PROJECT DELIVERABLE REPORT

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Have ethical issues been taken into consideration in this deliverable (Yes /No)?	
Please give a short summary (5- 10 lines) how the ethical issues have been considered in this deliverable, when working with children? (In addition, see the ethics check list prepared by Prof. Simon Rogerson available on Optima folder Ethical issues.) If the answer to the question mentioned above is no, please provide a short explanation why ethical issues have not been considered?	

Key words:
Children, Mobile Music Technology, social inclusion, JamMo, UMSIC, impact evaluation

Abstract (10-20 lines) summarising the content and results presented in the deliverable:
This deliverable focuses on collating key features of the project UMSIC design and its evaluation in the field. It includes summative findings from the emergent data and discusses the implications for further work.

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Description of the deliverable content:

The work on Work package 9 (originally including 254 pages) has been dived into three separate deliverables. However, the deliverables that formed the reporting on WP9 tasks (D9.1, D9.2 and D9.3) should be considered as an entity. In this particular deliverable the cohesive and valuable wholeness regarding the impact analysis may turn to become vulnerable. The referring notes may not find their right address in the separate Report Annexes. However, this deliverable forms the detailed project report in collating key features of the project design and its evaluation in the field. It includes summative findings from the emergent data and discusses the implications for further work.

1. Introduction

1.1 The UMSIC Project

Between September 2008 and August 2011, the *Usability of Music for the Social Inclusion of Children* (UMSIC) project sought to exploit modern music and mobile technology to promote a greater sense of inclusion for children aged 3-12 across Europe, especially those who may be in danger of marginalisation. In particular, UMSIC targeted two main groups of children deemed to be at a particularly high risk of marginalization. These included newly immigrant children growing up in bi-cultural contexts and children with moderate learning difficulties (such as attention deficit disorders) (UNESCO, 2010; Van Winden, 2001). The intention was to develop music software that could be used easily by children (including those that fall into the target groups) in a variety of contexts (such as at school and at home).

One of the major challenges in pre-schools and schools across Europe is the inclusion of an increasingly diverse range of learners with particular needs (Frederickson and Furnham, 2001; Tisdall *et al*., 2006; UNESCO, 2010). Learning requires self-regulation and communication skills supported by an effective and supportive context-sensitive scaffolding (Frederickson and Furnham, *op.cit.*). Therefore, impaired language skills and learning disabilities are a major threat for positive child development (Atkinson *et al*., 2002). This may further lead to: lower self-esteem; lack of social relationships; problems in self-regulation; lower academic achievement; and behavioral disorders (Atkinson *et al*., *op.cit*.; UNESCO, *op.cit*.). Hence, it is important to try to prevent this negative cycle from developing by assisting children to feel socially included early on.

Funded as an ICT collaborative project by the European Commission under the Seventh Research Framework Programme (Grant FP7-ICT-2007-2), the UMSIC project brought together a team of musicians, software designers, technologists, engineers, psychologists and educators from across Europe. The project was led by the University of Oulu (Finland), in partnership with the University of Central Lancashire (UK), University of Zürich (Switzerland), University of Jyväskylä (Finland), Systema Technologies (Greece), Lappeenranta University of Technology (Finland) and the Institute of Education, University of London (UK). Collectively, they were supported by one of the world's major mobile telephone manufacturers, Nokia, to develop the first interactive software system for creating and sharing music on a mobile phone. The software is called *JamMo*, short for 'Jamming Mobile'.

Researching, designing, developing and evaluating *JamMo* and its associated research instruments and methodologies was a complex, multi-disciplinary, international process. In common with other EC FP7-funded projects, the enterprise was divided into a series of 'work packages' (WP) as follows (the lead institution is shown for each):

- WP0: Project Management (University of Oulu)
- WP1: Requirements Elicitation (University of Jyväskylä)
- WP2: UMSIC Architecture Design, Specification and System Integration (Lappeenranta University of Technology)

- WP3: Usability Requirements and Evaluation (University of Central Lancashire)
- WP4: *JamMo* design (University of Jyväskylä)
- WP5: Design of Evaluation methods (University of Zürich)
- WP6: Development of *JamMo* (Systema Technologies)
- WP7: Product testing (University of Oulu)
- WP8: Dissemination and Exploitation (University of Oulu)
- WP9: Impact Analysis and Project Closure (Institute of Education, University of London)

The lead institution of each Work Package was responsible for coordinating the generation of official reports and other outputs for the European Commission known as 'Deliverables'. Annex 8.1 contains a comprehensive overview of all the deliverables produced as part of the project.

1.2 Objectives of UMSIC Work Package 9

The Institute of Education, University of London coordinated UMSIC Work Package 9 (WP9) ('impact analysis and project closure') and thus was concerned with the overall outcomes of the project, as well as its contribution to key features of the design and fieldwork undertaken by UMSIC partners. The WP9 tasks overall were set out in the UMSIC 'Description of Work' document as follows:

- **T9.1** Examine the effects of *JamMo* on social inclusion measures in groups with children suffering from attention deficits and/or with children having a migration history.

- **T9.2** Investigate the music making processes and the learning of musical structures in order to test the effects of *JamMo* on progresses in the musical domain.

- **T9.3** Investigate the language use related to music and test the impact of *JamMo* on quality and quantity.

- **T9.4** Conduct an impact assessment through qualitative analyses of the views of participants on their use of technology, its benefits and challenges (using simple survey instruments that will have been piloted in WP5 and which are age sensitive, drawing on established methods for gathering such data from young children as well as older participants, including care givers, parents and any teachers involved in the project).

- **T9.5** Initiate an impact assessment of musical behaviours and language skills.

- **T9.6** Undertake quantitative analyses of the demographics of the participant groups.

- **T9.7** Undertake quantitative analyses of technology use, drawing on data from inbuilt software.

- **T9.8** Create an overview of related (i) ADHD and (ii) immigrant participant change data, using evidence from site-based data collection that uses established assessment protocols for tracking change in (i) ADHD profiles and (ii) social inclusion.

- **T9.9** Generate summative key findings and implications for further work and application for dissemination to user groups.

  (from Fredrikson, 2008: 61)

1.3 The Composite Impact Analysis and Project Closure Report

This composite report seeks to collate and review all the elements of the UMSIC project in terms of (i) actual impact on targeted groups, (ii) potential impact on others outside these groups, and (iii) an assessment of the technological innovations that emerged. In line with the objectives of WP9, the review draws upon the assessment protocols and measures designed and piloted earlier in UMSIC Work Package 5 ('Design of Evaluation Methods'), as well as the deliverables, publications, public presentation materials and other documents produced within other work packages (see Annex 8.1 for an overview of all deliverables generated throughout the project and Annex 8.2 for a list of all project publications and other public outputs). For participants, qualitative and quantitative data synthesis is used to compare patterns of within target group behaviours generated by the use of these new technologies, as well as referring to case study data on individual participants.

Since the *JamMo* software was the centre-piece of the UMSIC project, a significant task within WP9 was to evaluate the use of this software in a range of educational, social and musical settings and with a range of users, particularly those highlighted by the UMSIC Consortium as at risk of being socially excluded. During the final year of the UMSIC project (September 2010 – June 2011), *JamMo* and its musical materials were the subject of extensive user impact evaluation studies in the UK, Finland and Germany in the form of classroom-based, focus group and case study research studies. An overview of *JamMo* 1.0 (the first public release version) is provided in section 2 of this report. The practical fieldwork was reflected against an extensive literature review on music technology, children with special educational needs and those from immigrant backgrounds (see Annex 8.5 for the full literature review).

UMSIC WP9 is collaboration between the research teams working at the following UMSIC consortium institutions (see Figure 1.1)[1]:

- The Institute of Education, University of London, UK
- The University of Jyväskylä, Finland
- The University of Central Lancashire, UK
- The University of Oulu, Finland
- The University of Zürich, Institute of Psychology, Switzerland

[1]Institutions are listed in order of person months allocated to WP9 within the Annex DoW document, June 2008.

Figure 1.1: UMSIC Work Package 9 partners and fieldwork locations

Each of these institutions pursued a distinct approach to the WP9 objectives in order to address specific client groups, to reflect local contexts and particular institutional foci. Fieldwork was undertaken in the UK, Finland and Germany. In the case of the last site, the town of Herborn in the Hesse Region of Germany was the location of the University of Zürich's WP9-related fieldwork.

Table 1.1 provides a research team-level breakdown of how the nine tasks assigned to WP9 within the 'Description of Work' document were pursued by the WP9 partners.

Table 1.1: Overview of WP9 tasks by research team

	WP9 tasks	IOE	JYU	UCLAN	UOULU	UZH
T9.1	Examine the effects of *JamMo* on social inclusion measures in groups with children suffering from attention deficits and/or with children having a migration history.	L	✓	✓	✓	
T9.2	Investigate the music making processes and the learning of musical structures in order to test the effects of *JamMo* on progresses in the musical domain.	L	✓	R	✓	
T9.3	Investigate the language use related to music and test the impact of *JamMo* on quality and quantity.	✓				L
T9.4	Impact assessment through qualitative analyses of the views of participants on their use of technology, its benefits and challenges using simple survey instruments... drawing on established methods for gathering such data from young children as well as older participants, including care givers, parents and any teachers involved in the project	✓	✓	L		✓
T9.5	Impact assessment of musical behaviours and language skills	L	✓	✓	✓	✓
T9.6	Quantitative analyses of the demographics of the participant groups	L	R	R		
T9.7	Quantitative analyses of technology use, drawing on data from inbuilt software	L	R	R		
T9.8	An overview of related (i) ADHD and (ii) immigrant participant change data, using evidence from site-based data collection that uses established assessment protocols for tracking change in (i) ADHD profiles and (ii) social inclusion	L	✓			
T9.9	Summative key findings and	L	✓	✓	✓	✓

	implications for further work and application for dissemination to user groups					

Key: L =Leading institution, ✓=participating institution, R=institution providing 'raw data' for leading institution to analyse.

1.5 Ethical considerations

In the narrative that follows, all research fieldwork with children and adults has been subject to the ethical policies of the local institutions and their host countries.

1.5.1 Institute of Education, University of London, UK

Fieldwork followed the British Educational Research Association ethical guidelines (BERA, 2004). All activities were explained to participants in advance, were noted to be voluntary, with the participants told that they were able to withdraw at any time should they feel uncomfortable. The ethical requirements were explained verbally and in writing to the appropriate carers (whether teacher, headteacher, local education authority representative, and/or parent) and to the children. All data have been anonymised, are held in secure locations and only available for the explicit research purposes of this project.

For school-based fieldwork, parental permission was sought on the research term's behalf by the Headteacher or Deputy Headteacher both for participation in the project and also to video the pupils using the *JamMo* where necessary. Where pupils did not return their permission slips in time, the class teacher arranged alternative activities and they were not included in the final school session.

The research team all held enhanced disclosure to work unsupervised with children from the UK Criminal Records Bureau.

1.5.2 University of Central Lancashire, UK

All fieldwork activities followed the ethical guidelines outlined by the UMSIC project, as well as the specific ethical working practice of each university involved. There is no sensitive data being gathered and the ethical concern has been to ensure that the children are protected from psychological harm (potentially caused by activities being too difficult or by frustrations with the technology being unstable) and physical harm (potentially caused by poor management of activities or by the use of unsafe products) and that they are treated with fairness and respect.

All contact with children at UCLan has been assessed by the University of Central Lancashire Ethics Board, and is covered the Child Computer Interaction (ChiCI) Group's code of conduct. Any researcher who has individual or unsupervised contact with the children is subject to an enhanced Criminal Records Bureau (CRB) check, as is the standard working practice in the UK. Records were made of all activities conducted, including the class that participated, the researchers that conducted it, who designed the activities and the research questions behind it. Before the evaluations the school teachers were contacted, and any children with disabilities were reported. According to the size of the class and if any special attention required, the evaluations were designed to allow enough time and fair treatment to all children. We made sure each session was packed with fun activities by piloting it to a small number of children first.

Children were treated as volunteers in the studies and made able to withdraw at any time, and it was stressed to them that they would not 'fail' a task if they could complete it. Where possible, all children in a class were given the chance to try any technology brought into a classroom, even if their data could not be used, so that no-one should be excluded – if this was not possible, care was taken to give them a task of equal or greater 'fun'. The evaluations took place in school breakout rooms and classrooms, since children felt more at ease in their familiar environments. Children were normally paired with a working partner (a system already in place at the schools), which helped some children to overcome shyness and encouraged them to help each other and to be more involved with the activity. They all showed great enthusiasm and engagement while working in groups.

Data kept from the studies were always anonymised – only ages and genders were recorded along with the results, not names, and where photographs or videos were used to record activities care was taken to omit faces or identifying information before publication. Photography and video were only used if the school held consent from the pupils' parents for this type of activity, and if the children themselves did not object.

1.5.3 University of Jyväskylä, Finland

Ethical issues were taken into consideration at all stages of this intervention. Children and parents were informed about the research according to ethical principles, and permission for the intervention was acquired from all participants. Those children, whose parents gave permission to participate in the study but not to video their children, participated in the music lessons and filled in the questionnaires in similar to other participants, but were excluded from video. Anonymity of the all participants has been secured when reporting the results. Data (video recordings questionnaires) of classroom interventions has been stored at the Department of Music at the University of Jyväskylä.

1.5.4 University of Oulu, Finland

In the University of Oulu studies with young children, the study group was trained to identify those ethical issues which need to be addressed during work with children, such as access, being fair to all, the right to withdraw at any time that they felt uncomfortable, to gather informed consent from all parents and children, not only to participate, but also to have their words or drawings used in publications from the UMSIC project. Where the work of the project is disseminated, children and their parents/teachers have a right to know what is being said. In addition, there was a need to communicate the findings to these participants in a way that is appropriate for their needs. All people who came into direct contact with the children understood their privileged position and ensured that they did not put themselves or the children at any risk.

1.5.5 University of Zürich, Switzerland

At the day-care centre in Herborn in the Hesse region of Germany, all the administrative (informed consent) and practical ethical issues were carried out and completed. All information about the children (e.g. developmental risks, family background) was carefully and confidentially handled. All names were anonymised. All children voluntarily participated in the study, and all signs and wishes to withdraw from suggested tasks were respected. Informed consent statements were signed by all parents.

1.6 Recommendations from the previous Commission review (October 2010)

Recommendations from the October 2010 European Commission review of the UMSIC Project that have informed the work of WP9 partners and the preparation of this report were as follows:

- **R3** - Proceed with a more extensive validation of the *JamMo* system with both the primary and secondary users, and finally identify and draw some lessons learnt and best practices for the successful applications.

- **R4** – For the validation piloting, a short questionnaire should be prepared for immediate use after the interventions, in order to have a fresh feedback of the experiences. The template of this questionnaire should be included in the D3.5b Evaluation Report deliverable, due at M32 of the project.

- **R5** - Define indicators against which to measure the social impact of the *JamMo*. This should be included in the D3.5b Evaluation Report, Part 2 (M32), in which the results of the validation should be provided.

The short questionnaire requested as part of R4 was deemed to be more appropriately aligned with activities within Work Package 9 than with those of Work Package 3. As a result, responsibility for the generation and administration of this questionnaire was assumed by WP9 partners. The data gathered via this instrument will be discussed within sections 4.5.1.1 and 4.5.1.2 of this report.

2.1 Guiding design and development principles

JamMo 1.0 is a music-making game targeted at children aged between three and twelve years old. It was released in July 2011 following three years of research, design and development. This section offers an overview of the design principles and functionality of the software in order to provide a context for the research findings that follow.

JamMo is intended to support both music learning and social interaction. The software's design has been influenced by an extensive reading of the international research literature on the needs of children often perceived as marginalised or socially excluded due to particular learning difficulties, language or cultural barriers. However, it is intended to appeal more generally to children from the very widest range of backgrounds and cultures.

Figure 2.1: a four-year-old boy plays with *JamMo 3-6* on Nokia N900 smartphone

Figure 2.2: a nine-year-old girl with Nokia N900 smartphone running *JamMo 7-12*. The *JamMo 7-12* main menu is also shown on the screen behind.

Its interface and functionality have been developed, evaluated and revised through iterative collaborations with young people themselves, along with feedback from their parents, carers, teachers and other professionals (see Figures 2.1 to 2.9).

Figure 2.3: initial *JamMo* interface design session, Oulu, Finland

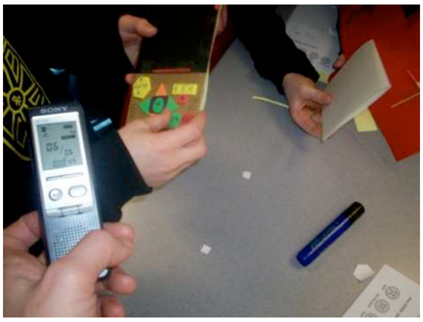


Figure 2.4: practical *JamMo* design session, Preston, UK

Figure 2.5: child's early design concept for *JamMo 7-12* interface, Preston, UK

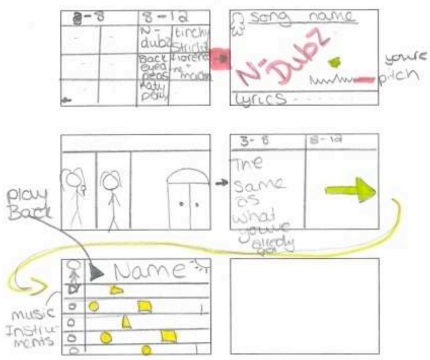


Figure 2.6: child's design ideas for selected *JamMo 7-12* screens, Preston, UK

Figure 2.7: Finnish child's drawing incorporated into *JamMo 3-6* singing game screen

Figure 2.8: Finnish children evaluating *JamMo 3-6* at the end of its second year of development

Figure 2.9: professional community musicians evaluate beta version of *JamMo* in London

JamMo 1.0 can be installed on the Nokia N900 (Figure 2.10) and Nokia N9 'smart' mobile phones. There is also an officially-supported version for the *Ubuntu* desktop distribution of the Linux operating system (Figure 2.11).

Figure 2.10: close-up of *JamMo 3-6* ('advanced' singing game) running on Nokia N900 smartphone

Figure 2.11: *JamMo 3-6* running on a touchscreen *Ubuntu* Linux laptop

JamMo's mobile phone platform offers access via a technology familiar to many European children. In addition, the use of mobile technology is designed to encourage collaboration and sharing naturally within classroom, playground or other informal contexts (Figures 2.12 and 2.13). *JamMo*'s pedagogical design and specially-created library of multi-cultural musical materials are aimed at ensuring that the game remains inclusive even for newly-immigrant children.

Figure 2.12: a pair of eight-year-old children play with *JamMo 3-6* on the Nokia N900

Figure 2.13: a small group of children play with *JamMo 3-6* on two Nokia N900s

2.2 *JamMo 3-6* and *7-12*

Distinct versions of *JamMo* for younger and older age groups provide children with music-making tools related to their developmental phase. *JamMo 3-6* consists of a singing game (Figure 2.19) and a composition game (Figure 2.14) and features an entirely text-free interface. *JamMo 7-12* provides a basic music 'sequencer' (Figure 2.15), music sample browsing/selection screen (Figure 2.16), a range of simple 'virtual' instruments (Figure 2.17), an 'orientation game' (Figure 2.32) and essential community/sharing features (Figure 2.33). Both versions of *JamMo* can make optional use of wireless networking to enable children to compose together in pairs or small groups using several mobile devices.

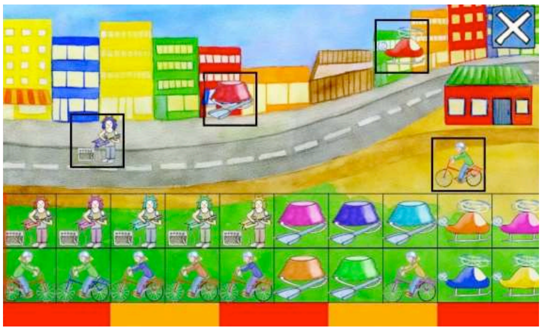


Figure 2.14: ***JamMo 3-6*** **composition game, city theme (advanced mode)**

Figure 2.15: ***JamMo 7-12*** **main sequencer screen**

Figure 2.16: ***JamMo 7-12*** **music sample browsing and selection. The 'wheels' are used to select (from left to right) rhythmic, melodic, harmonic or special effects sounds samples.**

Figure 2.17: ***JamMo 7-12*** **'virtual' drum instrument.**

2.3 *JamMo* Musical Materials

JamMo 3-6 and *7-12* make use of an extensive library of specially-prepared musical materials produced by members of the UMSIC team in collaboration with twenty-three professional instrumentalists and singers in Finland and the UK. Careful analyses were conducted to ensure contextual sensitivity of these materials with regard to age, to different immigrant and host musical cultures, and to specific musical requirements of children with more complex educational needs. The library consists of song backing tracks and short fragments of recorded musical material (more usually referred to as 'sound fragments' in *JamMo 3-6* and 'sound samples' in *JamMo 7-12*). Materials are presented in three musical keys (A, D and G major, or their relative minors) and at three tempi (90, 110 and 130 beats per minute) in order to cater for the needs and preferences of the *JamMo* target user groups. The variation in pitch centre allows the materials to be matched to the needs of young, developing voices. Similar, the tempi variations are also sensitive to the needs of young children's developing fine motor control.

Collectively, the song backing tracks draw upon European lullaby, folksong and pop/rock repertoires and are selectively presented with lyrics in English, Finnish, French, German, Spanish and Xhosa. *JamMo* users can choose whether to sing along with a live vocal guide or the backing track alone. Graphical icons have been carefully designed for each of these songs with reference to their musical content, culture or style (Figure 2.18).

Figure 2.18: examples of backing track icons for three stylistically-distinct versions of 'Scarborough Fair' in *JamMo 7-12*. The styles are, from top to bottom, Polish folk rock, Pakistani pop and UK Grime.

In total, over 3000 music samples are included within the *JamMo* 1.0 package. Many of these are derived from the song backing tracks, allowing users to freely reconstruct and fuse fragments of different backing tracks and musical styles within the *7-12* sequencer. The samples are categorised as either rhythmic, melodic, harmonic or 'special effects' material (Figure 2.16). In *JamMo 3-6*, pre-selected sets of music samples are presented to users within composition 'themes' (e.g. the 'city' theme in Figure 2.14).

2.4 *JamMo 3-6* Singing Game

The singing game is one of the two main activities in *JamMo 3-6*. This is a simple karaoke-style application where users are encouraged to sing along with a nursery rhyme/lullaby backing track selected from amongst the twelve available (eight in an 'easy mode' that offers less choice – see Figure 2.19). Optional guide vocals are provided in Finnish, English and, for selected backing tracks, French and German. Using an automatic recording facility, after singing along with a backing track users are invited to listen back to their live vocal performance. These recordings can be stored and subsequently retrieved from the 'cupboard' (Figure 2.20).

Figure 2.19: the song selection screen in *JamMo 3-6* ('easy mode' – see Figure 2.10 for 'advanced mode'). The lyric language and vocal guide are controlled via the icons on the right-hand of the screen).

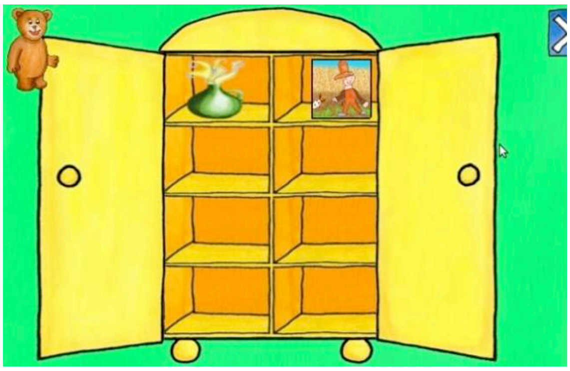


Figure 2.20: the *JamMo 3-6* cupboard, used to store users' compositions (left-hand icon) and recordings of song performances (right hand icon).

2.5 *JamMo 3-6* Composition Game

The composition game is the second main activity within *JamMo 3-6*. Users select one of three composition 'themes' as a basis (Figure 2.21) and construct a musical composition by arranging sets of sound fragments on top of a simple backing track. The themes are designed so that background images, icons, backing track and sound fragments are stylistically coherent. Sound fragments are first auditioned by clicking on their associated icons before dragging-and-dropping them onto a simple sequencer 'track', divided into bar-long grid squares (Figure 2.22). Sound fragments can subsequently be moved or removed from the sequencer track as necessary.

Figure 2.21: *JamMo 3-6* composition theme selection screen. Themes are (from left to right) 'city', 'jungle', 'fantasy'.

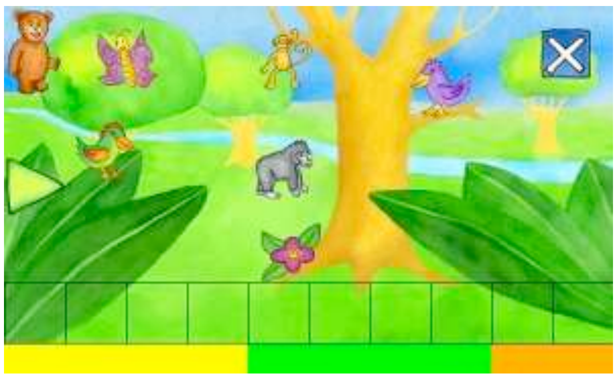


Figure 2.22: *JamMo 3-6* 'jungle' theme composition screen ('easy mode'). Six sound fragment icons 'float' above the background image and can be dragged onto the track at the bottom of the screen.

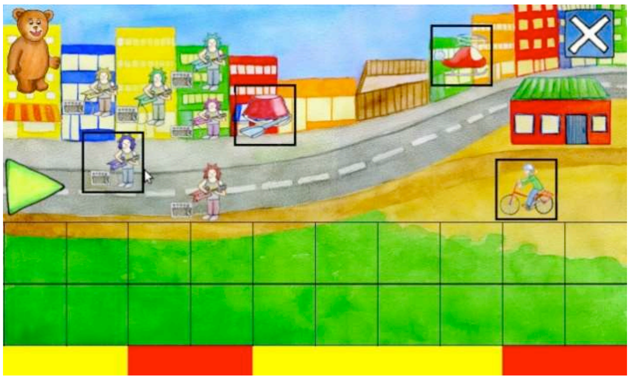


Figure 2.23: *JamMo 3-6* 'city' theme composition screen. In the advanced mode sets of sound fragments are presented, grouped into four musical categories. Two tracks are available for more complex composition textures.

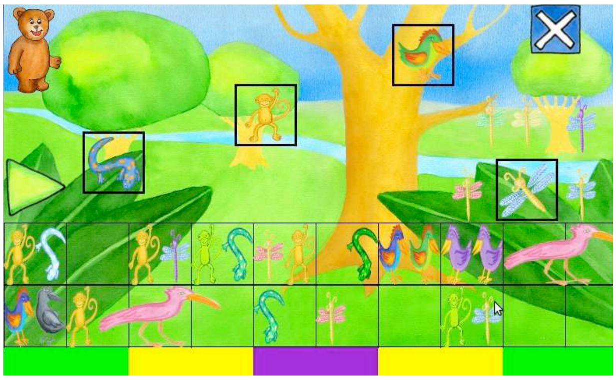


Figure 2.24: *JamMo 3-6* 'jungle' theme composition screen ('advanced mode'). Here a range of sound fragments (ranging in length between half a bar and two bars) have been added to both tracks.

To provide additional creative opportunities, each composition theme features three randomly-selected variations offering distinct sets of sound fragments. Additionally, an optional, 'advanced' mode is provided with a significantly increased choice of sound fragments (twenty instead of six in 'easy' mode) and the ability to sequence two tracks of fragments concurrently (Figures 2.23 and 2.24).

2.6 *JamMo 7-12* Sequencer

A more sophisticated music sequencer provides the main focus within *JamMo 7-12* (Figure 2.25). Sound samples can be browsed and auditioned using four sample selection wheels before selections are dragged down on to a four-track sequencer. The backing track (the top track with the 'cassette' icon) can be changed or muted to suit user preference. The general menu screen features options to change the pitch and tempo of sequencer playback and to save the project in either *JamMo* format or as an exported digital audio file, suitable for burning to CD or converting to an MP3.

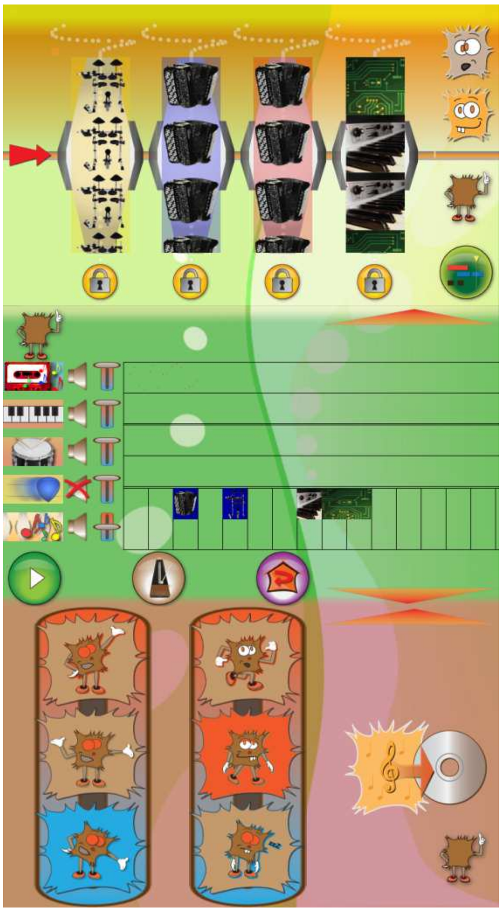


Figure 2.25: the *JamMo 7-12* screen layout. The main sequencer screen is shown in the centre, with the sound sample selection wheels above and the 'general menu' beneath. Users can scroll between these screens with a touch-screen gesture or by pressing the arrows.

2.7 *JamMo 7-12* 'Virtual' Instruments

JamMo 7-12 offers three very simple virtual instrument interfaces. These are presented as an on-screen piano keyboard (with a choice of sounds) (Figure 2.26), drum kit (Figure 2.17), and a sliding plectrum-based interface capable of producing microtonal pitches (Figure 2.27). These instruments facilitate near real-time melodic and rhythmic improvisations. Simple standalone recording and playback options are available for each.

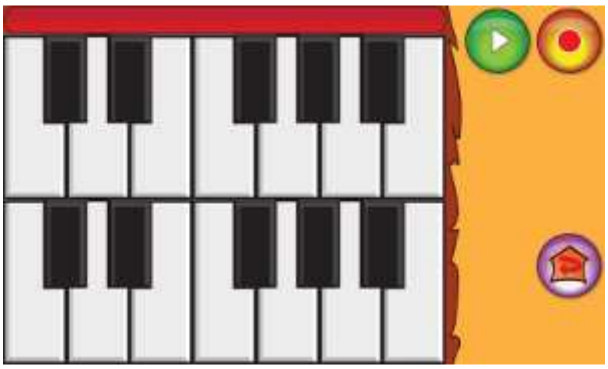


Figure 2.26: *JamMo 7-12* 'piano' virtual instrument interface

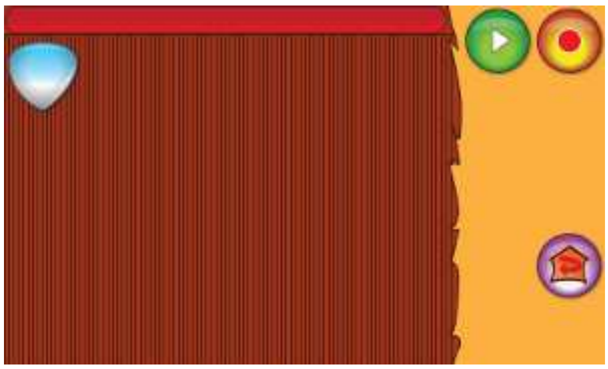


Figure 2.27: *JamMo 7-12* 'slider' virtual instrument interface

2.8 Wireless networking features

The functionality of both the *JamMo 3-6* composition game and the *7-12* music sequencer can be extended through wireless networking to include more than one user on more than one device. This networking happens invisibly on an 'ad hoc' basis. Here *JamMo*'s functionality automatically adapts when other devices are present and links directly to them (Figure 2.28).

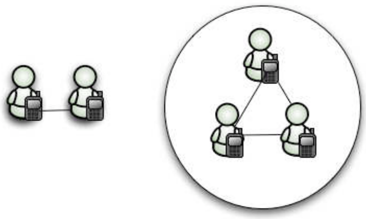


Figure 2.28: *JamMo* 'ad hoc' wireless networking in *3-6* (left) and *7-12* (right)[2]

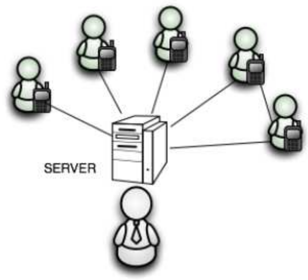


Figure 2.29: *JamMo 7-12* 'public' networking[2]

JamMo 3-6 supports an ad hoc pair game mode in which two users can create a two-track composition together. Each user is assigned one of the two sequencer tracks available and can and remove musical fragments on his/her own track only. The actions are then transferred to other user's screen in real time. The sequencer in *JamMo 7-12* can be used in ad hoc mode with groups of between two and four users. Again, each user can edit the sound samples on one track only with actions displayed to the screens of all other participating devices.

A more sophisticated 'public' networking mode is possible when *JamMo 7-12* is used within a classroom environment (Figure 2.29). Here, a teacher runs the *Ubuntu* desktop version of *JamMo* connected to a data project projector. Groups of up to four children can work together to construct a composition with each group member taking responsibility for one element of the musical texture, based on the categories of available sound samples (melodic, harmonic, rhythmic and special effects). The resulting four-track composition is displayed in real time on the connected data projector screen.

Further, more complex networking scenarios involving both local area wireless and wide area connectivity are envisaged for future versions of *JamMo*.

2.9 *JamMo* Mentors

JamMo users are supported by simple animated helpers known as 'mentors' who provide instructions and encouragement. In *JamMo 3-6* the mentor is styled as a

[2] Figure 2.28 and 2.29 from Myllykoski, M. (2010, 23-27 August). *Ubiquitous Music Learning Environment Scenario Analysis*. Paper presented at the ICMPC11 (International Conference on Music Perception and Cognition), Seattle, USA, 402-408.

friendly bear known as 'Teddy' (Figure 2.30) whilst in *7-12*, the mentor is depicted as 'Mr *JamMo*' (Figure 2.31). The mentors speak instructions in suitably friendly, warm and encouraging natural voices in the three UMSIC project languages of Finnish, German and English. The mentors appear when the software is started, when manually activated through tapping, or when no input has been detected for some time. In this way, they are intended to help children who are confused or re-engage those whose attention is wandering.

Figure 2.30: the *JamMo 3-6* mentor bear

Figure 2.31: the *JamMo 7-12* mentor, Mr *JamMo*

Should a user feel confident enough without recourse to the mentors' advice, a single tap with the stylus is designed to be enough to send them back to their home corners in silence. Tapping-and-holding the icons for longer results in a deactivation of the mentor until manually re-activated in the same way.

2.10 Orientation games

A progressive series of 'orientation games' have been designed to guide children through the use of *JamMo 7-12*'s sequencer and virtual instruments. These games are intended not only to encourage children to sing, play, improvise and compose using the software, but also to promote social and community-related skills (e.g. musical collaboration, sharing and mutual support).

JamMo 7-12 1.0 features an implementation of the first of these games, intended to introduce users to the creative potential of constructing a composition from the sound samples provided (Figure 2.32). Here, users listen to a backing track before being invited by the mentor to select and drag four rhythmic samples and four melodic samples onto the sequencer tracks.

Figure 2.32: *JamMo 7-12* level 1 orientation game screen, with mentor providing instructions

2.11 *JamMo 7-12* Community Features

The community features of *JamMo 7-12* are designed to manage individual user profiles and provide access to online forums for discussion, mutual support and the sharing of compositions and sound samples between users. As of version *JamMo* 1.0, it is possible to use the community features (Figure 2.33) to set up user profiles (Figure 2.34) and use these to post messages (Figure 2.35) and store composition projects within the local machine (Figures 2.36 and 2.37).

Figure 2.33: *JamMo 7-12* community menu screen

Figure 2.34: *JamMo 7-12* user profile (avatar) design screen

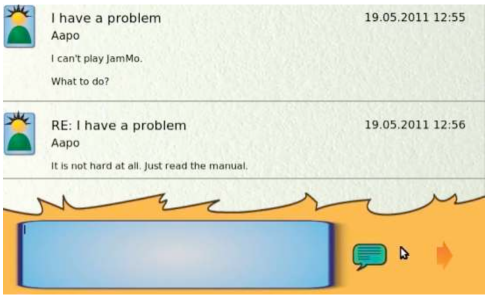


Figure 2.35: messages posted on the *JamMo 7-12* help forum

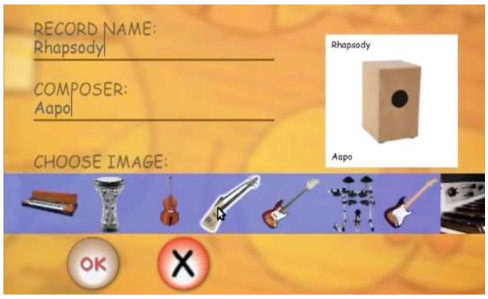


Figure 2.36: saving a *JamMo 7-12* composition – selecting a name, composer and icon

Figure 2.37: saved *JamMo 7-12* rendered audio file (green) and re-loadable composition project file (red)

Future versions of *JamMo 7-12* community are planned to link to online servers, enabling the sharing of discussions and musical materials between machines and across networks.

2.12 *JamMo* facilities for researchers and teachers

JamMo is designed to automatically record all user interactions and technical procedures in log files. These are generated in the background without any user involvement and provide a constantly updated, time-stamped record of usage. The resulting log files allow extensive analysis and offer researchers an extremely detailed 'window' into the musical thinking of *JamMo* users.

JamMo itself is designed to be extendable and it is currently possible for teachers and parents add their own musical content to the *3-6* advanced singing game without the need to alter the software's source code.

2.13 Open Source Status

JamMo 1.0 is released under the terms of the GNU Public Licence (version 2). Following the conclusion of the UMSIC project in August 2011, *JamMo*'s development will continue under the auspices of the *JamMo Open Source Project*. However, since *JamMo* is an open source application, anyone capable and willing to modify and redistribute the software can contribute to its future development.

2.14 *JamMo* online

Specific information downloading, installing and using *JamMo* is available at http://www.umsic.org/*JamMo*/. *JamMo*'s source code can be downloaded from http://gitorious.org/*JamMo*.

3.1 Young people

Throughout the three-year project, the emphasis was on participating children being asked to act in the role of co-researchers in an action research design. In all the different fieldwork locations, the participant children were invited to take part in the study, all had the opportunity to refuse and also it was explained that they could decline to continue participation at any time that they felt uncomfortable. It was deemed essential from the research team's perspective that the participant children were treated as co-researchers in order to gain maximum benefit from their input throughout the project. Such an approach was also likely to facilitate feelings of self respect and increased levels of motivation in the children. This approach was adapted from the outset of the project. Thus, the main products of the project and the evaluation methods used were determined and shaped by input received from the children. Without such intensive and detailed on-going empirical testing, the end product and the evaluation of the project may have been unsuitable for the target groups and unfit for its proposed purpose. Close collaboration with stakeholders in different fieldwork settings proved vital in generating feedback for refining and developing the product for its intended educational purpose and for it being able to be used in a variety of educational contexts (including formal and informal settings).

A significant strength of the project has been the extensive in-depth fieldwork conducted with a large number of young people, as well as with professionals and practitioners working in the field of educational and community settings. Such extensive fieldwork from the outset ensured that the project was not isolated from practice and sustained on its initial focus - the development of educational software for practical use.

In total, WP9 partners have worked with a total of over 345 children, aged between three and eleven years, across the thirteen months from July 2010 to July 2011 (see Table 3.1 for an overview).

Table 3.1: Overview of UMSIC WP9 young participants

Coordinating institution	N	Fieldwork location, age range and dates	Notes
IOE	29	Primary school in London, aged 8-9 years (UK School Year 4)(21/09/10-15/12/10)	Group included a high number for whom English was an additional language and a total of n=8 migrants.
JYU	35	University Music Therapy Clinic for Training and Research, aged 10-11 years (Finnish Grade 4)(30/9/10-16/12/10); Two local Primary schools (31/03/11-15/04/11)	This embraced a small number of children with ADHD and their classroom peers.
UCLAN	160+	Primary schools in Lancashire, aged 5-11 years (UK school years 1 to 6) (07/10-05/11))	This included children with moderate learning difficulties and those with an immigrant background.
UOLOU	91	Pre-school nurseries (x3), aged 5-6 years(1/9/10-14/11/10)	A small number of the children were recent immigrants to Finland. Three phases of the research were design studies (n=76 children) leading into the formal WP9 activity (n=15 children).
UZH	30	Day care centre for young children, aged *3-6* years (12/05/11-28/05/11)	76% of the children were immigrants.

Collectively, participants embrace the two main target groups of the UMSIC project and also include a range of similar aged children from other backgrounds that were representative of the school populations in the localities. Sections 3.1.1 to 3.1.5 provide more specific information on the backgrounds and profiles of the young people who participated at each fieldwork site.

