CHILD/MACHINE INTERACTION IN REFLEXIVE ENVIRONMENT.
THE MIROR PLATFORM

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ABSTRACT

This paper introduces the MIROR Platform, an innovative adaptive device for music and dance education, proposed in the framework of the EU-ICT project MIROR-Musical Interaction Relying On Reflexion. In concluding the MIROR project, 3 software applications (MIROR-Impro, MIROR-Compo and MIROR-Body Gesture) and the draft version of the User's and Teacher's Guides have been accomplished. In this paper, the technological and pedagogical principles of the MIROR platform, notably the "reflexive interaction" paradigm, the 3 applications and related experiments will be introduced. Finally, the draft of the full architecture of the platform is presented.

1. THE MIROR PLATFORM

The MIROR Platform is an innovative adaptive device for early childhood music and dance education, proposed in the framework of the EU-ICT MIROR-Music Interaction Relying On Reflexion.[1] It acts as an advanced cognitive tutor, designed to promote abilities in the field of music improvisation, composition and creative movement. The MIROR platform is designed to implement "reflexive interactive musical systems" (IRMS in short) [1], within technology-enhanced learning. On the basis of the interesting results observed with children and the first prototype of IRMS, the Continuator [2], in the context of the MIROR Project, we proposed, indeed, to extend the IRMS with the analysis and synthesis of multisensory expressive gesture [3], to increase its impact on the musical pedagogy of young children. In so doing, the MIROR Platform was conceived as an educational device composed by several software applications exploiting the reflexive interaction paradigm not only in music improvisation but also in the field of body and creative movement. The platform is not designed, however, to teach a specific instrument and instrumental skills, though it can also be used with this aim. It has been conceived rather as a "device" to stimulate and enhance musical creativity of children.

1 The MIROR Project is coordinated by the University of Bologna. The Consortium is composed by Bologna, SONY France-Paris, University of Genoa, University of Gothenburg, National and Kapodistrian University of Athens, University of Exeter and Compedia Ltd, Israel. For more information on the project, see the official website: www.mirorproject.eu.

2. TARGET GROUP SCENARIOS

The MIROR Platform is developed in the area of music and motor education of children aged from 2 to 10 years. Indeed, one of the challenges set by the MIROR proposal was that of building tools of technology enhanced learning addressing very young children, not only with regard to formal music education contexts, but also to foster children's music and motor creativity in informal contexts, and in the school. The targets are a number of settings and contexts: from nursery, kindergartens and the primary school, to music schools, dance schools, children centres, children hospitals, and social inclusion contexts such as centres for immigrants and social centres. Furthermore, the platform is also conceived for therapeutic and rehabilitation settings and scenarios. Teachers' training classes are another target group: both general programmes of teacher training, and classes aimed at the formation of music and dance teachers. Indeed, the platform can be used to foster the music and motor creativity of teachers, as well as a tool to learn how to use the reflexive interaction paradigm as a new way to teach music and dance.

3. CHILD/MACHINE INTERACTION IN REFLEXIVE ENVIRONMENT

The basic hypothesis of the MIROR Project is that "reflexive interaction" enhances music learning and musical creativity in young children. According to Pachet [1, 4], the reflexive interaction paradigm is based on the idea of letting users manipulate virtual copies of themselves, through specifically designed machine-learning software referred to as interactive reflexive musical systems. The idea was to develop a machine that gives users the perception of interacting with something similar to themselves. In this case, the machine does not exactly mimic the user's proposal, but her/his own musical style, or, in other words, her/his own musical identity.

The subsequent experiments with adults, e.g., see [1], and especially with children, e.g. see [2], immediately demonstrated the potential of these reflexive systems for the development of creative musical experiences. Despite the apparent simplicity of the mechanism, IRMS generate

very complex reactions, where the children are expected to form differentiated judgements about "self" and "others". In literature, these forms of awareness are considered crucial for the building of the child's identity. IRMS, by means of its mirror effect, help towards the construction of a "musical self". One innovative feature of the IRMS is the creation of a natural, organic dialogue with the child. This dialogue is based on the mechanism of repetition and variation, which is, in fact, at the heart of reflexive interaction: the system's repetition of the input given by the child allows the child to perceive the response of the system as a sort of sound image of him/herself. Moreover, this is the moment when the child shows an absolute attraction towards this other that appears similar to him/herself. The interesting thing is that it is not a mere repetition/imitation/echo, but rather a repetition that is always constantly varied. It is precisely the co-presence of something that is repeated along with something different that seems to make the reflexive interaction a sort of device of attraction first, and then of stimulation of interest to become involved in the interaction.

