Towards New Social Dimensions for Children's Music Making – JamMo as a Collaborative and Communal M-Learning Environment

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ABSTRACT

Children's collaborative music making has recently gained a lot of interest in the field of musical development and learning. Mobile learning (M-learning) is a relatively new field of educational research and so far there has been only few studies about children's musical collaboration with mobile devices. Current knowledge of children's social development forms a basis for communicational design of the ubiquitous learning environment. In the present study, which is a part of EU FP7 UMSIC research project, a software JamMo (Jamming mobile) will be designed for the Nokia N810 Internet tablet. In this paper, we report on the communal features of JamMo, which are specified to Jammo's different user interfaces and groups. The design will be based on the the existing literature of children's social cognition and the development on knowledge of others, social comparison, concept of self, language use, nonverbal communication, emotions and peer interaction and prosocial development. The requirements for social development as well as learning context are described. In the JamMo's communal features design, we focus especially on peer relations, interaction and collaboration. The end product will be an accessible mobile learning device to be used in classroom and informal creative music learning, and tested with user groups mentioned in stand-alone, ad hoc and networked social contexts to promote social inclusion of children.

Keywords: Collaborative music making, Mobile learning, Social development, Virtual community

I. INTRODUCTION

Mobile devices have merged as the "computing platform" for the 21st century. In recent years, researchers have been exploring the use of mobile devices for children's educational use. Mobile devices have supported children's learning in many domains from language and arts to science education. So far, novel technologies have been used to support children's multiple collaborative activities, such as storytelling, adventure games and outdoor field trips (Cole & Stanton 2003).

Mobile music as a concept covers any musical activity utilising portable devices that are not bound to a specific stationary locale; devices might possess properties such as context awareness, ad hoc or distributed network connectivity, or location sensing, sometimes combined with technology embedded in the physical environment (Gaye, Holmquist, Behrendt & Tanaka 2006). Salavuo (2006) argues that current results from mobile music learning have been contradictory. The reason for this could simply be, that up to this date there are only few educational and pedagogical music applications for mobile handheld devices.

Mobile learning environment is a relatively unexplored research subject in the domain of music. In order to fully understand the characteristics of this new environment, some important issues must be underlined. Parsons and Ryu (2006)

have categorized generic mobile environment issues as follows: *mobility itself, different user profiles, user interface, media objects, communication support*. We use these environmental categories in approaching mobile musical activities.

According to this categorization *mobility* can be conceptualised in different ways, i.e., mobility of the user, mobility of the device, and mobility of services, and these three together. In traditional class room learning musical activities have been tied to fixed physical locations. Mobility of the user, device and services opens totally new locational and contextual possibilities for the musical activities. One of the key issues in M-learning is the *user profile* and it's different roles in learning. In music learning, the importance of musical self-concept and musical identity has been widely studied and acknowledged (Hargreaves, Miell & Macdonald 2002). Musical identity may be reflected in the features included in a user profile, such as musical avatar, instrument and hobbies.

The mobile user interface have many constraints which have to be acknowledged. These include: small screens, poor input methods and limited battery life. However, many current mobile devices provide interesting features, like touch screens and accelerometers, for musical activities. Mobile applications tend to employ rich *media* objects and multimedia. In musical E-learning, multimodal learning materials are widely used. One generally noticed feature of mobile technologies is that they afford the possibility of perpetual contact. This sense of *communication support* can be seen as an interesting factor in collaborative musical activities and learning. Constant real-time interaction is a relevant part of collaborative and creative music making. On the other hand, non-real-time communication is suitable for musical discussion, problem solving, goal setting and assessment, which have been studied among Internet-based online music communities (Salavuo 2006). Thus, mobile environment opens new possibilities for real-time and non-real-time dimensions of musical communication.

Figure 1. Nokia N810 Internet tablet

UMSIC (www.umsic.org) is a multidisciplinary European Union research project, which aim is to develop a collaborative mobile musical environment for children, aged 3-12 years, to promote social inclusion. The end product, JamMo (Jamming Mobile) application, is designed for the Nokia N810 Internet tablet. In this paper we present the design of communicational features of the JamMo application. Theoretical foundation for the design is derived from children's social development and mobile communication theories.