3.1.1 London and the South East of England, UK

The Institute of Education, University of London's fieldwork was centred on one West London school that had taken part in the previous year's WP5 questionnaire development. The school selected a Year 4 class (8-9 years old in the UK system) to participate in the project. They were well placed as an age group to work with both *JamMo 7-12* and *3-6* versions, given that some of the pupils were developmentally reported to be below their chronological age on several core school measures. At the outset of the sessions, there were 29 pupils on the class register. However, since this was only the third week of the school year, the exact number on roll was still fluctuating, with the class teacher reporting that two pupils had joined the class only the day before the first project session. The class teacher was also keen to stress that the group dynamics within the class were still evolving in response to these ongoing fluctuations – it being still very early in the school year. The class had a high percentage of pupils for whom English was an additional language (EAL), with native speakers of Arabic, French, Kurdish, Lingala, Pashto, Turkish, Somali, Urdu and Jamaican dialect all present. As a whole, the school included speakers of 42 languages. Across the school, 68% of pupils had English as an additional language. 42% were on the special needs register and 42% were refugees.

3.1.2 Preston, Lancashire, UK

In Preston, over 160 children were involved in the eight fieldwork studies that constituted the final phase of evaluation of the usability of *JamMo*. The first study (summer 2010) was undertaken by 24 children from two schools in Preston, UK. Of these children, twelve were from Year 3 (age 7-8) and twelve were from Year 5 (age 9-10). The second and third studies (summer 2010) were carried out with 14 children in Oulu, Finland, aged 5-6. The fourth study (March 2011) took place in Preston, UK, and included 36 children aged 8-10 who were from two classes from a local school in Preston. The fifth and sixth studies (April 2011) included children from one class from a local school in Preston, UK. The seventh study (May 2011) involved five children from a UK preschool centre. In the eighth study (May 2011), 20 children aged 5-6 participated in the study in Preston, UK.

3.1.3 Jyväskylä, Finland

In Jyväskylä, the initial focus was on ADHD with a smaller number of children in a more one-to-one, clinical music therapy-based context. Here, the aim was to identify diagnosed ADHD cases in the age group of 8-12 years of age, willing to volunteer in our study. This was a challenging task. Nowadays, ADHD diagnosis is not easily given to children in Finland and children younger than 8-9 years of age are not generally given ADHD diagnosis at all. In the recruitment of participants, we collaborated with the Niilo Mäki Institute, the ADHD Association of Central Finland, and local Primary schools. We aimed to include non-ADHD peers (classmates) for the music therapy intervention, as well as the whole school class for the classroom intervention in the second phase of fieldwork.

Initially, the research team identified two volunteer children, aged 10-11 years. Their schools and classes (grade 4) volunteered as well, and the teachers helped in finding a peer for both participants for the music therapy intervention. In both schools, children and parents were informed about the research according to ethical principles, and permission for the intervention was acquired from all participants. Those children, whose parents gave permission to participate in the study but not to video their children, participated in the music lessons and filled in the questionnaires in similar to other participants, but were excluded from video. Target child 1 (school 1) was participating already in the classroom pilot stage 2009 (observation on general music lessons - see Annex 8.4), and was willing to continue in the interventions. Target child 2 (school 2) was recruited in June 2010, and participated in the two interventions only. See section 3.3.3 for more detail.

3.1.4 Oulu, Finland

In Oulu, the focus was on exploring the potential for social inclusion of immigrant groups through working with *JamMo*. In the different fieldwork phases, in total, 100 children aged 5-6 participated in the study. In phase 1, there were 15 participants. During phases 2 and 3, 61 children participated. In Phase 4, there were 15 participants aged 5-6 (including four 5-year-old boys, four 5 -year-old girls, two 6 year-old boys and five 6-year-old girls). Nine of the 15 were immigrant (from Germany, Singapore, Ireland, USA, Thailand and Laos). The phase 4 participants were drawn from three local nurseries. Two of these were recognised as institutions for multicultural education and one specialised in music education. Each nursery had a different working language with Finnish, English and German all represented.

3.1.5 Herborn, Hesse Region, Germany

The day-care centre is one of four city day-care centres in Herborn and hosts 120 children of between two and seven years. About 80% of the pupils have an immigrant background, which is primarily Turkish although children from a number of different ethnicities attend the centre and were represented in the fieldwork (table 3.2). School policy is focused on inclusive education and the centre aims to integrate children and parents within the wider community. One of the main integration strategies is identifying children at risk in order to ensure that every child achieves a specific developmental level in various domains as required for entering elementary school at the age of six. For this purpose, a wider team of experts outside the institution (including social workers and psychologists) regularly visits the day-care centre for supervising and supporting this process.

A total of thirty children participated in the *JamMo* fieldwork study. 50% were female and 50% were male. The ages ranged from 3 to 6 with a median of 4 year-olds.

Table 3.2: The ethnicities and numbers of children participating in the UZH fieldwork, conducted in Herborn, Germany.

German	7
Turkish	16
German and Turkish	3
German and Russian	2
Egyptian Arabic and	1

German	
Italian and Spanish	1

3.2 Professionals and other adult stakeholders participating in WP9-related activities

Across the five fieldwork research sites, the research process was informed by the professional support and insights of colleagues working in the various centres. These included teachers, teacher assistants, headteachers, day-care nurses, support staff and, in Jyväskylä, professional psychologists. Opportunity was taken in several locations to induct local teachers into how to use *JamMo* so that they could make use of the technology when the researchers were not present. Contact with parents was limited due to the developmental nature of the software and the relatively small number of Nokia N900 devices available across the whole project team.

3.3 WP9-related fieldwork objectives and methodologies

A wide variety of data collection methods have been employed across the five research sites. Many of these are summarised in Table 3.3.

Table 3.3: a summary of important fieldwork data collection methods employed by WP9 partners.

IoE	JYU	OULU	UCLAN	UZH (in Herborn)
• N900 Phones *plus* desktop Ubuntu *JamMo* • *JamMo* musical materials bank (sound samples) • Research team observation notes • Informal discussions with participants • Text logging (exploratory perl script developed by research team) • Text logging (as part of *JamMo* – from version 0.7.1 onwards) • Exploratory screen capture tests • Ambient video of participants • Close-up video of one selected pair • Social inclusion questionnaire • Participant background questionnaire covering demographics, ICT and music • Analysis of musical products	• N900 Phones • *JamMo* musical materials bank (sound samples) • Video observation • Annotation Software • Field notes • End of session feedback questionnaire (open questions and labelled faces representing emotional states (big smile = very happy, smile = happy etc) • UMSIC social inclusion and background questionnaire • Analysis of musical products • *JamMo* interaction logs.	• N900 Phones *plus* separate *JamMo* musical materials • Introductory music games suitable for the youngest age group • Measures of enjoyment (see references below) • UMSIC background questionnaire – sections were extracted and modified for this younger age group in consultation with UZH – administered verbally by the research team in the participants' own languages – (n.b. research team translating English in 'real time' whilst being administered). • Usability testing • Peer tutoring • Group testing (via data projector) • Analysis of musical materials evaluated through observed physical engagement with music – Finnish songs used throughout • Video capture • Field notes	• *JamMo 3-6* and *7-12* software • Nokia N900s • HP touchscreen laptops • usability testing (various methods) • observation • interviews • 'fun toolkit' • 'smileyometers' • peer tutoring and pair games • Field notes *See UMSIC Deliverable 3.5b for a comprehensive list.*	• *JamMo* musical materials (song backing tracks) • Computer-based digital audio recording hardware • Audacity digital audio software • Video analysis using inductive categories • Interviews with staff • School policy and data inspection. • Field notes

Notes:

- The *Funometer* (Fun-Meter) was taken from the following study: Risden, K., Hanna, E., & Kanerva, A. (1997). Dimensions of intrinsic motivation in children's favourite computer activities. *Poster*, Society for Research in Child Development, Washington, DC.
- The *Smileyometer* was taken from: Read, J.C., S.J. MacFarlane, & C. Casey. (2002).Endurability, Engagement and Expectations: Measuring Children's Fun. *Proceedings,* Interaction Design and Children. Eindhoven: Shaker Publishing.189 - 198.
- Barendregt, W., Bekker, M.M., Bouwhuis, D.G. and Baauw, E. (2006) Identifying usability and fun problems in a computer game during first use and after some practice, *Int. J. of Human-Computer Studies* (64), 830 -846.

3.3.1 London and the South East of England, UK

The Institute of Education, University of London's own WP9 fieldwork activities were focused on meeting a range of WP9 objectives, including exploring the use of *JamMo* in more formal educational environments (Figure 3.1). The focus was on working within a formal, Primary school-phase educational environment (six sessions over the Autumn term 2010, supplemented by additional data collection using *JamMo*'s interaction logging facilities in the Spring and Summer terms 2011).

The key research objectives were to (i) gain an overview of the stability, functionality and usability of the *JamMo* software, including with larger groups of children in a classroom setting, particularly those with an immigrant background and, in some cases, moderate learning difficulties; (ii) explore and assess the appropriateness of the *JamMo* software for use in formal educational environments; (iii) develop a multi-methods research approach for capturing data on the *JamMo* user experience within a formal educational setting; the methods included observation, interviews, data logging, video recording and action research – in which the teacher and the pupils acted as co-researchers to provide insights into their experiences of the *JamMo* from the perspective of users; (iv) develop a range of educationally- and musically-rich activities in which to situate the *JamMo* software;

Figure 3.1: the London Primary school classroom where much of the Institute of Education, University of London's *JamMo*-based fieldwork was completed.

(v) measure participants' sense of social inclusion, using the assessment protocol designed in WP5; both within the *JamMo* focus group and also across a wider comparative group of pupils who were not part of the UMSIC research; (vi) within this measurement, evaluate a variety of psychometric parameters that form the concept of social inclusion (such as degree of loneliness, sense of self-identity and level of self-confidence) pre-and post *JamMo* sessions, with the use of the protocol designed in WP5, in order to determine any significant changes as results of the intervention; and (vii) determine whether *JamMo* appears to facilitate participants' feelings of social inclusion.

3.3.1.1 Background Questionnaire and Social Inclusion Instruments

Pupils completed social inclusion instruments and questionnaires on demographic, music and IT background factors in four, 5-minute 'sittings' in order for them to remained fully focused on its content. Annex 8.6.1 lists provides copies of these questionnaires (English and Finnish versions). These sittings took place between 14th and the 23rd September 2010. This was a period in which the class register was still being finalised. As such, not all pupils in the group were present for all three sittings, reducing the total number of completed questionnaires to 19. The social inclusion instrument was also administered during these sessions. These data were to be used as a baseline that presented the pupils' background knowledge and experience in music and IT, other demographic factors (such as the country they were born in and the language they felt most comfortable speaking with) and their feelings of social inclusion prior to *JamMo* sessions.

The social inclusion instrument was administered to the pupils again at the completion of the *JamMo* sessions in December, in order to be able to compare the data collected before the intervention to those collected after the intervention. The intention was to assess for any statistically significant changes in the data as a result of the intervention.

3.3.1.2 Classroom Research Sessions: Software and Hardware

Two distinct technology 'setups' were used to run the *JamMo* application within the six sessions that comprised the London-based fieldwork study.

'Laptop/projector': In this setup, a single IBM ThinkPad T43 laptop computer with *Ubuntu* Linux Desktop 10.04 was used to run *JamMo 3-6* and *7-12* packages between versions 0.6.9 and 0.6.16 in the development of the software. The VGA output of this laptop was projected for the children using the school's Promethean Interactive Whiteboard and its audio output sent to a wall-mounted amplifier/speaker set. In whole class sessions, this setup was mainly used to demonstrate *JamMo* to pupils before they went on to use the software on the Nokia N900 phones. In small group sessions, groups of 4-6 pupils would sit around the projected display, taking it in turns to come to the laptop and 'drive' *JamMo* with suggestions and encouragement from the rest of the group. The laptop/projector setup was used in sessions 1, 2, 3, 4 and 5 and took place in both the class teacher's classroom and the classroom belonging to the Deputy Headteacher/ICT Coordinator.
'Nokia N900 Phones': This was the set up used in sessions 2 (second half) and 6. Here, between n=12 and n=14 Nokia N900 phones were distributed to pupils, who worked with them in pairs. Session 2 used version 0.6.13 of *JamMo* and

session 6 used a mixture of 0.7.3 and 0.7.4 (the discrepancy being due to the developers issuing 0.7.4 halfway through the phone updating process). The installation process for 0.7.3 and 0.7.4 required that the Nokia N900 phones were first updated with the latest version of the *Maemo 5* operating system. The two sessions using the Nokia N900 phones took place in the class teacher's classroom.

3.3.1.3 Classroom music making and learning activities

The six sessions embraced a range of whole class, group and paired activities using the *JamMo* software. Much of educational impetus for the design of these activities derived from the class teacher's broader curricular objectives for the term. Other factors, such as the ongoing developmental nature of the software and the availability of laptops on which to run the *Ubuntu* Desktop version of *JamMo* also influenced the design of the activities. In particular, a decision was made from week three onwards of the project to focus on *JamMo 3-6* since, at the time, this was more stable and functionally complete than the equivalent releases of the version designed for the oldest age group, *JamMo 7-12*. In all activities, it was *JamMo*'s sound fragment- and sample-based composing functions that were the focus, as opposed to the karaoke-style singing games, because we were particularly interested in the participants' ability and engagement with the creative potential of *JamMo*.

Whole class activities formed the basis of session 1 (week one) and in the first part of session 2 (week two). *JamMo 7-12* was employed using the laptop/projector set up, as described above. In session 1, it was important to introduce the pupils to the concepts underpinning the *JamMo* application, to explain that this was still experimental software and that we wished for the pupils to provide feedback on possible improvements. Following conversations with the class teacher, it was decided to build the activity around a 'three times table rap' that the pupils had been working on, using acoustic drum accompaniment. An initial introduction to the project and the software by a member of the research team was designed to link the pupils' pre-existing music technology knowledge to *JamMo 7-12*'s sequencing view, virtual instruments, sound sample selection wheels and various other functions and icons. The default *JamMo 7-12* (0.6.9) backing track ('Kiiriminna') was then used to provide a folk-rock/country accompaniment to the pupils' performance of their rap. Additional lyrics were devised by the pupils to extend and synchronise the length of their rap with the overall structure of the backing track: "The three times table is the best; I've got a vest that is better than the rest". Again following a suggestion by the class teacher, the next part of the activity sought to add a range of 'silly sounds' to the backing track, ostensibly in a bid to make the three times table easier to remember and more enjoyable for the pupils to perform. At a technical level, these 'silly sounds' were implemented by reconfiguring *JamMo*'s virtual drum machine to use a range of alternative sample files in consultation with the core *JamMo* development team. The pupils were asked to work out which grid squares on the sequencer screen (corresponding to beats of the bar) would be best to place the silly sounds. The most musically satisfying (and humorous) result was found to be placing a sample on the fourth beat of each bar, resulting in a pattern of three free grid squares followed by one containing a sample.

Two distinct activities were designed to be delivered using *JamMo 3-6* during sessions 3, 4 and 5 with small groups of between four and six pupils. Over the course of these three sessions, all members of the class were able to participate in at least one of the two activities, which typically lasted between 30 to 45 minutes each. The small group activities also made use of the laptop/projector *JamMo* setup. Although technically the Year 4 pupils in this study were slightly older than the target age group for the *JamMo 3-6* application, this age discrepancy was explained to them and they were asked to imagine they were the age of younger brothers or sisters when using the software.

In the first of the small group activities, three short video clips were selected as visual prompts for pupils to compose suitable 'soundtracks' using the range of sound fragments available within the three composition themes of *JamMo 3-6*. The class teacher, whose idea it had been for pupils to compose (to picture) in this way, had supplied a DVD of the film *Koyaanisqatsi: Essence of Life* (2002). The research team then selected three short, evocative video clips, stripping the original soundtracks from each. During the class activity, the clips were played back alongside the *JamMo* interface via the data projector screen using *Ubuntu*'s Totem video player. The working name of each clip, a representative still and clip length is given in table 3.3:

Table 3.3: illustrative stills taken from the three short video clips used as part of the small group activities

	'Cityscape' (1min, 32 secs)
	'Clouds' (56 secs)
	'Trees and Rivers' (45 secs)

After watching each clip in turn, pupils discussed as a group how various musical elements might usefully be employed to best match the 'mood' of the moving images. Subsequently, they auditioned the sound fragment sets available within each of *JamMo 3-6*'s composition themes (see Figure 2.21) and selected the most appropriate theme to be used as the basis of a composition for each video clip. They then took it in turns to 'drive' the software using a mouse, auditioning samples and placing them on the sequencer track in consultation with the group. After completing a series of sample allocations, the sequence was played back alongside the video output and the pupils were encouraged to evaluate how well their compositions had suited the mood and timing of the visuals.

The second small group activity made use of the 'advanced' mode of *JamMo 3-6* (see Figure 2.14). At the time of the session (early November 2010), the UK television show *X Factor* was reaching its season peak and the show's finalists were becoming household names. Pupils were, therefore, asked to compose a backing track that might be suitable for their choice of *X Factor* finalist to sing over. The pupils were shown pictures of each of the finalists and encouraged to discuss how their media 'image' might influence the styles of music that could be composed. The rest of the activity was designed to follow a similar line to the composing to picture task, with individual pupils taking turns to audition and add sound fragments to the sequencer tracks. Since there were more sound fragments to choose from and more potential to layer them together within the advanced mode, it was anticipated that the composition process would evoke more detailed discussion.

Unfortunately, due to the developmental nature of *JamMo* at the time when these small group activities were undertaken with participants (versions 0.6.13 to 0.6.16), it was not possible to save the compositions produced by the participants (i.e., this feature did not become available until session 6). The research team instead made observation notes and collected qualitative data through brief discussions with participant groups regarding their experiences.

Pair activities were a feature of the second part of session 2 and the whole of session 6. These made use of the Nokia N900 phones setup, with session 2 focused on *JamMo 7-12* and session 6 focused on *JamMo 3-6*. In essence, these were designed as opportunities for pairs of participants to interact freely with the composition features of the *JamMo* software, with individuals taking it in turns to 'drive' the Nokia phones. The aim of these activities was to provide as much freedom as possible for the pupils to explore *JamMo*'s creative possibilities, whilst discovering developmental software 'bugs' and limitations in the process.

Due to the developmental nature of the *JamMo 7-12* version employed in session 2 (0.6.13), it was not possible to save pupils' compositions for later analysis. However, by session 6, saving was fully implemented on *JamMo 3-6* and so all compositions produced by the pairs were stored. The addition of composition saving also meant that the class teacher was able to incorporate a 'listening and appraisal' plenary during session 6 in which pupils re-loaded favourite compositions to share with the group.

3.3.2 Preston, Lancashire, UK

The University of Central Lancashire coordinated UMSIC WP3 ('Usability Requirements and Evaluation') and also contributed significant input into Work Package 9. This research effort was collectively concerned with the design of appropriate technology for the target groups within UMSIC. During final year of the UMSIC Project, a series of eight fieldwork evaluations were undertaken to ensure that *JamMo* was fit for purpose for the target groups and other possible users. The focus during these studies was on evaluating the technology, and the technology solutions for their usability, for their attractiveness to children and for their general fit to the users (Figure 3.2). The University of Central Lancashire produced a final summary document – Deliverable 3.5b[3] - that reported this work and have fed into the general impact analysis within Work Package 9. Colleagues in Lancashire were also able to

[3] Deliverable 3.5b (McKnight, L., Iivari, N., Read, J. & Xu, D. (2011) – see Annex X) provides more detailed information on the methodologies employed in these studies.

support fellow WP9 research teams in WP9 in the repeating of interventions initially conducted elsewhere and in the arrangement and facilitation of additional fieldwork opportunities.

Figure 3.2: children working with *JamMo* on Nokia N900s and a touchscreen Ubuntu laptop during the University of Central Lancashire's *JamMo*-based fieldwork

A variety of methods were used within these eight studies, depending on the age and ability of children taking part, the resources available in the school or laboratory where the studies were conducted, and the status of the software that was available. For example, *JamMo 3-6* was developed to a stable level earlier than *JamMo 7-12*, meaning that more user participation studies could be conducted with *JamMo 3-6*, whereas for *JamMo 7-12* the software was still in development until a later date, and so fewer user participation studies could be conducted.

In the first study (summer 2010), children each played three games on a Nokia N900, and completed three evaluation methods for each game. The second study (summer 2010) featured some free testing but was mainly focused on task-based usability testing because of *JamMo*'s instability at that time. Active intervention, individual tests, and peer tutoring method (where one child taught another to use the application) were all in use. The third study (summer 2010) employed observation, the fun toolkit and interviews. The fourth study (March 2011) centred on the participants' use of touchscreen laptops, with observation and 'smileyometers' used to gather their views. The fifth piece of fieldwork (April 2011) was designed as an observation study using *JamMo 3-6* on a Nokia N900. The sixth study (April 2011) focused on evaluating the peer game feature. This session formed part of the same half-day of activities as study 5 above, with children who did not take part in the observation study instead taking part in a test of the peer game. Children worked in pairs on a laptop, which was then paired using the peer-to-peer network with another laptop situated on the other side of the room, for children to play the co-operative networked pair game in the *JamMo 3-6* composer. The seventh study (May 2011) was an informal session using *JamMo 3-6*. This aimed to gather information from the youngest end of the age range of *JamMo*, but due to the children's age this study was designed to be as simple and non-threatening for the children as possible. The eighth study (May 2011) was the final evaluation of *JamMo 3-6*. The method was informed by findings from previous studies, using a mixture of observations and questionnaires.

3.3.3 Jyväskylä, Finland

The University of Jyväskylä worked most closely with the ADHD Target group and pursued a particular focus on (i) the self-regulation and coherence of behaviour in musical contexts; and (ii) the proactive and interactive processes that participants employed when using *JamMo*, along with the resulting musical products. In addition to a series of pilot studies that took place before WP9 began (see Annex 8.4), two interventions with children with ADHD were conducted by JYU: A music therapy intervention with non-mature *JamMo* software, consisting of *3-6* composition games and *JamMo 7-12* sequencer, and a classroom intervention, in which children used the *JamMo 3-6* composition game advanced, the *JamMo 7-12* level 1 orientation game and the *JamMo 7-12* sequencer (see also section 4.1.3).

3.3.3.1 Music therapy intervention

Regulation of attention, concentration and hyperactivity of children with ADHD and their non-ADHD peers was studied at the music therapy clinic of the University of Jyväskylä in the autumn 2010. The intervention was a continuation the music therapy pilot study conducted before the WP9 phase of the fieldwork (Annex 8.4). The main aims of the intervention were to identify:

- possible differences in self-regulation between children with ADHD and children without ADHD;
- possible differences in self-regulation when participants composed with *JamMo* as opposed to playing band instruments;
- possible differences in self-regulation between stand-alone and pair composition activities with *JamMo*.

After completing both quantitative and qualitative analysis of the children's behaviour it is possible to discuss and conclude essential elements affecting the children's self-regulation and contributing to the reduction of inattentiveness and hyperactivity.

Two ADHD children and two of their non-ADHD peers participated in the music therapy intervention. A 12-week music therapy intervention was planned for September-December 2010. This planned consisted of 12 sessions of 45 minutes, each session consisting of musical activities, such as singing, percussion playing and band instrument playing, along with *JamMo* activities, which were to be included in ten of these sessions. The first four sessions would have included *JamMo* stand-alone playing of the orientation games, next four sessions *JamMo* pair work with the Jammer and sequencer, and last four sessions *JamMo* playing in small groups within the workshop scenario (see UMSIC Deliverable 5.2).

However, due to the delayed development of the *JamMo* software, the initial plan had to be modified. In the event, a total of eleven sessions (45 minutes each) were executed, nine of which included *JamMo* playing. The aim was also to apply pair tutoring as a core teaching method in the intervention, but finally it was instructed only in one session. Additionally, since *JamMo* did not include logging facilities by autumn 2010, children's *audio products* form the only data for this fieldwork (see 4.4.2). Video and questionnaires were used in analysing children's self-regulation in *JamMo* activities during the music therapy intervention (see 4.1.3).

During the intervention, there were a series of bugs and crashes, which disrupted music making with *JamMo*. The participant children were informed that they were testing a new application and their opinions were valuable for the developers. *JamMo* orientation games *7-12*, which were pedagogically designed specifically for children with ADHD, were not technically implemented until April 2011. The *JamMo* composition game *3-6* advanced game was used in sessions 2-3. *JamMo 7-12* with a backing track and one sound sample track in the sessions 4-7. At the time, this remained non-mature software still under developmen. The same sequencer, togetherwith a backing track and four sample tracks, was used in sessions 8-10. In the last session, the children listened to their*JamMo* compositions. Sound sample selection and the backing tracks from *JamMo 7-12* could be used, but there were constant crashes with the software. Orientation games *7-12* were not tested.

JamMo composition work was executed mostly in stand-alone mode, with pair work included in three of the sessions. When the children were composing with *JamMo* within a pair, they had one Nokia N900 device in use with two styluses. Unlike in the classroom intervention, headphones were not used at the music therapy clinic context. Children came to sessions either in pairs or all together. Collaboration emerged also in standalone situations. The two music therapists actively guided the children even when children did not ask them to.

Other musical activities included in the music therapy intervention were djembe playing and the playing of traditional band instruments. In addition to the *JamMo* stand-alone and pair work acitivities, instructed band playing and improvised band playing activities were analysed. In instructed band playing the children played together with music therapy students. They played songs that were part of *JamMo* repertoire. In the improvised band playing the children played freely improvised music, with or without a stimulus title. The band instruments used in these activities were acoustic drum-kit, electronic drum-kit, piano, electronic piano, synthesiser, bass guitar, and MalletKat (MIDI percussion controller).

At the end of each session, the participants completed a feedback questionnaire. The sessions were monitored and recorded with unobtrusive therapy clinic video cameras.

3.3.3.2 Classroom intervention

The two target children with ADHD and their respective school classes (all aged 10-11 years) participated in the classroom intervention in April 2011 (Figure 3.3). This intervention consisted of teacher training and three music lessons at school. The three lessons were carefully planned and the lesson plans were discussed with the two music teachers during the training. *JamMo* games and sequencer were demonstrated and written *JamMo* lesson plans were delivered to the teachers, who then rehearsed *JamMo* use under supervision. The teachers were also delivered two N900 devices with *JamMo* software for independent use for a week before *JamMo* school sessions.

Figure 3.3: children using Nokia N900s during the University of Jyväskylä's classroom-based *JamMo* fieldwork.

The three school sessions were planned similar in both schools (45 minutes each). In the beginning of *JamMo* lessons, children were divided in random pairs. N900 devices were prepared for use, and the number codes of the devices were collected form each pair of children by the researchers (N=2), who worked as assistants in the classroom for video recording and for helping children in technical problem situations (system failure). The first and second lessons included collaborative and individual composing activities with both *JamMo 3-6* and *7-12*. The third lesson consisted of listening to everybody´s composition, offering verbal feedback and answering the feedback questionnaire. The built-in *JamMo* mentors (see section 2.9) were employed throughout the classroom intervention. Music teachers from both the participating elementary schools were trained at the Department of Music at the University of Jyväskylä beforehand. This training consisted of how to use *JamMo* and generating detailed plans for each *JamMo*-based classroom lesson. Basic lesson plans were prepared by the music education researchers and discussed with the music teachers during the training period. The teachers were issued with copies of *JamMo* running on Nokia N900s so they had the possibility to get to know the software in advance.

Lesson 1 (45 minutes), included *JamMo composition game 3-6 advanced* in pairs with shared devices (20 minutes) as well as standalone *JamMo 7-12 orientation game, composition game level 1* (10 minutes). This game is not implemented technically, excepting few tasks in the beginning: listening to the backing track, exploring the sound sample selection screen, adding four rhythmic sound samples to the rhythm track, adding four melodic sound samples to the melody track, and deleting one non-suitable sound sample that the mentor 'had accidentally dragged' to the track. These tasks are performed in the guidance of the mentor, and mentor gives positive feedback after each successfully performed task. There was still one bug in this game during the classroom intervention: In the middle of the game, there should have been an automatic navigation to the track view, so that users could have listened to the unfinished product. Some children managed to listen to the product in spite of the bug and continued to the end of the game (even added extra sound samples to the composition), while others got stuck and could not continue the game to add melodic sound samples.

The children played in pairs with a single N900. The audio output of the N900 was split to drive each child's headphones. After the class teacher´s short instructions children started to compose together. They were allowed to choose their own composition theme from the three available. The main aim was that children would experience positive co-operation and would choose their sound fragments in collaboration. A second aim was for those children with ADHD to offer advice and tips to peers based on their experiences during the pilot study in Autumn 2010 (see Annex 8.4). Pairs had about 20 minutes to play with the *JamMo 3-6* game, with the rest of the first lesson focusing on the *JamMo 7-12* orientation game level 1 (stand-alone mode). In this part of the leson, pupils were given individual N900s and their own headphones. To save time, the children worked in the same places as in the earlier pair work situation. Pupils were then given ten minutes time to play composition game (stand-alone). Two ten-minute sections were chosen from this lesson for analysis. Both these analysed sections of pair work and stand-alone situations were selected to commence thirty seconds from the beginning of the *JamMo* activities (as noted in the log files).

Lesson 2 (45 minutes). This lesson consisted of a 'simulated' *workshop* (25 min) with *JamMo sequencer 7-12,* because the wireless workshop was not yet functional or tested. The class was divided in to groups of four (randomly selected) children, each at one table. In each small group, there were two pairs of children who shared a device and worked in collaboration to compose additional material based on a *JamMo* backing track. Before the workshop started, the teacher gave instructions with the help of Linux-PC and smartboard. Each workshop had different backing track to form the basis of compositions. Moreover, in each workshop two pairs were composing in collaboration. Each group had a different backing track. In each group, pair 1 composed with rhythmic sound samples and pair 2 with effect sound samples. After the first composition period, children paused to discuss their progress thus far. In particular, they shared the kinds of musical materials that they had explored and used. Each pair was given the opportunity to listen to peers´ uncompleted compositions and the teachers encouraged the children to give some tips to each other. After the discussion, they completed their compositions using different types of samples to those employed before.

The ten-minute section chosen for analysis began thirty seconds from the teacher´s instruction for group discussion. The section started with group discussion and continueed to include the pair work.

Lesson 3 (45 minutes). This consisted of listening to the musical products, giving feedback about the compositions to each other and to the researchers, and completing the questionnaires about experiences of *JamMo*. The musical products were copied from the N900s to a CD for this purpose. The teacher encouraged the children to tell why they liked others' compositions after each pair's composition had been listened to. Self-regulation was not analysed during this lesson.

3.3.3.3 Log file analysis: creative processes and products

JamMo software is designed to continually generate time-stamped log messages every time *JamMo* is been used. These messages are stored automatically as text files in the N900 file system and can be downloaded easily to a desktop computer via a USB connection. Besides logging non-user related technical timestamps, like notifications on wireless networking and technical actions within the software, logging system records every action made by the user. During the last steps of *JamMo* software development (2010-2011) the logging system was enhanced to be able to record important user-made musical actions (i.e. sound sample names in detail).

Log files were imported to Excel software, which automatically produced a list of actions in correct time order. Before statistical analysis phase, logs were sorted so that only user actions were listed. Sorted user action listing allowed detailed content and time-analysis of musical processes by calculating elapsed times for actions. Musical product content (unfinished and finished songs) was sorted and extracted from the same user-action listings.

Annexes 8.3.1 and 8.3.1 provide examples of an unsorted log-file and a sorted log-file showing elapsed time for each user-made action. Table 3.4 breaks down the log content used in the 'musical processes and products' analysis.

Table 3.4: log content used in 'musical processes and products' analysis

Process Analysis	**Product Analysis**
Song playback and stop actions	Composition theme selections
listening, dragging and removing sound fragment/sample icons	Composition length
Tempo and pitch changes	Sound fragment/sample count
Song finalizing	Sound fragment/sample types

Structured task performance	Use of unique musical materials
Use of interactive mentor	Use of repetitive structures

Annex 8.3.3 provides an example of product content and time analysis; a composition (fantasy theme) made by two boys.

3.3.3.4 Video and log file analysis: musical collaboration and communication

The target children collaborated with shared devices with their pairs, each of the pairs manipulating *JamMo* in turn, and each child having a headset, so that the pairs could hear their own and each other's actions within the composition process. Each of the target children had a different pair in different learning sessions (for example target child 1 collaborated with child A in *3-6* game and with child B in *7-12* workshop). The target children 1-2 and their pairs were recorded with a video camera for analysing their *JamMo*-related collaboration and communication at lessons 1-2. In addition, there was another video camera recording the whole class.

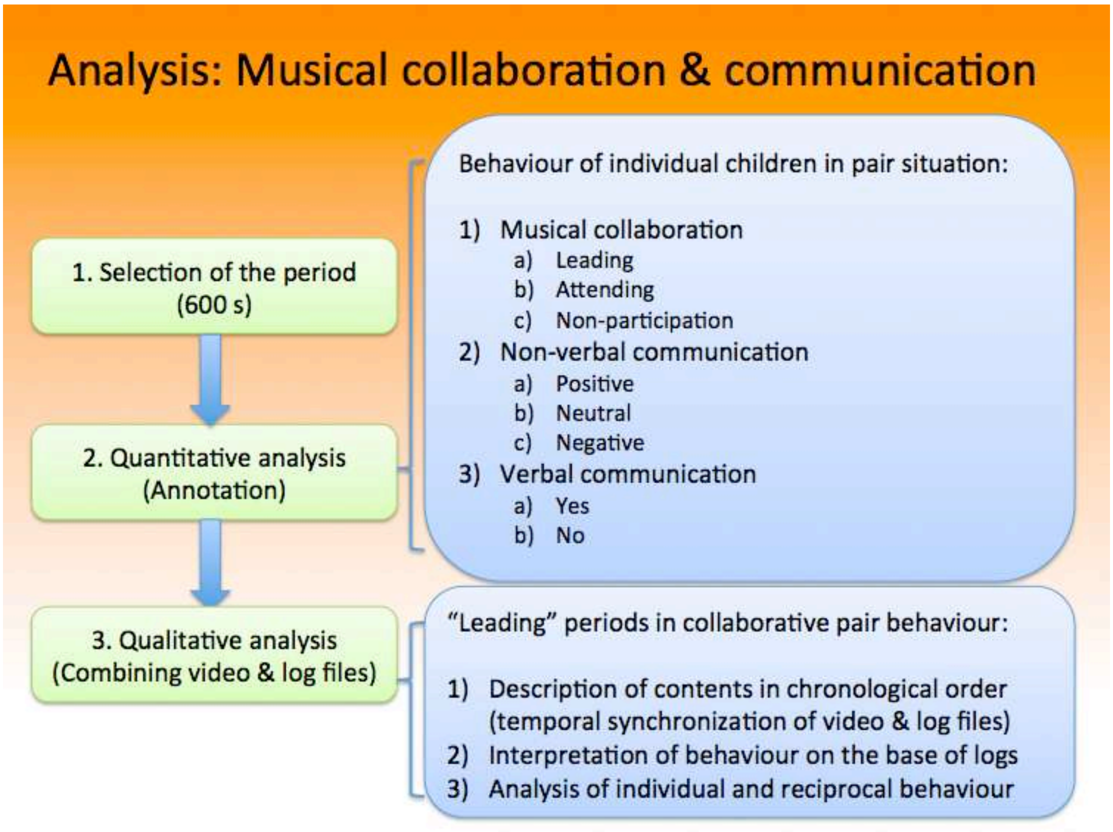


Figure 3.4: Analysis of musical collaboration and communication.

In systematic video observation and time analysis, Annotation software was used for creating the variables of musical collaboration and communication related to it (Figure 3.4). For time analysis, a 10-minute (600 sec) period was extracted from the middle of each collaborative *JamMo* learning session of the target children 1-2 and their pairs: composition game *3-6* advanced (total duration: 15-20 mins) and workshop *7-12* (total duration: 20-25 mins)..

The three focus elements of musical collaboration were:

1) leading = manipulating *JamMo*,
2) attending = closely focusing on what the pair is doing,
3) non-participation = not collaborating, doing something else.

The three focus elements for non-verbal communication were:

1) positive non-verbal communication (smiling etc.),
2) neutral non-verbal communication,
3) negative non-verbal communication (negative expressions /gestures).

The percentage of verbal expressions of the total time (600 sec) of the period under analysis (10 min) was calculated.

In addition to quantitative analysis, log files were used in qualitative analysis of collaboration. For each period, during which the target child or his pair was classified as leading the session (i.e. manipulating *JamMo*), contents of the activity was brought from *JamMo* log, utilising the synchronised time of the videotape and logs (Figure 3.5). This is how it was possible to describe what was behind the leading role at particular moments: exploring the sound samples, creating the composition by dragging and dropping or organising the sound samples, or listening to the uncompleted product to get feedback.

Figure 3.5: video footage from Jyväskylä classroom-based *JamMo* fieldwork. The video timecode has been synchronised with the internal clock of the Nokia N900 to allow parallel analysis of video and log data.

3.3.3.5 Analysis of participants' self-regulation using video data

Overall, the Jyväskylä-based ADHD intervention was conceived within-subject study, where each child's behaviour was observed in social situations over time. Therefore, self-regulation of the same ADHD children was observed within the music therapy clinic context and then again during the classroom intervention. All the music therapy clinic sessions and *JamMo* school music lessons were video recorded. The video data was analysed both quantitatively and qualitatively. The same coding categories for self-regulation were used in the analysis of both of these contexts. However, participants wihout a diagnosis of ADHD were analysed slightly differently in the two interventions. The music therapy intervention was also observed and analysed by a different panel of raters than the classroom intervention. Thus, subjectivity and differences in the learning context have to be considered and the results of the two interventions are not directly comparable.

The music therapy intervention sessions consisted mainly of using the *JamMo* software individually or within a pair. Further activities employed band instrument playing within a group. For the purposes of the video analysis, each session was divided into a series of 'musical episodes':

1) *JamMo* individual, stand-alone work
2) *JamMo* pair work
3) Instructed band playing
4) Improvised band playing.

A five-minute excerpt from each *JamMo* episode (i.e. either stand-alone or pairwork), and a five-minute excerpt from each band playing episode (i.e. either instructed or improvised) was generated. All these excerpts were started thirty seconds after the onset of the musical episode, or from the moment when each child had a musical instrument or an N900 in their hands (and when the cameras had an unobstructed view of all the children). In total, five *JamMo* stand-alone excerpts, three *JamMo* pair work excerpts, six instructed band playing excerpts, and two improvised band playing excerpts were analysed.

In the classroom context, a ten-minute period starting at thirty seconds from the onset of a new *JamMo* game was selected. Within workshop situations, an extract beginning thirty seconds after teacher´s instructions was generated for video analysis. The sections were selected from different social situations within the *JamMo*-based activities, specifically 'stand-alone' (*JamMo 7-12* Composition game level 1), 'pair work' (*JamMo 3-6* Advanced Composition Game) and 'workshop' (*JamMo 7-12* Sequencer). Participants with a diagnosis of ADHD were analysed in each section alongside their pair (non-ADHD diagnosis). Moreover, the cohesion of whole-class activity within each ten-minute period was also considered in the analysis.

Quantitative analysis was completed with the video analysis application *Annotation*. The categories used in this analysis concerning self-regulation were defined as 'on-task behaviour', 'selective on-task behaviour', 'passive off-task behaviour', and 'hyperactive off-task behaviour'. Each category was defined as follows:

1) On-task behaviour: The child is concentrating on playing *JamMo* or band instrument as instructed.

2) Selective on-task behaviour: The child is concentrating on the *JamMo*-based musical activity and looking at the device. However, they are either a) exhibiting mild motoric hyperactivity, b) exhibiting mild inattentiveness, c) taking brief breaks in the playing, d) making frustrated comments about *JamMo*, or e) commenting on or listening to other child's musical activity when they had formerly been instructed to work individually.

3) Passive off-task behaviour: The child is not doing what instructed, but is not disturbing others. The child is either a) looking passively away from the *JamMo*/musical instrument, or b) remaining physically phlegmatic.

4) Hyperactive off-task behaviour: The child is not doing what instructed and is actively doing something else, such as a) playing another musical instrument or using *JamMo* in a manner inconsistent with teacher instructions, b) paying attention to distractions, c) exhibiting motor activity apparently unrelated to the class activity (e.g. tapping on the table or chair) d) verbally commenting topics other than the on-going musical activity, or e) verbally commenting to someone other than either the class teacher or their pair.

The data was exported from Annotation and subject to further analysis in with Excel. As in the pilot study (see Annex 8.4), the duration of each category for each child and the overlap between musical activities (i.e. *JamMo*-based activities or playing with band instruments), social settings (stand-alone, working in pairs or workshop), and self-regulation (on-task, selective on-task, passive off-task, hyperactive off-task), were calculated.

A qualitative description of each therapy session and music lesson was also generated both in recording situation and when watching the videos afterwards. In descriptive content analysis we have identified and categorised both reductions and increases of hyperactivity and inattentiveness. The qualitative analysis was combined with the quantitative analysis in order to find essential elements contributing to the changes of self-regulation concerning on-task behaviour, selective on-task behaviour, passive off-task behaviour and hyperactive off-task behaviour.

3.3.3.6 Survey: Experiences of JamMo use

Two questionnaires (Annexes 8.6.3 and 8.6.4) were designed to get feedback from the children and the teachers of *JamMo* use. The data was gathered in the final fieldwork session.

The children were asked (5-point scale, smileyometers):

- how much they liked *JamMo* tasks (composition game *3-6*, composition game *7-12*, workshop *7-12*);
- how much they liked the musical materials (composition game *3-6*, composition game *7-12*, workshop *7-12*);
- did they find each task difficult (composition game *3-6*, composition game *7-12*, workshop *7-12*);
- did they find each task too easy (composition game *3-6*, composition game *7-12*, workshop *7-12*);
- whether the mentor had guided them enough;
- whether they had found the necessary buttons in *JamMo* games;
- how well they felt collaboration with pair succeeded in composition game *3-6* and in the workshop *7-12;*

- how well they felt they succeeded in each *JamMo* task (composition game *3-6*, composition game *7-12*, workshop *7-12*);
- whether they would like to use *JamMo* at home;
- whether they would like to use *JamMo* with friends.

