmental organisation, registered as an organisation of social utility. It consists of 40 members, both blind and sighted. It was set up in 1998, by a group of blind and sighted music lovers, dedicated to continuing Edwin Kowalik's effort to promote the activity of blind musicians – those still in education and those performing music either as amateurs or professionals.

**I.Ri.Fo.R. (Istituto per la Ricerca, la Formazione e la Riabilitazione (Institute for Research, training and rehabilitation)** (<http://www.irifortoscana.it/>) is a non-profit organisation, registered as an organisation of social utility. IRIFOR was founded in 1991 by “Unione Italiana Ciechi e Ipovedenti” (UICI) (Italian Union of the Visually Impaired).

**Arca Progetti SRL.** ARCA Progetti s.r.l. (<http://arcaprogetti.veia.it/>) is a private company based in Verona, Italy, whose primary activity is the design and development of music software solutions for blind students (BME2 editors, music interfaces). Collaboration with Europe's chief associations and libraries for the blind, particularly with the Italian Union of the Blind, European Blind Union, has led to an unrivalled expertise in accessibility, in conjunction with the professional use of innovative technologies.

**New College Worcester** ([www.newcollegeworcester.co.uk](http://www.newcollegeworcester.co.uk)). New College Worcester (NCW) is a national residential school and college for young people aged 11 to 19 who are blind or partially sighted. Every student receives an individual programme of education, mobility and Independent Living Skills to support them in reaching their full potential both in and outside the classroom. Music is a very important part of the curriculum and many of the students study one or more instruments.

**UT2J Université de Toulouse II – Le Mirail, Department: IUFM Midi Pyrénées**

**Equipe: SIG-TOBIA, IRIT**

An area of activity at UT2J is research into Didactics and Teacher Training. UT2J organises a preparatory course for qualification for the teaching of music, and a Masters course in Music Education and Training.

#### 4. Plans for the future

The outcome of MUS4VIP is hopefully a set of innovative proposals, aimed specifically at the revival of music literacy among visually impaired students and non-students in Europe. Our common experience, our realistic attitude, has helped us to develop credible and feasible methodologies. Our hope is that the fruit of our common effort will yield at least the foundation of the actions and initiatives listed in this exploitation plan.

We believe that outcomes of our work, although it concerns a very specific subject area, contain different elements which can be transferred to other domains in the broader field of education and of rehabilitation, such as scientific studies. In particular, the idea to use interactive learning, combining different sensory channels, should bring benefits to all researchers and teachers whose aim is to improve attractiveness and effectiveness of their didactic tools and strategies.

Last, but not least, we have already developed a concrete idea that the adoption of our new format can really improve the quality of traditional services provided by Braille music libraries. Old and valuable works produced using traditional methods (paper, old software) will not get lost, but, on the contrary, will be revived through our new tools, and therefore contribute to close a virtuous circle between tradition and innovation, which are often perceived as incompatible. This, in turn, can generate new solutions in different fields, contributing to the overcoming of critical situations of different kinds, opening new and unexpected perspectives.



## 5. Contribution to EU policies

The Mus4VIP project aims to harness Information and Communications Technology (ICT) to develop innovative education practices in the field of music training for non-sighted users in conventional schools, music institutes, Universities and conservatories. It also aims to improve access to all levels of education and training, from elementary schools up to special music and composition and adult training courses, and helps develop advanced management systems.

The project is addressed to users of all ages in a transversal form, as indicated in the EU Programme for permanent learning about ICT promotion, and supports action on the general issue of content access and learning practices in the field of music.

The use of computer tools in the specific field of music training for the disabled has had an even more limited impact in recent years, if compared with other contexts. Mus4VIP wants to fill in this gap by making ICT integration actually possible in the education system, in order to outline teaching methods that will be able to modernise current practices. Thanks to the support of ICT, the Mus4VIP solution, which provides exploration of new pedagogical and teaching possibilities, facilitates the study of music scores, because it allows students to select significant music elements through hierarchical levels. The ability to write, process and listen to written music texts are all factors that help create new and more effective teaching and operational support models, also from the viewpoint of organisational innovation. It is known that ICTs are now embedded in our social and economic fabric; and they are becoming more and more indispensable for blind people's access to information and communication. Therefore, the project has the objective to promote large-scale dissemination of ICT in the field of education and music training, at all levels.

Mus4VIP is not about promoting technology in itself. Instead, thanks to previously developed solutions provided by such EU-funded research projects as

Play2 and Contrapunctus, it wants to boost the use of technology to enhance learning environments and support further experiences in the field of music for blind users.