Starting from the observation of children interacting with the interactive reflexive musical systems, several theories have been considered to explain human behaviours in action during the interaction with a reflexive system. From a systematic perspective, the theoretical framework of the reflexive interaction paradigm could include references ranging from the myth of Echo (Ovid), to the more recent semiological paradigmatic analysis [5, 6], and the theory of similarity perception in listening to music [7]. The capacity to replicate the behaviour of others is to a certain extent grounded on the non-conscious mechanisms of the mirror neuron system (MNS), a network of neurons, which becomes active during the execution and observation of actions [8]. The studies presented so far highlight the complexity of the processes set in place during an interaction between child and reflexive machines: *imitation*, *imitation recognition*, *self-imitation, repetition/variation* represent processes that develop in the first months of life and which structure the Self of the child and her/his interaction with the surrounding environment [9, 10, 11]. Anzieu [12], calls this kind of infant experience "musical wrapping" of the Self, in which the Self is described like the first embryo of the personality felt as a unit, an individuality, and which expresses one of the more archaic shapes of repetition: the *echo*. Another important aspect that we can draw from this literature is the importance of reflexive interaction as a *dynamic process*: the experience of repetition/variation is carried out within affective and emotional conditions, the *amodal* experience that Stern [13] calls "affective contours", which are the outcome of the child's interaction experiences. The mechanism of repetition/variation can also be explained by recent studies in neuroscience, which underline the neural and cognitive mechanisms that allow one to transform and manipulate existing representations. Zatorre [14], suggests that the dorsal pathway of auditory processing performs equivalent operations on musical inputs. The results allow new hypotheses about how novel musical ideas may emerge from pre-existing musical images.

4. REFLEXIVE INTERACTION MEETS BODY GESTURE ANALYSIS

An important extension of IRMS into the MIROR Platform is the pedagogical exploitation of the possibility of communicating with the machine through body "gestures". These issues are addressed by introducing the *expressive gesture analysis* [3], implemented in the MIROR-Body Gesture prototype. The term "gesture" is an expression of the mediation between mind and physical environment, and it is distinguished from action, movement and motion because it refers to both of them in relationship with the meaningful level of human behaviours. The research in the field of embodied music cognition [15, 16], highlighted the fundamental role of the body in relation to human musical activities. The concept of "resonance" by Leman [16] has much in common with reflexive interaction and helps to better understand the relationship between reflexive interaction and perception of the body.

5. REFLEXIVE INTERACTION REQUIREMENTS

A number of characteristics emerged as being the most interesting to retain and generalise for developing IRMS in the field of technology-enhanced learning.

5.1 Technical Requirements

According to Pachet [1, 4], the following technical requirements of IRMS can be listed:

Reflexive interactive systems are a particular "class of interactive systems in which users can interact with virtual copies of themselves, or at least with agents that have a mimetic capacity and can evolve in an organic fashion." [1, p. 360]. Their focus is not on solving a given, well-defined problem, such as querying a database, but rather on helping users express hidden ideas.

"Similarity or Mirroring effect: The IRMS produce musical sounds like what the user is (…) able to produce. This similarity must be easily recognisable by the user, who experiences the sensation of interacting with a copy of her/himself." [1, p. 360]

"Agnosticism: The system's ability to reproduce the user's personality is learned automatically and agnostically, i.e. without human intervention." In the case of the Continuator, for instance, "no pre-programmed musical information is given to the system".[1, p. 360]

"Scaffolding of complexity. Incremental learning ensures that the IRMS keeps evolving and consequently that the user will interact with it for a long time. Each interaction with the system contributes to changing its future behaviour. Incremental learning is a way to endow the system with an organic feel, typical of open, natural systems, as opposed to pre-programmed, closed-world systems. This scaffolding of complexity implies in turn a

number of technical constraints, such as the ability for the IRMS to store/retrieve models incrementally." [1, p. 360]

Build virtual images of users: Designing systems that effectively build virtual images of users in several disciplines. These images are built with the help of real time machine-learning components, which build models of the users that are continuously updated.