In addition, there were two open questions for:
- describing how their composition sounded in each task (composition game *3-6*, composition game *7-12*, workshop *7-12*);
- describing what they did not like in *JamMo* or in *JamMo* lessons.

The teachers were asked about their previous experiences of ICT in educational use, and their experiences of *JamMo* as a teaching tool. In specific, they were asked (5-point scale):
- how suitable they thought *JamMo* was for the particular age group (grade 4, 10-11 years), with or without ADHD;
- how motivated children, with or without ADHD, appeared to be about *JamMo*;
- whether *JamMo* had positive influence on children's social interaction in general, and interaction between children with ADHD and non-ADHD children;
- how children's (ADHD, non-ADHD) collaboration succeeded in *JamMo* lessons when comparing to general music lessons;
- whether they liked to use *JamMo* as a teaching tool;
- whether they had interest to use *JamMo* or similar application in the future in the classroom.

In addition, there were three open questions for:
- describing how they had been prepared to *JamMo* lessons;
- estimating how much time they had spent in preparing ;
- feedback about *JamMo*'s positive and negative features.

3.3.4 Oulu, Finland

The University of Oulu's fieldwork with *JamMo* was conducted in four distinct phases from the autumn of 2008 to the winter of 2010. Phases one, two and three took the form of design and evaluation workshops. These were intended to (i) generate preliminary paper prototypes of *JamMo* (Figure 3.6), (ii) provide potential graphics for the *3-6* singing game and (iii) offer opportunities to conduct usability testing with the preliminary version of the actual *JamMo* game.

Figure 3.6: early *JamMo* design sessions conducted by the University of Oulu and children from a local nursery.

Phase one of the fieldwork took place in the autumn of 2008. In the first study during this phase, five 5-year-olds and four 6-year-olds from a Finnish Nursery participated in this phase. 'The Magic Toy' activity video was used as a stimulus in order to inspire the participant children to design and build musical instruments from arts and crafts materials. The second study was carried out with six 6-year-olds at the same nursery as the first study. The participant children were administered a drawing-based activity and they were asked to respond to the following question: 'If you were there [i.e. the place in the drawn picture], what would you play with?'

Phase two of the fieldwork took place at a local nursery specialising in music education in March and April 2009. 5-6-year-olds participated in an activity called 'cheers me up, puts me down' focused on relating music to emoticon images. This phase of fieldwork was. In phase three of the Oulu fieldwork, referred to as the 'Kids-Tune' project, a total of 24 5-year-olds and 33 6-year-olds participated in a series of five workshops. These focused on: drawing pictures to be included in the software; testing the initial concept for an improvisation game; paper prototyping; testing for icon clarity; and collaborative usability testing. Phase three also focused on evaluating the MobiKid application, the predecessor of *JamMo*, on Nokia N800 and N810 through the use of usability testing and heuristic evaluation. Two 5-6-year old boys and two 5-6 year-old girls participated in the study.

Phase four of the University of Oulu's fieldwork explored the potential for social inclusion of immigrant groups through work with *JamMo* and fed directly into the impact analysis for UMSIC Work package 9. The *JamMo 3-6* stand alone application, singing game and composition game, were investigated and evaluated in three different nurseries in Oulu between September and November 2010. This fieldwork featured activities for integrated groups of immigrant and non-immigrant 5-6 year olds. The evaluators also worked with individual children and children in pairs who were playing the game together on the same device or on two different devices. In addition, two workshops focussing on evaluating the musical materials found on *JamMo* were organised. Data collection methods consisted of a questionnaire concerning social inclusion, usability testing, free testing, interviews and peer tutoring where children played the *JamMo* together. In addition, the children were asked to provide a measure of how much they enjoyed playing the game using the 'fun meter'[4]. Finally, an early version of the game was projected on the wall as the basis for playful embodiment exercises (see Figure 3.7). Through observations and discussions with children it was possible to identify and fix small issues with the *JamMo* software.

Figure 3.7: the *JamMo 3-6* song selection screen projected during the University of Oulu's WP9 fieldwork.

Throughout the phase four fieldwork, specific foci were placed on the children's feelings of social inclusion, application of the musical materials found in *JamMo*, usability of *JamMo* and the enjoyment of the activity from the children's perspective.

3.3.5 Herborn, Hesse Region, Germany

The fieldwork in Germany focused on using the musical materials from the *JamMo 3-6* singing game. The study had the following aims:

- to explore the participant children's reactions, engagement, and understanding of the phenomena 'recording one's own voice and singing';
- to explore the possibilities of using recording for music and (language) learning;
- to explore the participant children's understanding and practical application of 'digital literacy' concepts such as audio recording and saving digital files;
- to evaluate the extent to which the fieldwork activities provide opportunities for social inclusion (e.g. engagement, learning, sharing experiences, sharing meaning).

[4] See Kuivas, M. (2011). Musiikkipelin hauskuuden arviointi 5 – 6 –vuotiaiden lasten kanssa [Evaluating the fun factor of a musical game with 5 to 6 year old children]. Unpublished Master's thesis, University of Oulu, Oulu.

To hear one's own voice recorded was new for most of the children. For the first time, they perceived their voice and discovered it sounded different from what they heard by themselves. The intention was not to explain the complex backgrounds regarding technology or perception. Rather it was to offer them the experience of making causal connections between handling the computer, generating effects and using these for exploring, creating products and learning. Furthermore, the aim was to not to teach songs and to study song learning. The *JamMo* song games were designed for exploring informal singing as an enjoyable and playful activity and for discovering and developing their own singing with a set of songs, familiar and unfamiliar, by active listening, playing, managing and improvising (see Deliverable 4.3 'design games'). With the research questions in mind, the intention was to encourage children to sing and improve their singing and speaking while using technology as a support and exploring its possibilities.

Researchers worked with children in pairs or groups of three. The participants were encouraged to sing along with *JamMo* songs and to also sing them on their own (Figure 3.8). They were shown the computer recording equipment and introduced to the procedure for recording their own performances (Figure 3.9).

Figure 3.8: nursery-aged children exploring the *JamMo* musical materials with assistance from an UMSIC researcher during the University of Zürich's fieldwork in Herborn, Hesse Region, Germany

Figure 3.9: two nursery children using the recording equipment with support from an UMSIC researcher during the *JamMo* musical materials evaluation fieldwork in Herborn, Hesse Region, Germany

The research activity consisted of selecting a song, singing along with the *JamMo* song (alone with accompaniment, or with an adult singer), recording and listening to the recording. If they wished, the children could repeat same procedure. They were encouraged to carry out the digital recording and the reproduction by themselves. The fieldwork featured a participatory, action-research based model with those children who had participated twice or more asked to instruct and help the less experienced children (Figure 3.10). The children were asked about their experiences with technology, recording and the overall activity.

Altogether, there were 21 sessions with the thirty children, generating a total of 5.5 hours of video footage. In addition, audio recordings of the children's singing were made. The videos were analysed by repeated viewing and by creating inductive categories. The head of the institution and the children's educators were interviewed concerning any particular challenges to the children's developmental progress and the characteristics of their and their families' social inclusion. These characteristics included parental language, readiness for communication and social integration, and the children's social integration.

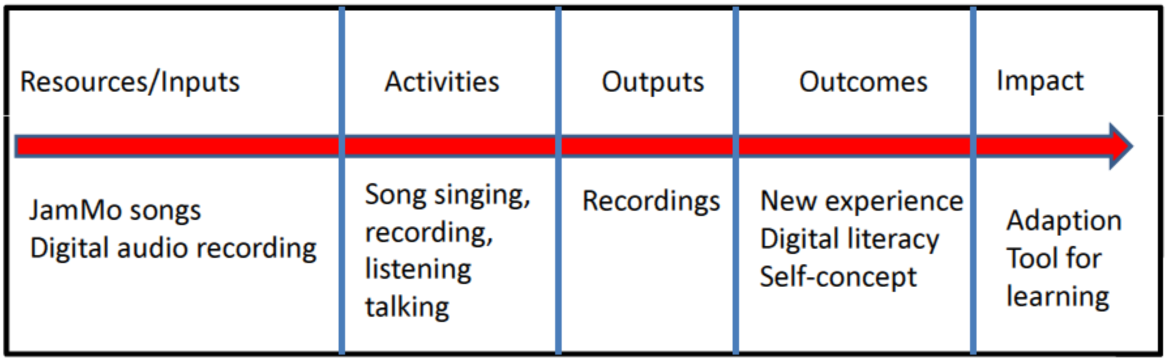


Figure 3.10: overview of action research model adopted by the University of Zürich's fieldwork research team in Herborn, Germany.

4. Findings from WP9-related Fieldwork

The findings reported below are based on a compilation of the various data sets available at each stage of the WP9 fieldwork. Findings have been grouped into a series of themes reflecting the social inclusion, technology and music-making and learning objectives of the UMSIC Project as a whole.

4.1 The Development of a Positive Self-Concept and Social inclusion

4.1.1 Findings from London and the South East of England

One-way ANOVAs were used in the analysis with the data gathered with the social inclusion instrument and the background questionnaire from the participant children (N= 29). The data were entered into an Excel-file. They were also entered into SPSS and analyzed statistically using SPSS version 14.00. (See section 2.1.1 for participating pupils' background).

The most significant finding was that the pupils felt more socially included subsequent to the *JamMo* sessions compared to prior to them ($t=67.564$, $df=108$, $p<0.05$). In particular, statistically significant differences ($p<0.05$) were recorded for the following items: 'I can be sure my friends take my side if I have an argument.'($t=31.964$, $df=3.981$, $p<0.05$); 'Having a few really close friends is more important than trying to be friends with everybody.' ($t= 30.544$, $df = 3.574$, $p < 0.05$); 'I would be sad if I had to leave my school.' ($t= 37.742$, $df = 3.971$, $p<0.05$); Other children like me just the way I am.' ($t = 43.737$, $df = 3.85185$, $p<0.05$); and 'I like to see my school friends outside school.' ($t = 33.004$, $df = 3.735$, $p <0.05$). The pupils agreed with the above statements more strongly subsequent to the *JamMo* intervention.

The video footage from session 5 of the *JamMo* intervention was analysed by the research team. In the analysis, special attention was paid to: social behaviour between the pupils; and any psychological benefits that seemed to arise from the session. The majority of the pairs (10 from 11) worked effectively in pairs and engaged in significant social activity while playing with *JamMo*. A great deal of talking was noted between the pairs, such as sharing ideas, giving advice and making suggestions (such as: 'Try that icon.'; 'The music from that picture sounded very nice.'; 'Well done, that's great'.). In addition, when one child was in charge of dragging the icons on *JamMo*, the other was watching closely to see what was being done.

As observed in the video recording of the *JamMo* sessions and as reported by the classroom teacher and the pupils themselves, there were marked social skills and behaviour evidenced throughout the London-based project. Such behaviours included: talking with one another; collaborating; sharing of ideas; working in pairs; making encouraging comments made towards one's partner; working in larger groups; and demonstrating a willingness to share compositions with the rest of the group.

The classroom teacher and the teaching assistant stated that they had noted that some pupils who were generally quiet and not likely to interact with their peers had, instead, engaged in social and collaborative behaviour and demonstrated a much greater involvement in a wider range of social activities than before such sessions. Moreover, many of the pupils considered as more socially excluded by the teacher and the teaching assistant also enthusiastically engaged in the activity (including immigrant and SEN children). Therefore, although caution is needed in the interpretation that the finding is a direct outcome of participation in the *JamMo* activities, an increase in social skills and behaviour throughout the *JamMo* intervention was recorded, as evidenced through the mixed-methods approach.

In addition to the social skills that the pupils used in the activities reported above (such as the sharing of ideas and encouraging each other), the psychological aspects that were observed to be facilitated during the session included: enjoyment and enhanced feelings of well-being; feeling part of a group; feeling proud about one's own composition and achievement; increased motivation; and improved concentration.

4.1.2 Findings from Herborn, Hesse Region, Germany

Staff at the nursery provided confidential information on each child's social background to the researcher. Out that of the 30 participant children, four parents were not willing to co-operate with the educators. Four other parents were viewed by the educators as not being integrated to the community primarily due to poor language and lack of communication. In addition to these specific parental social backgrounds, one Turkish boy was not well integrated into one of the children's groups. This particular boy was observed as exhibiting various social and emotional difficulties, due to which he received special attention and care.

The education team at the centre reported to be proud of the fact that, over time, they had managed to integrate children into their educational settings, including the ones with inaccessible parents. The team reported cases of children that were fluent in German and well socially integrated despite the fact that both or either of their parents could not speak German or possessed limited ability with the language.

During this piece of fieldwork, social inclusion was mainly assessed by interviewing the educators since they were well informed about any children at risk or children that receive special or additional care for ensuring their social integration. Moreover, such an approach was adapted due to the fact that young children since they might not understand the interview questions and could provide false answers. At institutional level, social inclusion issues with young children were mainly handled by identifying those at risk. In addition, the resource-oriented and 'inclusive education' paradigm served as the main guidelines.

According to the interview data, eight of the 30 children had parents with severe (4) and mild (4) problems concerning parental integration into the host country's culture and language. Interestingly, only one these eight children (a Turkish boy) did not actively participate (sing or use technical functions) during the fieldwork. The other seven children remained actively engaged. For some of the children, these musical and technical events offered an occasion to discover individual interests, competences, and a source for being respected as a participant.

4.1.3Findings from Jyväskylä, Finland: JamMo in music therapy and classroom intervention – self-regulation of children with ADHD

Self-regulation is a multi-faceted concept that is often used interchangeably with the concepts of self-management and self-control. In this study, we concentrate on the self-regulation of pupils' behaviour in a learning context. Self-regulation in learning is believed to require metacognition - the ability to monitor and control one's own cognitive processes such as attention, rehearsal, recall, checking for understanding, self-correction and learning strategy application (Westwood 2007). These abilities are essential for becoming an autonomous learner who is able to collaborate in various social contexts.

Self-regulation is reported to be evident at different stages of a learning process. It is seen in how students get ready for learning, stay engaged with tasks, and alter their problem-solving strategies (Singer and Bashir 1999). Self-regulation can be seen as a processthatconsists of three factors: knowledge, motivation and self-discipline or volition. On the one hand the pupils have to have the skill and the will to learn, but on other hand, they also have to know why they are learning. So their choices and different actions should be self-determined and not controlled by others (Woolfolk, 2007).

In this strand of fieldwork conducted by the University of Jyväskylä, the main focus was to observe aspects of the self-regulation of children with ADHD, who typically exhibit developmentally inappropriate levels of inattention, impulsivity, and/or hyperactivity. Based on the earlier music therapy pilot studies (see Annex 4.3) and an earlier UMSIC deliverable report (see D5.4 'Methods for the analysis of self-regulation'), this strand focused on observing regulation of concentration, attentiveness and impulsivity in both a specialist music therapy clinic and two elementary schools in the Jyväskylä area.

4.1.3.1 Findings from JamMo-based fieldwork in a music therapy clinic

As mentioned earlier (section 3.3.3.5), in the video analysis *JamMo* episodes were labelled as either *JamMo* stand-alone or *JamMo* pair work, and band instrument episodes were labelled as either instructed band playing or improvised band playing. Self-regulation was divided into on-task behaviour, selective on-task behaviour, passive off-task behaviour, and hyperactive off-task behaviour (see the definitions below). This way self-regulation could be analysed between ADHD children and non-ADHD children, *JamMo* playing and band instrument playing, as well as between different *JamMo* scenarios.

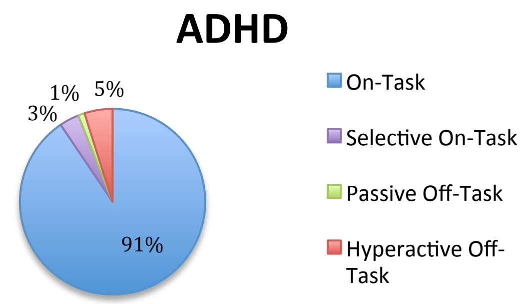


Figure4.1:self-regulation of the ADHD children

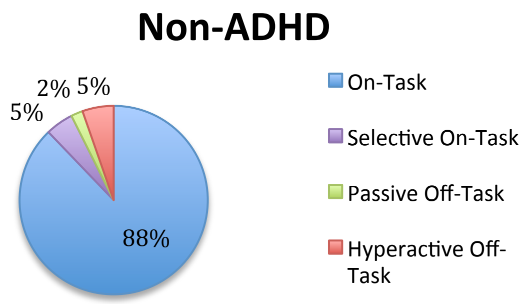


Figure4.2:self-regulation of the non-ADHD children

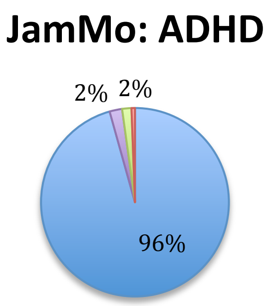


Figure4.3: self-regulation of the ADHD children when playing *JamMo*

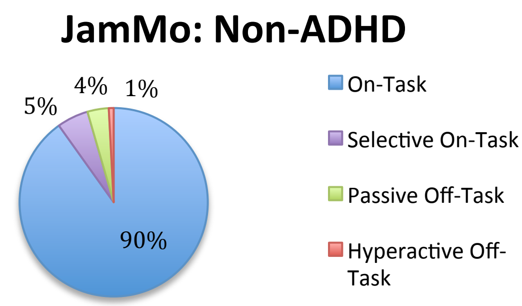


Figure 4.4:self-regulation of the non-ADHD children when playing *JamMo*

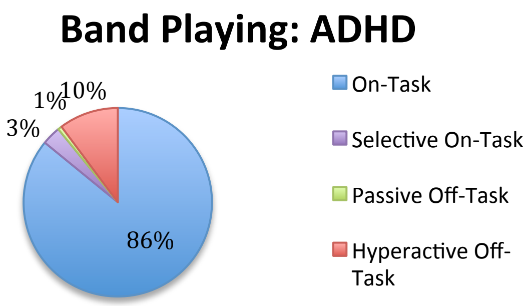


Figure 4.5: self-regulation of the ADHD children when playing band instruments

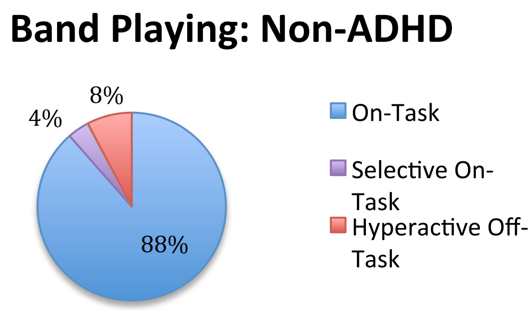


Figure 4.6: self-regulation of the ADHD children when playing band instruments.

As can be seen from inspection of the six pie charts above (three pairs of Figures),no clear difference in self-regulation is evident between the ADHD and non-ADHD children. The overall impression of the music therapy intervention was that *all* the children, both with and without diagnosed ADHD, behaved mostly in a tranquil and non-disruptive manner in all the musical contexts. This is supported by the quantitative analysis, which shows that with 94 %, of the total time of the analysed excerpts with ADHD children (Figure 4.1) and 93% of the time with non-ADHD children (Figure 4.2) 93 % consisted of on-task or selective on-task behaviour.

When comparing the observed self-regulation of the ADHD and non-ADHD children when playing with *JamMo* (Figures 4.3 and 4.4), it can be seen that there is slightly more (non-significant) selective on-task and passive off-task behaviour by the non-ADHD children than by the ADHD-children. In the band playing situation there was slightly more hyperactivity by the children with ADHD (Figure 4.5) than by the children without ADHD (Figure 4.6), but again this difference was non-significant.

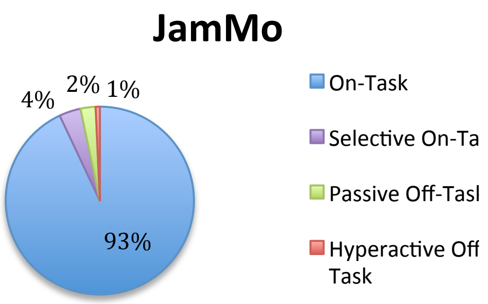


Figure 4.7: self-regulation of all the children when playing *JamMo*

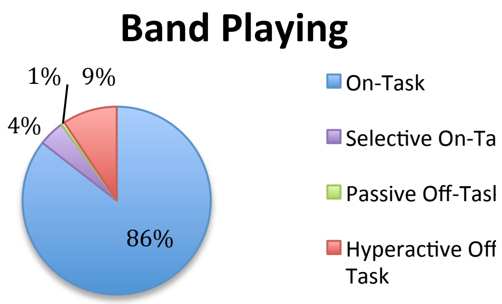


Figure 4.8: self-regulation of all the children when playing band instruments

There was clearly less hyperactive off-task behaviour in the *JamMo* playing (Figure 4.7) than in the band playing (Figure 4.8). When analysing the excerpts qualitatively, it could be seen that of the two types of of-task behaviour, hyperactive off-task behaviour was seen more in the band playing than *JamMo* context, while passive off-task behaviour was slightly more prominent in the *JamMo* context.

If both of these musical activities were included within the same 45-minute session, band playing took always place before *JamMo* composing. The *JamMo* activity was always individual or pair work, whilst band playing always took place in a group. Another essential difference between these two musical activities was that band playing required a lot of motor activity, whilst the individual *JamMo* composing required the phone to be held in one hand, and controlled by small and precise fine motor movements of the other hand.

In all the musical activities, the music therapy undergraduate students acted as facilitators and were active, instructing the children, offering help, and demoing the playing of the *JamMo*, or a particular focus musical instrument. The children also often asked for help. On only a few occasions did a child comment negatively on amusic therapy students' instruction. In band playing there were breaks between the songs when the children were supposed to be quiet and listen to the instructions, but often their interst was sufficiently strong that they continued to play their musical instrument. In contrast, when working with *JamMo*, the children were allowed to create music for the whole session and no quiet periods were required.

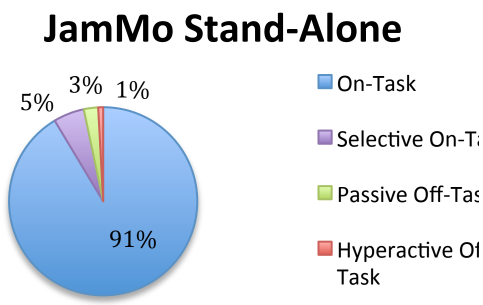


Figure 4.9: self-regulation of all the children when playing *JamMo* in stand-alone

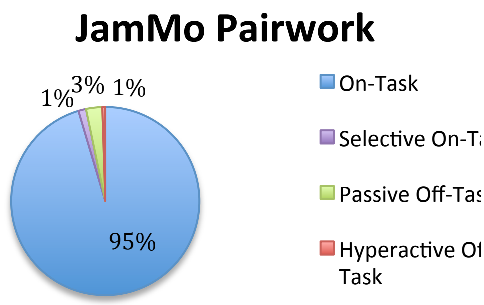


Figure 4.10: self-regulation of all the children when playing *JamMo* with a pair

Both in the *JamMo* stand-alone and *JamMo* pair work situation (Figures 4.9and 4.10), 96 % of the overall time analysed consisted of on-task or selective on-task behaviour, although there were very small non-significant differences in the make up of these percentages. When composing individually, the children were usually sitting quite close to their peer. They were not using headphones and, therefore, they were able to hear what their peer was doing. In contrast, in a pair work situation there was only one sound environment audible for the pair.

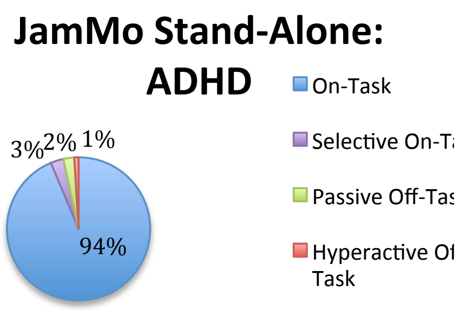


Figure 4.11: self-regulation of the ADHD children when playing *JamMo* in stand-alone

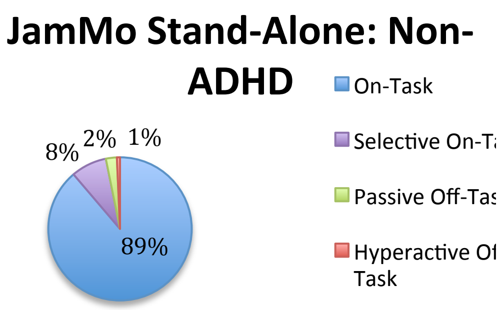


Figure 4.12: self-regulation of the non-ADHD children when playing *JamMo* in stand-alone

In the *JamMo* stand-alone scenario (illustrated in Figures 4.11and4.12) there was slightly more selective on-task behaviour by the non-ADHD children than by the ADHD children, although overall there was no difference at all in the total, combined on-taskbehaviour.

The children used the *JamMo* software patiently even when there were technical problems. The frustration was expressed through verbal comments, but very seldom in a physical manner. When the *JamMo* crashed, the child usually informed a music therapy student about it, and they rebooted the device together. Soon the children learned to do this independently. Still, the music therapy students offered help to the children and they were observed to providepositive feedback when the children managed to solve a technical problem.

When composing individually with the *JamMo*, non-ADHD child 1 was most eager to comment onhis own and his pair's composition, to play to the pair a sample that he found interesting or amusing, or to help his peer when his *JamMo* crashed. All in all, pair 1 were observed to have more collaboration and communication than pair 2 in the *JamMo* situations.

In one of the analysed stand-alone excerpts, the children were instructed to help each other, but no specific task was given. The ADHD child 1 was sitting next to an electric piano. When the *JamMo* did not work properly, he shifted his concentration to the piano for a while. In other sessions the children were sitting further away from the other musical instruments when composing with *JamMo*.

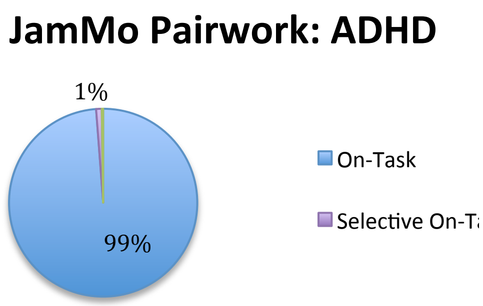


Figure 4.13. self-regulation of the ADHD children when playing *JamMo* with a pair

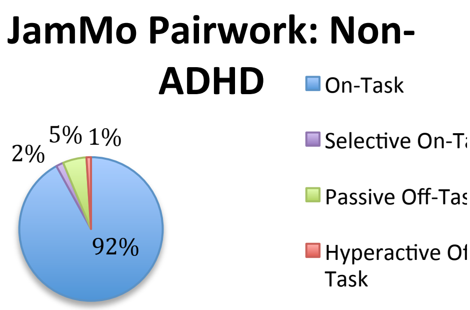


Figure 4.14: self-regulation of the non-ADHD children when playing *JamMo* with a pair

The non-ADHD children behaved more in a passive off-task behaviour mode than their ADHD peers in *JamMo* pair work sessions (Figures 4.13and4.14).

Observation indicated that the children had different roles from each other in the *JamMo* pair work sessions. In the first *JamMo* pair work session the therapist was constantly standing or sitting next to the children, advising and demonstrating the use of *JamMo* for them. For pair 2,*JamMo* was in the hands of the ADHD child throughout the whole analysed excerpt, while the non-ADHD child was mostly just observing his pair and having more passive off-task behaviour. In contrast, in pair 1 the *JamMo* was in the hands of the non-ADHD child, but in this pair the children were observed to be both contributing to the composing process with their own stylus.

In one of the pair work sessions, the analysed excerpt was preceded by a pair-tutoring demo by the music therapist students and a period of individual *JamMo* playing. The intention was that each child would learn to use sound samples from a certain *JamMo* instrument, and then teach his peer to use them. In the analysed period, in pair 2 the non-ADHD child was instructed to act as a tutor to his peer, and – in contrast – in pair 1 the ADHD child was instructed to advise his peer. In pair 2, the child acting as the tutor was mostly silent and followedthe peer's actions (passive off-task behaviour). However, in pair 1 the tutor took initiatives to help his peer and made suggestions to him (on-task behaviour).

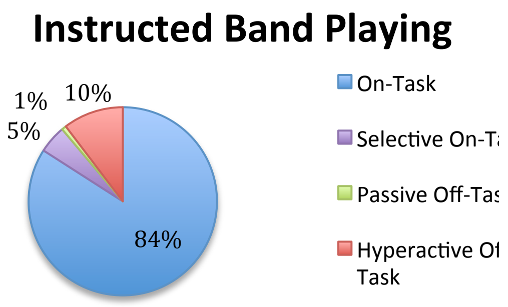


Figure: 4.15: self-regulation of all the children in instructed band playing

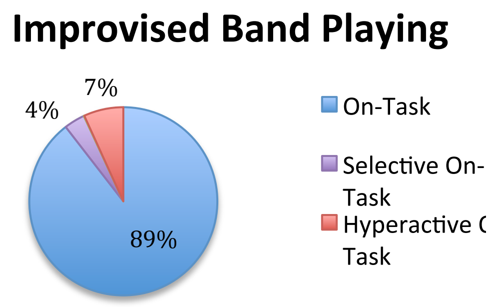


Figure 4.16: self-regulation of all the children in improvised band playing

The children behaved slightly more in a hyperactive manner in an instructed band play situation (Figure 4.15) than in an improvisatory band play situation (Figure 4.16), although the difference was non-significant.

In instructed band playing, the children received musically more restricted instructions than when improvising with band instruments. In theiron task-behaviour within an instructed band playing situation, the child did not necessarily play the correct notes, but he seemed to do his best and concentrate on the musical activity. If the child actively played something else than what was instructed, this was coded as hyperactivity. On the other hand, in an improvised band playing context, all kinds of playing was coded as on-task behaviouras long as it was done with the previously defined instrument and was not executed when verbal instructions were given.

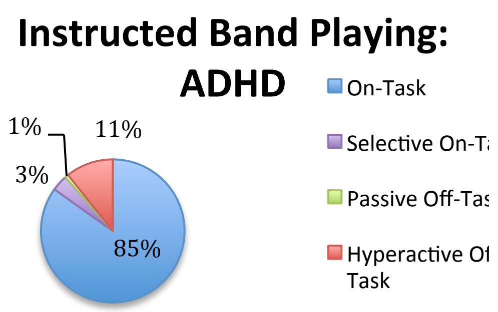


Figure 4.17: self-regulation of the ADHD children in instructed band playing

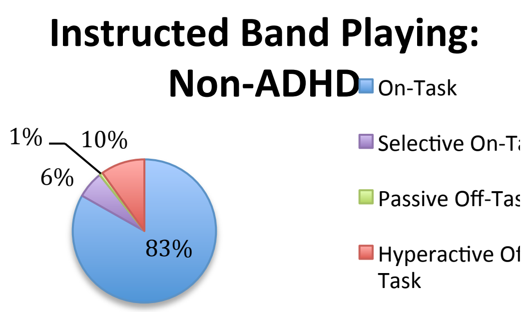


Figure 4.18:self-regulation of the non-ADHD children in instructed band playing

The quantitative results of instructed band playing show that 88% and 89% respectively of the behaviour of the ADHD children (Figure 4.17) and the non-ADHD children (Figure 4.18) was on-task or selective on-task behaviour.

Qualitative differences could be seen in the self-regulation depending on which instrument the children were playing. ADHD child 1 concentrated really well when playing the piano. In a different session, ADHD child 2 also concentrated really well on piano playing for a while, but then started to play something else than what had been instructed. When playing a more 'simple' percussion instrument than the drum kit, such as a maracas or jam blocks, the children became more hyperactive than when playing the drum kit and practising a certain composition. However, during the breaks there was hyperactivity at times with all of the instruments. Both children with ADHD seemed to have more motoric problems than their peers in playing the drum kit,and, relatedly, also more problems in keeping the rhythm with other instruments. In contrast, it was noted that the non-ADHD child 2 had been playing drums as a hobby.

On many occasions, ADHD child 1 wanted to reassure us that he had understood the given instruction. Other children were looking mostly at their particular musical instrument, while this child looked more at the music therapy students and at times his gaze wandered around the room. Similar to the *JamMo* context, the non-ADHD child 1 was the most eager to make comments about the other's playing in instructed band playing situation. His feedback to the others was always positive and encouraging.

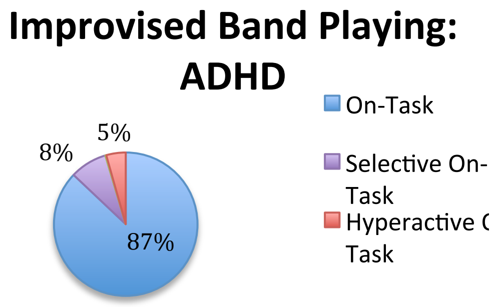


Figure 4.19: self-regulation of the ADHD children in improvised band playing

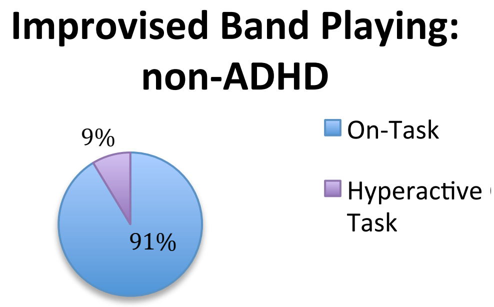


Figure 4.20: self-regulation of the non-ADHD children in improvised band playing

A small difference was observed between the hyperactive off-task behaviour between the ADHD children (Figure 4.19) and non-ADHD children (Figure 4.20) in improvised band playing.

In one of the improvisation sessions with band instruments, the musical improvisation had no evident theme. In the other analysed improvisation session, one child at a time was asked to give a name to their upcoming improvisation. Similar to the instructed band playing activity context, ADHD child 2 seemed to be the most cautious and it took him a longer time and more input from the music therapy student in order for him to come up with a title.

There was a difference in the instruments played by the ADHD and non-ADHD children. In the first improvisation excerpt the ADHD children were playing a piano and MalletKat instrument, while both of the non-ADHD children were playing with the drum kit. At the beginning of the second improvisation excerpt,ADHD child 2 was playing with the electric piano, whilst both non-ADHD children were again playing with the drum kit. The other ADHD child was absent. At the end of the same excerpt, the ADHD child was playing electric drums, whilst non-ADHD child 2 was playing acoustic drums and non-ADHD child 1 was playing with the synthesiser.

The self-regulation of two ADHD children and their non-ADHD peers was studied in stand-alone and pair work with the *JamMo* sequencer, as well as in instructed and improvised band playing using quantitative and qualitative video analysis. No clear differenceswere observed in self-regulation between the ADHD and non-ADHD children. It was noteworthy that the behaviour of all the children was for the vast majority of time on-task in each of the musical activities.

A small difference was found in self-regulation between composing with *JamMo* and playing band instruments. Band instruments appeared to be a little more challenging with regard to self-regulation, which confirmed the music therapy pilot findings (Annex 4.3). Both instructed and improvised band playing lead more often to slightly more hyperactive off-task behaviour than *JamMo* playing (although again its incidence was very smal). Hyperactive off-task behaviour was seen more in the band playing than *JamMo* context, while passive off-task behaviour was more prominent in the *JamMo* context than in band playing.

Because of the current state of the *JamMo* development at that time, technical problems with *JamMo* frustrated each participant equally and the frustration was expressed mostly in verbal form, while the behaviour remained calm. Usually the technical problems with *JamMo* lead to a slight passiveness, but hyperactivity was seen very seldom. There was more selective on-task behaviour in the stand-alone than pair work learning situation.

When using the *JamMo* sequencer, the children frequently asked for help from the music therapy students, but who also came to offer help without asking. The role of the instructors was significant, especially because the *JamMo* sequencer was not working properly at that time and there was no virtual mentor available in the software. From a pedagogical standpoint, it was noted that the clarity of the instruction appeared to play a key role in all the musical activities, whereas a lack of it was likely to be reflected in hyperactive off-task behaviour. Collaboration was evidenced between the children when a pair were sharing one *JamMo* in a pair work situation. There were also some comments offered during the stand-alone sessions, but mostly they were concentrating more on their own composing process. There was more interaction between pair 1 than pair 2.

Essential elements contributing to an improvement of self-regulation and reduction of inattentiveness and hyperactivity were for the participant to be sitting independently, far from other musical instruments. Other element improving self-regulation was clear (and repeated) instruction that was preferably given before the children were at close physical proximity to the N900s or band instruments.

The children had different kind of roles from each other in the musical activities. In the *JamMo* pair work situations,one child was often in a dominant role, whether instructed or not, which at times seemed to lead to passiveness of his pair. In the band instrument playing, a different choice of instrument might had affected to the amount of off-task behaviour, but this requires further study.

4.1.3.2 Findings from JamMo-based fieldwork in two elementary schools

Regulation of attention, concentration and hyperactivity of children with and without ADHD was also studied in two 4th grade classes (10-11 years old)at two different elementary schools in the Jyväskylä area in the Spring of 2011. The main research questions were:

1) What kind of differences and/or similarities are there inself-regulation between children with ADHD and children without ADHD in *JamMo* lessons?

2) What kind of differences and/or similarities are there in self-regulation between stand-alone, pair composing or workshop composing contexts with *JamMo*?

3) What kind of differences and/or similarities are there in self-regulation between composing with *JamMo* and ‘ordinary’ music lessons (compared with the classroom pilot study – see Annex 4.3)?

4) What kind of general group cohesion areevidenced in *JamMo* lessons?

This fieldwork was a continuation of the classroom pilot study (Spring, 2010 – see Annex 4.3). The key findingsin this pilotwere had been (1) that the majority of the time was used for verbal instruction by the teacher (Figure 4.21)and (2) that the children with ADHD were slightly more non-attentive than participatory (Figure 4.22). In other words, passive off-task behaviour was more common than hyperactive off-task behaviour. Nevertheless, the results of the actual *JamMo*-based fieldwork in elementary schools (see below)are in contrast with the findings of the earlier pilot study.

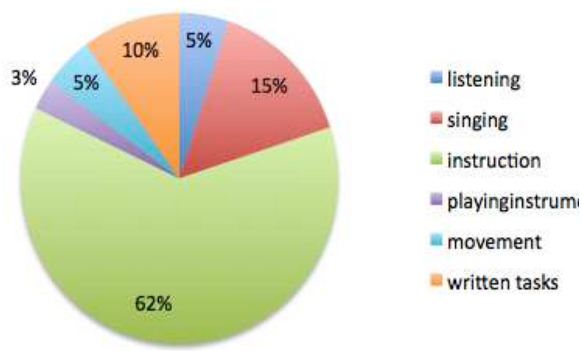


Figure 4.21: the frequency of different music activities in ordinary music lesson

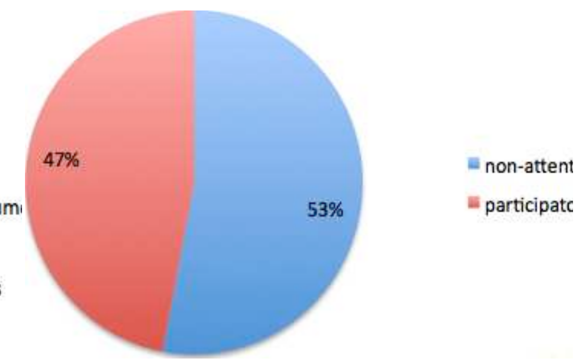


Figure 4.22: self-regulation of ADHD children in ordinary music lessons

Working alone with JamMo

Findings from the main fieldwork suggested that the self-regulation of the ADHD child consisted of more than 90% on-task or selective on-task behaviour when playing with the orientation game *7-12* in stand-alone mode (see Figure 4.23). In comparison, the headphones of the non-ADHD peer were on the table and his *JamMo* had some crashes and bugs, but anyway he seemed to try his best. The child with ADHD was also willing to help his peer with his *JamMo*. Although the peer from the music therapy pilot study in Autumn 2010 (Annex 4.3) tried to disturb the child with ADHD, the ADHD child was unaffected. At the end of coded section, the ADHD child chatted a little with his peer from the music therapy pilot (Annex 4.3), which lead to an increasing amount of hyperactive off-task behaviour.