To this purpose, the project has started a programming and a pilot stage that includes simulations in a real context. Young learners especially have discovered how to manage music with computers, with such operations as the selection of a part, a hand, a measure, a voice; of fragments for simultaneous reading and listening with respect to music sheets. This was highly attractive for the young, besides representing a significant tool for adults and for all those who are interested in music writing and composition. Even those who have found it difficult to manage Braille syntax will be attracted to studying music. By focusing on the use of a Braille-related music editor, Mus4VIP facilitate MIDI access, as well as the possibility of controlling MIDI keyboards, thus making the study of music theory more interesting. This attract back to the music world, for example, non-sighted and early leavers of music study, even outside conventional educational environments.

Mus4VIP is part of ICT Ka3 Transversal Multilateral Projects because it supports development and reinforcement in the field of permanent learning, especially of musical resources in digital format. These services are made available through the project's portal, with the purpose of disseminating and promoting the digitisation of music texts, also indicating pedagogical and practical solutions for music learning, with the acquisition of permanent competence in musical Braille

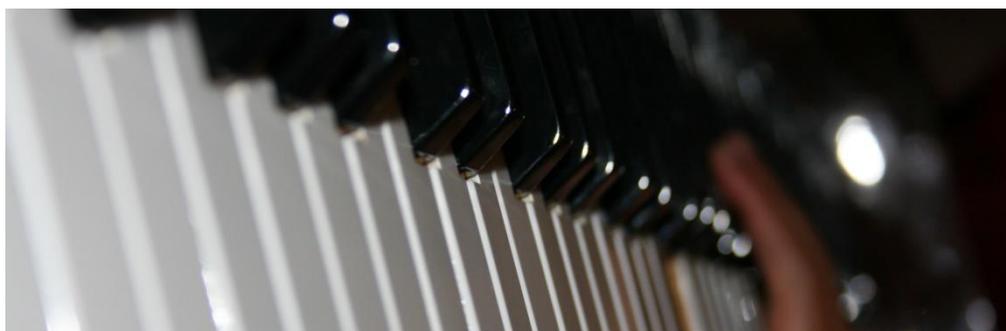
## 6. Impact

In order to better understand the expected impact in its different aspects, we are going to describe our work hypothesis, then we offer a short overview of the present situation concerning music studies for blind persons; after which we will present a short list of our products, and finally we will illustrate the impact of the innovative solutions in their different aspects.

### **Work hypothesis.**

We assume that music notation is one of the written formal languages, like mathematic notation, or like any known alphabet. Braille music notation should be also considered a written formal language, with its alphabet, its lexicon, its syntax. Braille's main limit is the fact that it can use only 64 symbols, which are normally arranged in a linear form. Common music notation on the other hand can rely on a 2-dimensional representation of music elements, and on a vast variety of graphic symbols, many more than 64. Furthermore, while common notation offers a visual image of the main music elements (structure of the piece, one-part / polyphonic texture, notes and attributes, such as fingering, slurs, etc.), Braille notation does not allow an intuitive association between graphic symbol and musical event.

**Learning by doing** is more effective the learning just by listening. At present blind persons have really almost no opportunity to experiment with learning by doing, except in a very limited number of examples, such as learning Braille using a 6-dot keyboard associated with voice synthesiser.



These factors produce a very relevant distance between the two music notation, the common notation and the Braille notation, a distance which is much bigger than the existing difference between literary notations. In other words, Braille alphabet can be understood in no longer than 5 minutes, although it requires months of practice in order to be mastered and in order to be able to teach it. Braille music notation, on the other hand, requires much more time to be understood, and consequently a long training in order to be able to teach it.

This circumstance has some important consequences, which have been illustrated in the above mentioned deliverable: a) few trained teachers; b) Braille notation discourages beginners; c) Braille transcriptions are often expensive and require long production time; d) need for extensive external help when it comes to writing homework or new compositions; memorising is very tiresome and errors are very easily made, especially in case of a new modern piece, where the ear is not so reliable.

### **Proposed innovative solution**

Our solution is based on a new xml format, called Braille Music Markup Language (BMML), which in turn is a subset of xml format.

The first innovative aspect of this solution is the fact that Braille is no longer just a way to represent a text coming from outside. On the contrary Braille becomes the balance for a new way of approaching music. Indeed Braille, with its limits (only 64 symbols), and its strong point (extremely precise in representing music elements), can be the foundation of a new format, which is fully compatible with the very popular MusicXML format.

In this way Braille becomes a bridge between common music notation and special music notation, and gives the opportunity for the best possible communication between sighted musicians and their blind peers, and vice versa.

The second innovative aspect of our new products is the integration of different strategies for exploring a piece of music: a) through listening; b) through verbal

description of music element; c) through reading on a paperless Braille display; d) through reading on traditional paper Braille.