II. SOCIAL DEVELOPMENT AND IMPLICATIONS FOR JamMo DESIGN

Psychosocial development, and the development of social cognition – children's understanding of self and others, social situations and social roles– as well as the development of peer relations and peer tutoring occurring in everyday life and play of children are the very central questions for the design of social contexts of JamMo. Peer groups provide children psychological distinctiveness, a sense of belonging, social identity and mutual support. In peer relationships the participants have broadly comparable social power: roles and behaviour tend toward a more egalitarian and reciprocal balance, than in relationships, which are formed between individuals of different abilities and status, such as parent and child (Hartup 1989).

In terms of Erikson's (1963) theory, JamMo users represent mainly three stages of psychosocial development: 1) Initiative versus guilt (3–6 years): Through make-believe play, children explore the kind of person they can become. Initiative develops when parents support their child's new sense of purpose; in contrast, when parents demand too much self-control, they induce excessive guilt. Following Erikson, JamMo is required to support preschool children's imaginative play, exploring of musical materials and musical expression, and participating in musical communication and turn-taking with peers. 2) Industry versus inferiority (6–11 years): At school, children develop the capacity to work and cooperate with others. Inferiority develops when negative experiences at home, at school, or with peers lead to feelings of incompetence. JamMo should then support children's musical self-esteem by modelling and scaffolding musical learning, as well as providing strategies and feedback for independent and self-disciplined music making, and support social inclusion in musical communities of practice by providing conventions and rules for musical collaboration and teamwork. 3) Identity versus role confusion: The oldest JamMo users (12 years) are in the beginnings of adolescence, which according to Erikson, is central for identity formation. JamMo should support formation of personal, cultural and musical identities of young people.

Selman (1976) characterizes children's social role-taking in a series of five stages: In egocentric (3–6 years) stage child is able to label others' overt feelings but does not understand the causal relation of motives to social actions. In the stage of social informational role-taking (6–8 years), child is aware of different social perspectives of herself and an other person, however, the focus tends to be on one perspective. In the stage of self-reflective role-taking (8–10 years), child becomes aware that each individual is aware of the other's' perspective and that this awareness influences self and other's view of

each other. However, child cannot reach the level of simultaneous mutuality until the stage of mutual role-taking (10–12 years), when child is able to view the interaction of self and other from a third-person perspective. During adolescence, in the stage of social and conventional system role-taking (12–15+ years), person realizes mutual perspective-taking does not always lead to complete understanding, and sees social conventions as necessary because they are understood by the community.

To be able to compose music in collaboration with JamMo children need at least some understanding of other's intentions in social situations of music making. Social situations include a sequence of social events, consisting of physical states and actions, and the feelings and mental states of oneself and other people that motivate these events. Bruner (1986) has labeled these two strands the landscape of action and the landscape of consciousness. Preschoolers' self-concept displays little organization and little negativity, however, it already includes some awareness of their own psychological processes and properties. Young children tend to focus on visible properties when describing themselves, while older preschoolers emphasize more their activities (Damon & Hart 1988). Young children also tend to describe friends with reference to common activities and mutual assistance, and their concerns are immediate and practical, focusing on recent events (Erwin 1993). They also become increasingly aware of standards of behaviour. Although preschoolers' understanding of others' emotions is limited and may often cause conflicts, their interactions in general are more friendly than unfriendly (Hay 1985). Parten (1932) found that the most frequent form of 2–5-year-old children's play was parallel play, in which children engage in similar activities but no not act towards a joint goal. Cooperative play, in which the child plays as part of a group, and tasks are shared out in complementary ways, increased with age. In 6-year old's thought the landscape of consciousness (internal events) is differentiated from and coordinated with the landscape of action (external events), which can be observed in children's narrative development (McKeough 1992) and knowledge of social roles (Goldberg-Reitman 1992).

In conclusion, JamMo should give young children opportunities for parallel (3–4 years) and cooperative (5–6 years) musical play, including musical expression (vocal or instrumental) and music composition and improvisation. Because young children's social cognition and role-taking tends to be restricted to one perspective and present events, JamMo games should support turn-taking in the form of pair gaming, visual feedback of musical patterns and produce tangible musical products.

During middle childhood the self-concept becomes more differentiated and typically includes evaluative components. Children's self-descriptions may then include references to competencies, knowledge, emotions, values and personality traits (Damon & Hart 1988). There is an increasing emphasis upon reciprocity, when children become aware of others' psychological distinctiveness (Erwin 1993). Peer interactions during school years are more complex and more discriminating, along with increasing linguistic competence and social cognition. Play activities are typically rule-based. It is typical for girls to form smaller peer groups, and their friendships tend to be dyadic, while boys form larger, more

hierarchic groups and have more accommodating friendships (Durkin 1995). Studies of social acceptance have shown that popular children exhibit fewer negative behaviours, lower levels of withdrawal, better problem-solving skills and more prosocial behaviours (Newcombe, Bukowski & Pattee 1993). Mrug, Hoza, Pelham, Gnagy & Greiner (2007) found that children who follow activity rules, help and pay attention to peers, contribute to group discussions and share more readily are better accepted by the peer group.