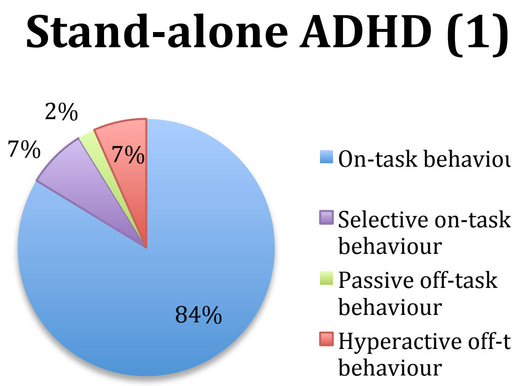


Figure4.23: self-regulation of the ADHD (1) when playing *JamMo* in stand-alone

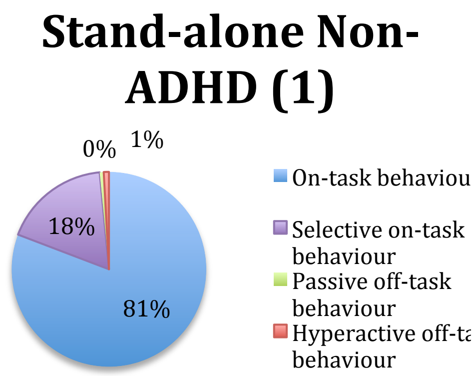


Figure 4.24: self-regulation of the non-ADHD (1)when playing *JamMo* in stand-alone

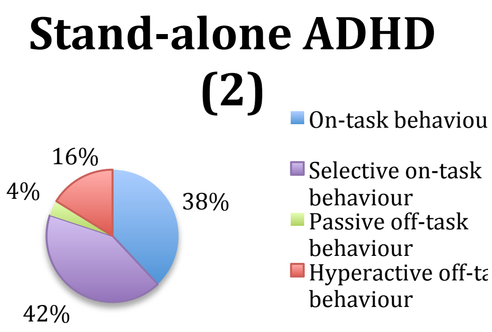


Figure 4.25: self-regulation of the ADHD (2) when playing *JamMo* in stand-alone

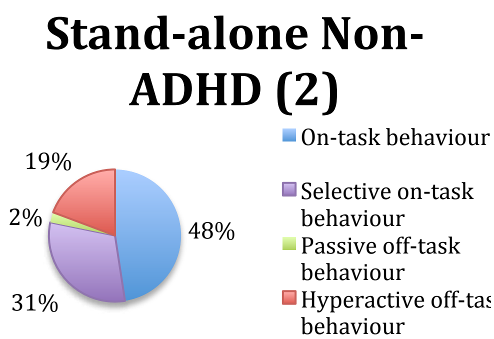


Figure 4.26. Self-regulation of the non-ADHD (2) when playing *JamMo* in stand-alone

In school 2, the self-regulation of target child 2 with ADHD and his peer without ADHD wasobserved to be mainly either on-task or selective on-task behaviour, when both were playing the orientation game *7-12* in stand-alone mode (Figures 4.25 and 4.26). They had more conversation during the standalone gaming session than target child 1 and his non-ADHD peer in School 1. During composing stand-alone activities, these children had conversations about the *JamMo*, but also about other external things. Both of the N900s used were compromised through software bugs in *JamMo*, but it was noted that especially Target 2 with ADHD was able to restart his *JamMo* system on his own without help from the teacher or an other adult. The non-ADHD peer had more hyperactive off-task behaviour than the target boy with ADHD. Thus, it may be that the peer influencedthe self-regulation of the ADHD child, not least because the former had more problems with his *JamMo*. The off-task behaviour in this observed session consisted of disturbing the others when the teacher was giving instructions and also in situations when the ADHD and non-ADHD children were playing with someone else´s N900. Self-regulation was coded as passive/hyperactive off-task behaviour if the child didnot follow the given instructions.

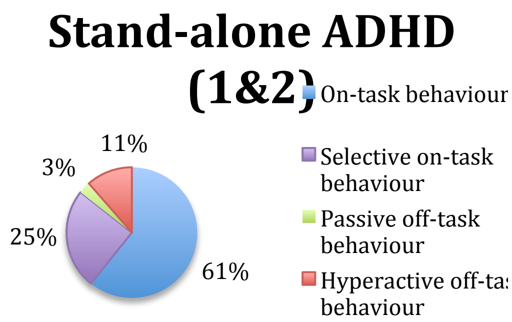


Figure 4.27: self-regulation of the ADHD (1and2) when playing *JamMo* in stand-alone

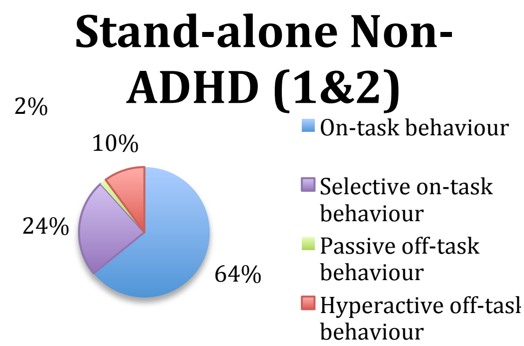


Figure 4.28: self-regulation of the non-ADHD(1and2)when playing *JamMo* in stand-alone.

Both quantitative and qualitative analyses showthat there is no clear difference in self-regulation between ADHD and non-ADHD children when composing with the *JamMo* orientation game *7-12* in a standalone situation. The self-regulation appeared to be more dependent on the peer with whom the ADHD is co-operating, as well as onthe amount of technical problems with *JamMo*. Compared with the classroom-based pilot study (Annex 4.3), there appeared to be a clear difference in the amount of passiveness. Overall, *JamMo* activated the children with ADHD in a positive way; only 3% passive off-task behaviour occurred during stand-alone gaming with *JamMo* for the target children 1-2 with ADHD.

Working in pairs

The *JamMo 3-6* composition game advanced mode which was played in this *JamMo* session was familiar for the ADHD-targets from UMSIC music therapy sessions from autumn 2010. There was no clear difference in self-regulation between ADHD child target 1 and with the child without ADHD when they composed with *JamMo* composition game *3-6* with a shared device in pairs (Figures 4.29 and 4.30).

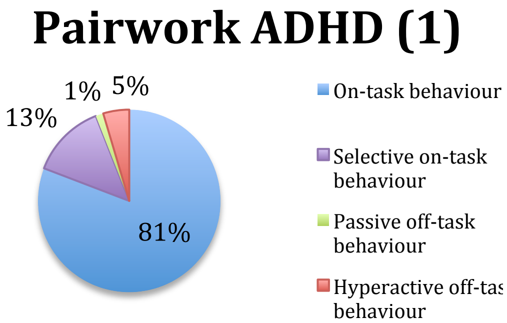


Figure 4.29: self-regulation of the ADHD (1) whenplaying *JamMo* in pairs

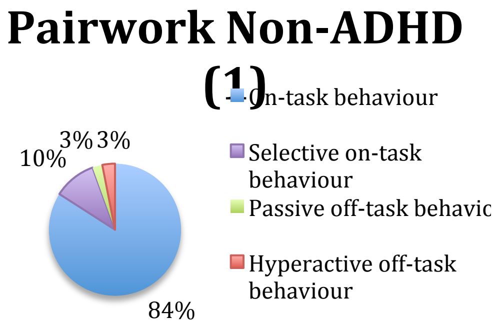


Figure 4.30: self-regulation of the non-ADHD (1) when playing *JamMo* in pairs

Hyperactive off-task behaviour was observed slightly more often in ADHD target 1 than with the child without ADHD, but this difference was non-significant. During this session, there were some potentially distracting events and noise in the classroom, but the target children did not seem to mind about these. In this *JamMo* session in School 1, the teacher did not give clear instructions to the children, in contraast with School 2 in which the teacher's instructions were very clear. However, the lack of clear instructions seemed to have no obvious effect on the self-regulation of target 1 with ADHD or his non-ADHD peer.

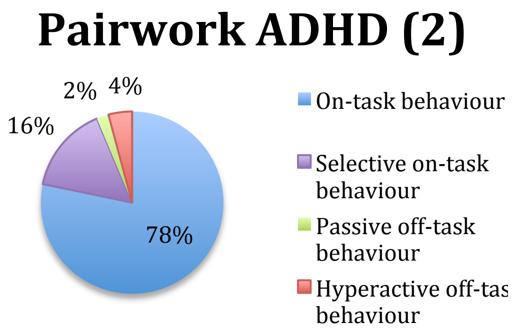


Figure 4.31: self-regulation of the ADHD (2) when playing *JamMo* in pairs

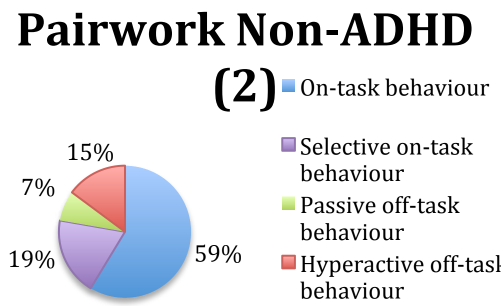


Figure 4.32: self-regulation of the non-ADHD (2)when playing *JamMo* in pairs

The results of the pair work of target 2 with ADHD and his non-ADHD peer (Figures 4.31 and 4.32) indicate that the behaviour of both children consists mainly of on-task or selective on-task behaviour when playing with *JamMo* in pairs (composition game *3-6* advanced). The children were jamming when listening to different backing tracks within different landscapes, *JamMo* composition themes (Animal World, City, and Fantasy). In contrast, the non-ADHD peer of target 2 had more of both passive and hyperactive off-task behaviours. The passiveness during this situation consisted of looking passively away from *JamMo* and hyperactivity included head shaking and shouting whilst the teacher was giving instructions. The non-ADHD peer talked more than the child with ADHD. AHDH child target 2 withdrew from his sitting place at the end of this excerpt. It was clear that the child whose turn in to manipulate *JamMo* was more likely to behave in an on-task manner than the child who was observing.

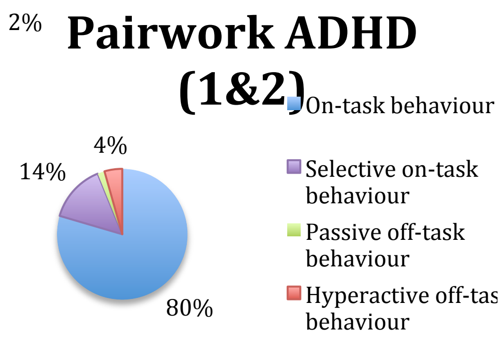


Figure 4.33: self-regulation of the ADHD (1 and 2) when playing *JamMo* in pairs

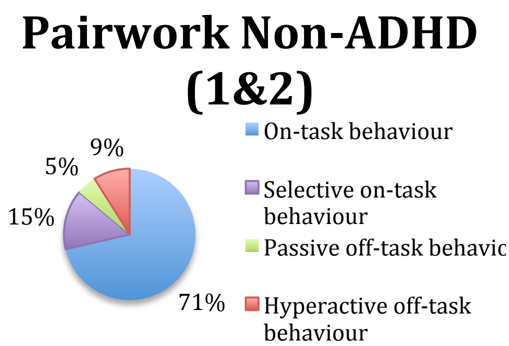


Figure 4.34: self-regulation of the non-ADHD (1 and 2) when playing *JamMo* in pairs

In sum, the results of composing with *JamMo* compositioin game *3-6* in pairs show that most of the time the children's behavour was either on-task or selectively on-task (Figures 4.33 and 4.34). In this social context, more hyperactive off-task behaviour was observed in the children without ADHD than the children with ADHD. All the children appeared to be very motivated to compose with *JamMo*; the quantitative results presented her support these qualitative findings.

Workshops

From all the different social contexts, composing in the workshop context with the *JamMo* sequencer appeared to be most challenging concerning self-regulation. The session started with a short discussion about composing with *JamMo*. The aim of the discussion was that pupils would be provided with some advice for each other and afterwards continue composing in pairs. Composing with *JamMo* seemed to succeed in an on-task manner, but the act of discussion seemed to have an effect on self-regulation in a passive way. During this session there were also several technical problems with *JamMo* which need to be taken into consideration when studying the self-regulation of the target ADHD children. The technical problems also meant that the target children needed quite a lot of the support from an adult.

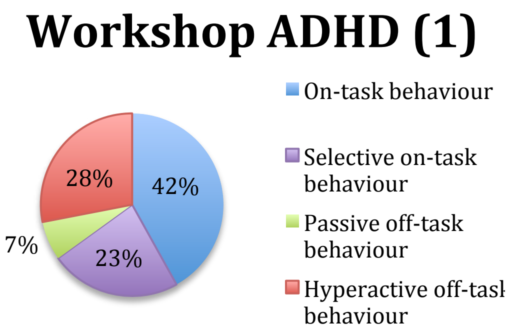


Figure 4.35: self-regulation of the ADHD (1) when playing *JamMo* in workshop.

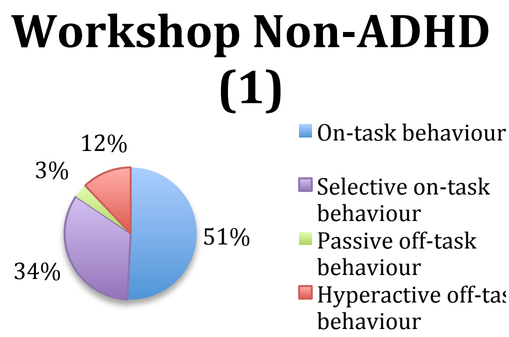


Figure 4.36: self-regulation of the non-ADHD (1)when playing *JamMo* in workshop

During the workshop situation, hyperactive off-task behaviour was more prominent in ADHD chil target 1 compared with the child without ADHD(Figures 4.35 and 4.36)and also more than in the other social contexts.Children seemed to have fun during their discussion, but they didnot follow the given instructions. The fact that given instructions werenot clear may also explain these results of self-regulation. Moreover, this pair had also some technical problems with their *JamMo* and needed support from an adult. The self-regulation was again best when each child had *JamMo* in their own hands. Observing the pair lead often to hyperactive or passive off-task behaviour.

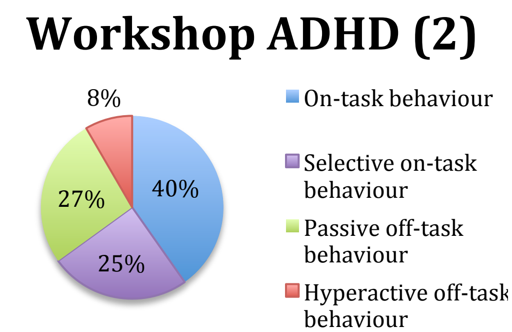


Figure 4.37: self-regulation of the ADHD (2) when playing *JamMo* in workshop.

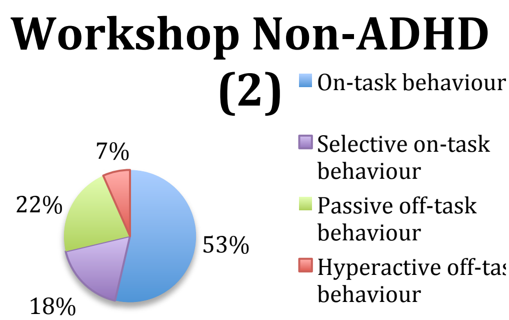


Figure 4.38: self-regulation of the non-ADHD (2) when playing *JamMo* in workshop.

There was no clear difference observed between ADHD child target 2 and his non-ADHD peer in terms of hyperactive off-task behaviour, but in the workshop situation ADHD target 2 seemed to have beenslightly more passive than his peer without ADHD. Especially, when the peer was composing, the child with ADHD didnot follow the action. Instead of observing, he was looking passively at other pupils (passive off-task behaviour),or was doing something with his fingers (categorised as hyperactive off-task behaviour).

This social context seemed to make the biggest difference between the child with ADHD and the child without ADHD (Figures 4.39 and 4.40). Although the behaviour was still more often on-task than not, the lack of clarity concerning the teacher's instructions seemed to have an negative effect on the self-regulation of the children with ADHD immediately. Similarly, the situation when the headphones were off and the children were instructed to discuss instead of composing with *JamMo* also seemed to lead to more passive/hyperactive off-task behaviour.

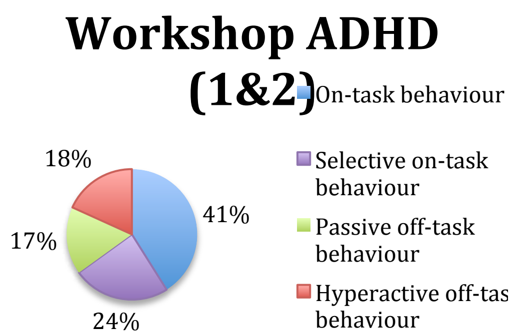


Figure 4.39: self-regulation of the ADHD (1 and 2)when playing *JamMo* in workshop

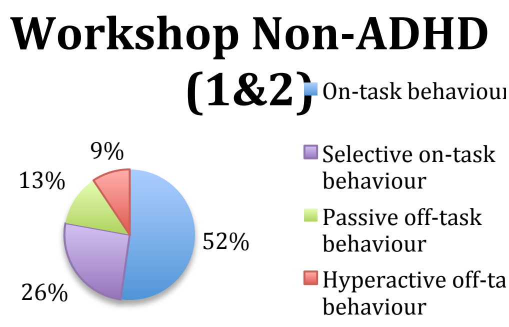


Figure 4.40: self-regulation of the non-ADHD (1 and 2) when playing *JamMo* in workshop

General cohesion of the JamMo activity

The general cohesiveness of the *JamMo* activity was analysed in two different ways related towhether the self-regulation of the majority of children in the class was on-task or off-task. The section selected for analysiswas the first lesson, when the children played the *JamMo 3-6* advanced composition game in pairs. The general finding of the classroom intervention was that all the pupils, both with and without ADHD, behaved mostly in a tranquil and non-disruptive manner during *JamMo*-lessons. Off-task behaviour (totalling 6%) consisted of disturbing others, acting against instructions (e.g. playing other *JamMo* games), non-attentive behaviour, or talking whilst the teacher was giving instructions (Figure 4.41).

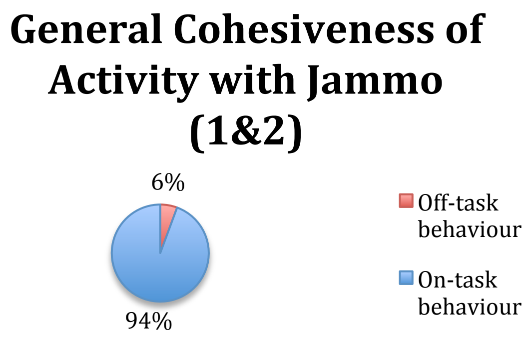


Figure 4.41: general cohesion of activity (1 and 2)

The analysis of this fieldwork showed there was no clear difference between ADHD and non-ADHD children in terms of their observed self-regulation when playing with *JamMo* in the classroom context. In comparison to the pilot study in the classroom context this intervention shows that *JamMo* had a positive effect on the self-regulation of children with ADHD. It was clearfrom the emergent case study data that *JamMo* was activating the children with ADHD and their keeping attention better than during their customary music activities (e.g. singing, playing different instruments and listening).

When comparing *JamMo* use in the different social contexts, composing in stand-alone situation and in pairs appeared to be easiest for children with ADHD. This study suggests that the 'simulated' workshop situation did not work so well with the children with ADHD: there was more hyperactive off-task behaviour than in the other social contexts. The inference is that to enable any *JamMo* workshop to be successful with ADHD children, the instructions should be very clear and the children should have been used to discussion in small groups. The two schools had different learning cultures which also may have had effect to the data. However, the results indicate that children with and without ADHD had very similar behaviour, whether in a workshop context or not.

It also seems that when a child has *JamMo* on their own hands and is able to manipulatd it, self-regulation is better. It was noted that when the ADHD participant was in the role of observing their partner for a longer time, the self-regulation of the children was impaired.

When composing with *JamMo*, children seldom appeared to needthe help of the teacher. The mentor in the different *JamMo* games appeared truly useful and supportive. The only times, when children asked for help were the situations when they had technical problems (for example, crashes or bugs) with their N900s or *JamMo* software. Not surprisingly, technical problems caused a little frustration, neverthelessall the children tended to behave in a tranquil manner, suggesting that the *JamMo* had an intrinsic interest for them.

The observed outcomes were in line with previous findings concerning the need for clarity of structure of activity and instructions when working with ADHD children. It seems also that the play-like features of the *JamMo*, combined with collaboration and regularfeedback had a positive effect on the self-regulation of ADHD.

4.2 Technology

4.2.1 JamMo

4.2.1.1 Use of JamMo 3-6 within a mainstream Primary school environment

Perhaps one of the most positive outcomes of the fieldwork in London, UK was the powerful, shared focus it provided between the WP9 research team and the core *JamMo* programming team. In part, this was because, along with the majority of the UMSIC consortium, the core programming team were present for session 2 (23rd September, 2010) of the fieldwork study in London (as observed by an independent member of the EC review team) and saw the results of their labours being actively explored by pupils. This experience, described as 'very memorable' by one of the programming team, led to an extremely healthy process of solving software bugs identified by pupils and also extending features in response to educational and musical motivations. A good example of this dialogue was the textual logging facilities added to *JamMo* from version 0.7.1 onwards. These now provide a constantly updated, time-stamped record of user interactions with the software and will facilitate syncing to video footage in further studies.

A further significant process outcome from the London fieldwork was the observed evidence of a congruence between the participants' prior experience and expectations of computer games, mobile devices and music technology in general and their experiences and expectations of *JamMo* in particular. Many pupils in the class had pre-existing experience of working with both music software and portable games devices (reported in the questionnaire data). They were able to bring these experiences to bear whist working with *JamMo*. Pupils usually had clear intentions of what it should be possible to achieve with such a tool and what they hoped to achieve during its use. This was in spite of the fact that the versions of *JamMo3-6* and *7-12* used in the fieldwork study remained partially compromised through bugs and functionality limitations. Put simply, and to borrow a phrase from computer software design, *JamMo* appeared to have the 'look and feel' of other, more established music software and games. During the London-based fieldwork study, this observation was judged to have both positive and negative outcomes. On the positive side, participants generally felt efficacious when using the software and were able work independently from an early stage. It also meant they were able to predict areas in which the software might usefully be developed next in their opinion. For instance, the comments from the children for *JamMo* software improvement were noted during session 2 by the UMSIC team members present included '*Put [a] keyboard on*' and '*Needs a guitar*'.

On the negative side, their previous experiences often meant they were able quickly to identify what they perceived to be as weaknesses or limitations in *JamMo*'s design and, in some cases, to become frustrated and annoyed by these.

The use of a mobile ‘smart’ phone as the target platform for *JamMo* was definitely popular with pupils participating in the London-based fieldwork study. Following their early experiences with the phones in session 2, they looked forward to using them again in session 6 and regularly asked the researchers whether a version would be made available for their own particular make and model of phone handset. Pupil comments included: ‘*It was fun to drag things and be creative on the phone’* and *‘Learning with phones is good*’.

Several pupils also commented favourably on the overall visual 'identities' of the two *JamMo* versions. General comments included: ‘*The icons are good and fun’,* ‘*The pictures and icons were well-chosen for younger children’, ‘The bikes that float are like space bikes’* and ‘*We can compose magic pop with this game and these pictures*’.

With particular regard to *JamMo3-6*, they perceived a clear link between the majority of the icons and the style/feel of the musical sound fragments that these represented. In particular, most pupils felt that the sound fragment icons for the ‘city’ and ‘fantasy’ composition themes were very well represented. Overall, there was a view amongst pupils within the small group sessions that the interface of the *3-6* version was clearer and simpler than that for the *7-12* version. However, since the pupils’ only experience with *7-12* by that point was the unfinished N900 version that they had used in session 1, this finding should be interpreted with caution.

By session 5, *JamMo3-6*’s ‘dot-to-dot’ password security feature had been partially implemented (version 0.6.16) and, although not a focus of the fieldwork study, the research team took the opportunity to gauge pupils’ responses to this tool. Generally, pupils responded positively and clearly enjoyed constructing ingenious shapes on the dotted grid. Unfortunately, 0.6.16 did not appear to allow pupils to actually set and subsequently re-enter a password shape. Nonetheless, the general view of the group was that they would be able to remember and re-enter this password related shape as required. By the final session 6 of the fieldwork study, the development team had implemented *JamMo*'s user interactions logging and composition saving. These 'products' were extremely helpful to the research team and have subsequently offered powerful ways of analysing users' work with *JamMo*.

Notwithstanding their general enthusiasm for *JamMo*'s mobile phone platform, pupils seemed pragmatic about the inherent technical limitations that this platform presented. Earlier session comments included: ‘*The phone version was much slower than the computer version’,* ‘*It was much easier to use the computer’* and ‘*The phone would freeze once in a while’*.

On the whole, the pupils were consistently accepting and realistic about the ongoing, developmental nature of *JamMo*, with some even expressing pride in their new-found roles as 'software beta-testers'. Nonetheless, a sense of frustration was often in evidence in both pair and small group activities and with both N900 and desktop versions when the software appeared to act in variance with expectations. In rare cases, these frustrations led to an observed sense of de-motivation or simply a lack of comprehension at what had happened: '*Some of our compositions disappeared all of a sudden*' and '*We did not like when we got messed up*'.

Over the course of the fieldwork project, the research team sent *JamMo*'s developers many bugs and crash reports. In the majority of cases, these were able to be addressed quickly and led to more stable, usable releases. This interchange was extremely fruitful and is certainly a cause for celebration within this report. To this end, the researchers list below only the more general, design- or interface-based technical issues that arose during the course of the London-based fieldwork.

(i) Dragging and dropping
A relatively common problem reported by pupils throughout the fieldwork was related to 'dragging and dropping' sound fragment icons around the composition game interfaces. This issue appeared to affect the N900 version slightly more than the desktop *Ubuntu* version, at least at the outset of the project. There is no doubt that some of these problems may be due to a paradigm conflict between the actions of 'tap and hold' (more common on tablet devices) and 'point and click' or 'point and double-click' (more common on desktop systems). However, the researchers did observe apparently genuine difficulties related to the interface as well. Specifically, some pupils found it necessary to drag sound fragment icons onto the sample tracks directly from above as sliding them over diagonally from left or right did not seem to result in them 'sticking' to the sequencer track grid squares. A related issue was that pupils sometimes found it difficult to know where their fragment was being 'placed' on the track as the grid square would not highlight as expected. Nevertheless, the pupils persisted on playing with the interface, summarised aptly by the classroom teaching assistant: *'Not one of them has given up and put it down. If it were me I would have given up, but this age are OK.'*.

(ii) Icon choice and placement
A problem identified during a small group activity was related to the choice and placement of icons within the background images for the advanced composition game theme worlds. Several pupils said that it was sometimes hard to see which elements of the overall image were 'clickable' icons and which were part of the background image. In the *JamMo 3-6* easy composition activity, this is less of a problem since all clickable sound fragment icons 'float'. However, in the advanced option, the icons representing groups of sound fragments do not float, hence the potential for confusion.

(iii) Composing game icon
Some pupils appeared confused at the 'meaning' of the *JamMo 3-6* composition game icon (the girl playing the piano keyboard in Figure 4.42).

Figure 4.42: the *JamMo 3-6* game selection screen with the 'composing' game icon in the centre

When asked, most pupils thought that selecting this icon would lead to a 'piano playing' game and only one girl correctly identified that it may represent a composition activity. On the other hand, all pupils appeared to understand that the smiling boy with floating quavers by his mouth represented a singing game.

(iv) The password screen

As mentioned above, a partially functioning graphical password protection facility had been implemented by session 5 of the London-based fieldwork project. The research team took the opportunity to demonstrate this facility to the participants and solicited feedback. On the whole, this feedback was positive. However, many children did not appear to understand that tapping on the word 'skip' would cancel the password option and deliver them straight to the activity selection screen.

(v) The JamMo 3-6 mentor ('the bear')

Both *3-6* and *7-12* versions of the *JamMo* software were designed to include a 'mentor' (initially termed 'mobile teacher', reflecting the mobile technology platform). These features were to be animated on-screen Figures who would address users verbally in their local language. From the earliest stages of the UMSIC Project, such features were regarded as important in meeting the specific needs of the targeted user groups, a view formed from a close reading of the developmental psychology literature:

> Young children and children with ADHD often differ from school aged children without learning difficulties in respect of their attentional resource. *JamMo*'s pedagogical design is tailored according to children's different levels of cognitive and musical development... In addition, *JamMo* is user sensitive by including a mobile teacher, who supports attention, encourages, provides feedback and information and guides the user during the creative process.
> (From Frederiksen, 2008: 16)
>
> Parental actions which support the development of positive achievement motivation across the whole childhood include providing the child some autonomy and possibilities for doing things independently, still providing guidance and encouragement

to do well, and accepting and providing praise in response to children's successful accomplishments (e.g. Schaffer, 1999). These patterns of encouragement, independence, and praise provide general foundations and principles for designing *JamMo*, especially its mentor-function.
(From *D1.2 Requirements for social situations*)

By the time of the fieldwork studies in London and Preston Primary schools, the implementation of the English language *3-6 JamMo* mentor functionality was complete and was a central feature of both the Nokia N900 and *Ubuntu* Linux laptop versions of the software used by participating pupils. However, it would be fair to say that, in reality – and despite his well-meaning, research-based motivations, the bear proved to be one of the more contentious issues highlighted during the UK fieldwork study. In fact, at least in within the context of a formal mainstream primary UK school environment, the London- and Preston-based researchers perceived the bear's presence to be more of a hindrance than a support. (However, see section 4.2.1.3 for other perspectives on the *JamMo 3-6* mentor in practise). Many pupils reported finding the bear's regular re-appearance during *JamMo* game-play annoying and disruptive to their creative flow. They tapped on him as soon as he began to venture forth from his home corner, ensuring he would return to his silent state as soon as possible. Pupils' comments to the London research team included: *'Delete the bear'* and *'I hate the bear'.* Furthermore, colleagues in Preston observed some participating children to invent their own 'kill the bear' activity, the goal of which was to see who could make the bear return to his silent, corner position the fastest. For at least one pupil in London, the bear did not offer assistance at the one point that this might have proved useful. Specifically, this user felt that the bear should give more information on the different musical/stylistic features of the three composition themes in order to help users make an informed choice between them.

A further concern related to the mentor's disruption of conventional Primary school classroom management. In a sense, the bear was perceived by the research team to be too 'eager to help' users. Specifically, after only a few minutes of idle time (i.e., no stylus activity), he would 'check' to see whether they still wanted to play the game, prompting them to either continue or quit. This caused particular problems at the end of a pair activity when the class teacher instructed pupils to sit in a circle on the floor to listen back to each pair's composition work (see Figure 4.43 for an illustration from the London-based fieldwork).

Figure 4.43: Pupils gather at the end of a *JamMo*-facilitated lesson at the London Primary school to appraise composition work. Nokia N900 mobile phones can quite clearly be seen resting on the floor around the middle of the circle.

This type of plenary appraisal task is a common feature of class music lessons within the UK. Unfortunately, since the pupils were sitting listening to each others' work and not interacting with their Nokia N900 mobile phones, there were frequent, chorused evocations from the collectively assembled individual bears to return to the game or quit.

The results of the fieldwork study suggested that some means of restricting the mentor's interruptions on a *per user* basis was necessary. Whilst the fieldwork team recognised and understood the importance of providing the designed level of guided support to certain categories of user, classroom experience had shown that the majority of mainstream users found the mentor less than helpful. A solution that offered both groups of users the level of mentor support they required grew from a further pupil comment made during the fieldwork study. This individual suggested, *'Make it so the bear only talks when you click on him'*, interpreted by the research team as meaning that the bear would remain silent until intentionally 'woken up' by a user requiring assistance.

Whilst a simple concept at a design level, this idea presented additional technical hurdles in practice and the problem engendered an extensive email discussion between members of the development, design and fieldwork research teams. An initial suggestion to prompt users to double-click on the bear upon his first appearance in order to silence him permanently was rejected as being too inflexible. A second suggestion to allow a user to subsequently double-click the bear again in order to 'bring him back to life' was also rejected since the double-click gesture is harder to achieve with a stylus-and-tablet interface than it is with a mouse. A further suggestion to use the screen 'dim' hardware button on the Nokia N900 to 'dim' the bear was also rejected due to there being no direct parallel on the *Ubuntu* desktop version of *JamMo*.

Finally, the decision was taken to allow users to 'mute' the bear at any time during the game by using a tapping and holding the bear's icon, with a further tap-and-hold gesture providing an 'unmute' option.

(vi) The random selection of musical 'style and feel' in the 3-6 composition game
The initial design of *JamMo 3-6* specified that an 'easy version' of each of the three composition game themes should offer six sound fragments. In order to provide musical variety and a wider user experience, there was an additional requirement that each theme should be further divided into three variations categorised by tempo (90, 110 and 140 beats per minute). Significantly, *JamMo*'s 'design for learning and development' specification document stipulated that the three variations of sound fragment sets 'change automatically when the user starts a new game' (see *D4.3 Design for learning and development*). In this way, users have an equal opportunity to construct musical pieces from the sound fragments at slow, medium and fast tempi.

In the event, the requirement for the subsets of sound fragments to change automatically with each new game was implemented at the development stage through random selection. In other words, clicking on one of the three composition game theme icons would result in the random selection of one of the three fragment subsets. Since each subset featured different fragments and had a different prevailing musical tempo, the musical implications of this random selection were far-reaching for the user and problems were quickly identified within the London Primary school fieldwork study.

As part of the Primary school study, a series of small group activities were designed to enable the researchers to explore using with *JamMo* with between four to six pupils at a time. These activities typically lasted between 30 to 45 minutes each and featured *JamMo* on a single *Ubuntu* laptop with the output projected for the pupils on a whiteboard. Pupils took it in turns to come to the laptop and 'drive' *JamMo* with suggestions and encouragement from the rest of the group. In the first such activity, the research team selected three short, evocative video clips to form visual prompts for pupils to compose suitable ‘soundtracks’ using the range of sound fragments available within the three composition themes (see table 4.3). The second small group activity was inspired by the UK television show *X Factor*, then reaching its season finale (November 2010). Pupils were asked to use the composition game to compose a backing track that might be suitable for their choice of *X Factor* finalist to sing over. The pupils were shown pictures of each of the finalists and encouraged to discuss how their media ‘image’ might influence the style of the composition game theme that might form the basis for the backing track.

It was anticipated that the small group design of these activities might offer a useful teaching and learning forum for metamusical discussion and encourage the participating pupils to reflect on their experiences with *JamMo* in more detail. Such a scenario also had the added potential benefit of enabling the research team to stimulate discussion, probe for additional comments and observe social interactions. A key means of achieving these various was by encouraging pupils to compare the musical features of the three composition themes and discuss which was the most appropriate for the film clips and chosen *X Factor* finalists. Unfortunately, the random selection of sound fragments and tempo effectively limited the level musical comparison since it was impossible to predict which of the variations *JamMo* would serve up to the user on any given selection. This was unfortunate, since informed discussions about which musical sounds/textures are appropriate for a task is an important meta-musical educational outcome, at least in the UK.

This problem presented an interesting dilemma for the development and fieldwork research teams since, by this time in the project, *JamMo*'s graphical user interface had largely been finalised, making any additional icons or selection screens very difficult to implement. Furthermore, there were concerns that what might seem to be a 'restriction' for researchers working in a mainstream educational environment could be an important 'feature' for researchers working in other contexts, e.g. self-directed play in the home environment. The chosen solution to this potentially dual requirement was derived from the concept of the 'cheat' in computer games interface design (e.g. see Consalvo, 2007). Specifically, each of the three icons of the composition worlds shown in Figure 2.21 was divided horizontally into three distinct hotspot 'areas' (invisible to users). With the control key held down, clicking on the top, middle or bottom of each icon would result in the section of the fast, middle or slow variation for that theme. For those researchers where random selection produced an advantage, this 'cheat' could be safely ignored. However, those researchers requiring consistent variation selection in all cases could now instruct users accordingly.

4.2.1.2 JamMo usability and user experience: a summary from Deliverable 3.5b

The following text summaries the key findings of colleagues from the University of Central Lancashire and the University of Oulu as reported in Deliverable 3.5b (McKnight, L., Iivari, N., Read, J., & Xu, D., 2011).

There were several issues which affected the whole of *JamMo 3-6* in terms of usability and user experience. The main problems experienced for all users were system crashes, bugs, or the software not functioning as intended. Due to the software being still in development, some system instability was unavoidable. In the main, most of these problems that were discovered in evaluations were fed back to the developers and fixed in following versions, or hardware solutions were discovered, such as disabling the wireless capabilities of the N900s, which was found to use processing power and to slow the application down. System lag remained the largest problem for users, and any delay between user action and system response caused frustration, and repeated pressing of icons such as the mentor, close icon and sound fragment icons. This did affect user experience, although usually not to any serious extent, and the users were very patient and understanding that they were using developing software. Even children who gave feedback that the game had not worked very well for them said that they would want to play it again, and rated it as ‘highly fun’. In the final evaluations, all children said they would want to play the game again, and rated it as ‘highly fun’ and easy to play. However, it should be noted that children of this age-group are known to respond positively in evaluations, so this finding should be treated with caution, and while it appears an encouraging finding at this stage in terms of usability it remains to be seen how the user experience changes with long-term use.

The main issues encountered in *JamMo 7-12* that affected user experience were system crashes and instability. This often made the dragging of sound samples more difficult, and occasionally quit the game unexpectedly, losing a user's compositions. In particular in the earlier evaluations with children, the feedback was very negative, mostly relating to the speed of the software and saying that it 'didn't work', and the worst part of the game was that it broke down. In the final evaluations though, many of these issues had been addressed. While there were still occasional issues, and the worst part of the game was often reported to be system crashes, the worst part for many other children was instead the dragging of sound sample icons. In the final evaluations, *JamMo 7-12* was only rated mediocre on ease of use and how well it worked, but was still rated highly on fun, and all users said they would want to play the game again.

Throughout all the evaluations with children, however, the music, sound fragments and samples in *JamMo* were rated very highly with the users. They nearly always responded that the best part of the game was the sounds in it, or the act of making their own music. This does suggest that this format of game is likely to be popular and engaging with this age-group, and while there are usability problems with the interaction method, the challenges of the game design are appropriate for a good level of user experience. However, as with *JamMo 3-6*, the user experience after extended use has yet to be determined, and this will be addressed in later work-packages.

Overall, the main source of usability and user experience problems encountered during testing usually related to system errors and software lag, which have continually been addressed in *JamMo* releases, and many of which were solved by the time of the release of version 1.0 Thus, it is the remaining underlying usability issues relating to the design that are the most use to consider. In particular, the level and format of instructions given by the mentor seem to be an issue to address, although some of this has already been addressed by the development team. The other main outstanding issue seems to be the drag-and-drop interaction used in the game, which caused considerable difficulty, but there was evidence that children began to overcome the difficulties in a reasonably short space of time when the system lag and novelty of the system were no longer an issue, suggesting that this is an issue that can be fixed in later versions of the software rather than a problem with the underlying interaction method.

In general, usability of the two games was good, with children understanding the aim of the games and the options that were available to them and, despite a few problems, could use the games to build compositions. User experience, however, was very good, particularly with later versions of the software where system errors and hardware issues were reduced, and children generally reported that use of *JamMo* was a positive experience for them, and they greatly enjoyed the music and the sounds, and were enthusiastic about using the device to make music.

4.2.1.3 Perspectives on the technology from Jyväskylä and Oulu

At the time of the beginning of Jyväskylä's fieldwork in the late Autumn, early Winter 2010, the sound samples and backing track functionality were the only working features in *JamMo 7-12*. The research team noted that there were lots of software crashes and that dragging and dropping was not very successful. However, the touch-screen GUI worked relatively well with children. Because of the ambient noise levels and the sound from the *JamMo*, it was felt that although headphones were not used in this intervention, they should be in any school intervention involving ADHD children, particularly when working alone. During the course of the intervention, different versions of *JamMo 7-12* featured different numbers of sequencer tracks (i.e., between one and four). Nevertheless, the majority of compositions used between one and two tracks even when four were available.

The Oulu team reported that there was a positive iterative process that involved continuous feedback to members of the development team that allowed the technology to be improved as the Oulu-based activities progressed. This was a common finding across research sites. For example, it was observed that children's singing was not recorded loud enough by the N900. In addition, when singing together in pairs or in a bigger group, children could only concentrate on approximately three strophes of the song while the songs were having too many verses. When playing the backing tracks children were spontaneous moving and showing their positive attitude for the musical design of the game.

As noted in section 4.2.1.1(v), the *JamMo* mentor appeared to offer both positive and negative contributions to usage of the software within UK-based Primary school environments. The role of the mentor was also a focus of the analysis of fieldwork in Jyväskylä. Here, there was a general view that the presence of the mentor was far more positive and supportive for end *JamMo* users. After analyzing classroom video and questionnaire data, the Jyväskylä research team concluded that the *JamMo* mentor functionality was a necessary and valuable feature particularly for children with ADHD. Yet, they also concluded that that the presence of the mentor did not hinder the *JamMo*-based activities of ten and eleven-year-old children without ADHD.

Colleagues in Oulu worked mainly with children within the target age range of *JamMo 3-6* and their fieldwork activities also explored the role of the mentor. Fieldwork with three- and four- year-old children suggested that the mentor was most valuable when these participants were engaging with the singing game for the first time. However, after having played this game several times, the four-year-old participants preferred to de-activate the mentor. This de-activation appeared to be motivated not out of annoyance at the mentor, but simply because the participants appeared to already know what the mentor was likely to say, i.e. they had learned how to use the game. The Oulu research team reported more mixed results with participants aged between five and six years. Here, some children clearly enjoyed the mentor's encouragement despite noticing that, on occasion, his advice appeared potentially confusing (e.g. one observation was that the mentor congratulated a user on having composed an 'empty' track, devoid of sound fragments). As in the UK, however, children appeared to view the mentor's constant appearance as a distraction on occasion. A recommendation from Oulu was that children participating in future *JamMo*-based fieldwork should always be advised how to de-activate the mentor following their initial induction into the software.

4.2.2 Project technical highlights

As a whole, the UMSIC Project generated a wide variety of technical innovations and developments. Many of these were related to *JamMo* but others stemmed from various analysis techniques and technologies employed to aid fieldwork analysis. UMSIC team members' views on the project's overall technical highlights were collected with the use of a specially constructed questionnaire (see Annex 8.6.6). The questionnaire was circulated to all team members in June 2011. A meeting on technological highlights and challenges was also held at the summer workshop in Oulu in June 2011 where most partners were present.