Feedback by designing an image of the user: unlike feedback systems, reflexive interactions do not consist of feeding back the output of a system to its input. They consist of influencing the actions of the user by providing her/him with a carefully designed image of her/himself.

Learn the behaviour of the user: RI software are essentially intelligent mirrors that learn the "behaviour" of the users.

Technically, this image is most of the time imperfect, for many reasons, including the intrinsic limitations of machine-learning systems. However, it is precisely this imperfection that produces the desired creation of side effects.

Side effect: target objects (e.g. a melody, a drawing, a taxonomy, etc.) are not produced *directly* by man-machine interactions, but as *side effects* of these mirroring interactions.

Collaborative production of object: Mirroring interactions can then take place in which the system continuously learns from the user, *to collaboratively produce an object*.

The *basic playing mode* of the IRMS is a particular kind of turn-taking between the user and the system governed by three principles: 1. Automatic detection of phrase endings. 2. The duration of the phrase generated by the IRMS should be set to be the same as the duration of the last input phrase. 3. Priority is given to the user.[4]

5.2. User Requirements

An empirical list of children user requirements concerning the reflexive paradigm has been derived from the results of the experiments with children [2, 17].

5.2.1 Modes of interaction

Repetition/variation (mirroring, reflexion): This is the "core" of reflexive interaction. The particular ability of the system to imitate the style of whoever is playing generates dialogues based on repetition and variation. Or rather, we observed that a real dialogue between the child and the system actually begins as soon as the child recognises something from her/his own proposal in the system's reply, and tries to answer by repeating and varying what s/he has just heard

Turn-taking: The children learn the implicit rule of turn-taking. They stop and listen to the system's reply, respecting the "turn-taking" with the system. Turn-taking lets you hear and be heard, it is a rule of interaction that is applied intuitively.

Regular timing of turns: The duration of the phrase generated by the system was set to be the same as the duration of the last input phrase. Bullowa [18], sustained that in order to share meaning with the adult, rhythms must also be shared and that this sharing is at the basis of communication.

Temporal contingency: the MIROR-Impro detects phrase endings by using a (dynamic) temporal threshold (typically about 400 milliseconds). Research on infant/mother interaction supports these "requirements": in the presence of maternal stimulations that are *non-contingent* (i.e. the mother does not respect the timing of the interaction), lacking in emotional sharing, or are excessive and intrusive, the behaviour of the child is characterised by passiveness or disorganisation.

Role-taking: this is the moment when one of the two interlocutors takes the partner into account and as a consequence regulates his/her own behaviour according to that of the other. Children are, for example, able to adapt their language when speaking to children younger than them.

Co-regulation of the communication: during the dialogue, the child and the system adapt to each other and co-regulate the contents and the timing of the interaction [19].

5.2.2 User Experience

To interact and manipulate a virtual copy of themselves. The children are allowed to manipulate virtual copies of themselves, and to reflect about their own musical style.

Imitation, self-imitation, imitation recognition: the children should be involved in several processes of imitation, self-imitation and imitation recognition and be able to control them for communicative purposes.

The life cycle of interaction: it deals with the temporal dynamic of the interaction, which is an important factor for the children's musical experience. We noticed several moments in child/Continuator interaction, characterised by different emotional and cognitive states: Surprise, Excitement, Concentration and analytical attention, moments of Engagement and Readjustment, Relaunching, Exploration, Invention, Attunement.

Flow state [20]: it should be possible to observe higher level of flow experience in children interacting with the IRMS.

The invention of rules: The children learned the rules of the system: it replies by playing alone, it replies when you stop playing (turn-taking), it repeats what you play, it repeats with variations (or 'errors'), it's capable of establishing a dialogue made up of repetition/variation, it does not always respect the rules, you can teach the system, and the rules of the system can be taught to others.

Joint attention: Of particular interest are the relationships established between two children playing together, and between them and the system: playing, listening, exploring together, watching the partner's reactions, playing separately, alternating, or conflicting. A typical situation encountered was the phenomenon of 'joint attention': more precisely, one of the children would force the other to stop playing in order to listen to the situation.

The system develops and enhances *self-regulated and self-initiated activities, self-efficacy, autonomy, and intrinsic motivation.*

Music-maker in style: The system stimulated and reinforced conducts of an exploratory type, but it also prompted inventive conducts. Both in the exploration and in the improvisations themselves, we can see very personalised styles in the children's approach to producing sounds, in their handling of the instrument and other equipment, and their working out plans of action to satisfy their own goals. The IRMS might be able to reinforce these individual styles, and allow their development and evolution.