Vygotsky's (1978, 86) concept of the Zone of Proximal Development fits with adult guided, scaffolded learning in early childhood as well as school children's informal learning, ZPD being "the distance of the actual developmental level as determined by independent problem solving and the level of potential development as determined by problem solving adult guidance or in collaboration with more capable peers". Young (2003) studied 3- and 4-year-old children's social interaction during play on an Orff xylophone, and suggests that children's musical ideas arise from movement vocabulary and play potentials of the instrument, and as a result of playing with "attuned" adult partners children spontaneously begin to play well-balanced and expressively varied musical sequences. Similarly, peers act as tutors in school children's informal musical play activities, such as singing and clapping games at playground (Marsh 1999). In informal learning of these musical games, it is typical that they take place in groups, in which children closely observe the more experienced models in action, employ kinaesthetic modelling and the shadowing of musical sound and action, and finally reiterate the complete rendition of the game (Marsh 1999). As Barrett (2005) points, children who adopt and adapt musical convention of their culture learnt through for example electronic media in constructing their own songs is working within a cultural view of ZPD, as suggested by Lave and Wenger (1991, 48): "the distance between everyday actions of individuals and the historically new form of societal activity".

JamMo games for school children should encourage in social participation to musical communities of practice, pair-gaming as well as teamwork with everyone in the classroom and in the online community. JamMo environment should prevent all negative forms of social interaction, and support collaboration, mutual support as well as sense of belonging and social identity of all children.

In addition to age-related social development, special concern is on children with attention deficit disorders, who also typically suffer from problems with peers. In intervention studies of children with ADHD, peer tutoring has proved to be effective . In this form of intervention, instructional pace is determined by the learner, academic responses are continuously prompted and immediate feedback of performance provided. Especially, classwide peer tutoring (CWPT) has been found to effectively enhance ADHD children's skills in mathematics, reading and spelling (Greenwood, Maheady & Delquadri 1998; DuPaul, Erwin, Hook & McGoey 1998). In CWPT, everyone in the class takes turns tutoring each other, and teacher provides bonus points for tutoring pairs that are following prescribed procedures. It is possible to create mobile music education climate, which adopts principles of peer tutoring to support social inclusion of children with attention deficit disorders.

One special group of JamMo users is newly immigrated children. Cultural prejudice and lack of language skills form a threat for social inclusion. JamMo should provide a multicultural learning environment, which employs musical and visual cues and feedback and is adaptable according to users' mother tongue. When considering children living in bi- or multicultural contexts, it should also be taken in account that cultures are different form each other in emphasizing individual versus group-oriented self-concept (Erwin 1993).

III. DESIGN

A. Key aspects of mobile communication and collaborative m-learning environment

According to Squire, Johnson, Holland, Nataf & Klopfer (2005), PDA devices have many advantages in facilitating collaborative m-learning environment:

Portability - can take the computer to different sites and move around within a location
Social Interactivity - can exchange data and collaborate with other people face to face
Context Sensitivity - can gather data unique to the current location, environment, and time, including both
real and simulated data
Connectivity - can connect handhelds to data collection devices, other handhelds, and to a common
network that creates a true shared environment
Individuality - can provide unique scaffolding that is customized to the individual's path of investigation

Danesh, Inkpen, Lau, Shu & Booth (2001) suggest, the mobility of these devices opens up the potential for children's group collaboration. However, according to Cole & Stanton (2003), there is still relatively little understanding of the ways in which mobile technologies might be designed to best support co-present collaboration. Their analysis of children's collaboration with mobile devices highlighted the importance of occasional well-structured information than continuous flow of information. Unfortunately, they noticed that the key restricting aspect of current handheld devices on collaborative activity is the limited size of the screen. However, it shouldn't be a barrier to collaborative work (Cole & Stanton 2003).