The unique feature of *JamMo,* as an **open source software** with a large code base and sound bank to build on, licensed under GNU Public License (GPL) version 2, was perceived to be one of the main technical highlights. The **middleware platform** that could be used for different approaches, applications and user groups, as well as the **pair game facility** were regarded as innovative features of the project. In addition, the **group management feature over peer-to-peer connections** using a **centralised controller** for managing the group memberships was a unique addition to the software. The fact that only a single connection between devices in a peer-to-peer environment was needed highlighted that individuals could easily connect with each other via the devices. The **clock synchronization protocol** for real time collaboration in peer-to-peer environment also facilitated effective collaboration between individuals when using the devices. The prototypes developed for stand-alone, public, networked and ad hoc use enabled *JamMo* to stand out as a versatile and easily-accessible technological invention.

The **protocol used for formatting the music project files** was considered to be a crucial feature in enabling effective management of such data. The ability of the software to **convert Ogg files to WAV files** during the installation process of *JamMo* provided the opportunity to benefit from the use of both types of files. Algorithm developed for **calculating delta times and for analysing log file messages** was a unique feature that could be effectively used in other projects. Furthermore, the use of a unified, consistent naming or categorisation system for all musical materials that was developed for the project was regarded to be an efficient method for musicians to keep tabs on their work,

Deeper understanding of **user-developer communication** in open source software development projects that are based on experimentation was another unique feature of *JamMo*. In particular, the roles of domain and user experience (UX) specialists have been studied throughout the project, in addition to children having been considered as a special user group.

The major pillar of the project, the **understanding of capabilities and limits of the current mobile technology based on empirical data**, was deemed to be a new source of innovative research material that subsequent research projects could build on. Furthermore, the specially-designed technological features for addressing the concept of social inclusion (such as the **multi-cultural song**

bank and the **voice-overs in different European languages**) were regarded as elements that no other project had previously developed.

In addition, **increased understanding of icon design and interface design of mobile devices** that can be used with children was a major highlight of the project. For example, the proof-of-concept development of the **gesture-based visual passwords system** was an innovation that can also be applied to other software. Furthermore, creation **of the song icons for the *3-6 JamMo* singing game** with end users was an innovative aspect of the project that deemed to appeal to both younger and older project participants.

Nevertheless, it was reported that the achievement of the technical highlights had demanded a great deal of time and resources, primarily due to the fact that most of the features had been built from scratch. The large-scale nature of the project and the limitations of hardware as to hosting all the new features were outlined as one of the greatest hindrances throughout the project (i.e. that the devices used in the project would not necessarily be able to effectively process all the new features). A further challenge had been the attempts to decrease the real-time delays found when playing with the musical games in *JamMo*. The need to implement the games in ad hoc, public and stand alone scenarios also prolonged the process.

There was a general consensus amongst the project partners that the unique technological features of *JamMo* were applicable beyond the UMSIC-project. The partners strongly agreed that the technological highlights could be re-used in other software, products and technologies. The partners stated that mobile technologies and innovative software design were in increasing demand and would be used to an even great extent in educational settings in the future. Therefore, the technological achievements of UMSIC could be of significant benefit for subsequent technological projects that could build on these innovative elements. Furthermore, the process of involving end users in the design and assessment of the product was perceived to encourage the young to collaborate with their elders and for them to feel valued and respected.

The technological highlights were considered to be linked to a number of the wider motivation for the UMSIC Project. These included: interdisciplinary research; social inclusion; social sharing and identity; usability of technology and software with children; ethical considerations when working with children; participatory design when designing technology for children; musical creativity; and collaborative music making. Close links between the wider motivations and the technological highlights were reported due to the fact that such technological features had been designed on the basis of the wider aims of UMSIC. For instance, the pair games had been specifically designed for collaborative music-making and the inclusive features for social inclusion and social sharing.

The technological highlights were reported to have resulted in the following ethical implications: anyone can use the public content of the software but data are not shared without authorization; personal data needs to be safeguarded at all times; the logging of user actions can be switched off at any time in order to maximize users' privacy; general ethical implications of working with children that should be addressed at all times; children's passwords, albeit in a visual (shape) form, should be stored securely; and ethical issues in using children's designs in the software should be addressed at all times. Provided that these aspects were taken into consideration, no other ethical concerns were reported. Furthermore, since all of the technological aspects of the project were conduced under the UMSIC and GNU Public License, there were no additional licensing or copyright issues to consider as to the distribution and use of the software. Despite the fact that the graphic design for the software was undertaken by a colleague who was not a project team member, an agreement of no restrictions on copyrights was constructed.

The outputs of the technological highlights included: the project website; a separate website for *JamMo*; publications in international peer-reviewed academic journals; research papers presented at international conferences; articles in magazines and newspapers; and workshop proceedings from national conferences. Examples of the research outlets are the Wireless Forum Research Meeting in Helsinki, Finland, in 2009, an academic research article in the Vehicular Technology Magazine in 2010 and an academic research paper in International Journal of Mobile Human Computer Interaction in 2010

See Annex 8.2 for a complete list of publications covering the technical achievements of the UMSIC project).

4.3 Language issues

4.3.1 Findings from London and the South East of England

The video and observational data indicated that some pairs of children worked very well together, sharing tasks and communicating effectively when playing with *JamMo*. The overwhelming majority of the pairs (10 out of 11) seemed engaged in social activity while playing with *JamMo* and significant 'talk' was noted between the pairs, such as sharing of ideas, giving advice and suggestions for musical creation ('*Try that icon*'; '*The music from that picture sounded very nice*'; '*Well done that's great*'.). All participants, including migrants and those with special educational needs, appeared to be able to play with *JamMo* without language difficulties. All the children also appeared able to communicate effectively when they played with the *JamMo* and talked with one another without difficulties. There was a general impression that the mobile platform facilitated social activity and language use more effectively than the PC/projector platform in that less teacher/researcher prompting was required. The social inclusion and biographical data questionnaire was pre-piloted with Year 6 children (aged 10-11 years), but the language used was also accessible to Year 4 children (aged 8-9 years) when completed in stages at the teacher's discretion. Children who spoke English as additional language (EAL) and/or with special needs were able to complete the questionnaire with adult assistance.

4.3.2 Findings from Oulu, Finland

In the Oulu nursery settings, the migrant children were integrated into Finnish speaking groups. Migrant children either chose Finnish or English when interacting with others in the peer games. It was noted that the language should be common between peers. English was the most popular choice of language for the immigrant children to wish to use, followed by Finnish. However, Finnish children found it harder to engage with any non-Finnish language musical materials.

Results show 1) that children were very interested. This might be biased by the fact that they all voluntarily participated. Their engagement varied from very shy and passive reactions (the younger ones) to very active participation (repeated sessions). All were astonished to hear their vocal production being preserved in the computer. They made a causal connection between the technical operations shown and the phenomena of having repeatedly available their own vocal production. Reactions to hearing their own voice was mostly laughing and also covering the face by the hands.

4.3.3 Findings from Herborn, Hesse Region, Germany

Recording is a basic function in the domain of music technology. In this study, for most of the children, it was the first time to hear their own voice recorded and to explore the recording functions. The more the children explored the sounds of their voice and sung songs, the more the interaction focused on individual learning. The majority of the children experienced difficulties with starting and continuing to sing a song due to the fact that they firstly need assistance for the lyrics. Here, unclear or incorrect pronunciations were most striking. The children with articulation difficulties (L, 3 yrs, C, 5 yrs.) seemed to hear the target syllables or phoneme, and they were very motivated to learn and hear again improvements in the recordings. In one case, C (5 yrs.) discovered a way to improve his pronunciation of the German vowel /SCH/. He was extremely motivated to articulate /SCH/ instead of /S/, and he even started to over generalise this pattern. The recording clearly helped the children to localise the crucial events, to talk together and to gain control. C not only improved his pronunciation, but also, together with the research team, he discovered his musical potential. We noticed that his level of participation increased. The educators welcomed this change, because C had been rather passive. His parents were considered not to be well integrated (i.e. the level of their German was rather poor).

C was not the only child with a poor articulation of the consonant /SCH/. The singing-and-recording context provided a relaxed and playful occasion for the research team and the children to work individually on this issue by repeating, recording and changing some elements. In some of groups, some children started to discuss eagerly correctness of song singing. It was interesting to find out which aspect they were focusing on since, in song reproductions, various different levels could be focused. It seems that such discussions mainly concerned the correct pronunciation of words (i.e. the intelligibility but not yet musical features). These features would be introduced in a later phase when the children were ready to broaden their focus and their attention span.

Apart from an individually adapted focus on articulations, the children started to use new words and their meaning with regard to the technical functions (recording, saving, loud, soft etc.). Some children showed difficulties in distinguishing between adjectives for intensity and those for velocity or tempo. With some children, progress in using correct meanings for words was traceable (e.g. Z, 4 yrs.).

In summary, children were enthusiastic about participating in this study although this might be biased by the fact that they all voluntarily participated. Their engagement varied from very shy and passive reactions (the younger ones) to very active participation (repeated sessions). All were astonished to hear their vocal production being preserved in the computer. They made a causal connection between the technical operations shown and the phenomena of having repeatedly available their own vocal production. Reactions to hearing their own voice was mostly laughing and also covering the face by the hands.

4.4 Music making and learning

4.4.1 Creative processes and learning in classroom contexts: Findings from Jyväskylä, Finland

4.4.1.1 Pair game 3-6

The log-based time analysis of the *3-6* pair game (school 1: 9 pairs, school 2:8 pairs) was divided to four activity classes: 'Listening' indicates the amount of time used to listen to the developing composition. 'Exploring' refers to the time used to listen and explore the musical materials in the sound sample selection wheels. 'Creating' refers to the time used to drag sound sample icons to the timeline, in other words creating music with these samples. 'Other' consists of all the other actions made within the software, which are not directly related to musical process.

The average results of the whole population indicate that children spent approximately two thirds of their time in exploring musical materials and creating their compositions (Figure 4.44). Listening of whole composition took 22% of their time, while 15% of the time was used for other actions within the software. School 1's musical activity was more explorative (35%) in nature compared to school 2, where music creation activities (36%) were more present.

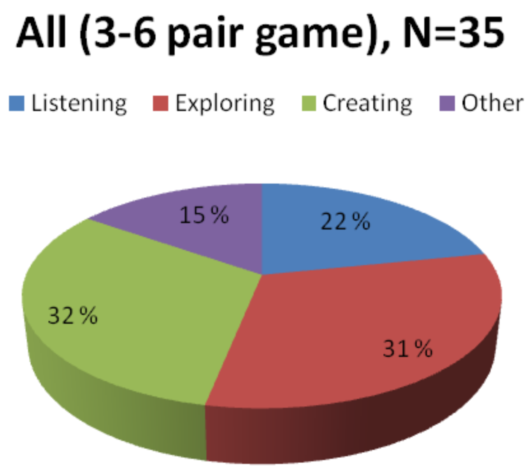


Figure 4.44: time use in *3-6* pair game among all participants

The target 1 pair used 39% of their time to explore the musical materials, which is slightly higher than whole population and school averages. Both ADHD target pairs used more time to listen to their composition (target 1:28%, target 2: 30%) than other pairs (Figure 4.45).

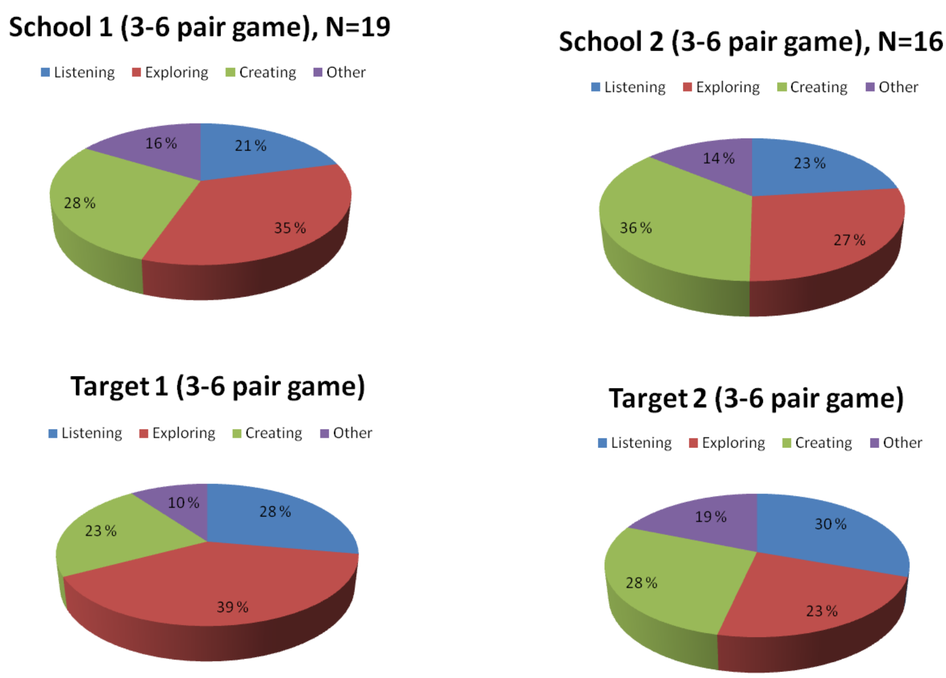


Figure 4.45: time use in *3-6* pair game: schools and target children

The time-analysis(Figure 4.46) of the composition process time per composition (All N=42 SD=0:04:22, School 1 N=22 SD=0:05:11, School 2 N=20 SD=0:03:14) in the *3-6* pair game indicates that the average time spent creating a composition with the software was approximately 7 minutes. Both target pairs 1 and 2 crafted their compositions a little longer compared to the average time. The target 2 pair's second composition process lasted only three minutes because the next task (the orientation game) has been started.

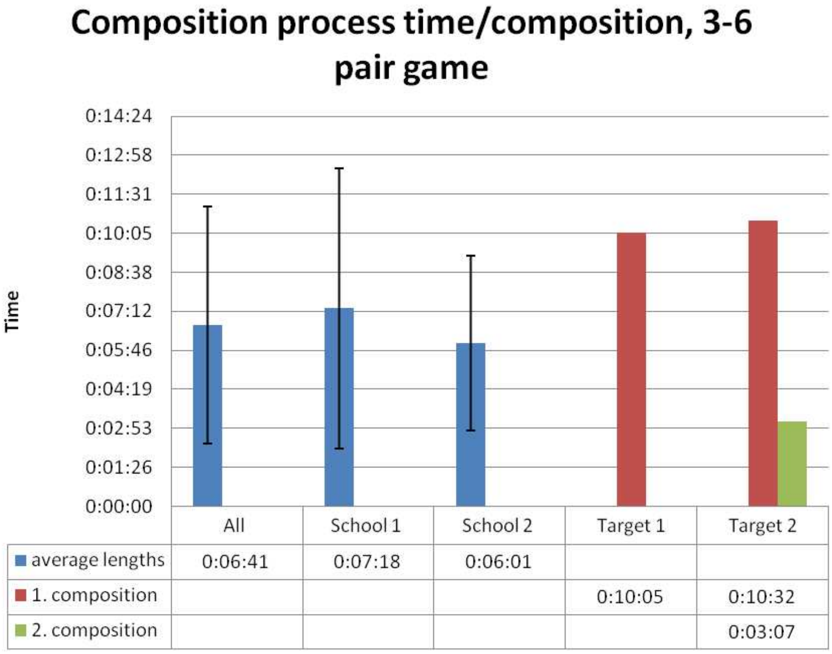


Figure 4.46: composition process time in *3-6* pair game

An analysis of the sound fragment-based musical activity (Figure 4.47) – determined by the total number of fragments explored and used in the *3-6* pair game (All M=103 SD=33.45, School 1 M=105 SD=37.61, School 2 M=101 SD=29.80) – indicates that each pair's average was between 80-100 fragments within a 30 minute composing session. There was no significant difference between schools. Target 1 pair's fragments activity level was a little lower than target pair 2's level.

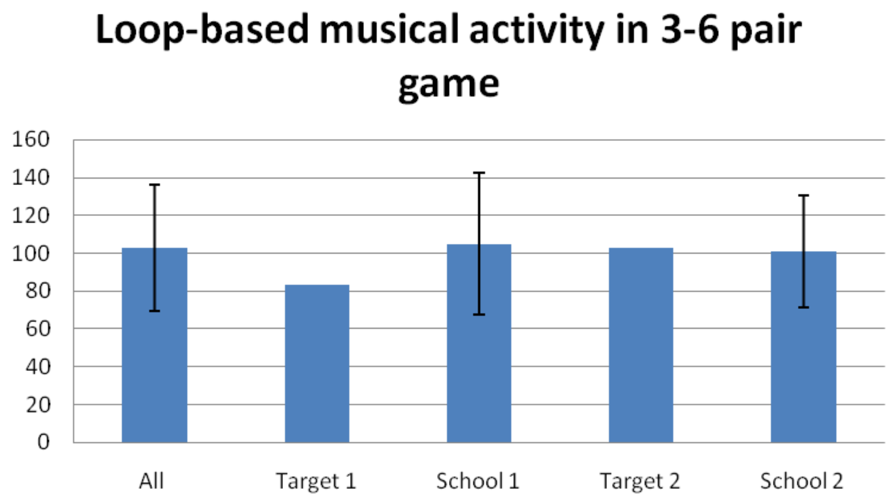


Figure 4.47: sound fragment-based musical activity in *3-6* pair game

When comparing the relationship between dragged, listened to and removed sound fragments to the total fragment amount (All N=1861, School 1 N=1051, School 2 N=810, Target 1 N=83, Target 2 N=103), analysis of the results indicate that there was a clear difference between schools (Figure 4.48). School 1's musical processes were more explorative (sound fragment listening 72.2%) compared to school 2, where more sound fragments were dragged (52.5%) to the sequencer timeline. The fragment drag removal actions were relatively small across whole population (averaging 3.2% from the whole fragment activity). This may be an indication of the inability to remove to fragments technically from the track, or it may be regarded as an undeveloped understanding of music composing process, or of a general satisfaction and engagement in this relatively exploratory activity. Both target pair's rates are similar to the pairs' peers' school average rates.

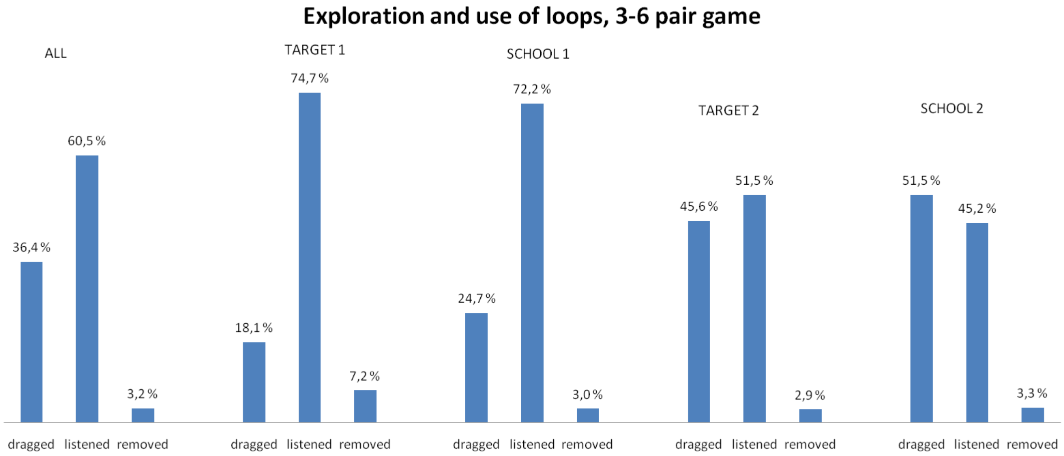


Figure 4.48: exploration and use of sound fragments *3-6* pair game

4.4.1.2 Orientation game 7-12

The individual *7-12* orientation game success (Figure 4.49) was measured by game task performance (All N=35, School 1 N=19, School 2 N=16). 33 children managed to play the correct game (2 boys played the wrong game at school 1) and, from that population, 32 children managed to proceed to the game tasks. The composition game level 1 consisted of 7 different kinds ofstructured tasks related to the essential sequencer features, like sound sample listening, dragging and removing and listening of the product. 5 children (4 girls) completed all 7 tasks within the 15 minutes time limit. The last task, removing a sample from the sequencer track proved to be too difficult for many children (and/or they did not understand the task instruction); 17 children got stuck in this task. A visual cue to find the particular focus sound sample was designed, but not implemented in the software; this also might have been the reason for this outcome. School 2 performed better compared to school 1. Target 1 boy's performance was relatively low compared to the average. Target 2 boy's performance was the same as the average (see table 4.4).

The essential feature in orientation game, the animated interactive mentor, gave instructions to children in the game tasks. Without instructions, the gaming progress should have been very difficult from a design point of view. An interesting phenomenon was seen with the log files; children put the mentor into a passive state (not giving instructions) during the game tasks. Technically, this was due to a so-called tap-hold gesture on the touch screen, which was not taught to children at any point of *JamMo* practice. In school 1, 57.9% from participants managed to put the mentor to passive state during game tasks. In school 2 43.8% did the same thing.

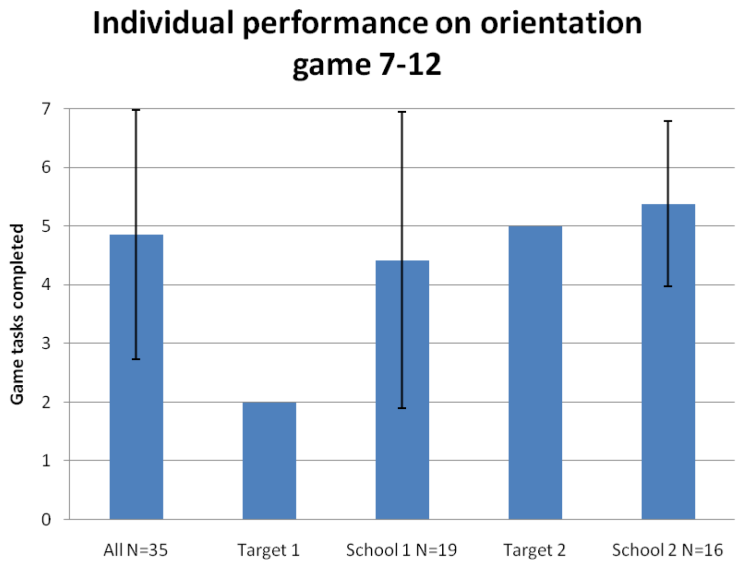


Figure 4.49: orientation game *7-12* performance

Table 4.4: orientation game *7-12* performance statistics

	All N=35	Target 1	School 1 N=19	Target 2	School 2 N=16
mean/performance	4,857	2	4,421	5	5,375
sd	2,116		2,523		1,408

A somewhat clear indication of gender difference was seen in the orientation game performance results. In both schools, girls (school 1 M=5.875, school M=5.647) performed better than boys (school 1 M=3.1, school 2 M=4.111) (Figure 4.50 and table 4.5).

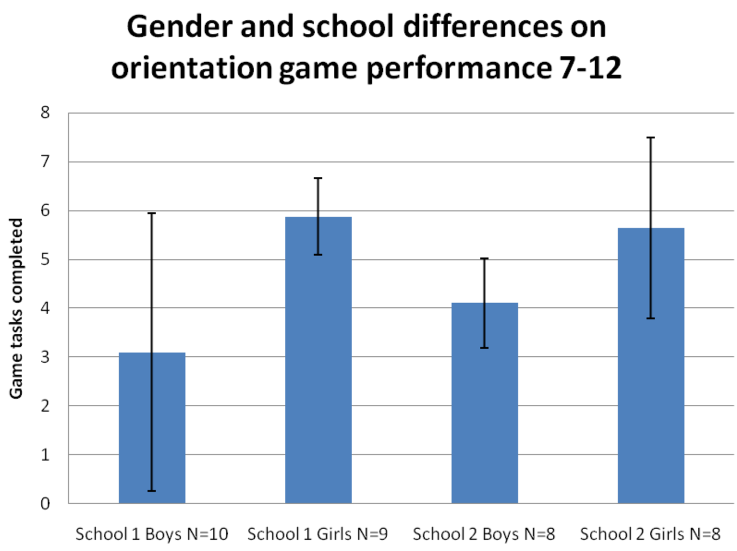


Figure 4.50: gender differences: Orientation game *7-12*

Table 4.5: gender differences in orientation game *7-12*: statistics

	School 1 BoysN=10	School 1 Girls N=9	School 2 Boys N=8	School 2 Girls N=8
mean/performance	3,1	5,875	4,111	5,647
sd	2,846	0,781	0,916	1,846

4.4.1.3 Workshop 7-12

The log-based analysis of time use in the*7-12* workshop (school 1: 9 pairs, school 2: 8 pairs, one pair had 3 participants) was divided into four activity classes: listening, exploring, creating and other. These are the same classes as used in *3-6* pair game time analysis.

Analysis of the whole population (N=35) indicates that children used over one third (36%) of the total time to create their compositions with the sound samples (Figure 4.51). Nearly the same amount (31%) was used to exploring musical materials. Listening the composition took 25% of their time and other actions with the software 8%. Half (50%) of target 1 pair's time was used for music creation that was significantly higher percentage than whole population (36%) and school averages (school 1: 36%, school 2:35%). Target 2 pair used over one-third (36%) of the time in creating and nearly half (47%) in exploration.

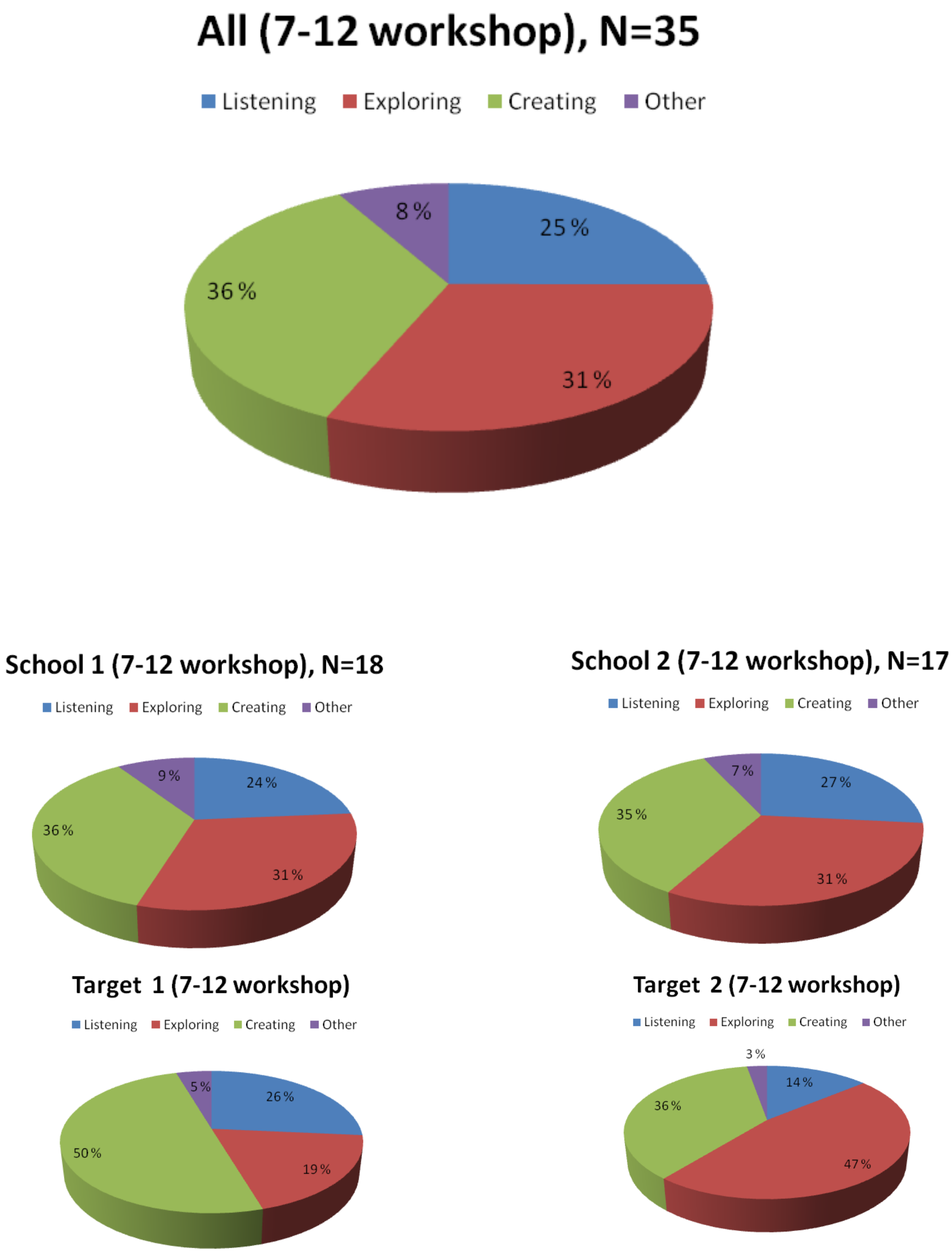


Figure 4.51: analysis of time use in *7-12* workshop

The analysis of sound sample-based musical activity was determined by investigating the total number of samples explored and used in the*7-12* workshop compositions (All M=146 SD=51.57; School 1 M=146 SD=52.16; School 2 M=146 SD=54.50, Target 1 = 179 samples, Target 2 = 252 samples). Data analyses indicate that both target pairs were more active than the whole population and school averages (Figure 4.52), with especially target 2 pair (252 samples) being very active in the composition workshop task.

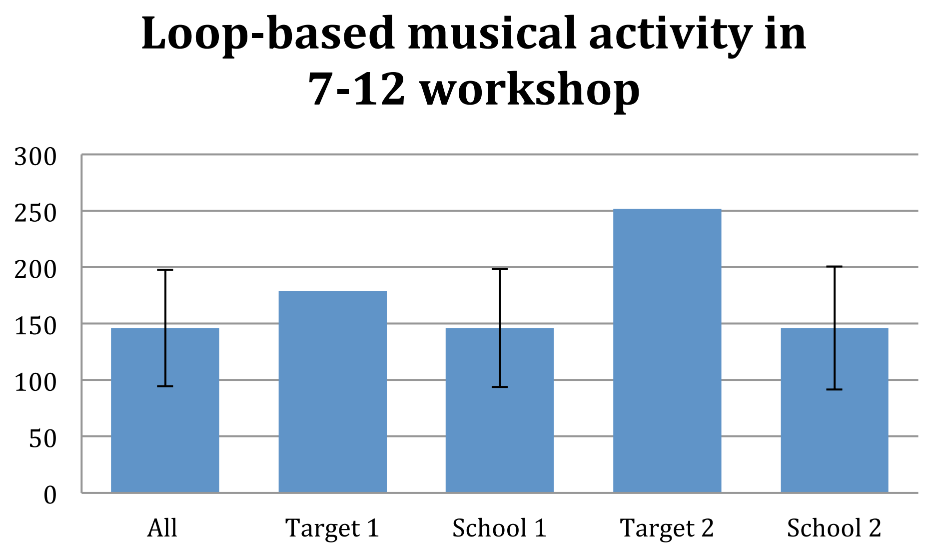


Figure 4.52: sound sample-based musical activity in *7-12* workshop

When comparing amounts of dragged, listened and removed samples to the total sound sample activity in *7-12* workshop compositions (All N=2486, School 1 N=1318, School 2 N=1168, Target 1 N=179, Target 2=252), results indicate that children listened to sound samples much more (87.4%) than they dragged them to the sequencer tracks (Figure 4.53). They rarelyremoved samples from sequencer tracks (1.6%). There were no significant differences between schools. The target 1 pair dragged samples significantly more (29.6%) than other participants. The target 2 pair's listening rateswere the highest of the whole population and school averages.

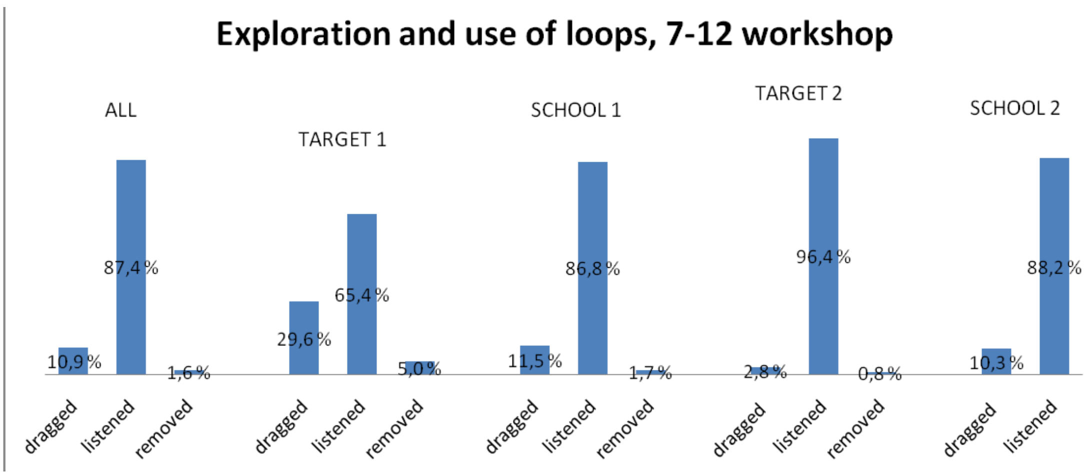


Figure 4.53: exploration and use of sound samples in the *JamMo 7-12* workshop

The *JamMo 7-12* logging system was able to separate sound sample icon drag attempts and actual performed sample insertions to the sequencer timeline. The statistical analysis of technical success in sample dragging process (Figure 4.54) describes the percentage of drag attempts that succeeded. This analysis reveals that target 1 pair's technical success (67.1%) was significantly higher that the other's. Target 2 pair's drag attempts were relativelyunsuccessful, with only a

14.9% technical success rate. The relatively low rate (40%) of success suggests that sample icon dragging was technically difficult for the children in *7-12* sequencer at this point in the software's development.

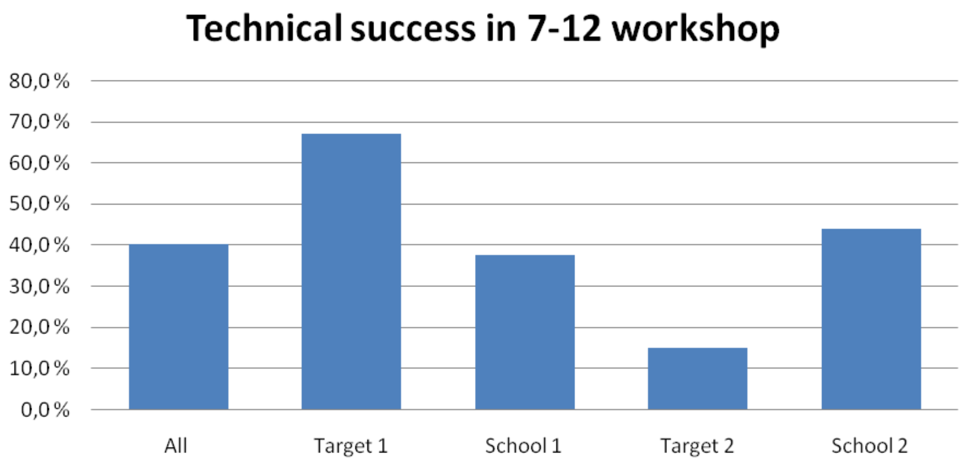


Figure 4.54: technical success in *7-12* workshop

The analysis of the relationship of unique explored and used sound samples to the total sample amount (all N=2486, School 1 N=1318, School 2 N=1168, Target 1 N=179, Target 2 N=252) shows that, among whole population, nearly 30% of explored and used samples were unique. School 2 participants utilized significantly more unique samples than school 1 participants. The target children's results were relatively similar to each other (Figure 4.55).

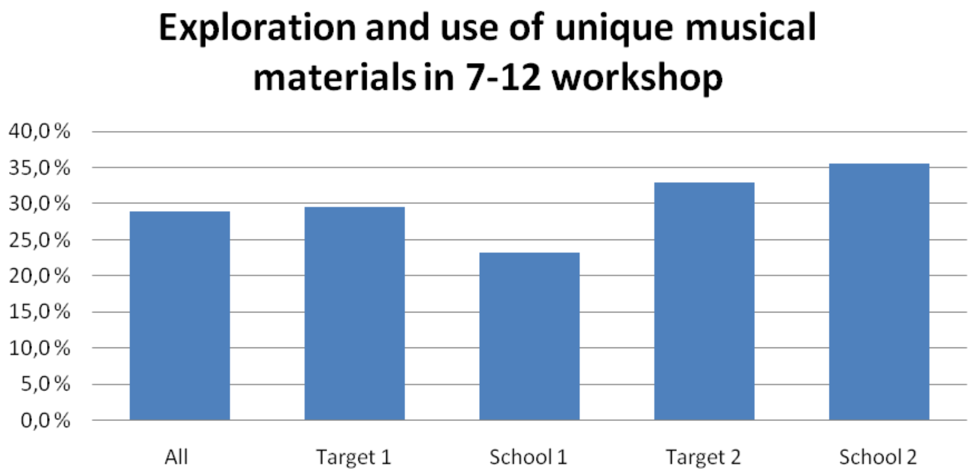


Figure 4.55: exploration and use of unique musical materials in *7-12* workshop

4.4.2 Musical products in music therapy and classroom interventions: Findings from Jyväskylä, Finland

4.4.2.1 Music Therapy Intervention

The musical products from the music therapy intervention (Fall 2010) were analyzed qualitatively from compositions saved by the target children (ADHD) and their two peers. The children experienced lot of crashes and bugs due to partially complete and not fully bug-tested software. Therefore, results derived from a number of compositions per participant cannot be made. Consequently, the analysis below consists of notes and qualitative descriptions of composition content, including notes on sound sample amounts and types, the use of backing tracks, musical ideas, structure and form.

School 1 Peer
School 1 peer's compositions were the most advanced regarding the structure and sample content of compositions compared with the whole test group. Sound samples fitted very well acoustically with the backing track. He favoured modern and rock-like samples in three time.

1. Scarborough fair folk metal (6 samples) 110bpm
Effect
Distortion guitar + accordion
Banjo
Effect
Effect

2. Scarborough fair folk metal (5 samples) 110bpm
Effect
Synthetic pulse
Distortion guitar + accordion
Flute (does not fit well)

3. Kiiriminna (7 samples) 110bpm
Brass + drum beat
Drum beat
Percussion
Distortion guitar
Distortion guitar 2
Percussion

School 2 Peer
The school 2 peer created relatively structured compositions, including many similar sound samples, especially using the rhythmic and synthetic content. It seems that his aim was to supplement the backing tracks with additional rhythms.

1. La Bamba (9kpl) 130bpm (bit messy, all samples in one pile)
Acoustic guitar, 2 times
Synthetic effect
Acoustic guitar, same as the first ones
Flute
Synthetic effect
Acoustic guitar, same as earlier
Tambourine
Flute

2. Kiiriminna (8kpl) 110bpm (beats fit very well)
Drum beat, 3 times
Synthetic sample
Acoustic guitar
Drum beat, 3 times

3. Pendolino 110bpm (12kpl) (bit messy, straight beat on top of shuffle beat)
Straight drum beat, 2 times
Straight drum beat, 4 times
Synthetic sample
Shuffle bass + synthetic sample
Synthetic sample
Straight drum beat, 2 times

Target 1 (ADHD) (male)
Target 1's four analysed compositions indicated that he had put a clear effort the compositions. Sound sample placements complemented well the sounds of the backing tracks, which indicated a relatively developed understanding of musical form. He also succeeded in parallel sound sample placements (e.g. composition 3) and managed to use sound samples from the same genres as backing tracks.

1. Pendolino (7 samples) 90bpm(funny composition with clear compositional structure)
Drum beat
Synthetic effect 1 (short)
Synthetic effect 2 (short)
Beatbox sample
Saxophone 1 -> sounds very good with backing track
Saxophone 2 -> sounds very good with backing track
Robotic effect

2. Kiiriminna (3kpl) 110bpm
Ethno perc + hanuri
syntikka

3. Scarborough folk metal (8kpl) 110bpm (little bit messy, genre-based samples, somewhat clear form)
Acoustic guitar
Strings (pizz) + accordion
Acoustic guitar + Tambourine
Strings (pizz) + 2 synthetic effects on top of each other

4. Short and unclear

Target 2 (ADHD) (male)
Target 2's four analysed compositions weregenerally pretty chaotic, with many similar sound samples playing on top of each other. Compositions consisted of a

maximum of ten samples. All the samples were mainly placed in the first sample slots, producing a messy mix of sounds. Many samples were placed in series, so that every empty sample slot was filled. This can be regarded as an indication of a relative lack of conceptual structure and form in his compositions. However, he managed to explore and use all the sample types from the sound sample selection wheels in his compositions. He also managed to select different backing tracks and tempi for his compositions.

(5 samples) La Bamba 90bpm (all sound samples in series)
Polka drum beat
Effect
Tambourine
Acostic guitar
Mallet

(8 samples) Kiiriminna 110bpm (very chaotic start)
Many synthetic samples in series
Vocal samples

(10 samples) 110bps(synthetic samples chaos, lots of parallel sample structures)

(10 samples) Black Betty 110bpm (messy, every slot has a sample)

4.4.2.2 Pair Game 3-6

The analysis of selected *3-6* pair game themes (N=47) among all commenced compositions (including also those processes that stayed at an exploratory level and did not include any sample icon dragging) indicates that children in school 1 significantly favoured the city theme (Figure 4.56). In school 2 there wasn't any difference between theme selections. The result is highly interesting because school 1 is located at city area and school 2 is located at rural area.