6. PEDAGOGICAL CONCEPTS

According to the requirements above introduced, it is possible to describe several pedagogical concepts of the reflexive interaction paradigm and of the MIROR Platform. However, one of the results of the research conducted in the framework of the MIROR Project is that even if some pedagogical theories can be used to define the "reflexive" pedagogy, actually the reflexive interaction paradigm cannot be fully described by any of the pedagogical categories already existing. Instead, this paradigm proposes a novel and innovative pedagogical perspective dealing with the child / machine interaction. The IRMS could represent a new and original application of technology-enhanced learning.

6.1. The pedagogical framework

Priority to children's and Learner-centred learning: the centre of the attention in the reflexive interaction process is not the end product, but the subject engaged in the interaction. Reflexive interaction naturally produces a learner-centred approach.

Adaptive: The system adapts itself constantly and in an organic way to the musical style of the user, that is to say to everyone's style. It reinforces the children's musical style (both musical and learning style)

The 'teaching method' is based on turn-taking and regular timing of turns, on the strategies of mirroring, modelling and scaffolding [21, 22], and on starting up 'affect attunement' [16], intrinsic motivation, collaborative playing and joint attention.

Not to be programmed with fixed musical objectives, as for examples software for ear training, chord recognition etc. *Side effect*: the musical products and the learning objects should be the result of the interaction, as a side effect.

The system possesses the properties of transparency, involving "a shift from the representation of music to the music itself" [23], the children only interact by playing, without other graphic or mechanical interfaces (e.g. mouse, buttons, switches etc.), *and reflection,* in the sense that it is the system itself that helps the user to understand the mechanism of interaction; the rules are learnt during the interaction.

The factor of distance: the children are able to interrupt the game when they want, thus preserving the factor of "distance" between child and machine, vital from aesthetic and pedagogical points of view [24].

The attractiveness. The IRMS avoid the monotony of mere repetition, by introducing variation continuously, the "error", as an "imperfect machine". The only interface is the keyboard. The findings show that the attractiveness of IRMS is based on the conceptual and technical features of the software rather than external or nicely designed interfaces.

Collaborative playing in classroom setting: the double role of an IRMS, as virtual partner and tutor, enhances music creativity in children based on exploration and socialisation: sharing the discoveries and the newly invented games with partner and teacher. Furthermore, classroom activities with the IRMS enhance the self-regulation of the group of children in the use of the equipment and in managing the turns to play.

Music improvisation: the improvisations revealed rhythmic and melodic patterns, synchronisation on the same pulse, forms of song and accompaniment, individual improvisation styles, brief formal constructions based on imitation, repetition, alternation and contrast. With IRMS children learn to improvise by interacting with a computer, which is necessary if their teacher cannot, or does not want to improvise.

Creativity in child/machine interaction: the reflexive interaction paradigm proposed for music learning and cognition, and its connected theories (such as flow theory) could be applied not only to music education but also as a novel paradigm to the studying of general cognitive and creative processes. "Reflexive" learning is not learning by imitation. On the contrary, during RI the learning mechanism is activated by the experience "to be imitated".

IRMS also exploit the Vygotskian concept of zone of proximal development (ZPD). However, the difference with the Vygotskian concept of ZPD is that the IRMS are not *more* capable than children: they are agnostic systems and adapt themselves in an intuitive way to the child's musical knowledge during the interaction. In this way, IRMS establish an interaction between pairs, where the mirroring reflection creates a balance between challenges and skills, a basis to create Flow experiences [20] and creative processes. This characteristic will enable the MIROR Platform to enhance self-regulation, self-initiated activities, and the learner-centred approach. IRMS support children in mixing old musical skills with new ones, in an original and autotelic way, according to the "cognitive fiction" perspective [25], where the innovative technology enables the subject to see and listen in a more original way, bringing out previous childhood experiences.

Finally, the MIROR project owes to the Laban Movement Analysis (LMA), elaborated by the Hungarian dance artist and theorist Rudolf Laban (1879-1958). LMA has been widely used in the field of dance education and was applied also to music and movement education. This analytical approach is the basis of the *expressive gesture analysis* implemented by the MIROR-Body Gesture application.