Weasenforth, Meloni, and Biesenbach-Lucas (2000) presented that, in mobile computing, the *synchronous communication tools* are usually instant messaging system used by the participants to exchange messages in real-time. Discussion forums can be utilised as a tool for *asynchronous* group collaboration among geographically dispersed participants as they offer many benefits to users. The main benefit that discussion forums offer is that they facilitate the construction of low-level learning up to and including high-level evaluative skills. Hill & Roldan (2005) argued that online threaded discussions seem particularly well suited to mobile enhancements given that their effectiveness depends heavily on active participation and timely posting/response cycles. According to Chen, Kinshuk & Lin (2005), enabling the discussion to have the flexibility to take place synchronously in addition to asynchronously offers students the benefits of immediate feedback and increased motivation. They present that immediate feedback allows students to

strengthen their learning by being able to immediately correct wrong or ill thought out assumptions, which are needed in group decision-making, brainstorming, and analysis. In addition synchronous discussion motivates students to participate, as there is a compulsion to be present and participate, which in turn increases students' involvement in learning and activities, hence resulting in better learning experiences.

Community support systems, according to Koch, Groh & Hillebrand (2002), help communities to form or function by providing a physical and/or virtual space where people can communicate and where they can find other people. In M-learning, the possibilities for community support have increased – new functionalities and new scenarios can be contrived. They address three main categories for community support in M-learning: 1) services for matchmaking and awareness, 2) services that support synchronous and 3) asynchronous communication. Matchmaking is the process of bringing together people that have common attributes. It can't basically happen without having awareness from other users. Synchronous communication requires different tools for reachability management. Automatically or manually updated user status can be seen as a core tool in synchronous communication support. As an example, in collaborative music making, user status can present a current state of a composer; trying new ideas, recording, arranging etc. Asynchronous communication support can include automatic messaging tools for group postings. All of these previous community support categories should be taken into account of in musical M-learning environments.

Salavuo (2006) presented that online communities in the field of music are, on one-hand, knowledge communities, since they include members with a wide range of expertise who are seeking and sharing knowledge. On the other hand, these communities are musical communities, where distributing one's own music and listening to peers' music have great importance. Current online music communities in the Internet consist at least of following sections:

- Music: The music created by the members of the community. Usually in mp3-format. This section may also include reviews. Some sites have separate review-sections.
- Charts: Song rankings according to the user ratings.
- Forums: Sections for discussion. Is sometimes called `community'.
- Artists: Introductions, biographies, interviews, virtual album covers.

(Salavuo 2006)

To sum up, the concept and ideology of online music community could be implemented into the mobile learning environment.

B. Communicational design of the JamMo environment

The JamMo mobile environment is designed to support both synchronous and asynchronous communication between children by means of tools designed to facilitate user interactions. According to the theories presented above, the immediacy of communication and feedback is important for the youngest JamMo user group (3-6 years). Therefore,

especially synchronous communication tools are provided for that target group. Asynchronous communication requires more abstract level of social cognition and thinking, and as well as more advanced language skills. Asynchronous JamMo mobile community, containing a discussion forum as a core communicational element, is provided for school-aged children.

Interactions within JamMo environment can be traditional place- and/or time-dependent. JamMo will also provide tools and features for place and/or time independent communication. According to this same principle, musical practises with JamMo can also be synchronous or asynchronous: children can make their songs in real-time with their peers or share a *composition workshop*, which gives an access to the song at any time. There have been many attempts to make network based musical groupware tools. In most cases, music is created at each endpoint and uploaded for synchronization and reconciliation (Tanaka 2004). JamMo will extend musical communication from this kind of simple peer-to-peer file sharing systems towards ad-hoc mobility, streaming and networked collaboration.

Cole & Stanton (2003) concluded in their study that the use of PDAs for input enabled children to switch smoothly between individual, paired and whole group activity. In our project, JamMo will introduce multi-user sequencer functionality in a mobile environment; songs can be created individually, in pairs or with small group. The JamMo application will be designed to work in four different scenarios: *stand-alone*, *ad hoc*, *public* and *networked*.
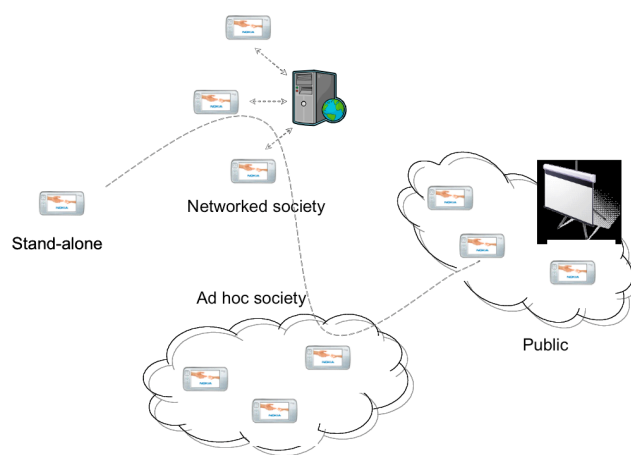

Figure 2. Scenarios of the JamMo

Stand-alone use of JamMo encompasses individual composing, singing and playing activities. This scenario has been presented in detail in our other paper (Paananen & Myllykoski 2009). In this paper we focus on three other communicational scenarios.