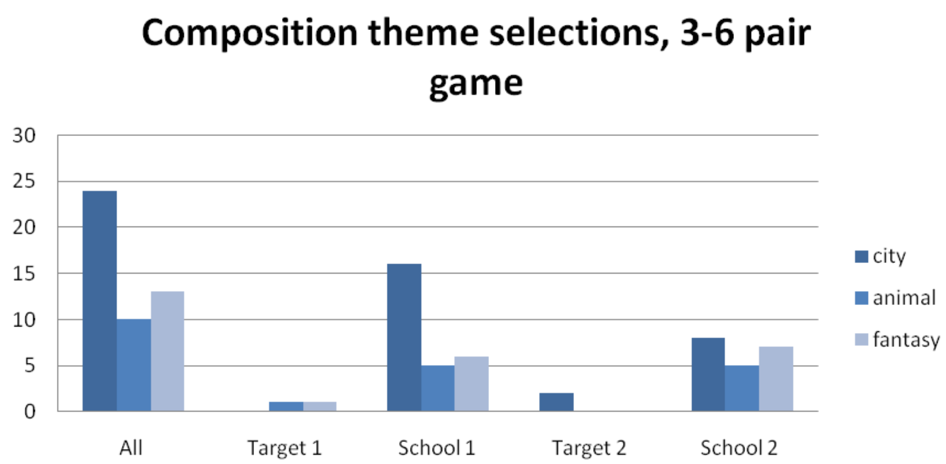
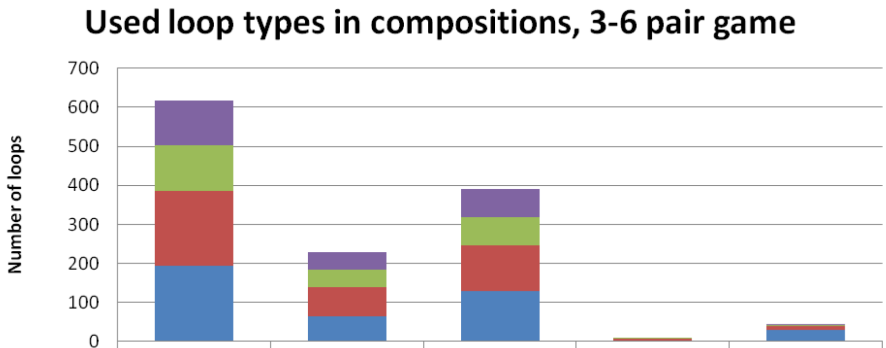


Figure 4.56: composition theme selections in *3-6* pair game

Table 4.5: composition theme selection statistics

	All	Target 1	School 1	Target 2	School 2
city	24		16	2	8
animal	10	1	5		5
fantasy	13	1	6		7

The *3-6* advanced composition game provides four sound fragment subgroups, each containing five unique fragments. These subgroups are rhythm, melodic, harmonic and sound effect fragments. Statistical analysis of used fragment types (All N=618, School 1 N=228, School 2 N=390) reveals that melodic and rhythmic fragments were the most popular types in children's compositions (Figure 4.57). This analysis also indicated that the school 2 pair used significantly more fragments (N=390) in general within their compositions compared to school 1. The target 2 pair preferred rhythmic fragments in their compositions.



	All	School 1	School 2	Target 1	Target 2
effects	116	45	71		3
harmony	116	43	73	2	1
melody	192	76	116	6	11
rhythm	194	64	130	1	29

Figure 4.57: used sound fragment types in *3-6* pair game compositions

When measuring the number of sound fragments used per composition (All M=16.7, SD=8.86, School 1 M=13.4, SD=7.53, School 2 M=19.5, SD=9.12), the results indicate that on average approximately 17 fragments were used in one composition (Figure 4.58). The school 2 pairs used slightly more fragments per composition than the school 1 pairs. Target 1 pair's composition consisted of nine fragments, which was lower product performance when compared to the whole population and school averages. Target 2 pair's compositions had a slightly larger number of fragments when comparedto the average.

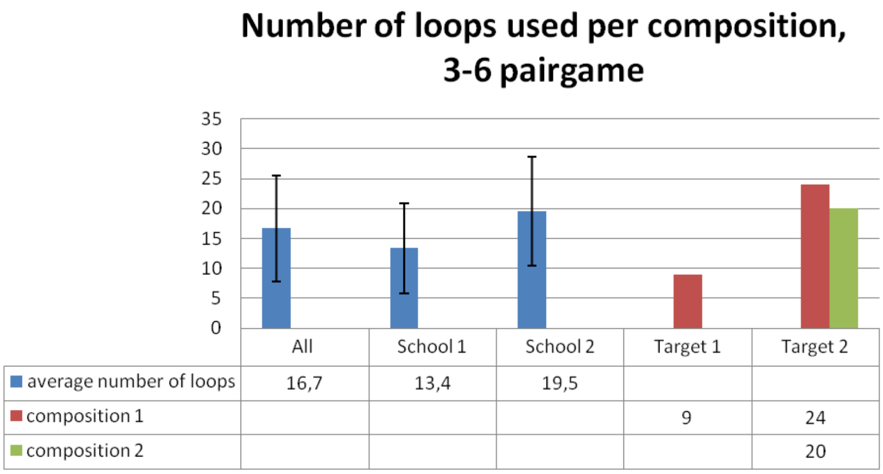


Figure 4.58: number of sound fragments used per composition in *3-6* pair game

The analyses of the *3-6* advanced pair game compositions (All N=37, School 1 N=17, School 2 N=20) indicate that composition content was similar in both schools, having similar averages on all four composition content factors. School 2's compositions were a bit longer compared to those of school 1. Target 2's and his peer's pair compositions were longer compared to the average of all children in both schools. Their first composition also had a high number of unique sound fragments compared to the whole population and school means. This can be inferred as an indication of advanced exploration and use of musical materials. As mentioned earlier, Target 1 pair's low performance on this task resulted in a relatively short composition with a low number of unique fragments.

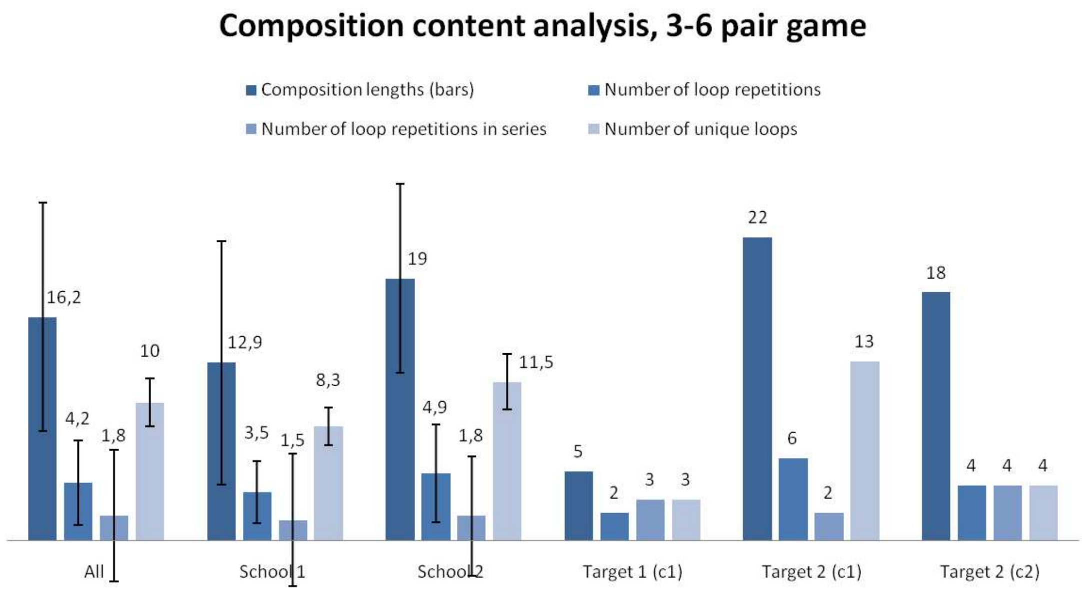


Figure 4.59: composition content analysis, *3-6* pair game

Table 4.6: composition content analysis statistics: *3-6* pair game

	All (M)	All (SD)	School 1 (M)	School 1 (SD)	School 2 (M)	School 2 (SD)	Target 1 (c1)	Target 2 (c1)	Target 2 (c2)

Composition lengths (bars)	16,2	8,286	12,9	8,806	19	6,859	5	22	18
Number of fragment repetitions	4,2	3,067	3,5	2,239	4,9	3,552	2	6	4
Number of fragment repetitions in series	1,8	4,755	1,5	4,805	1,8	4,310	3	2	4
Number of unique fragments	10	1,737	8,3	1,374	11,5	2,022	3	13	4

4.4.2.3 Workshop 7-12

Composition content analysis of the *7-12* workshop indicates that composition lengths and the number of unique sound samples varied greatly amongst pairs in both schools. The number of sample repetitions were also relatively small among the whole population. However, target 1 pair's compositions consisted of significantly higher number of unique samples and sample repetitions compared to the average. The composition length was also longer compared to the average. In contrast, target 2 pair's compositions were shorter and consisted of significantly lower amounts of unique samples.

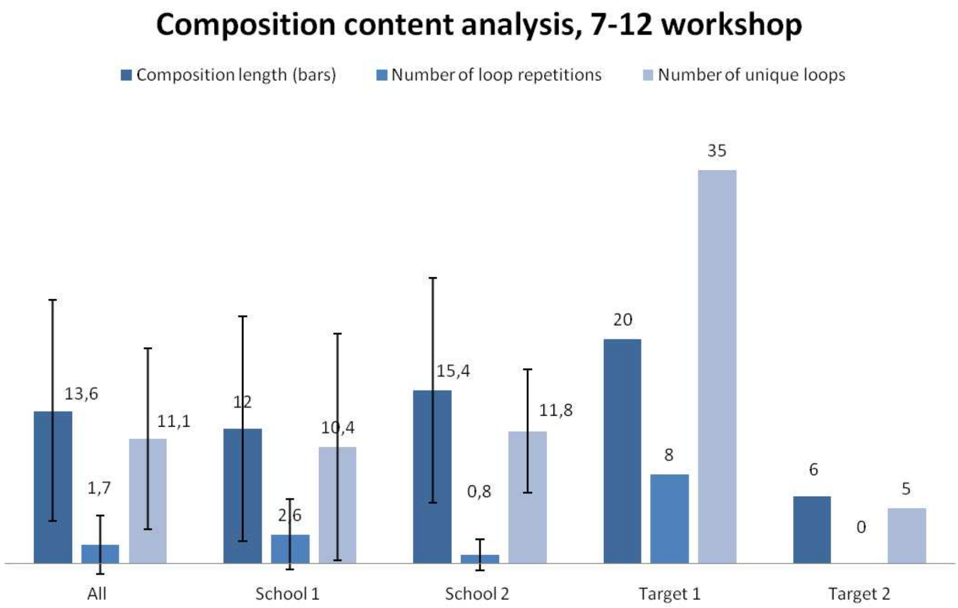


Figure 4.60: composition content analysis: *7-12* workshop

Table 4.7: composition content analysis statistics: *7-12* workshop

	All	**All (SD)**	**School 1 (M)**	**School 1 (SD)**	**School 2 (M)**	**School 2 (SD)**	**Target 1**	**Target 2**
Composition length (bars)	13,6	9,823	12	9,974	15,4	9,999	20	6
Number of sample repetitions	1,7	2,568	2,6	3,126	0,8	1,388	8	0
Number of unique	11,1	8,011	10,4	10,063	11,8	5,470	35	5

samples

4.4.3 Musical collaboration and communication in classroom contexts: Findings from Jyväskylä, Finland

The musical collaboration in pairs were analysed with Annotation software (section 3.3.3.5) for collaboration, leading, attending and non-participating roles (in seconds) of each composer pair (i.e., target and peer) calculated from the selected 600 sec time period. In addition, the amount of verbal communication related to the composition process was calculated, as well as the amount of non-verbal communication, which was classified as positive, neutral or negative. After the time analysis, the actions of each 'leading' event was analysed.

4.4.3.1 Time-analysis of collaboration and communication

A time analysis was performed on collaborative composition processes for lessons 1-2 in both schools. In lesson 1, the children worked in pairs and used *JamMo* composition game *3-6* advanced with shared devices for 15-20 minutes. In lesson 2, children used *JamMo* sequencer *7-12* in pairs, who in turn gathered into small groups of four children to discuss their compositions. From each lesson, a 600 sec period of time was analysed.

Lesson 1 (composition game 3-6): School 1

Table 4.8 presents the results of collaboration for Target 1 in school 1, as well as his pair in this game (Pair 1). Target 1 was leading more (49% of the time) than his pair (24% of time) and attending less (41% of time) than his pair (66% of time). Non-participative behaviour in both participants was only 10% of the time.

Table 4.8: collaboration in composition game *3-6* advanced (Target 1 and Pair 1 in School 1).

Musical collaboration (*3-6* composition game)	Target 1 (sec)	Target 1 (%)	Pair 1 of Target 1 (sec)	Pair 1 of Target 1 (%)
Leading	293.5	49%	144.0	24%
Attending	243.9	41%	396.1	66%
Non-participation	62.6	10%	59.9	10%
Time total	600.0	100%	600.0	100%

Table 4.9 presents the results of the analysis of non-verbal communication for Target 1 and Pair 1. Communication was mainly neutral (focused) for Target 1 (80% on time) and for Pair 1 (80% of time). Positive communication was found

in 7% of the time for Target 1, but 20% in Pair 1. Negative communication was minimal (Target 1 3%, Pair 1 0%).

Table 4.9: non-verbal communication in composition game *3-6* advanced (Target 1 and Pair 1 in School 1).

Non-verbal communication (*3-6* composition game)	Target 1 (sec)	Target 1 (%)	Pair 1 of Target 1 (sec)	Pair 1 of Target 1 (%)
Positive	43.0	7%	118.5	20%
Neutral	538.4	90%	480.5	80%
Negative	18.6	3%	1.0	0%
Time total	600.0	100%	600.0	100%

Verbal communication was also measured for the 600 sec period: Target 1 communicated 64.3 sec of the measured 600 sec period (11 % of time) with his pair, while Pair 1 of Target 1 communicated 26.4 sec (4 % of time).

Lesson 1 (composition game 3-6): School 2

Table 4.10 presents the results of collaboration for Target 2 in School 2, as well as his pair in this game (Pair 1). Target 2 was leading more (37% of the time) than his pair (27% of time). There was a small difference in attending roles: 48% of time for Target 1, and 54% of time in his pair. Non-participative behaviour was 15% of time in Target 1, and a little higher in his pair (19% of time).

Table 4.10: collaboration in composition game *3-6* advanced (Target 2 and Pair 1 in School 2).

Musical collaboration (*3-6* composition game)	Target 2 (sec)	Target 2 (%)	Pair 1 of Target 2 (sec)	Pair 1 of Target 2 (%)
Leading	223.9	37%	163.3	27%
Attending	287.1	48%	324.9	54%
Non-participation	89.0	15%	111.8	19%
Time total	600.0	100%	600.0	100%

Table 4.11 presents the results of non-verbal communication analyses for Target 2 and Pair 1. Communication was mainly neutral (focused) for Target 1 (81% of the time) and in Pair 1 (70%). Positive communication was observed for 19% of the time for Target 1 and 30% for Pair 1. No negative communication was observed.

Table 4.11: non-verbal communication in composition game *3-6* advanced (Target 2 and Pair 1 in School 2).

Non-verbal communication (*3-6* composition game)	Target 2 (sec)	Target 2 (%)	Pair 1 of Target 2 (sec)	Pair 1 of Target 2 (%)
Positive	114.9	19%	182.8	30%
Neutral	485.1	81%	417.2	70%
Negative	0.0	0%	0.0	0%
Time total	600.0	100%	600.0	100%

The time spent in verbal communication during the composition game *3-6* advanced was nearly equal between the two boys in School 2. Target 2 communicated 35.2 sec (6 % of measured 600 sec period) with his pair during the collaborative composition, while Pair 1 of Target 2 communicated verbally 36.2 sec (6 % of measured 600 sec period).

Lesson 2 (workshop 7-12): School 1

Table 4.12 presents the results of collaboration in the*JamMo* workshop for Target 1 in School 1 and his pair, who was not the same child as the pair in lesson 1. Target 1 was leading less (36% on time) than pair 2 (47% of time). Target 1 also attended less (28% of time) than his pair (39% of time). Non-participative behaviour was 36% for Target 1 and 14% for his pair. The conclusion is that Target 1 collaborated better in lesson 1 with Pair 1 in the composition game *3-6* advanced than with Pair 2 in the workshop.

Table 4.12: collaboration in workshop with *JamMo* sequencer (Target 1 and Pair 2 in School 1).

Musical collaboration (*7-12* sequencer)	Target 1 (sec)	Target 1 (%)	Pair 2 of Target 1 (sec)	Pair 2 of Target 1 (%)

Leading	214.5	36%	282.7	47%
Attending	170.4	28%	233.2	39%
Non-participation	215.1	36%	84.2	14%
Time total	600.0	100%	600.0	100%

Table 4.13 presents the results of the analyses of non-verbal communication for Target 1 and Pair 2 in the workshop. Communication was mainly neutral (focused) for Target 1 (59% of the time) and for Pair 2 (65% of the time). There was also a high amount of positive communication: 41% for Target 1 and 33% for Pair 2. Negative communication was rare (0% for Target 1 and 2% for Pair 2).

Table 4.13: non-verbal communication in workshop with *JamMo* sequencer (Target 1 and Pair 2 in School 1)

Non-verbal communication (*7-12* sequencer)	Target 1 (sec)	Target 1 (%)	Pair 2 of Target 1 (sec)	Pair 2 of Target 1 (%)
Positive	247.4	41%	200.3	33%
Neutral	352.6	59%	387.8	65%
Negative	0.0	0%	11.9	2%
Time total	600.0	100%	600.0	100%

Target 1 communicated 46.7 sec (8% of the time) with his Pair 2 during the collaborative composition, whilst Pair 2 of Target 1 communicated verbally 50.8 sec (8% of the time), measured from the 600 sec period.

Lesson 2 (workshop 7-12): School 2

Table 4.14 presents the results of collaboration in the *JamMo* workshop for Target 2 in School 2 and his pair 2. Target 2 was in the leading role (88% of the time) compared to pair 2 (47% of time). Target 2 also attended less (28% of time) compared to his pair (39% of time). Non-participative behaviour was 36% for Target 2 and 14% for his pair. The conclusion is that Target 2 collaborated better in lesson 1 with Pair 1 for the composition game *3-6* advanced than with Pair 2 in the workshop.

Table 4.14: collaboration in workshop with *JamMo* sequencer (Target 2 and Pair 2 in School 2).

Musical collaboration (*7-12* sequencer)	Target 2 (sec)	Target 2 (%)	Pair 2 of Target 2 (sec)	Pair 2 of Target 2 (%)
Leading	528.3	88%	0.0	0%
Attending	36.5	6%	480.1	80%
Non-participation	35.2	6%	119.9	20%
Time total	600.0	100%	600.0	100%

Table 4.15 presents the results of non-verbal communication analyses for Target 2 and Pair 2 in the workshop. Communication was mainly neutral (focused) for Target 2 (80% of the time) as well as his Pair 2 (81% of the time). Positive communication was observed as 19 % for both children. Negative communication was rare (1% for Target 2 and 0% for Pair 2).

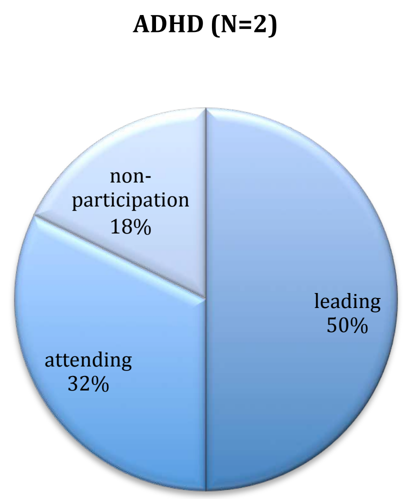
Table 4.15: communication in workshop with *JamMo* sequencer (Target 2 and Pair 2 in School 2).

Non-verbal communication (*7-12* sequencer)	Target 2 (sec)	Target 2 (%)	Pair 2 of Target 2 (sec)	Pair 2 of Target 2 (%)
Positive	114.7	19%	115.2	19%
Neutral	482.2	80%	484.8	81%
Negative	3.1	1%	0.0	0%
Time total	600.0	100%	600.0	100%

Target 2 communicated for 19.0 sec (3% of time) with his pair during the collaborative composition, whilst Pair 2 of Target 2 communicated verbally 5.5 sec (1% of time), as measured from the 600 sec period.

4.4.3.2 Summary: Collaboration and communication between ADHD and non-ADHD children

Figure 4.61 shows that the children with ADHD had a more leading role than their non-ADHD pairs in the collaborative composition sessions. Both collaborated for the vast majority of the analysed periods and there is no clear difference in non-participation. Each pair appeared to adopta different rhythm in turn-taking, some pairs having shorter and others longer paces. This socially dependent feature of collaboration might have effected the results where the pace of turn-taking was slow.



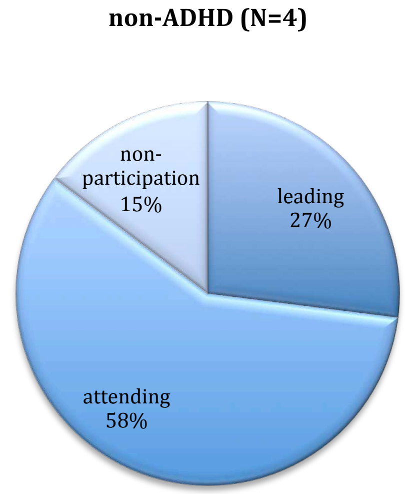


Figure 4.61: musical collaboration. Upper graph: the two target children with ADHD (N=2); lower graph: the non-ADHD pairs (N=4) in lessons 1-2 (Schools 1-2).

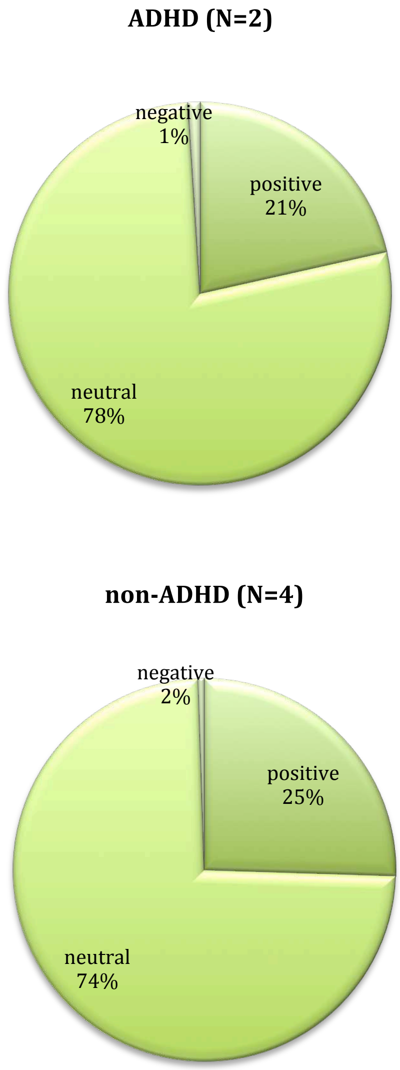


Figure 4.62: non-verbal communication. Upper graph: target children with ADHD (N=2); lower graph: non-ADHD pairs (N=4) in lessons 1-2 (Schools 1-2).

Figure 4.62 indicates that non-verbal communication was mostly neutral (focused) in the two ADHD children and their non-ADHD pairs. Positive expressions occurred in 21% (ADHD) to 25% (non-ADHD) of the time analysed. Negative expressions were rare, only 1% in both groups.

4.4.3.3 Qualitative description of collaborative composition processes of children with ADHD and their non-ADHD pairs.

The log files were used to specify user actions in detail and video (Annotation) to interprete log file-based information and turn taking in collaborative composition with shared devices in *JamMo* pair work (see Figure 4.63). In this section, collaborative processes (600 sec periods of each collaborative task) of the two target children with ADHD and their two different pairs are described and analysed.

8:18:17	:07	Jonne	USER	:	"advanced clicked"
8:18:28	:00		USER	:	"Selected composing game (starting theme-selection)"
8:19:06	:11		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90__34_2_chimes.wav' listened on stage"
8:19:09	:00		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90__34_2_gong.wav' listened on stage"
8:19:12	:12		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90__34_2_gong.wav' added to track:Upper at slot = 0"
8:19:22	:15	Samu	USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90__34_1_vibraslap.wav' listened on stage"
8:19:28	:03		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90_Dn_34_2_synth.wav' listened on stage"
8:19:34	:03		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90_Dm_34_2_crystal.wav' listened on stage"
8:19:39	:21		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90__34_2_gong.wav' listened on stage"
8:19:43	:21		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90__34_2_chimes.wav' listened on stage"
8:19:47	:14		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90__34_2_gong.wav' added to track:Bottom at slot = 0"
8:20:06	:11	Jonne	USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90_Dm_34_2_crystal.wav' listened on stage"
8:20:10	:17		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Fx_90_Dn_34_2_synth.wav' listened on stage"
8:20:12	:22		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Am_34_2_cello.wav' listened on stage"
8:20:14	:18		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Am_34_2_elpiano.wav' listened on stage"
8:20:16	:19		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_D_34_2_accordion.wav' listened on stage"
8:20:18	:03		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Dm_34_2_guitar.wav' listened on stage"
8:20:22	:10		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Dm_34_2_synth.wav' listened on stage"
8:20:24	:01		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Rh_90__34_1_triangle.wav' listened on stage"
8:20:26	:09		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Rh_90__34_1_shaker2.wav' listened on stage"
8:20:32	:13		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Rh_90__34_2_bassdrum.wav' listened on stage"
8:20:37	:01		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Rh_90__34_2_bassdrum.wav' added to track:Upper at slot = 2"
8:20:50	:05	Samu	USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Dm_34_2_synth.wav' listened on stage"
8:20:54	:14		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Dm_34_2_guitar.wav' listened on stage"
8:20:58	:01		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_D_34_2_accordion.wav' listened on stage"
8:21:00	:00		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Am_34_2_elpiano.wav' listened on stage"
8:21:02	:00		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Am_34_2_cello.wav' listened on stage"
8:21:04	:13		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Dm_34_2_guitar.wav' listened on stage"
8:21:08	:21		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Dm_34_2_synth.wav' listened on stage"
8:21:14	:24		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_A_34_2_whistle.wav' listened on stage"
8:21:19	:02		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_C_34_2_flute.wav' listened on stage"
8:21:23	:01		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_A_34_2_vibraphone.wav' listened on stage"
8:21:25	:09		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_F_34_1_piano.wav' listened on stage"
8:21:27	:12		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_D_34_1_synth.wav' listened on stage"
8:21:32	:19		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_D_34_1_synth.wav' added to track:Bottom at slot = 2"
8:21:39	:04		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_F_34_1_piano.wav' listened on stage"
8:21:41	:15		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_D_34_1_synth.wav' listened on stage"
8:21:44	:18		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_D_34_1_synth.wav' added to track:Bottom at slot = 3"
8:21:56	:19	Jonne	USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_C_34_2_flute.wav' listened on stage"
8:21:58	:20		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_A_34_2_whistle.wav' listened on stage"
8:22:03	:06		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_A_34_2_vibraphone.wav' listened on stage"
8:22:12	:06		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_D_34_1_synth.wav' listened on stage"
8:22:14	:22		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Me_90_F_34_1_piano.wav' listened on stage"
8:22:18	:19		USER	:	"Sample '/opt/jammo/themes/fantasy/advanced/Ha_90_Am_34_2_cello.wav' listened on stage"

Figure 4.63: combining video and log files in collaborative *JamMo* composition with shared devices: a fragment of log file added with video-based observations of turn taking.

Target 1 ("Bob") with ADHD collaborating with his pair 1 ("Mike"): JamMo composition game 3-6 (School 1, lesson 1)

Bob's and Mike's composition process, including the musical activities with *JamMo* and their classification as types of creative activity, is described in chronological order in table 4.16. These boys composed in turns, the pace of switching *JamMo* being relatively short at the beginning of the process, each boy adding only one or two sound fragments in turn. Bob appeared to lead the latter part of the analysed period. Bob started the process by selecting the advanced game level and theme Fantasy. Without listening to the backing track, he directly started the process by listening to two different percussion fragments and then immediately adding one of them to the track. The relatively swift beginning without any orientation to the sound world of the backing track shows that Bob was likely to be familiar with the notion of backing tracks as he had been previously used *JamMo3-6* during the music therapy intervention. Without any familiarity with the backing tracks, this kind of action would be classified as rather random composing.

Bob's and Mike's process included imitation of each other several times: they tended to add sound fragments that the pair had added previously. Bob appeared quite critical of the musical materials and edited the product several times by removing fragments away from the tracks, replacing them with others or changed their temporal position. He actively sought a goal in the composition, but was not happy with the selected materials or the product, because the final number of fragments in the end product was quite low. At the end of the process he also opened another theme, Animal World, but quit this before composing within it. Moreover, Bob reported in the questionnaire that he was not happy with how his composition sounded, but was quite content in general with *JamMo3-6* game musical materials (backing tracks and fragments).

Table 4.16: Bob's (ADHD) and Mike's collaborative process with *JamMo* composition game *3-6* advanced.

Composer	Onset time	Musical activity	Type of creative activity
Bob	8:18:17	Selects the advanced level of the game, and theme Fantasy	Start
Bob	8:19:06	Listens to two percussion fragments and adds one of them (gong fragment) to track	Exploration, creating
Mike	8:19:22	Listens to four different percussion fragments	Exploration
Mike	8:19:47	Adds one of the perc. fragments (a similar gong fragment that Bob had added)	Creating (imitation)
Bob	8:19:06	Listens to 10 different fragments, each of them once	Exploration
Bob	8:20:37	Adds one of the fragments (bassdrum) to track	Creating
Mike	8:20:50	Listens to different fragments (12 listenings), each one once or twice, except one fragment five times	Exploration
Mike	8:21:44	Adds a synth fragment that he had listened to five times	Creating
Bob	8:21:56	Listens to different fragments once or twice, some similar to those that Mike had listened	Exploration, feedback
Bob	8:22:58	Adds a synth fragment similar to that which Mike had added	Creating (imitation)

Mike	8:23:13	Listens to seven different fragments once each	Exploration
Bob	8:23:53	Adds a synth fragment similar to those already added	Creating (imitation)
Bob	8:23:56	Listens to the product	Feedback
Bob	8:24:18	Removes the gong and synth fragments from tracks	Elaboration
Bob	8:24:22	Listens to the product	Feedback
Bob	8:24:42	Listens to three fragments (whistle, flute and vibraphone)	Exploration
Bob	8:24:49	Adds the vibraphone fragment to the upper track and a similar fragment to the lower track	Creating
Bob	8:24:54	Listens to the product	Feedback
Bob	8:25:39	Removes both vibraphone fragments from the track	Elaboration
Bob	8:25:47	Listens to 7 different fragments	Exploration
Bob	8:26:11	Adds an electric piano fragments twice into the positions where the vibraphone fragments had been removed	Creating
Bob	8:26:17	Listens to the product	Feedback
Bob	8:26:35	Removes the electric piano fragments form the track	Elaboration
Bob	8:26:49	Listens to 7 different fragments	Exploration
Bob	8:27:18	Adds twice a synth fragment, that had previously been romoved, into two new positions	Creating, elaboration
Bob	8:27:24	Listens to the product three times and finishes with composiing in Fantasy theme	Feedback, Completing the product
Bob	8:29:08	Enters the theme Animal World, listens to 7 different fragments and then the backing track, then exiting the sequencer	Starting a new composition, orientation and ending the process

Target 1 ("Bob") with ADHD collaborating with his pair 2 ("Dave"): JamMo sequencer 7-12 (School 1, lesson 2)

Bob started the process also this time, as he worked as a pair of Dave, using the*JamMo* sequencer *7-12*. Their collaborative process is described in chronological order in table 4.17. These boys worked with the backing track Siya Hamba, which was preselected for them by the researchers. Bob and Dave did not complete the product within the period selected for analysis, but their composition process took a longer time until completion. Within the period analysed, these boys worked equally in turns, each one exploring materials and adding a sample before each turn with the device. Neither boy dominated the other. Their work analysis suggests a smooth collaboration. During the*JamMo* sequencer task, and within the analysed period, Bob did not appear as critical towards selected musical materials as in the*JamMo3-6* game with Mike. He did not remove any sound sample from the track this time. However, his response towards this composition in the questionnaire was not very positive either, as he stated "the composition sounded odd with Dave".

Table 4.17: Bob's (ADHD) and Dave's collaborative process with *JamMo* sequencer *7-12*.

Composer	Onset time	Musical activity	Type of creative activity
Bob	8:14.33	14 sample listenings, one to three times each sample	Exploration
Bob	8:15:27	Adds a effect sample 'rubber' to track	Creating
Bob	8:15:40	6 sample listenings, each sample one to three times	Exploration
Bob	8:16:21	Adds a synth sample to track	Creating
Dave	8:16:36	7 sample listenings, each once	Exploration
Dave	8:17:11	Adds a synth sample to track (different than previous sample added)	Creating
Dave	8:17:20	13 sample listenings, each sample one to four times	Exploration
Dave	8:18:20	Adds effect sample 'swoosh' to track	Creating
Dave	8:18:26	Listens to the product	Feedback
Bob	8:18:46	13 sample listenings, each sample once or twice	Exploration
Bob	8:20:51	Adds a vocal sample to track	Creating
Bob	8:21:03	10 sample listenings, each sample one to three times	Exploration
Bob	8:21:32	Adds a synth sample 'filterpulse' to track	Creating
Bob	8:21:35	Listens to the product	Feedback
Dave	8:22:25	6 sample listenings, each sample once or twice	Exploration
Dave	8:23:49	Adds a flute sample to track	Creating
Dave	8:23:52	Listens to the product	Feedback
Bob	8:24:41	7 sample listenings, each sample once or twice	Exploration

Target 2 ("Jim") with ADHD collaborating with his pair 1 ("Sam"): JamMo composition game 3-6 (School 2, lesson 1)

The composition game *3-6* was started by Sam (non-ADHD), a lively boy, who happily reported to the teacher that they had selected the advanced level of the game. Jim's and Sam's rhythm of taking turns with *JamMo* was slower than for Bob and his pair. The collaborative process of Jim and Sam is described in a chronological order in table 4.18.

Jim's and Sam's collaborative composition process can be described as smooth in both social and musical-cognitive senses. They added a lot of sound fragments in their composition in a fast tempo and worked without any pauses between turn-takings. Typically in the creative process, these boys' composition activity began with an exploration of the musical materials. Sam, who started the game, listened to a lot of different fragments and added the first ten fragments to the composition. After this, Sam explored many fragments and then passed the device to Jim. When it was Jim's turn to continue the composition, he re-listened to some fragments that Sam had already played back and added them to the track. Then he started to explore new materials. After Jim had added seven fragments in total, he listened to the uncompleted product. Then he added three more fragments without having a need to re-listen to all of them. This reduced amount of feedback is probably related to the familiarity of the explored musical materials: Jim had learned how these materials sounded. For the second half of the process, the two boys added mainly different drum fragments to the product in turns. The need for feedback decreased for both boys, and especially for Jim, who generated the end of the composition without re-listening to the fragments, but just elaborated their temporal order and directly added previously listened to materials to the track in finally completing the product.

Table 4.18: Jim's (ADHD) and Sam's collaborative process with *JamMo* composition game *3-6* advanced.

Composer	Onset time	Musical activity	Type of creative activity
Sam	12:42:13	Selects the advanced level of the game, and the City theme. Listens to the backing track.	Orientation
Sam	12.45:07	Adds a guitar and a bass fragment to track	Creating
Sam	12:45:16	Listens to different guitar, bass and synth fragments, each once or twice (7 listenings)	Exploration
Sam	12:45:46	Adds one guitar sample and two bass samples to track	Creating
Sam	12:46:04	Listens to a synth sample again and adds it to track	Feedback & creating
Sam	12:46:10	Listens to the product	Feedback
Sam	12:46:50	Adds a guitar and a synth sample to track	Creating
Sam	12:47:11	Listens ro drum and percussion samples (5 listenings), each once	Exploration
Sam	12:47:36	Adds one of the drum samples;	Creating, feedback

		listens again another drum sample and then adds it to track	
Sam	12:47:42	Listens to many different sampless (11 listenings), each once or twice	Exploration
Jim	12:48:41	Listens to a synth sample	Exploration
Jim	12:48:47	Listens and adds one of the drum samples Sam had previously played back	Feedback, creating
Jim	12:48:56	Listens and adds another drum sample Sam had previously played back	Feedback, creating
Jim	12:49:02	Listens and adds a third drum sample Sam had previously played back	Feedback, creating
Jim	12:49:12	Listens and adds a fourth drum sample Sam had previously played back	Feedback, creating
Jim	12:49:16	Listens to different samples, each once (4 listenings)	Exploration
Jim	12:49:30	Adds one of the synth samples to track	Creating
Jim	12:49:34	Listens to a synth sample and adds it to track	Feedback, creating
Jim	12:49:41	Listens to a clap sample and adds it to track	Feedback, creating
Jim	12:49:46	Listens to the product	Playback
Jim	12:51:17	Re-listens to one sample and adds three samples	Creating (feedback)
Jim	12:51:37	Listens to the product	Feedback
Jim	12:51:50	Touches playback and stop button several times	Feedback
Sam	12:53;26	Touches playback button, then composition game button several times, then quits the game without saving the product	Feedback, completing the product
Jim	12:54:11	Restarting the game, advanced level and city selected	Beginning of a new composition process
Sam	12:56:28	Listens to three	Feedback, creating

		different drum samples which have been used in the previous composition and adds them to track, one of them is added twice	
Sam	12:56:51	Listens to a drum sample and adds three drum samples to track	Creating, feedback
Sam	12:57:06	Listens to a percusiion sample and a drum sample	Exploration
Sam	12:57:18	Adds two drum samples	Creating
Sam	12:57:24	Re-listens to two drum samples, the other sample three times, and adds it	Feedback, creating
Jim	12:57:41	Adds five drum samples	Creating
Jim	12:58:16	Removes two drum samples to a different temporal position	Elaboration
Jim	12:58:22	Adds two more drum samples	Creating
Jim	12:58:30	Listens to the product and saves it	Feedback, completing the product

Target 2 ("Jim") with ADHD collaborating with his pair 2 ("Andy"): JamMo sequencer 7-12 (School 2, lesson 2)

During the whole of the analysed period (600 sec), Jim was leading the compositional process and manipulated the*JamMo* sequencer *7-12* independently, while his pair Andy was watching and more passively attending to the process. Jim's process is described in chronological order in table 4.19. The backing track "La Bamba" was preselected for this pair by the researchers. Typical to the creative process, Jim's activity began with an exploration of different musical materials and then proceeded towards testing certain materials (using feedback) and selecting some materials forthe composition. Towards the end of the analysed period, Jim reorganised the sound fragments, elaborated the product and listened to the incomplete composition to get feedback of his actions. Jim appeared to work independently, fast and in a goal-oriented fashion, and did not ask his pair or the teacher to help him. The process can be described as more explorative than generative in nature because the number of added fragments is relatively small. Of course, the analysed period represents only a part of the whole process and more fragments were added after this period. However, when comparing Jim's independent leading period with the*JamMo* sequencer *7-12* to Jim's and Sam's collaborative process with the*JamMo3-6* composition game advanced, a difference in generativity is clearly observable.

Also, Jim's and Sam's finished product (*JamMo3-6* game) is more complex than Jim's and Andy's (*JamMo7-12* sequencer). From Jim's point of view, the reasons may be social (collaboration was easier with Sam than with Andy) and/or cognitive (*JamMo3-6* was easier than *JamMo7-12* Sequencer).

Table 4.19: Jim's (ADHD) process when leading the collaborative composition as a pair of Andy (non-ADHD) with *JamMo* sequencer *7-12*.

Composer	Onset time	Musical activity	Type of creative activity
Jim	12:44:22	Listens to many fragments, mainly effects, one to four times each (25 listenings).	exploration
Jim	12:45:36-	Listens to fragments five times, one to three times each.	exploration
Jim	12:46:01	Listens to three different vocal fragments	exploration
Jim	12:46:19	Listens to a vocal fragment	exploration
Jim	12:46:31	Manipulates pitch (key) and tempo control (fast and slow) settings	exploration
Jim	12:47:24	Listens to four different drum beat fragments	exploration
Jim	12:47:34	Listens to one drum fragment again	feedback
Jim	12:47:37	Listens to 19 times different fragments, one to three times each	exploration
Jim	12:48:52	Listens to 7 times different fragments, one to three times each	exploration
Jim	12:49:05	Listens to one fragment three times	exploration, feedback
Jim	12:49.24	Adds a synth fragment to track	creating
Jim	12:49:52	Listens to 12 times different fragments, each one to two times	exploration
Jim	12:50:44	Adds a chimes fragment to track	creating
Jim	12:50:47	Listens to the product three times	feedback
Jim	12:51:03	Listens to two fragments, each twice	exploration
Jim	12:51:22	Adds a beatbox fragment to track, then removes it and	creating, elaborating

		adds it to a different slot; then removes it and adds it to the original slot	
Jim	12:51:39	Listens to the product once	feedback
Jim	12:52:21	Listens to 39 times different fragments, one to five times each	exploration
Jim	12:53:37	Adds one of the fragment to track	creating
Jim	12:53:45	Listens to two fragments, one of them twice	exploration
Jim	12:54:02	Listens to the product once	feedback

4.4.4 Creative processes and learning in classroom contexts: Findings from London, UK

Sessions 3, 4 and 5 of the London fieldwork study provided the research team with opportunities to develop and evaluate musically rich activities based around *JamMo3-6* within the context of a formal, Primary school educational environment. Whilst the focus for sessions 2 and 6 was free composition in pairs, in sessions 3 to 5 there were defined learning aims for compositional work. Moreover, the small-group nature of the sessions afforded opportunities for revealing musical discussion between participants and researchers.