6.2 Reflexive Listening

The listening behaviour of children interacting with the Continuator and MIROR Impro was particularly rich and varied: concentrated, analytical, but also symbolic. A particularly interesting aspect is the quality of the children's listening to their own productions while they played, heightened by the interactive element that encourages them to listen carefully so as to compare their own pieces with the reply and new proposal of the system, and to identify repetitions and differences. As already reiterated many times, in the world of teaching, listening to one's own musical productions while playing is one of the main objectives of music education [e.g. 26]. Different types of listening stimulated by the reflexive interaction can be distinguished:

Attentive and analytical listening: children listen carefully to the system's answers, they seem to be seeking to understand the rules that govern them;

Embodied listening: while listening to the system the children dance and move their body freely, interpreting the sounds they hear;

Tutoring: In sessions in pairs, the child who already knows the system usually guides her/his partner;

Empathic listening: children follow the musical evolution of the system "affectionately" and treat it like a living thing;

Joint listening: in games in pairs or in groups, listening becomes socialised; the children share the experience through looks, words, gestures;

Ecstatic listening: sometimes listening achieves moments of genuine ecstasy, of pure aesthetic pleasure, followed by expressions of joy: "It's beautiful!";

Autotelic listening: in many cases, however, the listening becomes particularly intense, concentrated, deeply intimate, regardless of everything else;

Listening by immersion or multi-modal listening: some children were seen to participate with their whole body, bringing into play every single electronic component available;

Symbolic listening: children dramatise a story or a character that mimics the response of the system, or invent a story while the system's replies serve as a soundtrack;

Listening to their productions: the children are encouraged to listen carefully and compare their productions with the response of the system, to identify repetitions and differences;

Listening "pseudo-distracted": Interaction through moments of great effort and times when the interaction seems loose, but not interrupted;

Virtual Listening: one of the most interesting acts observed was staring at an invisible point in space, a trait that characterises the conduct of enjoyment developed through the increasing use of means of reproduction, from the walk-man to the IPod;

Intertextual listening: finally, the IRMS could be placed in an aesthetics of the fragment and of intertext, being itself by definition a machine that produces intertexts. Dialoguing with it generates a kind of intertextual listening in children during which they are asked to interactively build and reconstruct the fragments of their own musical discourse, relaunched by the system, using those of the system's answer and the friend's. And it is this variation which attracts the child and motivates her/him to produce a new answer, to develop a musical idea: ultimately, to produce musical "meaning".

6.3. The MIROR Platform as a "device" for music and dance creativity

In the pedagogical field, the "device" has been defined as the concrete mediation that the teacher should individuate in reference to the specific situation, in order to allow children focusing their attention on the sound and the movements, and on their characteristics [26]. From this perspective, the MIROR platform can be defined as a "device" to enhance musical and dance creativity and invention in children. That is a tool to enhance children's creative conducts, both in music improvisation, composition and dance education.

6.3.1 The Practices

Several practices can be implemented with the 3 components of the MIROR Platform. We can distinguish 3 kinds of practices:

Practice 1: the children use the software applications of MIROR Platform. This is properly the setting of MIROR applications, that is the child/machine reflexive interaction. In this kind of practice, the reflexive interaction develops between child/ren and system.

Practice 2: the children and the teacher use the MIROR Platform together. In this practice the teacher acts as mediator between the child/ren and the applications.

Practice 3: the teachers use the MIROR Platform. In this kind of practice, the reflexive interaction is established between teacher and system. Indeed, the MIROR platform can also be used for teachers' music and dance education (Figure 1).

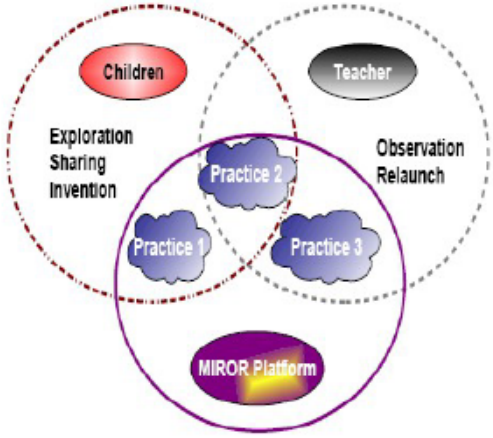

Figure 1: Creative Practices with Children/Teacher/MIROR platform.