The third innovative aspect is the flexibility of our new products. In fact, at present the most popular way of learning music for blind persons is based on a combination of learning by ear, listening to recordings made by the teacher or by a friend, having somebody (mother, friend) describing each single element (the so-called “spoken music”). Only a small minority use Braille, which, despite its limits, is still the more flexible and effective way for access to written information. The flexibility of our solution consists in the fact that the end user can choose at any time the best combination (only listening, listening to notes and obtaining their names, listening and reading on Braille display, ...), and he can choose speed, level of details (chord / single components, multi-part / separate parts) ...

Last, but not least, our products are interactive learning tools, following the principle of “learning by doing”. Our solution, for the first time in the history of the education of the blind, allows steady interaction between listening and doing. This means that Braille and sounds are closely connected to each other, in a positive and reciprocal relationship. In other words, our first provisional results show that the student of music is encouraged to improve his / her mastery of Braille through listening to the outcome of his / her writing. On the other hand, the student becomes more aware of music events because he himself is the author of his piece, and he can have a live and direct experience, in real time, of the musical results of his Braille writing.

### **Impact**

Our provisional results legitimise the following expectations:

#### **Learning process.**

Learning process will be:

- a) Faster. In fact up till now the memorisation process has required a continuous jumping from paper score to instrument. The blind student must read with one hand if possible and execute notes on his instrument. In some cases (singer) execution can be immediate, but in other cases (violin, guitar) execution has to be postponed. Piano allows partial execution in real time (only one hand at a time). Our solution allows a faster process of learning and memorisation.
- b) more effective. This means that, besides memorisation, the student will better understand many aspects of the piece he is trying to memorise. In fact, because our tools are interactive tools, the student will be offered the opportunity to analyse some relevant details, and to gather direct experience of their functions in the score. Our learning process is based, among others, on difference. In our case, if the student suppresses an accidental, he can immediately listen to the musical effect of his action. This was not possible until now.
- c) Emotional aspects. Learning is more attractive, because it offers the opportunity to invent, and to create new situations.

**Social aspects:**

- a) self image - more independence produces higher self-esteem. Our software, as well as our training modules considers both special schools and integrated schools. In particular, BME2 is specifically devoted to blind musicians who want to write their own scores and to print them, either in Braille, or in common notation. Printout is based on BMML format, which is automatically converted into music XML, for further treatment. Music XML format is compatible with over 100 music editors, including Finale, Sibelius, and many others. Thanks to BME2 the blind student can fulfil all his homework in full independence, the blind composer can deliver his scores to the publisher, a blind music teacher is in the position to print his exercises of the day for his class.

- b) Esteem by others - more independence enhances the image of the blind in the common awareness. The relevance of help relationship should be considered here. Indeed one of the most important aspects in the learning process concerns positive and flexible relationship in the class. Normally the blind person is relegated to the role of the person in need for help. Through our products the help relationship can be significantly enriched, and the blind student is now able to interact with his sighted peers on an equal level, that is he can ask for help, but he can also offer his help, thus enjoying the experience of feeling himself useful to his group.
- c) Distance communication will enhance exchange possibilities through our portal. A contact form has been posted on the web site, and messages received via this form that might be of interest to our users are compiled in the feedback section. This solution was preferred to having a forum – not only is it more easily accessible but it also means that messages can be checked by a moderator before they are actually posted to the feedback section of the web site.

### **School organization.**

Our solution significantly reduces the need for teacher training. This fact should reduce resistance to accepting blind students at music institutions, such as conservatories, academies etc. Furthermore we expect that an increasing number of blind students, who at present are discouraged by school leaders, will find their way and start, or continue studying music, attending their nearest school, just like any other student.

### **Economic aspects.**

Access to music for the blind will be less expensive, faster and more flexible. Our software and our online resources make it possible now to set up customised services, such as transcription of music scores on demand, at sustainable costs.



### **New opportunities**

- a) At school. - Some specific subjects that were very hard to study will be now fully accessible. In particular musical dictation, composition, musical analysis, harmony, counterpoint.
- b) Job opportunities. Through our solution a blind teacher can work with sighted students in full independence. Many music teachers produce exercises for the day and give them to their students. A blind music teacher will be able to do the same thanks to our BME2.
- c) Job opportunities. - Arrangements of songs can now be performed in full independence by a blind musician. Likewise, preparing separate parts for choir members is now a very simple task and requires no external help.

### **For associations of and for the blind**

Considering the fact that their mission is the progress of blind people, a new approach to music, the only art which is totally accessible to them, should contribute to the improvement of services in the domain of education, job opportunities and leisure activities.

### **Further research**

In our deliverable on the State of the Art we pointed out some analogies between music literacy and scientific studies. Researchers in the domain of education of the blind in cooperation with IT experts could well consider the idea of developing a tool for enabling a blind person to draw mathematical functions without external help, with the help of an acoustic feedback for checking and reviewing. Likewise, the idea of employing an interactive tool, allowing a blind person to monitor and control his actions while doing his homework in different subjects, might contribute to the development of new learning/teaching strategies, based on the multisensory approach.