The composing 'to a picture' task (sessions 3 and 4) elicited some musically informed discussion and compositional outcomes. Pupils were able to make effective choices regarding which of the *JamMo3-6*'s three composition themes would provide the most appropriate sound fragments to use to accompany each selected video clip. The researchers observed discussions that related the musical fragments to the clips in terms of musical style, mood and visual pace. It was the research team's impression that *JamMo*, and particularly the musical materials on which the software is based, provided an effective stimulus for this kind of meta-musical discussion. When working with care and focus, some individual participants were able to continue this level of musical thinking into the actual composition process itself. For instances, on a small number of occasions, the researchers observed careful placement of sound fragments on *JamMo3-6*'s sequencing track grid with considerable regard for both the on-screen activity within the video clips and more general musical structural conventions. In one case during session 3, a pupil commented that a pleasing pattern of fragment icons on the track grid (i.e., one characterised by repetition of sound fragments along with well-chosen variations) was also likely to result in a pleasing musical result. This joint visual and musical pattern making was also a feature of selected compositions produced in session 6. It must be said, however, that the majority of compositions produced within sessions 3 and 4 did not reach this level of sophistication, even if their general mood (as defined by the choice of composition theme world) suited the clips well.

Session 5 further developed the idea of creating musical compositions based on a stimulus. Here, instead of composing 'to a picture', pupils were asked to choose a contemporary pop act from a range of supplied pictures and then to produce a backing track that would be stylistically appropriate for the chosen act to sing to. In the event, the group chose to create a backing track for *One Direction*, a popular boy band from the UK's 2010 *X Factor* TV show (Figure 4.64).

Figure 4.64: UK 2010 X Factor Finalists One Direction[5]

Of the three composition theme worlds available within *JamMo3-6*, the pupils chose the 'City' as the most appropriate for *One Direction*. The pupils' consensus was that this theme best suited *One Direction*'s penchant for contemporary 'urban' clothing styles, including hoodies, 'Onepieces' and sweatpants. Both the images/icons associated with the City composition theme and the sound fragments contained within appeared to the pupils to coincide with *One Direction*'s image and thus made a suitable medium for the backing track. One pupil commented: '*They would be able to move well to the sounds.*' The group remained absorbed and excited throughout these initial tasks. Unfortunately, technical problems with that particular release of *JamMo3-6* (0.6.16) effectively prevented pupils from continuing to compose the backing track itself. Frequent crashes occurred when dragging sound fragment icons onto the tracks and this caused significant frustration on the part of the pupils. Nonetheless, it was clear that this activity held the group's interest and there were frequent moments when, as a group, they were completely absorbed in the task[6].

Taking sessions 3, 4 and 5 as a whole, it was clear that pupils appeared happy to work in a small group (n=4 to n=6) with the focus on a single laptop and projector screen. They were able effectively to share the tasks between themselves, taking it in turns to 'drive' the laptop and contribute creative ideas. Such a setup had the added benefit of enabling the research team to stimulate

[5] Picture Credit: Beacon Radio, 2010, released on the Creative Commons License.

[6] Subsequently, the software crashes were reported to the *JamMo* programming team, who addressed them in future releases.

discussion, probe for additional comments and observe social interactions. As a result, we believe that this small group model has a great deal to recommend it pedagogically and for further studies of *JamMo*'s impact on target users.

As previously mentioned, most pupils worked very constructively and collaboratively in pairs during session 2 and 6. In a significant number of cases in session 6, the researchers observed that these positive working relationships engendered good quality musical discussion and reflection. Some pairs decided that one partner could complete a whole composition with on-going feedback from their colleague. On completion, they would often listen back to the piece before swapping to allow the other partner to lead the composition process. Other pairs decided to collaborate more explicitly on individual compositions, taking it in turns to audition and select sound fragments before dragging them onto the sequencer grid. Listening back to compositions either during or after their completion was also a feature of pair behaviour deemed by the researchers to have been particularly creatively fruitful. Figure 4.65 shows three snapshots of one pair as they shared responsibility for a composition before listening to it back.

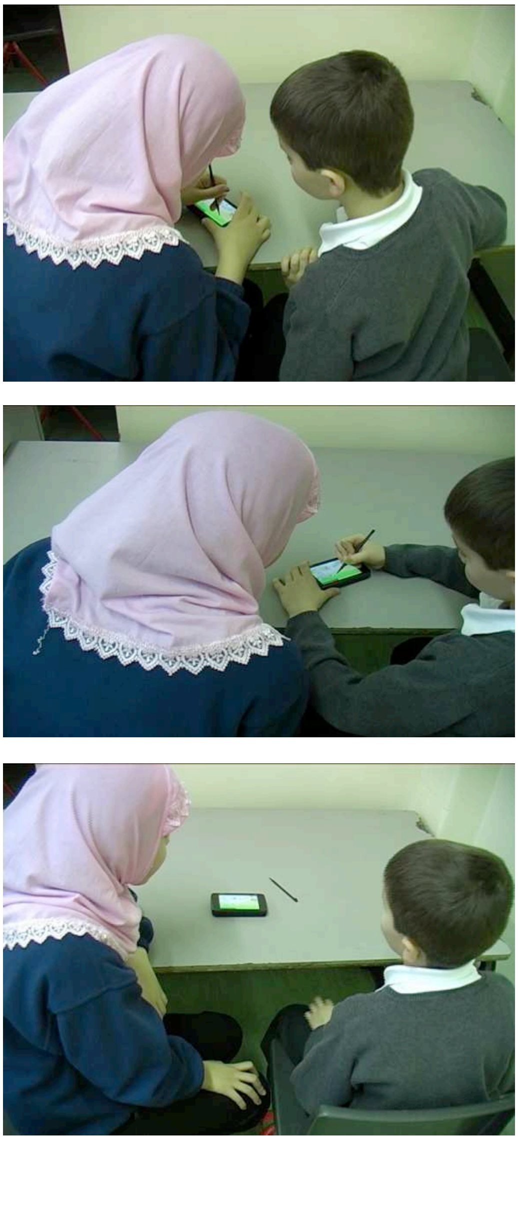


Figure 4.65: one pair of pupils taking it in turns to 'drive' *JamMo* and listening back to composition work

In the section that follows below, the term 'products' refers to compositions produced by pupils during pair work with *JamMo3-6*. Although pair work was a feature of session 2 of the fieldwork project, it was not until session 6 that a version of *JamMo* became available in which composition saving had been implemented successfully. An analysis of the n=108 compositions created and saved during session 6 provides some excellent insights into the musical thinking of the pupils whilst using *JamMo3-6*.

The IoE research team continues to develop a simple software utility that can batch process sets of *JamMo* compositions to produce some overall descriptive statistics. This utility revealed that *JamMo 3-6*'s 'City' composition world theme was the most popular amongst pupils, accounting for 55.5% of all compositions produced during Session 6. The 'Animal' and 'Fantasy' were as popular as each other, accounting for 22.25% of the compositions each. Overall, 52% of compositions made use of both the sequencer 'tracks' available in *JamMo 3-6* 'advanced' mode. Of those that featured sound fragments in one track only, it was most common for the lower track to have been used (i.e. the track nearest the bottom of the screen). Very few compositions made use of the entire track length available within the 'advanced' mode. Instead, the average composition length (taking in to account both tracks) was 14 grid squares, being approximately 25 seconds of music. Since, technically, *JamMo* can store two fragments per grid square on a track this represents an average length of 7 bars in musical terms. It was also rare for these 8+-year-old pupils to have filled every available grid square from the start to the finish of their composition. In addition, 83% of compositions featured unfilled grid squares, suggesting that pupils had intentionally left space (in musical terms, 'rests') to provide textural contrast within the music.

The n=108 compositions produced during session 6 also varied in their levels of musical sophistication and in their adoption of common musical conventions. However, the majority appeared to fall within reasonably predictable age-ranges on the well-established Swanwick-Tillman (1986) 'spiral' model of musical development (see Figure 4.66). A more detailed analysis of four particular compositions illustrates the range of musical development found in the compositional dataset as a whole.

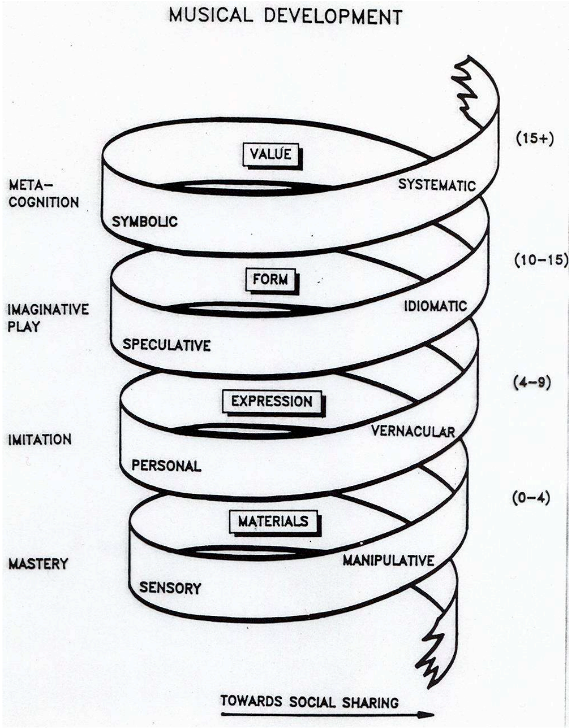


Figure 4.66: The Swanwick-Tillman spiral model of musical development[7]

In compositions characterised as being lower down the Swanwick-Tillman spiral, it is common to observe less concern for musical conventions in terms of structure, expressiveness or texture, and a greater focus on exploration. These are all features associated with Swanwick and Tillman's 'sensory', 'manipulative' and 'personal expressive' developmental modes. Compositions in this category often demonstrate that their composers have begun to consider the particular musical resources available (i.e., with particular regard to *JamMo 3-6*, the palate of sound fragments and the two-track texture) and have an elemental awareness of important conventions, such as repetition. The graphical depiction of the *JamMo3-6* advanced composition shown in Figure 4.67 below offers a useful example of work assessed to be in this region of the Swanwick-Tillman spiral.

[7]Reproduced from Swanwick, K., & Tillman, J. (1986). The sequence of musical development, *British Journal of Music Education 3*(3), 305-339.

Figure 4.67: screenshot of the sequencer interface for a composition showing less conventional musical structures

Figure 4.67 represents a finished musical product that features a few repeated, or at least re-occurring, sound fragments (i.e. those depicted with 'monkey' and purple 'snake' icons), but these lessen in frequency as the piece continues and fragment choices appear to be become less organised. The composers appear to have been more influenced in their placement of fragments by icon colour or style, as can be seen by the diagonal pattern of purple monkeys and snakes in the first three track grid squares.

In contrast, the composition depicted in Figure 4.68(below) perhaps could be characterized as slightly further up the Swanwick-Tillman spiral, perhaps lying somewhere between 'personal' and 'vernacular' developmental modes. Here a definite subset of sound fragments has been exploited, as the composers have explored the musical variations available within each group of fragments (represented by 'ghost' and 'unicorn' icons). Musically, this represents an intentionally constrained range of timbres and textures and suggests an awareness of the conventional importance of a consistent style and more limited variation.

Figure 4.68: screenshot of the sequencer interface for a composition showing more conventional musical structures, particularly with regard to repetition and variation

The composition represented in Figure 4.69 would appear slightly further up the Swanwick-Tillman spiral yet again. As in Figure 4.68, an intentionally constrained range of sound fragments is employed (represented by 'guitarist' and 'pushbike' icon groups), but in this case these are 'layered' to create more complex musical textures. There is also a developing sense of structure with a definite change of musical character from the sixth sequencer grid square (when sound fragments depicted with 'bucket and spade' icons begin to predominate). Whilst all these features are consistent with Swanwick and Tillman's 'vernacular' developmental mode, it should be noted that the composers of this piece are not yet thinking in the conventional four-, six-, or eight-bar phrases that are common for this stage of development.

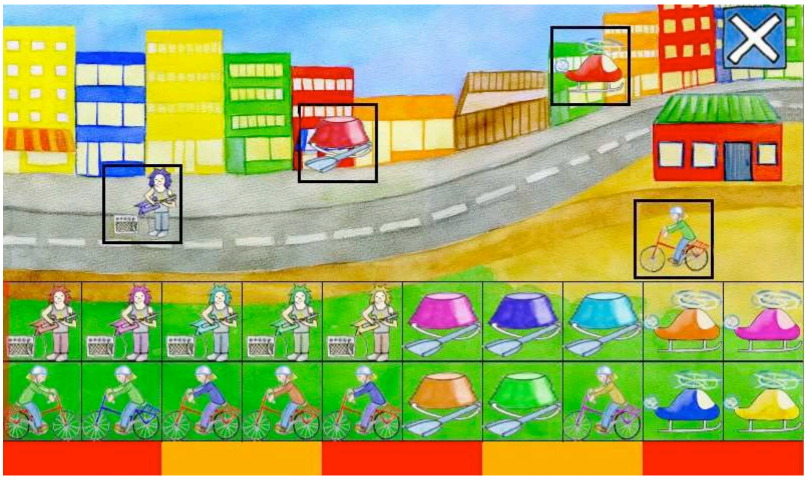


Figure 4.69: screenshot of the sequencer interface for a composition showing consideration for layered musical textures and contrasting sections

The composition depicted in Figures 4.70a and 4.70b was perhaps one of most sophisticated produced during session 6 of the London-based fieldwork project in terms of its use of conventional musical ideas. Using nineteen sequencer grid squares, it was certainly one of the longest, yet it retained a well-defined ‘arc’ of musical development and built towards a climax of a loud, held chord in grid square 19 (a sound fragment depicted by the ‘yellow helicopter’).

Figure 4.70a: A screenshot of the sequencer interface for the first half of a composition with layered and antiphonal textures

The first 11 sequencer grid squares (i.e., mainly Figure 4.70a) feature a two-part texture. The sound fragment depicted by the repeating blue ‘bucket and spade’ icon is a drum pattern, providing a regular, repeating rhythm to this section. Superimposed on the drums are a repeated series of five fragments. However, on the repeat of this series, a rhythmical offset is inserted (grid squares 9 and 10) which offers a slight variation on what has come before. In the second half of the composition (i.e., Figure 4.70b), a highly sophisticated antiphonal or ‘call and response’ texture is created through the staggered laying of the same fragment on both tracks. Features such as these would tend to characterise such a composition within the ‘speculative’ developmental mode on the Swanwick-Tillman model.

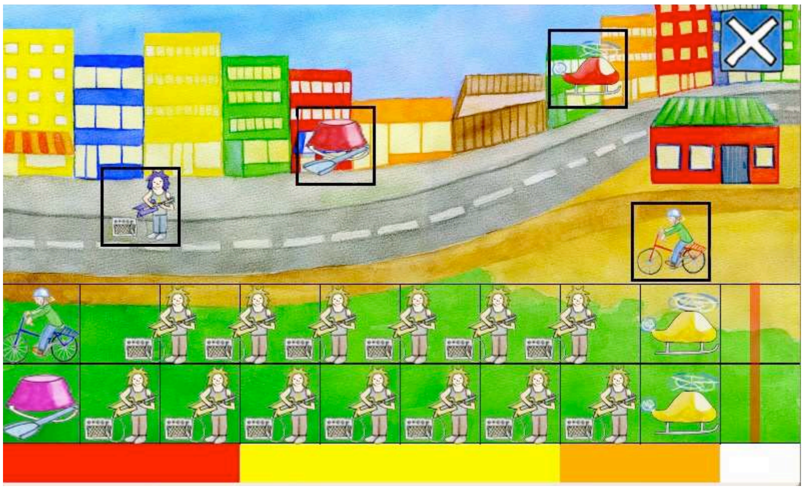


Figure 4.70b: A screenshot of the sequencer interface for the second half of a composition with layered and antiphonal textures

Overall, the majority of the n=108 compositions produced within session 6 of the London-based fieldwork project fall around the 'personal' and 'vernacular' modes of the Swanwick-Tillman spiral. Relatively few reach the musical sophistication of that depicted in Figures 4.69a-c. At first glance, such a finding may be seen as disappointing, since the biological ages which the Swanwick-Tillman model attributes to the 'personal' and 'vernacular' developmental modes are at or below the ages of the pupils who produced the compositions in session 6 of the fieldwork study. However, Swanwick has been keen to emphasise that 'the developmental spiral has to be re-activated each time music is encountered... or when composing/improvising'[8]. Given that this was only the second time that the fieldwork study pupils had made use of *JamMo* in a free-composition activity using the N900 phones, it is perhaps less surprising that so few compositions reached the developmental levels on the spiral consistent with their biological ages. One may thus speculate that, with further time to explore the range of musical materials and creative possibilities afforded by the *JamMo* sequencer interface, many more pupils would naturally reach the 'speculative' modes and perhaps beyond.

Two issues were noted during the fieldwork project relating to the choice of musical styles and tempi in selected sound fragments. Specifically, some children would have preferred to have been able to alter the tempo of their composition. This should at least be possible in principle, since musical materials were all generated at three selected tempi. However, such a feature was not available in the available software versions of *JamMo3-6*that were used in this fieldwork project. Additionally, a few children commented that certain fragments within the 'fantasy' composition world were perceived as slightly 'scary'. Whilst they themselves did not feel scared by them, they were concerned since they knew the software was intended for a younger target group.

Despite the various technical problems encountered, it was the research team's impression that pupils enjoyed making music with *JamMo*. Moreover, further engagement with the software (particularly the *7-12* version) may well offer an

[8]Swanwick, K. (1988). *Music, Mind and Education*. London: Routledge (p. 82).

even more effective platform for aspects of musical learning for this age group. In particular, the software functioned well as a stimulus for good quality musical discussion and reflection. Nonetheless, it has to be noted that the majority of compositions produced during session 6 were rather simplistic in nature and did not demonstrate particularly advanced levels of musical thinking, at least in terms of the Swanwick-Tillman spiral model of musical development. Possible reasons for this include the short time available for the free-composition task itself (around 45 minutes, allowing for introduction and plenary) and the relatively novel nature of the interface (this was only the second time pupils had used *JamMo* on the N900 phones). Perhaps, as a result of these constraints, pupils did not have sufficient opportunity to 're-activate' (to use Swanwick's word – see above) their musical development 'spiral' within the context of *JamMo*.

4.4.5 Perspectives on the use of JamMo's musical materials outside JamMo.

4.4.5.1 Employing the JamMo music materials outside JamMo: perspectives from Preston, England

As part of the final evaluations of *JamMo*, small-scale in-depth studies were carried out in order to investigate the usability of the musical materials present in *JamMo* with children aged eight to ten years. A key research question behind these studies was: how do children respond to the *JamMo 7-12* musical materials when these are used within a non-*JamMo*-based musical sequencer package?

The four children who participated in this study were drawn from two different classes from the same Primary School in Preston as a collaboration between the London and Preston UMSIC fieldwork research teams in March 2011. The participating children were visiting the University of Central Lancashire's Children and Computer Interaction Lab for a day of activities embracing *JamMo* and other related technologies. The four participants were provided with an IBM ThinkPad T43 laptop running Windows XP, Cakewalk SONAR 5.2 digital audio workstation software, ceiling mounted data projector, powered PC speakers, USB mouse, and a subset of 227 sound samples produced for *JamMo 7-12* by the IoE team previously (Figure 4.71). See Annex 8.6.7.1 for a more detailed account of the sessions.

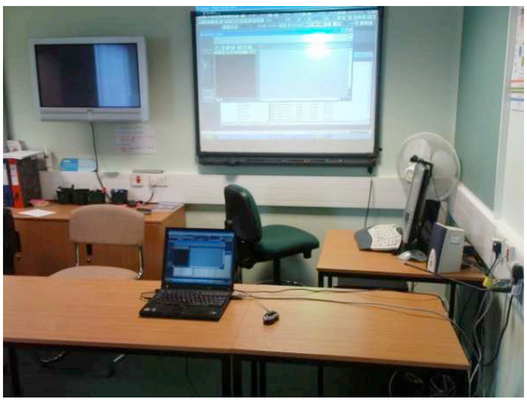


Figure 4.71: research activity equipment used in the Preston-based

Two individual pairs of students were introduced to the *JamMo* sample bank and software. A brief demonstration was given on how these sound samples could be 'auditioned' and dragged onto tracks in the sequencer window. The children were given time to browse the folders of samples feely and to construct short compositions. A member of the UMSIC team was on hand to advise on software usage and also to probe children's musical decisions. Another member of the team stood nearby making written notes. All compositions by the children were saved in proprietary SONAR format and also OMF format for sharing with UMSIC colleagues in Jyväskylä, who were conducting parallel studies.

The musical materials and the composition activity were well-received by the participant children. They enjoyed making their own music and were excited to listen to their own compositions. There was evidence of effective collaboration throughout these sessions, with the pairs liaising with each other over sound sample auditioning, musical style selections and turn-taking with dragging and dropping. There was also evidence of higher order musical thinking (such as children recognising when two different musical styles did not fit together). The children were able to understand how to undertake the activity easily, yet since they had not engaged in much composition activity prior to the sessions, a significant amount of scaffolding and prompting was required by the research team in order to encourage the children to continue with the composition activity.

4.4.5.2 Employing the JamMo music materials outside JamMo: perspectives from Herborn, Hesse Region, Germany

As part of the fieldwork in Herborn, children were invited to participate voluntarily in exploring recording functions with singing. As in the UK study reported in 4.4.5.1 *JamMo* musical materials were used but the 'host' application was a further, unrelated piece of digital audio recording software. Thirty children agreed to participate in this aspect of the study. All were very interested and open for new experiences. Only two 6-year-olds reported to have previously participated in recording a CD. Three out of 30 reported that there was a laptop at home. In the first activity, 12 children (40%) were very actively exploring the recording of their song singing. 14 children (47%) needed encouragement to get involved and received various types of support tailored to their needs. Four children (13%) did not explore their voice or the recording function. Interestingly, two of them were German children (3 and 4 years with well socially integrated parents) that gave the impression of being very shy. The other children were two Turkish boys here known as Y (4 years of age) and B (5 years of age). Y's parents were reported by staff at the centre as not being integrated at all in their local community, nor was Y integrated as a member in the day-care centre. On the other hand, B was more integrated, but only one of his parents was willing to communicate with educators. It should be noted that the number of children in this study is too small for allowing any general conclusions to be drawn about migration background and engagement in musical activities.

Approximately half of the children (14.47%) needed encouragement of various kinds. This high proportion may have been caused by the fact that the children were faced with a new situation and an unfamiliar person (the researcher). A great deal of encouragement was needed in particular for one of the familiar songs provided by *JamMo*. The majority of the children were not, at this stage, able to reproduce a familiar song on their own without any help, primarily due to the fact that they were used to singing together as a group. Assistance during singing was offered in two forms: the researcher sung one part and the child repeated it in the form of alternation; or a song was produced together with the child leading and the research filling the gaps.

When some of the children participated for the second or the third time, it was highly possible to observe any progress. One specific aspect of progress was that these children widened their focus of attention to various aspects. Some children started to be interested in the recording procedure (such as pressing one button for recording, another for stopping it, and again another button for playing and listening). Others began to draw attention to their pronunciation of words and to improve elements of the song structure. Some children, such as Z (4 years of age) started to comment on the other children's singing. During the sessions, Z learnt to distinguish between the dimensions of intensity (loud-soft) and tempi (slow-fast).

Several interesting case studies were recorded. N (4 years of age) was very fast in discovering the recording functions. When the researcher handed him over the tools, he was happy to record the singing of another child. Henceforth, the researcher called him the sound engineer of the group, as he very much enjoyed this job. Another child, C (5 years of age) discovered a wrongly pronounced consonant (/SCH/). The researcher repeatedly showed him how to improve the pronunciation and he was very motivated to sing the *JamMo* songs containing this consonant. The research team used the recording function to monitor his pronunciation and improvements.

For some of the children, in particular those who participated twice or more frequently, the recording functions had the effect of focusing attention on certain aspects of their singing and enhancing observation and reflectivity. Whereas during the first trial, most children were shy and preferred to engage in reproductive song singing. These children only started to explore the recording function in a creative and playful manner when they had more time and received encouragement. The group dynamics among the members of the small groups may also have affected individual children's productivity. Some groups were open and courageous, whereas some remained shy and lacked 'an icebreaking Figure'. The educators also enjoyed recording their own singing, as well as engaging in using this technically basic tool for improving children's productive expression.

4.4.6 An evaluation of JamMo 3-6 singing games: perspectives from Preston, England

Two fieldwork activities were conducted in June 2011 in order to allow the London and Preston UMSIC research teams to evaluate the impact of *JamMo 3-6* singing games with groups of recent immigrants within the target age group for this software. In the first of these studies, five three and four year olds from a nursery school participated with a nursery nurse on hand to facilitate the session. In the second study, 26 children from a Preston primary school aged between five and six took part in a

JamMo singing game activity. This group embraced a number of immigrant children originally from Pakistan, China, Nigeria, India (2) and Poland.

In the nursery school activity, the main aim of the session was to observe how the participating children used the *JamMo* singing game and, in particular, whether there were any significant obstacles in its use. The researchers were also keen to find out what the children thought of the game. The participating children appeared to be used to working with technology. In fact, the research team observed an unrelated music game in use on a computer situated close by. All of the participants reported being familiar with games equipment (e.g. Nintendo DS or Wii) at home. Furthermore, the nursery nurse confirmed that the children engaged in singing at the nursery on a regular basis. A female participant was noted to be a confident singer, having sung in the Christmas show (according to the nurse).

The first four children were grouped to work in two pairs. One of the pairs remained the same throughout the session, with both of the boys apparently thoroughly enjoying playing with *JamMo*. The other pair had one of the participants changed at one point (a girl was replaced by a boy). This pair was further replaced by another pair of boys. Both pairs were introduced to the singing game on the N900. The researchers encouraged the children to start playing with the singing game after the phones had been set up on the singing game start-up screen. At the start, the researchers prompted the participants by explaining the interface to the children. Nevertheless, the children understood the game quickly and continued playing with it by themselves.

The first pair (two boys, one of them mixed race) selected the songs 'Incey Wincey Spider' and 'Twinkle, Twinkle Little Star'. The mixed race male quickly started to engage with the music, evidenced in physical movement and confident singing. His partner joined in on the odd word but he sang far less. Both boys demonstrated a great deal of mouthing to the songs when they were not singing. Next, the pair started to listen to 'Row Your Boat', but stopped halfway through and exited the screen via the blue cross that they had observed the researcher to use when wanting to exit the game. At this point, the pair experienced a strange bug where they exited the singing screen but the music continued, completed by with the bear mentor talking over the top. A member of the research team swapped the phone to a spare. As a result of this, the pair switched to the composition game and remained on this for the rest of the session. They quickly began to argue about sound fragment selection (i.e. whether to go for the city or the easy theme). Both of them tried to drag sound fragments onto screen together using fingers and soon started to disagree over the choices. A member of the research team re-started the pair on the singing game, but they soon switched back to composition.

The second pair started listening to 'Row Your Boat', with the three-year-old girl mouthing along with words, some head nodding and singing the odd word or phrase. His partner, a Polish boy did not sing at beginning but 'warmed up' after a while. At this point, the nurse asked whether the game had any Polish songs since it would be nice to encourage the Polish boy to use Polish in nursery (hw normally only speaks English there). The pair started listening to 'Old Macdonald'. The three -year-old was clearly very familiar with the song and started doing actions, whilst making eye contact with nurse to show his familiarity. This same behaviour was also observed with ‘Incey Wincey Spider’. The pair took turns in making decision and selecting songs. The pair was quick to pick up on how to use the software after observing the researcher to press specific icons on the screen. They were able to play with the software without any difficulties. At this point the girl was replaced by a boy. After listening to and singing to ‘Twinkle Twinkle Little Star’, the pair moved to the composition game. This was their own decision. Almost immediately, there was a stronger sense of engagement than there had been with the singing game. The Polish boy in particular seemed very engaged.

Once both pairs had switched to composition, there was a definite change in overall level of engagement and enthusiasm in evidence. The first pair was observed to clap along to the jungle theme samples. The pairs joined into a group activity in the end of the session in order to compare their compositions against one another as a larger group activity. The research activity reached a natural conclusion when the participants heard their peers start singing in a class singing activity taking place on the other side of the large room. in the singing activity, a nursery nurse was the children to sing to a backing track from CD. The children were visibly excited to join in this activity and quickly requested to finish working with *JamMo*.

Generally, all the participants enjoyed the *JamMo* activity and engaged in it throughout. The nurse had to ask them to cease the activity in the end of the session in order to enable the researcher to ask the children about their experience. Overall, the composition game seemed by far the most popular activity, as opposed to the singing game (approximate 80:20 ratio). Moreover, all the participants were consistently engaged in the composition activity, despite there being occasional technical problems that interrupted the flow of the activity. When the children were asked whether they enjoyed the singing, the first pair (who had been the more vocal singers) replied that they had not enjoyed it. However, the Polish boy (who had sung far less) said that he had enjoyed the activity. The 3-year-old girl did not comment. By contrast, all the participants said that they enjoyed the composition game and each listed particular sound fragments and themes that they had particularly liked. The participants were also asked to name their favourite songs not included in the *3-6* singing game. Two of the children requested ‘Baa Baa Black Sheep’. A further comment from a boy was that ‘Incey Wincey Spider’ was a good choice.

A member of the research team also had a chat with the nurse who said that they did a great deal of singing in the nursery and used computers on a daily basis. She said that the children were used to singing and enjoyed it a great deal. The nurse commented that the songs were performed at too high a pitch for adults to join in. She felt that this was a common problem with songs aimed at children and resulted in adults not wanting to join in the singing with the children.

In the second session that aimed to evaluate the *JamMo 3-6* singing games, 13 pairs from Year 1 children at a primary school in Preston played with the game on mobile phones. A member of the research team facilitated the pair sessions and closely observed their activity. The activity took place in an empty classroom, with three pairs playing on individual phones at a time.

Overall the children enjoyed the singing game activity, as long as it was not too long and they had authority over which songs they would sing. The majority of the children enjoyed the activity from the start. A couple of them felt shy about singing and join in the activity later on once their peer has started singing along to the packing tracks. The use of headphones was perceived to encourage singing, as the children felt that the activity became more private when they used the headphones and not everyone could hear their singing. Furthermore, the children enjoyed using the mobile phones.

Although the children generally enjoyed the activity, they started losing concentration after ten minutes when the research team needed to come up with ideas for additional activities that the children could be motivated with to carry on. The children liked the song selections on *JamMo*, with a couple of them coming up with suggestions for songs that could be added to the song bank (such as slower songs and songs in additional languages). The children liked the icons that represented the different songs and were curious to know who had drawn them. Evidence was gathered for the usability of *JamMo 3-6* singing games with children above the age of 6. These games seemed to work with such kids when they were allowed to explore the games by themselves. For instance, some of the children started singing the songs in foreign languages and picking up some words as they did so. See Annex 8.6.7.2 for more detailed information and notes on the sessions.

4.4.7 Further musical observations from Oulu, Finland and Herborn, Hesse Region, Germany

Within their *JamMo*-based fieldwork in three pre-schools, the Oulu research team observed a variety of musical behaviours. In particular, it was noted that the *JamMo* musical materials encouraged the children to move. The children got excited when they heard the sounds and moved their arms, toes and legs. When they were standing still, they still moved parts of their faces and eyes on hearing music. It seemed to the research team that the children's movement 'had character'. It was also noted that the children's backgrounds made a different in that those with a background in dance moved differently. Comments from the children and carers suggested that hearing adults singing as well as hearing one's own voice were important to these 5-6 years olds. Although the children were capable of singing, three verses of a song was too much when singing on their own, particularly if the song was new or relatively unknown. However, the children were capable of singing in tune.

For some of the children participating in the fieldwork in Herborn, Germany, the recording-listening function had clearly beneficial effects. These effects appeared most pronounced amongst children who had participated in the study in more than one phase. Listening back to self-made recordings served to improve pronunciation, lyrics, creativity and the general quality of singing. As the children were encouraged to sing *JamMo* songs, the general focus was on song reproduction. Only very few children (C, 4 yrs. and B, 4 yrs.) explored other musical modes (such as inventing new songs and new vocal sounds). When the children spontaneously explored beyond song reproduction, they preferred to laugh together first or to vary the intensity of their song singing (i.e. singing loud or soft). For the exploration of musical and linguistic parameters, clear instructions by the researcher would have been necessary.

4.5 Perspectives on *JamMo* from users and other stakeholders

4.5.1 UMSIC Target user groups

4.5.1.1 Children's perspectives on JamMo: Findings from London, UK

Within the London-based Primary school fieldwork, many children considered to be less socially included by the class teacher and the teaching assistant enthusiastically engaged in the *JamMo* activity. Moreover, a significant number of migrant children and children with special educational needs engaged in the activity and also enjoyed it a great deal.

Throughout the project, the participating pupils remained overwhelming enthusiastic about *JamMo* and its potential musical opportunities. Pupils clearly looked forward to their participation, whether in whole class, small group and pair activities. The pupils were, of course, well aware of *JamMo*'s ongoing developmental status and their important roles as both 'beta-testers' and 'co-researchers'. Perhaps, as a result of this, they tolerated missing functionality and frequent software crashes and they made many helpful design and interface suggestions drawing from often extensive pre-existing music and IT experience. The researchers were also fortunate to work with an outstanding class teacher, whose infectious and relentless positivity towards both *JamMo* and the UMSIC project as a whole was an important influence on pupils. General positive comments made by the pupils during various sessions and activities included the following: *'[It was] fun.'; '[It was] excellent'*; 'G*ood for children.'; 'The software is easy to use'*; '*We liked it all.'; 'My brother would love it. My brother would be jealous!' 'One of the best things I've ever seen!*

The class teacher also provided a range of general, positive comments, including: '*We had a blast and the kids loved working with the phones!'* and '*The software was really good for the kids, even though it was designed for a younger age group.'*

Comments from several pupils revealed that they were already thinking about how *JamMo*'s functionality (at the time of the fieldwork study sessions) could be extended and developed. Interestingly, all such comments at least hint at either initial or ongoing technical aspirations for *JamMo*'s development, such as '*Make it so you can share it'; 'Internet is important'; 'Could it record my video so I can add it to the backing tracks?'*

On the other hand, it is only fair to note that some pupils did become frustrated nearly to the point of de-motivation by ongoing bugs and crashes experienced whilst using *JamMo*. The whole UMSIC consortium, but particularly the core development team, have been committed to reducing and eliminating these issues and significant advances have been made with each weekly release. A positive outcome of the problems experienced by pupils was the detailed range of crash reports that the researchers were able to feed back to the developers.

There is some evidence that participants (including migrant participants and children with special educational needs) felt more socially included on post-test questionnaire (i.e. after *JamMo* sessions) than they did on pre-test questionnaire – although the cause and effect remain less clear. Nevertheless, classroom observation by the adults involved (teacher, teaching assistant, researchers) also noted that children were collegiate in their approach to *JamMo*. In particular, many participants considered as less socially included by the teacher and the teaching assistant enthusiastically engaged in *JamMo* activity. Furthermore, many migrant children and children with special educational needs engaged in the activity. They reported (and were observed) to enjoy *JamMo* a great deal.

Pupils quickly made the association between pleasing graphical arrangements of icons on the screen with pleasing musical results. In this, they demonstrated a regard for repetition and variation rather than random placement. They also were aware of the need for a sense of space to break up a piece of music. However, it would be fair to say that in this exploratory activity the majority had a somewhat 'random' approach. Nevertheless, time was limited and it is possible that with more experimentation, they would be able to make more meaningful decisions about sound fragment placement.

Pupils liked the immediate feedback provided by clicking on the icons in the composition game and hearing the musical result. They quickly understood the relationship between image and music and thought that many of the icon choices (but not all) were well made.

After playing with *JamMo* on an embedded laptop over a month, the children recorded their experiences on a booklet left by the computer in their classroom where they could use *JamMo* during break times. The children were asked to try *JamMo* out when they wished to do so during this month and to record their opinions and ideas down in the booklet after each trial. The booklet included a question on the type of activities that the children did with *JamMo* ('What did you do with *JamMo* today?').

However, rather than just explaining the activity, the majority of the children noted down their opinions on *JamMo*. The feedback was positive and included the following comments: 'I was playing the park one and it was fun.'; I like playing the *JamMo* because it had different senders. You have lots of sounds.'; I like this *JamMo* because it will help with your music.'; 'I love this because it is wicked.'; 'Good.'; 'Nice and I had fun.'; 'Nice tunes.'; 'I had lots of fun.'; I had very fun, very fun in *JamMo*.'; 'A bite of fun.'; 'I made some smooth music. I had so much fun'. Therefore, the feedback indicated that the children had thoroughly enjoyed playing with *JamMo* and making their own music.

4.5.1.2 Children's perspectives on JamMo: Findings from Preston, UK

During selected fieldwork activities in Preston children completed a simple participant feedback instrument regarding experiences using *JamMo* (see Annex 8.6.5). This section reports on data gathered with this feedback instrument in March 2011. The participants were 35 primary school pupils visiting the University's Children and Computer Interaction Lab. The pupils were aged from eight to ten years. *JamMo* was being used within the context of a free composition activity. Both *JamMo 3-6* (N900) and *JamMo 7-12* (HP touchscreen laptop) were in use.

The feedback instrument contained the following open-ended questions: 'The best bit about playing the game was...' and 'The worst bit about playing the game was...'. The feedback provided for the first question by the children from both of the groups focused on the sounds, the images and usability of the software. Comments from the children included: 'I think I'll get this phone for my birthday.'; 'The music was good.'; 'The sounds were the best.'; 'I liked the sounds and the pictures.'; '[It was] funny.'; '[On the laptop] the touch screen was ace.'; 'The different sounds and the good graphics.'; 'You can make your own tune easily.'; ''You can play the game on a big screen.'; 'Making sounds and moving the mouse about.'; I like the Big Pen and the games.'; 'It is easy to handle.'; 'Sending messages to someone.'; 'You could move the mouse without using the keyboard.'; 'Making the music.'; 'I liked playing the games on the *JamMo*.'. The negative comments provided by the children to the second question were primarily concerned with: the price of the mobile phone ('I hate Nokias.'; 'This phone is a rip-off.';); and the slow pace that the software worked at and problems encountered whilst paying with *JamMo* ('It didn't work on the phone.'; 'It broke and it was slow.'; 'I couldn't drag and drop the items and it was a bit slow.'; 'Sometimes the sound Figures were hard to move.'; ''Putting the objects in the boxes was tricky.').

The same feedback instrument was administered to the children who participated in the pair game sessions. Feedback for the first question was primarily concerned with the function of the game. This included the following: '[The best bit was} coming over to each other's computer.'; 'I like playing the sounds.'; 'I liked playing the sounds with the others.'; '[The best bit was] when we played the song.';'[The best bit was] making the music.'; '[The best bit was] playing music.'; 'The best bit was [the] dragging.'; 'The best bit was dragging the animals and connecting with your friend.'; 'Connecting with your friend was the best.'; 'Picking the sounds.'; and 'Picking the animals'. The majority of the children stated 'nothing' when asked about the worst aspect of the game. The rest of the responses were centred upon the usability of the pair game. Comments provided for this question included: 'I couldn't move other people's stuff.'; 'The other person was dragging my music'; and 'It didn't connect the sound when playing'.

The feedback questionnaire contained 9 items that inquired the children about their experiences and opinions on using *JamMo*. The feedback instrument contained a 5-point scale with smiley faces (see Annex 8.6.5). On average, the children rated their experience of using *JamMo* on the positive side of the scale (3.58), indicating that the children had enjoyed playing with *JamMo*. When looking at the average ratings for the three groups (Group 1, Group 2 and the group who used the pair game), the pair game group provided the highest ratings (4.62), with the second group providing more neutral feedback (3.68) and the first group providing more negative feedback

(2.69). It is likely that the technical problems encountered by the first group resulted in the participants perceiving the game more negatively.

When looking in detail at the individual items in the feedback instrument, item 4 'I like the music and sounds in *JamMo*' generated the least differences between the groups (Group 1= 3.75; Group 2 = 4.68; and Pair Game Group = 4.66). This finding implied that all the participants, on average, liked the music and the sounds in *JamMo*. Item 7 'I understood all the pictures and screens in *JamMo*' also generated a minimal difference between the groups (Group 1 = 3.69; Group 2 = 4.12; and Pair Game Group = 4.75). Such a finding indicated that all the participants felt that they could understand the pictures and screens on the software. The most significant differences between the groups were recorded for items 8 and 9. Item 8 '*JamMo* is easy to use' was rated most positively by the Pair Game Group (5.00), followed by Group 2 (4.21), with Group 1 rating its usability much more negatively (2.50). Item 9 '*JamMo* worked well on the phone (or computer)' also received more positive responses from the Pair Game Group (4.42) and Group 2 (3.84) than from Group 1 (1.69). The technical problems encountered by Group1 during their sessions are likely to have caused such differences in perception and experiences. Therefore, in general the feedback received from the participants on their use of *JamMo* was positive.

Furthermore, the children greatly enjoyed the activities during the day at UCLAN and wrote thank you-letters to the research team subsequent to their day at the computer laboratory. The letters were overwhelmingly positive. Below are quotes from the letters as examples:

- 'My favourite was the loop [sound sample] game. I made some awesome beats.'
- 'I hope that you invite us again sometime so that we can show you some more tunes.'
- 'It was great working with you and people from other countries… I liked the game with translating languages [singing game] but I liked *JamMo* too.'
- 'We had a great time using your gadgets. It was a blast.'