7. THE SOFTWARE APPLICATIONS: MIROR-IMPRO, MIROR-COMPO, MIROR-BODY GESTURE

The MIROR project aimed to develop 3 software applications of the MIROR platform: MIROR-Impro, MIROR-Compo and MIROR-Body Gesture. They have been designed and developed by the engineers of Sony team [27] and of the University of Genoa [28, 29], in cooperation with the other partners: experts in psychology and pedagogy of music, which are the Universities of Bologna, Athens, Exeter and Gothenburg, and an expert in children educational software, which is Compedia Ltd.

7.1 MIROR-Impro

MIROR Impro software is linked to a normal midi-linked keyboard. When the children play something, making up a music phrase of their own and then pause, the software creates and immediately plays a "reflexive" reply that is based on the child's input. What is very new and interesting about this software is that the children can improvise with the computer as a kind of partner, discovering what elements in the replies stay the same or what changes. The educational aim of this software is both to support children in learning to improvise and to encourage their aural awareness through play in which they can control the levels of challenge by their own input. The reflexive interaction, with its mechanism of repetition/variation, triggers a dialogue between the two partners during which the improvisation process develops.

7.2 MIROR-Compo

MIROR-Compo allows children the composition of music: it acts as a sort of "musical scaffolding" that allows the children the combination of several musical phrases on the basis of their own style and musical taste. In this MIROR Platform application, the reflexive interaction paradigm is employed so that the software produces musical phrases similar to the opening sentences produced by the child. The educational aim of this software is to support children in creating music, storytelling, and engaging in collaborative compositions in a classroom context as well as in the family.

7.3 MIROR-Body Gesture

MIROR-Body Gesture was conceived so as to pick up the children's movements and convert them into "reflexive" sound, i.e. sound with the same characteristics of the related movement (heavy/light, fast/slow, and so on). In this way, the children can dance and create music via movement, and control their own improvisations and compositions. The educational aim of this software is to support children in discovering musicality through embodiment, i.e., by means of their own body, its movement, and its dynamic nature. MIROR-Body Gesture is composed by 2 components: BeSound and The Potter.

8. EXPERIMENTS WITH CHILDREN AND MIROR APPLICATIONS

A vast number of psychological and pedagogical experiments are being carried out in the framework of the MIROR project in order to implement the 3 applications - Impro, Compo and Body Gesture - and test them with children and teachers.

8.1 Psychological experiments

The Protocol no 1, "Music making with MIROR-Improvisation", showed interesting results concerning the analysis of the flow experience of children interacting with the Miror-Impro [17]. In the field of human/machine interaction, Leman, Lesaffre, Nijs, and Deweppe [30] and Leman [21], indicate the theory of flow as one of the areas of expertise which should be explored to study human/machine interaction. The experimental results with children and MIROR-Impro showed that the *Flow emotional state* increases not only when children play with the system, but also when they play using the set-up Same, that is the more "reflexive" set-up used in the experiment, as the system's output melody is musically much closer to the user's input melody. These results would support, in terms of quantitative data, a wide range of qualitative observations related to the mechanism of mirroring, repetition/variation, imitation, turn-taking, co-regulation, which characterise reflexive interaction, showing that they are able to create flow experience, well-being and creativity process.

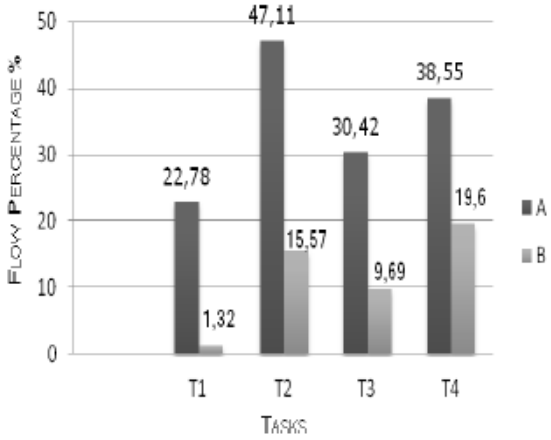

FIGURE 2. Percentage of the presence of flow with the set up A (same) and set up B (very different) in each task (set up A*set up B: $t = 8.151$; $df = 3$; $p = .004$). T1=the child plays the keyboard; T2=the child plays the keyboard with MIROR-Impro; T3= the child plays the keyboard with a friend; T4= the child plays the keyboard with the MIROR-Impro with a friend.