Ad hoc connections are direct connections between multiple mobile devices. The general idea of ad-hoc musical collaboration can be derived from the use of infrared beaming in children's storytelling. Following Cole & Stanton (2003), children developed part of an image and then passed it on to someone else in the group to add more detail and so on. In a composition process the song can be treated in a similar way. We have concluded that ad hoc working is especially suitable

for musical collaboration in pairs. Furthermore, the target age group (3–6 and especially 5–6-year-old children) is socially mature for this, and is likely to develop social skills, such as turn taking and negotiating, through musical collaboration with JamMo.

The *public* scenario of JamMo is intended for formal education in the inclusive music classroom, including individual JamMos of the children, a class room server and a public screen, which are administered by the music teacher. The selected user group is 7–9-year-old children. In this scenario, JamMo will be designed to enable real-time musical activities and both synchronous, and asynchronous communication inside the classroom. Children have their own JamMos and they can work individually, in pairs, with small group or even with the whole class room.

The *networked* scenario of JamMo is intended for fostering 9–12-year-old children's informal music learning, including individual JamMos of the children and a web-server. This scenario can also be used for formal learning situations in school. However, there is no teacher administrative functions or screen in the classroom. Teacher may give tasks and discuss the results with children. Children's musical practises are highly independent and for a major part should happen outside of the classroom.

The JamMo mobile environment can utilise many different wireless networking technologies, such as Bluetooth, WiFi (WLAN) and GPRS, through *Peerhood* middleware software (Porras, Hiirsalmi & Valtaoja 2004). Peerhood will provide a *seamless connectivity* over different network technologies. Seamless transition between different wireless access technologies, depending from the movement of the user, can ensure the continuity of synchronous musical communication.

C. The JamMo mobile community

The JamMo application version for 7–12-year-old children, employs the idea of an online music community and transforms it to a mobile environment. The JamMo mobile virtual community is an asynchronous communicational tool between mobile devices and users. JamMo users access the community with their own user profiles.

The JamMo virtual community consists of following features:

1) jukebox

2) song bank

3) sound and loop bank

4) discussion forum

5) help desk

The *Jukebox* offers an easy way for music listening and social navigation. The songs created with JamMo are circulating in the Jukebox and users can find other JamMo users through their songs. The Jukebox shows the composer's avatar when the song is playing, which acts as a link to the user profile. The *Song bank* is the main song storage in the JamMo virtual community. Children's compositions can be stored, listened and reviewed in the song bank. Children can also find and access open composition workshops through the song bank. The song reviews can be textual or auditive depending on child's ability to write. Furthermore, the songs can be categorized through user profiles, musical genres or instruments. JamMo sequencer contains a possibility for making musical loops and samples. Users can store and share these sounds in the virtual community's *sound and loop bank* for other JamMo users. JamMo's *discussion forum* is a standard text-based forum for sharing musical knowledge, thoughts, tips and experiences. Community's *help desk* is a text-based FAQ-section for JamMo users who have encountered problems or otherwise need extra instructions.

IV. CONCLUSION

This paper has presented the communicational design of JamMo mobile music application and environment. The design principles have been derived from children's social development and mobile communication theories. JamMo application is designed to work as an independent and collaborative creative music making tool. It will open many new and novel possibilities for studying children's musical learning, communication and collaboration.

Roschelle (2003) argues that pedagogical applications are often led down the wrong road by complex views of technology and simplistic views of social practises. In addition to theory based design, UMSIC research project tries to avoid these pitfalls by employing child-centered design and usability testing as a core tool within software development. Forthcoming JamMo prototypes will be tested with children in different scenarios and communication situations. The end product will be assessed through extensive and multidisciplinary impact analysis, which will provide detailed information about children's mobile musical activities.

M-learning environment offers a whole new kind of communication tailorability for different users and user groups, as well as learning contexts. The JamMo environment will provide a wide variety of different communication tools, according to children's social development level, in a domain of music.

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