The results of the protocol no 1 also raised some problematic aspects related to the reflexive qualities of the Impro's replies that should be improved. Alexakis et al. [31] introduced a computer assisted music analysis, in order to assess the progress of children's creativity skills when using the MIROR-Impro. The results would suggest a potential progress of several variables, which

might be indicative of creativity advancement. Other exploratory studies showed further scenarios in schooling contexts [e.g. 32, 33], nursery schools included [34], and suggested several recommendations for the implementation of the applications, according to the "spiral model" of collaboration adopted by the MIROR Consortium [e.g. 35].

8.2 Pedagogical experiments

In the second phase of the project, an extensive package of pedagogical experiments are being carried out by the partners and members of the Advisory and Liaison Board, in several European countries, in order to validate the MIROR applications in different scenarios, therapeutic and rehabilitative settings included. The Protocol no 2, "Teaching to improvise" has been carried out in order to verify if the reflexive interaction is necessary and sufficient to enhance children's ability to improvise. Focus groups with university students have been organised to explore the pedagogical conceptions developed in the context of reflexive interaction. The data analyses are being carried out. See the official website of the MIROR Project for further information and update.

8.3 The User's and Teacher's Guides

The User's and Teacher's guides are pedagogical practices and guides for teachers and children, to be used with MIROR applications. The deliverable 6.2 is the first draft of the Guides, composed with the contributions of the partners expert in music and dance education: UNIBO, NKUA, UGOT and UNEXE.

8.4 Theoretical contributions

On one hand, the experimental results have allowed supporting a series of theoretical hypotheses presented in the theoretical framework. On the other hand, they also raised a number of issues regarding some problematic aspects of the reflexive interaction paradigm, thus prompting further investigations in the field of embodied music cognition, pedagogical and multicultural contexts.

9. FUTURE STEPS AND CHALLENGES

In concluding the MIROR project, 3 software applications (MIROR-Impro, MIROR-Compo and MIROR-Body Gesture) and the draft version of the User's and Teacher's Guides have been accomplished.

The future challenge is to realise the MIROR platform by designing and implementing the learning/teaching environment and related architecture and technology tools (platform interface, tutorials, forum, data base, learning objects, etc.). The concept of the MIROR platform architecture includes the following parts:

The MIROR Platform interface: The interface will introduce the links to each application and to the other tools of the Platform.

Software applications with related interfaces, manuals and tutorials: MIROR Impro, MIROR-Compo and MIROR-Body Gesture. New software applications could be added in the future, based on the reflexive interaction paradigm.

The User's and Teacher's Guides: The User's and Teacher's guides are pedagogical practices and guides for teachers and children, to be used with MIROR Platform.

Practices for: educational settings (nursery, kindergarten, primary school), music schools, schools of dance, at home, therapeutic settings, teacher training, etc.

Children_Log: to upload interesting children compositions, improvisations and choreographies.

Work in progress: to upload interesting practices, experiments and videos, documenting the research work in progress.

Forums: for teachers, for researchers, for children, for parents, for the MIROR community.

Feedbacks: to upload feedback for software implementation, usability, user experience.

Publications: to upload or suggest interesting publications.

News and Events: dissemination of the project results.

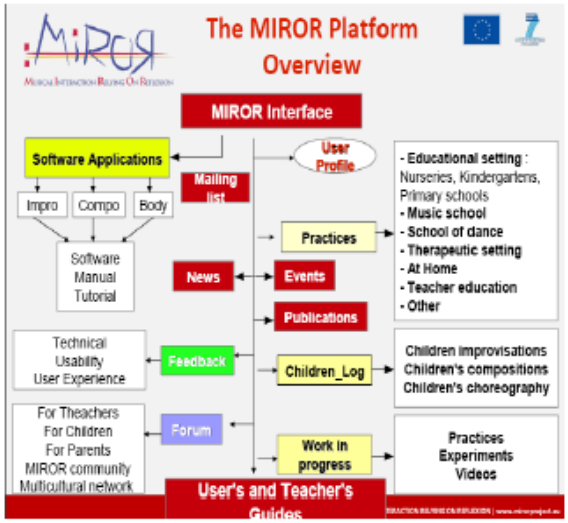

Figure 3: The overview of the MIROR Platform architecture showing the most important parts as described in the section above.

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