4.5.1.3 Children's perspectives on JamMo: Findings from Jyväskylä, Finland

A similar participant feedback instrument was used by the research team in Jyväskylä (see section 3.3.3.6 and Annex 8.6.4).

Participant children's ratings to the questions are described using five learning and motivation –related themes of the questionnaire: *preference, challenge, feeling of success, positive collaboration, and enthusiasm for independent use:*

"Musical preference" is related to the question "I liked the backing track and the sounds", which was asked in three different contexts: composition game *3-6* (pair game with shared device), composition game *7-12* (standalone) as well as workshop *7-12* (pair and small group work).

"Game preference" is related to the questions "I liked to play the game, in which there was a scene (city, castle or jungle)" (composition game *3-6* in pairs), and " I

liked the game, in which loops [sound samples] were dragged from the loop [sample] rolls and dropped to the track" (composition game *7-12* standalone).

"Workshop preference" is related to the question "I liked the group work task" (workshop *7-12*).

"*Challenge"* is described with two sum variables: *"Difficult"* relates to the questions "The game was difficult" (composition game *3-6* in pairs, and composition game *7-12* standalone); "The composition task was difficult" (*7-12* workshop), "The mentor did not guide enough in touching the buttons" (composition game *7-12* standalone), and "I could not find all buttons needed" (workshop *7-12*). *"Easy"* relates to questions "The game was too easy" (both in composition game *3-6* in pairs, and in composition game *7-12* standalone), and "It was easy to compose music with the loop [sample] machine" (*7-12* workshop). These questions could have been analysed within one variable (challenge), however, the results for *difficult* and *easy* are here described separately, because some children answered inconsistently to these questions, rating sometimes a task both difficult and easy simultaneously.

"Feeling of success" is related to the questions "I succeeded in the task" (composition game *3-6* in pairs), "I succeeded in the game" (composition game *7-12* standalone), and "I succeeded in the composition task" (workshop *7-12*).

"Positive collaboration" is related to the questions "Me and my pair collaborated well" (composition game *3-6* in pairs), "We had a good spirit in our group" (workshop *7-12*), and "Collaboration was easy" (workshop *7-12*).

"Enthusiasm of independent use" is related to the questions "I would like to make music with *JamMo* at home", and "If I would have a *JamMo* of my own, I'd like to make music with it with my friends in freetime".

In addition, there were two open questions for describing the compositions and for describing the non-preferred features of *JamMo* and *JamMo* lessons.

All children's experiences (N= 35)

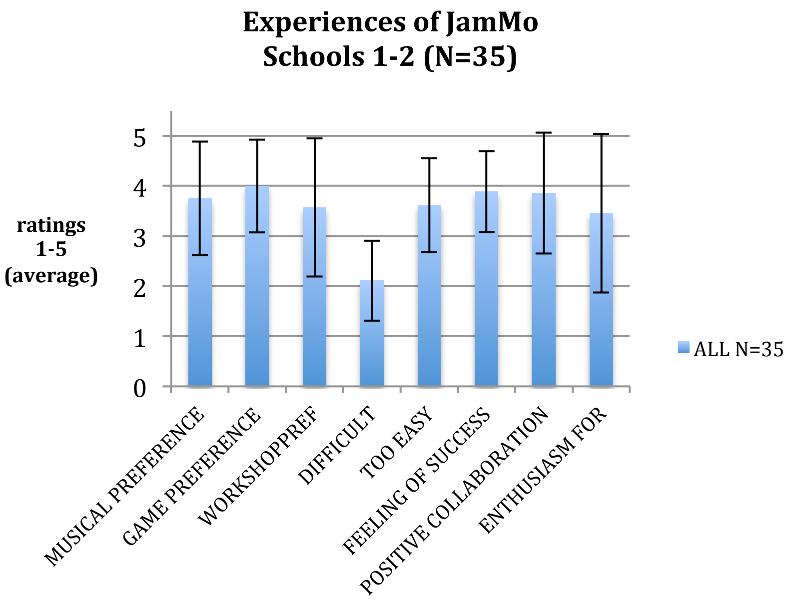


Figure 4.72: experiences of *JamMo* in all children (N=35): preference, challenge, feeling of success, positive collaboration and enthusiasm for independent use of *JamMo*.

Figure 4.72 and table 4.20 describe the averages and standard deviations of the ratings (5-point-scale) of all children (N=35) in the grade 4 in the schools 1-2, including children with ADHD (N=2), for the eight themes: *musical preference, game preference, workshop preference, difficult, easy, feeling of success, positive collaboration, enthusiasm for independent use.* In general, the children preferred *JamMo* games *3-6* and *7-12* and musical materials. The children also appeared to get a feeling of success in *JamMo* gaming and *JamMo* related tasks.

Table 4.20. experiences of *JamMo* in all children (N=35): means and standard deviations of preferences, challenge, feeling of success, positive collaboration and enthusiasm for independent use of *JamMo*.

ALL CHILDREN N=35	MUSIC. PREF.	GAME PREF.	WORK-SHOP PREF	DIFFIC-ULT	TOO EASY	FEEL. OF SUCC.	POSITIVE. COLLAB.	ENTH. FOR INDEPEND. USE
MEAN	3.75	4.00	3.57	2.11	3.61	3.89	3.86	3.46
ST DEV	1.13	0.93	1.38	0.80	0.94	0.81	1.21	1.58

Preference of games and musical materials (ADHD and non-ADHD)

Table 4.21: preference of games and musical materials (ADHD and non-ADHD in Schools 1-2): means and standard deviations.

JamMo game and music	*School 1 Non-ADHD (N=18) mean*	*School 1 Non-ADHD (N=18) st dev*	*Target 1 ADHD*	*School 2 Non-ADHD (N=15) mean*	*School 2 Non-ADHD (N=15) st dev*	*Target 2 ADHD*
3-6 game	4.1	0.8	2	4.0	1.3	5
7-12 game	3.7	1.1	3	4.4	1.1	5
7-12 workshop	3.2	1.3	1	4.1	1.1	5
3-6 music	3.1	1.4	4	4.3	1.1	5
7-12 game music	3.3	1.3	5	4.3	0.9	5
7-12 workshop music	3.3	1.3	5	4.1	1.0	5

Table 21 presents the means and standard deviations of the preference *JamMo* games and workshop as well as musical materials for the schools 1-2 (non-ADHD children) as well as the ratings of the target children 1-2 with ADHD. Figure 4.73 presents, how much non-ADHD children in School 1 liked *JamMo* games, workshop and musical materials (means and standard deviations), as well as the ratings of target 1 (ADHD) for these variables. Both games (*3-6* and *7-12*) were preferred by the children in School 1. The musical materials did not motivate these children as much as the games did. The workshop with *JamMo* sequencer was also less liked and opinions were more divided. In contrast with his peers, Target 1 (ADHD) does not appear not motivated in younger children's composition game *3-6* (rate: 2) or workshop *7-12* (rate: 1). Standalone game *7-12*, which was presented for the first time for him, appeared to be more motivating (rate: 3). Moreover, he liked all musical materials well above the average of his non-ADHD classmates, especially *7-12* music, for which he gave the highest possible rating (5).

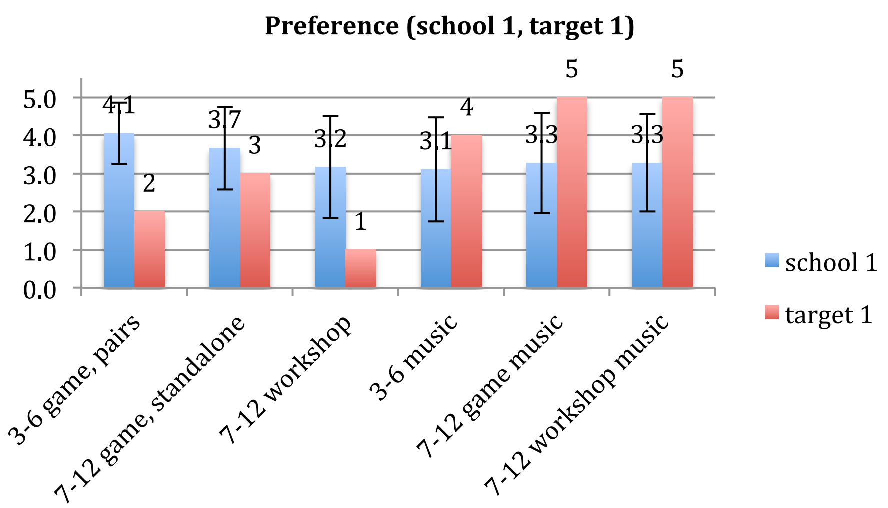


Figure 4.73: preference of games and musical materials. School 1 and Target 1.

Figure 4.74 presents, how much non-ADHD children in School 2 liked *JamMo* games, workshop and musical materials (means and standard deviations), as well as the ratings of target 2 (ADHD) for these variables. The children of School 2 appear well motivated in all *JamMo* activities and musical materials. Moreover, the ratings of Target 2 show that he is very well motivated all games and tasks, as well as the musical materials (the highest rate 5 in every task and type of musical material).

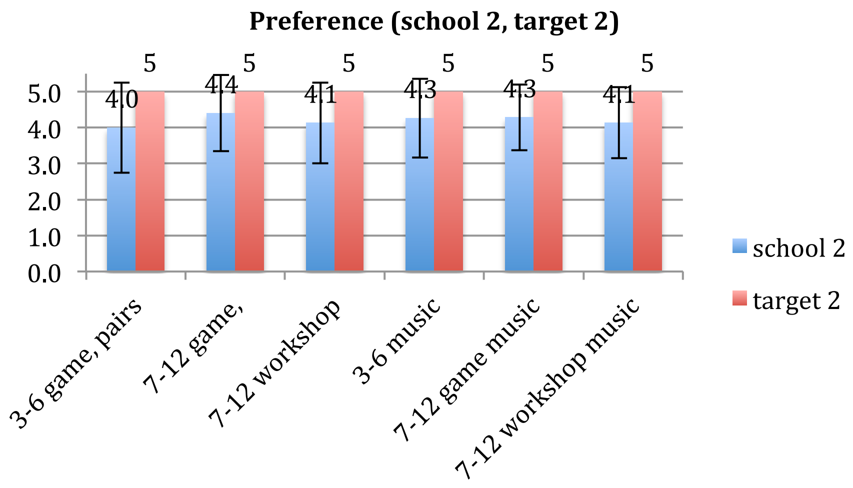


Figure 4.74: preference of games and musical materials. School 2 and Target 2.

Challenge (ADHD and non-ADHD)

Table 4.22: challenge of *JamMo* games and tasks (ADHD and non-ADHD in Schools 1-2): means and standard deviations.

JamMo game and music	*School 1 Non-ADHD (N=18) mean*	*School 1 Non-ADHD (N=18) st dev*	*Target 1 ADHD*	*School 2 Non-ADHD (N=15) mean*	*School 2 Non-ADHD st dev (N=15)*	*Target 2 ADHD*
3-6 game difficult	2.1	1.3	1	1.7	1.3	4
3-6 game too easy	3.9	1.2	4	3.8	1.1	5
7-12 game difficult	2.7	0.5	1	1.8	0.1	3
7-12 game too easy	3.0	1.3	2	3.7	1.2	5
7-12 workshop difficult	2.2	0.3	1	1.9	0.3	2
7-12 workshop easy	3.3	1.3	4	4.1	1.2	5

Table 4.22 presents the means and standard deviations of the challenge of *JamMo* games and tasks for the schools 1-2 (non-ADHD children) as well as the ratings of the target children 1-2 with ADHD. Figure 4.75 presents, how difficult or easy non-ADHD children in School 1 regarded *JamMo* games and workshop (means and standard deviations), as well as the ratings of target 1 (ADHD). The

results show, that the composition game *3-6* advanced, which was designed for children from 3 to 6 years of age was regarded too easy more often than difficult by the 10-11-year old children in School 1. In similar, Target 1 rated this game too easy (rate: 4). The composition game *7-12*, designed for children form 7 to 12 years of age, appeared to be more challenging than the *3-6* game. The results of the whole class and Target 1 show, that *7-12* game was not regarded difficult, nor too easy, suggesting that this game is possibly at suitable level for children aged 10-11 years. The workshop task with *JamMo 7-12* sequencer was regarded more like easy by the children School 1. Target 1 rated this task easy (rate: 4), not difficult.

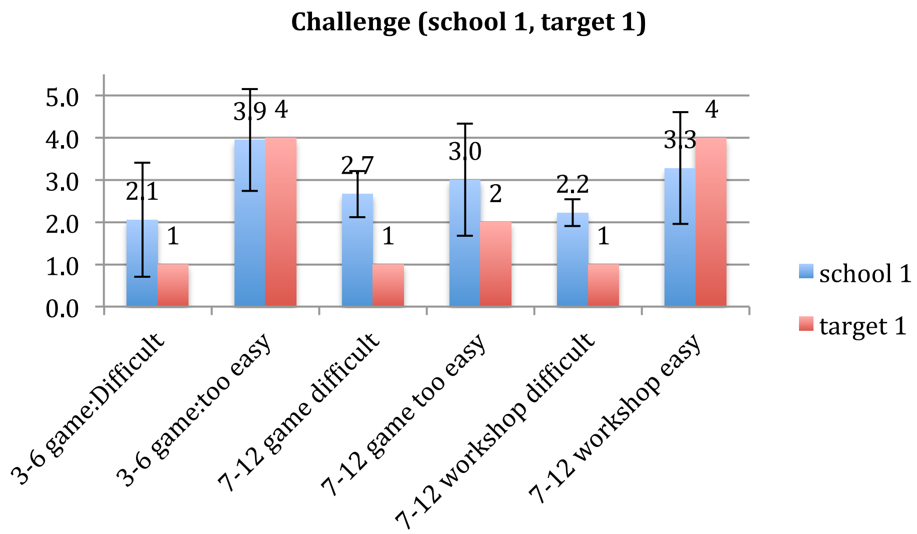


Figure 4.75: challenge. School 1 and Target 1.

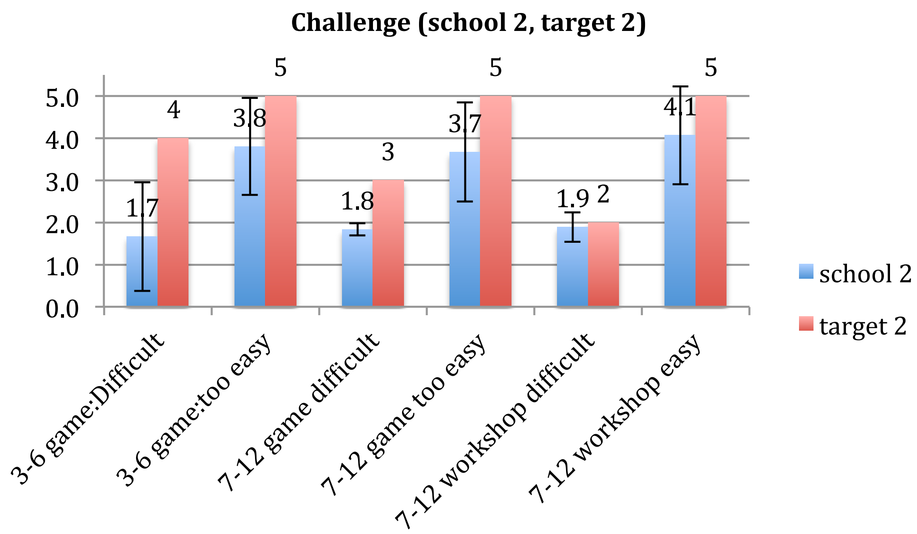


Figure 4.76: challenge. School 2 and Target 2.

Figure 4.76 presents, how difficult or easy non-ADHD children in School 2 regarded *JamMo* games and workshop (means and standard deviations), as well as the ratings of target 2 (ADHD). The results of the School 2 in general are not very different form the results of School 1, except that in School 2 children regarded games and tasks more easy than in School 1, and there was not clear difference between *JamMo* games and tasks in School 2. Target 2 was somewhat non consistent in his ratings: he rated the *3-6* game bot difficult (rate: 4) and too easy (rate 5). Game *7-12* was rated too easy (rate: 5) and workshop *7-12* easy (rate: 5) by Target 2.

Feeling of success (ADHD and non-ADHD)

Table 4.23: feeling of success in *JamMo* games and tasks (ADHD and non-ADHD in Schools 1-2): means and standard deviations.

JamMo game and music	*School 1 Non-ADHD (N=18) mean*	*School 1 Non-ADHD N=18) st dev*	*Target 1 ADHD*	*School 2 Non-ADHD (N=15) mean*	*School 2 Non-ADHD (N=15) st dev*	*Target 2 ADHD*
3-6 game	4.2	0.9	3	4.2	1.2	4
7-12 game	3.6	1.0	3	4.1	1.2	4
7-12 workshop	3.8	1.0	1	4.1	0.9	4

Table 4.23 presents the means and standard deviations of feeling of success in *JamMo* games and tasks for the schools 1-2 (non-ADHD children) as well as the ratings of the target children 1-2 with ADHD. Figure 4.77 presents, how well non-ADHD children in School 1 regarded their success *JamMo* games and workshop (means and standard deviations), as well as the ratings of target 1 (ADHD). In general, the ratings of success were positive children in the children of School 1. In contrast, Target 1 appeared neutral about succeeding in the games *3-6* and *7-12*, and negative about succeeding in the task in workshop *7-12*. The results of School 2 (Figure 4.78) appear more positive: both the classmates without ADHD and Target 2 with AHDH appear happy with their success in all *JamMo* activities. Target 2 rated the success 4 in both games and the workshop.

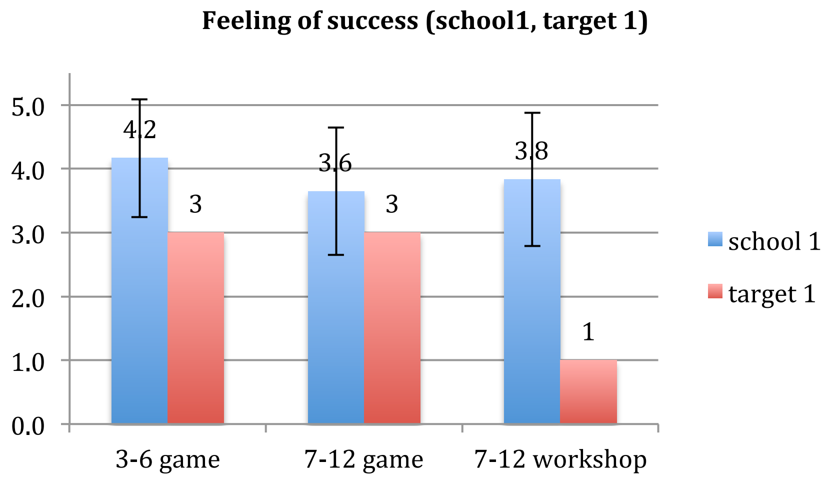


Figure 4.77: feeling of success. School 1 and Target 1.

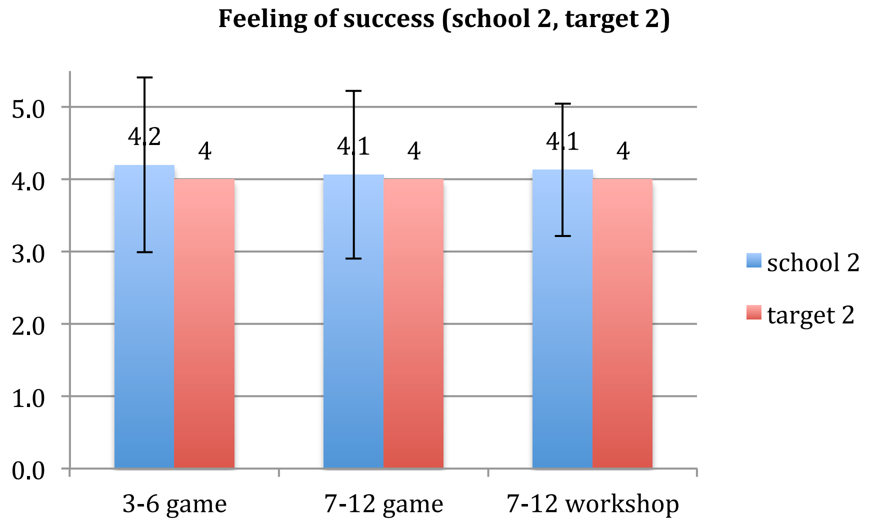


Figure 4.78: feeling of success. School 2 and Target 2.

Positive collaboration (ADHD and non-ADHD)

Table 4.24: positive collaboration with *JamMo* (ADHD and non-ADHD in Schools 1-2): means and standard deviations.

JamMo game and music	*School 1 Non-ADHD (N=18) mean*	*School 1 Non-ADHD (N=18) st dev*	*Target 1 ADHD*	*School 2 Non-ADHD (N=15) mean*	*School 2 Non-ADHD (N=15) st dev*	*Target 2 ADHD*
3-6 game	3.9	1.5	1	4.5	0.7	5
7-12 workshop	3.7	0.3	1 (mean of 2 questions)	4.1	0.2	4.5 (mean of 2 questions)

The children also rated how well they had collaborated in *JamMo* pair situations. Table 4.24 presents the means and standard deviations of positive collaboration in *JamMo* games and tasks for the schools 1-2 (non-ADHD children) as well as the mean ratings of the target children 1-2 with ADHD Figure 4.79 presents, the ratings of the non-ADHD children in School 1 as well as the ratings of target 1 (ADHD). In general, children in School 1 seemed content to collaboration in workshop *7-12*. The mean (3.9) of collaboration in game *3-6* is also quite high, but also the standard deviation is higher. In contrast with these results, Target 1 rated collaboration not succeeded with either of his pairs. Classroom Pilot study (Annex 4.3) showed that he had been used to work only with his best friend in classroom collaborative tasks, and during the *JamMo* classroom test he was not very happy to random grouping of pairs. In addition, it is possible that he was not motivated in *JamMo* games in general, because of the music therapy pilot study with the non-mature *JamMo* software and several system failures encountered. This target's own ratings are in contrast with the teacher's ratings about positive collaboration (see 4.5.2.2).

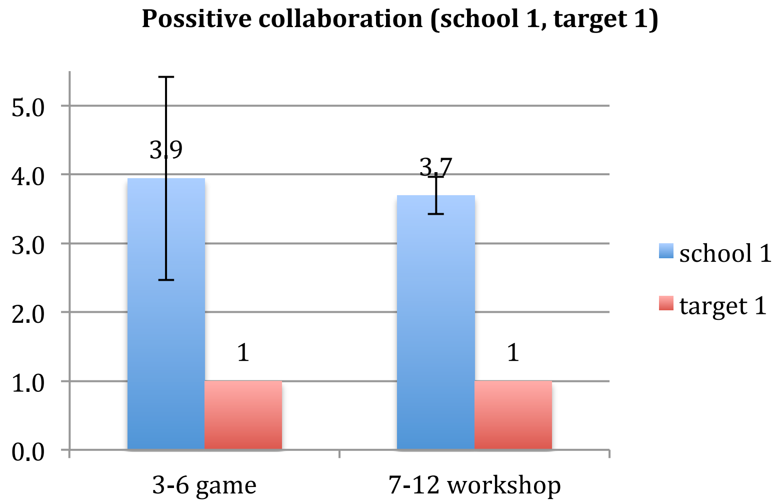


Figure 4.79: positive collaboration. School 1and Target 1.

Figure 4.80 presents, the ratings of the non-ADHD children in School 2 as well as the ratings of target 2 (ADHD). Children in School 2 seemed quite content to collaboration, especially in the game *3-6* but also in workshop *7-12*. Target 2 was very happy to collaboration in game *3-6* (rate: 5) and in the workshop (average rate: 4.5).

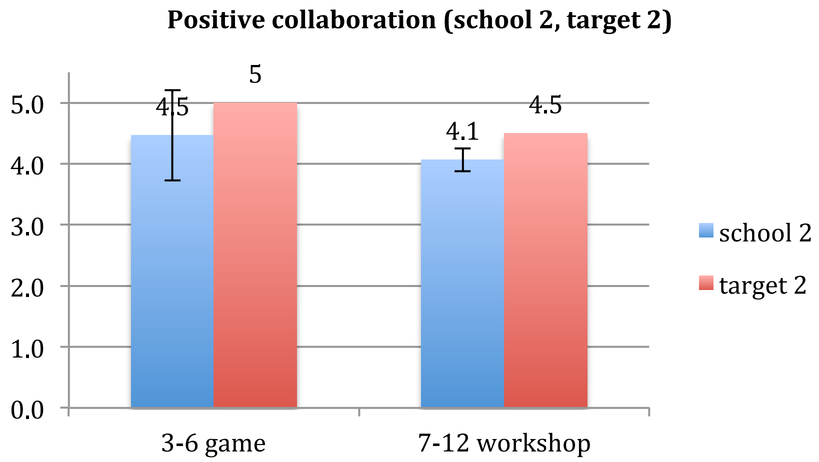


Figure 4.80: positive collaboration. School 2 and Target 2.

Enthusiasm to use JamMo independently (ADHD and non-ADHD)

Table 4.25: enthusiasm to use *JamMo* independently at home and with friends (ADHD and non-ADHD in Schools 1-2): means and standard deviations.

JamMo game and music	*School 1 Non-ADHD (N=18) mean*	*School 1 Non-ADHD (N=18) st dev*	*Target 1 ADHD*	*School 2 Non-ADHD (N=15) mean*	*School 2 Non-ADHD (N=15) st dev*	*Target 2 ADHD*
At home	3.4	1.6	2	3.6	1.7	5
With friends	3.2	1.5	2	3.7	1.7	5

Two questions measured how much children had interest to use *JamMo* independently after the classroom test. Table 4.25 presents the means and standard deviations of enthusiasm to use *JamMo* independently at home and with friends for the schools 1-2 (non-ADHD children) as well as the ratings of the target children 1-2 with ADHD. Figure 4.81 presents, the ratings of the non-ADHD children in School 1 as well as the ratings of target 1 (ADHD). It seems, that in general children were quite neutral about it, however differences between children existed, for the standard deviations are relatively high. Target 1 seemed not particularly interested in informal use of *JamMo* ar home (rate: 2) or with friends (rate. 2), both ratings being below average of the non-ADHD peers.

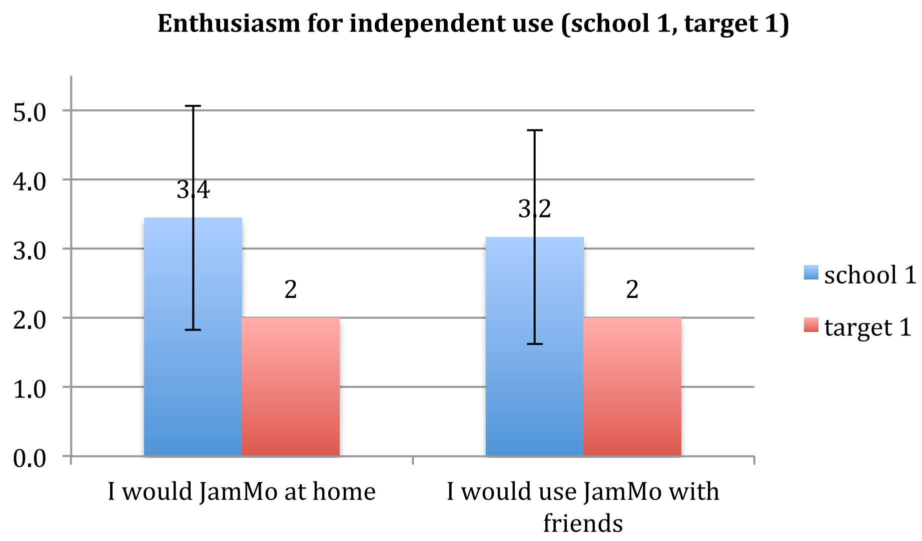


Figure 4.81: enthusiasm for independent use. School 1 and Target 1.

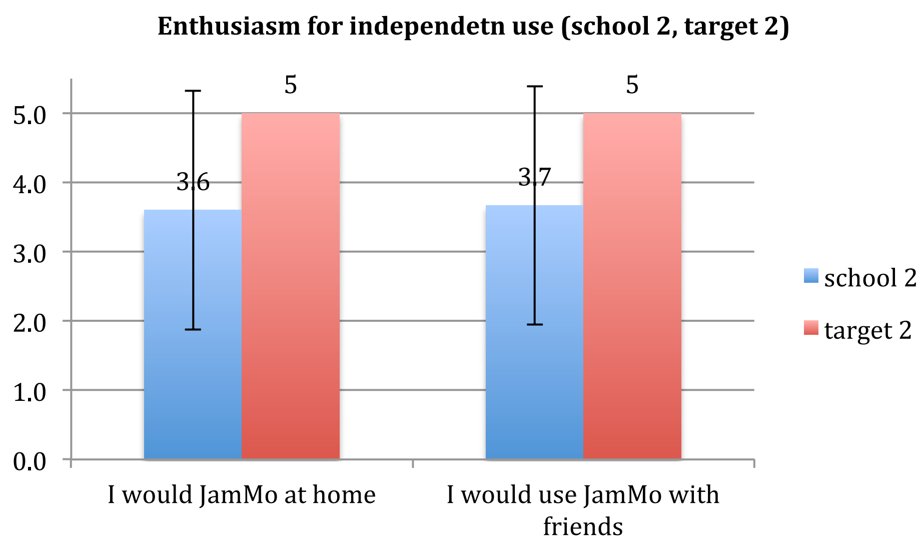


Figure 4.82: enthusiasm for independent use. School 2 and Target 2.

Figure 4.82 presents, the ratings of the non-ADHD children in School 2 as well as the ratings of target 2 (ADHD). Children in School 2 seemed a little bit more interested in informal use of *JamMo* than in School 1, however, the standard deviation is high. Target 2 appeared very much interested to use *JamMo* at home (rate: 5) as well as with friends (rate: 5).

Children's descriptions of their compositions

Children were asked to describe their compositions, which were made in *3-6* game, *7-12* game and in the workshop *7-12*. The answers of all children (N=35) were classified into positive, negative or other descriptions (Figures 4.83 and 4.84). In composition game *3-6* advanced (pair work), 76% of descriptions or attributes were positive, such as "cool, good, fun, nice" etc. Only 21% of attributes were negative, such as "dumb, bad, boring" etc. Some attributes (3%) were not positive, nor negative, such as "strange". Somewhat similar results were obtained of the *7-12* standalone game were obtained for the positive attributes, which were 70% of descriptions. There were less negative attributes (15%) than in the *3-6* game and more (15%) other descriptions. The results for the workshop (Figure 4.85) were different in the sense that 64% of attributes were positive, only 8% negative and as much as 28% were other attributes,. In addition to expressions like "strange" children described here also the musical genre or style, such as "Egyptian, heavy, rock" etc.

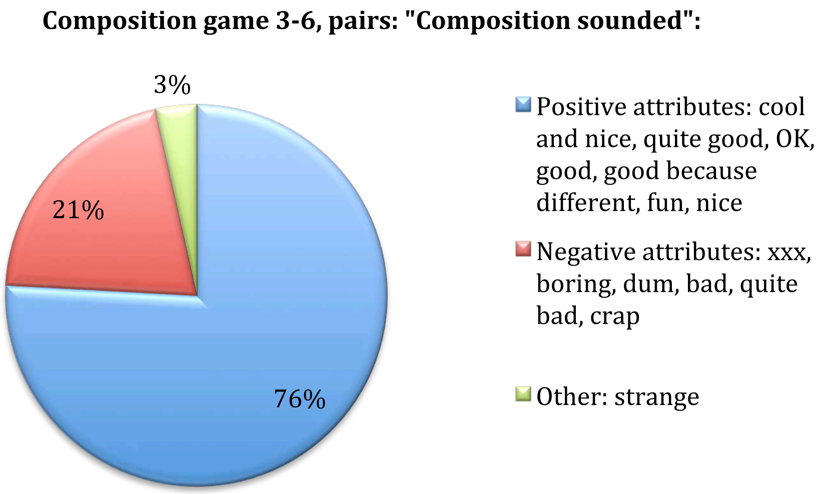


Figure 4.83: the children's (N=35) descriptions of their collaborative compositions in the composition game *3-6* advanced at lesson 1.

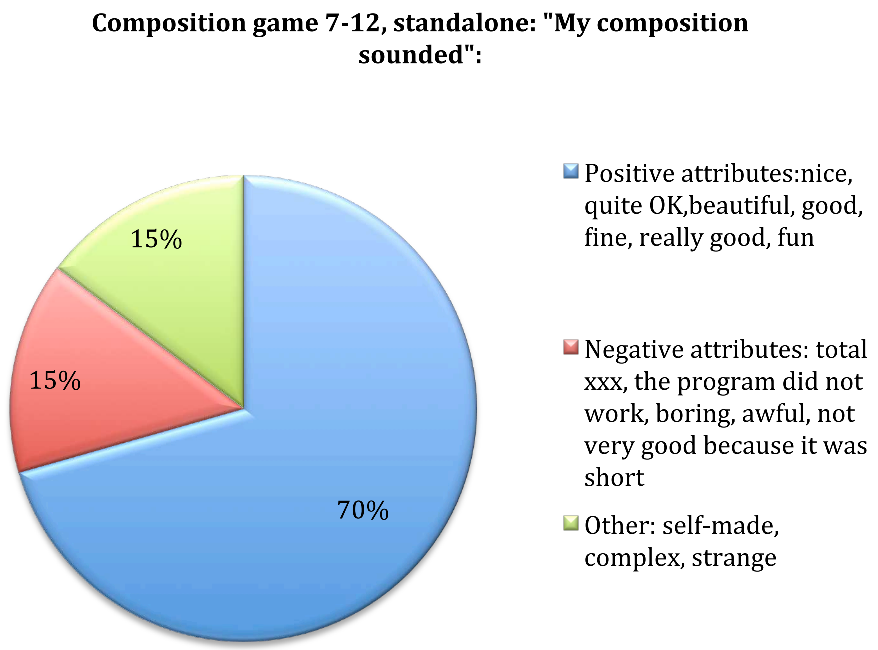


Figure 4.84: the children's (N=35) descriptions of their standalone compositions in the orientation game (composition game level 1) *7-12* at lesson 1.

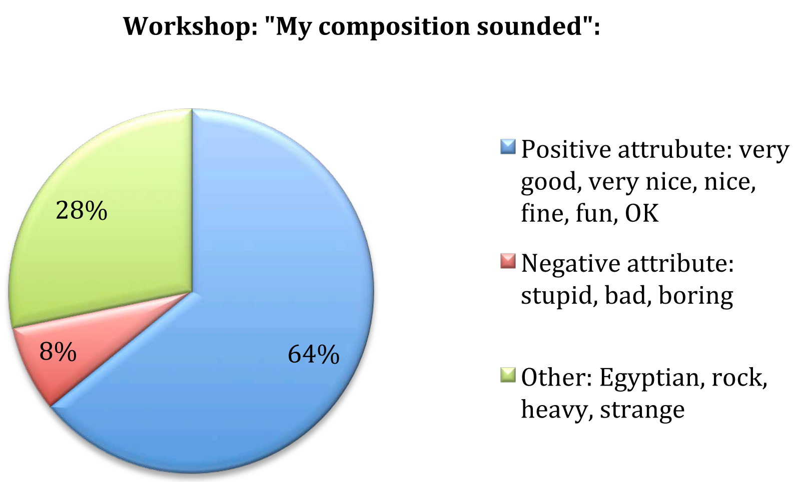


Figure 4.85: the children's (N=35) descriptions of their collaborative compositions in the workshop with *JamMo* sequencer at lesson 2.

Disliked features of JamMo or JamMo lessons

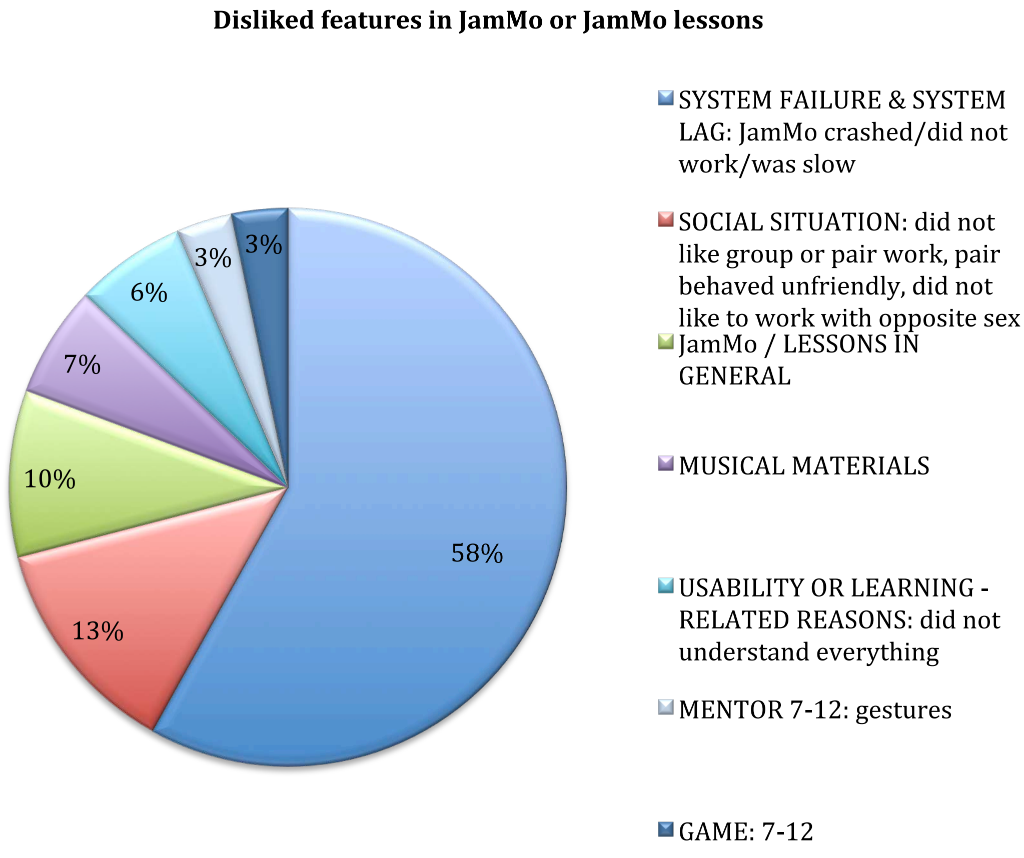


Figure 4.86: disliked features in *JamMo* in children's (N=35) descriptions.

In the question "What did not you like in *JamMo* or *JamMo* lessons? Why?" 6% of children (N=35) did not answer, 11% answered that they liked everything in *JamMo*, and 83% mentioned some feature they had disliked. Figure 4.86 shows that 58% of described features were related system failure or system lag: *JamMo* was slow to react or did not respond, or crashed; 13% was related social situation (the pair or working in collaboration). 10% to *JamMo* in general or in the lessons, 7% to musical materials, 6% to difficulties in understanding, 3% in the mentor and 3% in the games.

4.5.1.4 Children's perspectives on JamMo: Findings from Herborn, Hesse Region, Germany

The 30 children in the Herborn study only explored selected aspects of the *JamMo* and not the entire *3-6* games. However, they reported a liking for the *JamMo* songs that were used in the fieldwork and they greatly enjoyed recording, listening to the recordings and repeating it. A portion of the children were very fast in understanding the technical functions (such as buttons to start, stop and play). The most difficult part proved to be the saving a file function, as this needed an assignment of a symbol.

It seemed that, during the first steps, children understood the mentioned functionalities (i.e. start recording, stop and play), but they did not yet fully understand about how data (such as a sound file) could be stored and retrieved and that this implies some technical handling.

During the first phase (i.e. when exploring the technology), all the children showed interest and curiosity. Yet, about half of them were shy and needed encouragement to be active and productive. After this initial warming up phase, they felt freer to explore and to sing.

Overall, some children appeared highly interested in learning to handle the technical procedure to record, stop and to play the files, whereas others focused other aspects of the event, e.g. their own singing. The children managed the technical functions easily, except for saving and naming the recorded files.

4.5.2 Secondary user groups

4.5.2.1 Teachers' perspectives on JamMo: findings from London, UK

The London research fieldwork team were very pleased to have the opportunity to work with a highly enthusiastic and supportive class teacher for the duration of their Primary school-based fieldwork. The class teacher was happy to team teach sessions with members of the research team and pleased to agree that his pupils be regarded as co-researchers on the project, gaining as much 'hands on' experience of working with *JamMo* and Nokia N900 phones as possible. An experienced musician and ICT specialist, he had already used a range of music technology products with his classes in previous work. He was also reflexive regarding the ongoing developmental nature of the *JamMo* software and encouraged the pupils to report their views and feelings on the product in order that these might be communicated back to support the design and implementation teams. As a result of his pre-existing experience with educational technology, the research team were keen to gauge his overall views on *JamMo* at the end of the fieldwork activity.

Overall, the class teacher was very positive about both *JamMo 3-6* and *7-12*, despite their ongoing developmental nature. Although his pupils were eight to nine years, he felt that *JamMo 3-6* had still proved to be an engaging and worthwhile activity for this older age group. Moreover, the mobile phone platform was perceived to provide a particularly strong appeal with both pupils and teacher having a 'blast'.

As a whole package, *JamMo 7-12* was perceived by the class teacher to be 'good fun' with high quality musical materials (the Banana Boat song had proved to be a particular favourite with pupils and staff). The interface for this version of

JamMo was described as still a little too complex for his particular pupil age group yet this had not prevented good quality musical engagement with the software. A particularly important feature of *JamMo 7-12* was deemed to be the rapidity with which it was possible to generate a musical composition that 'worked' through dragging and dropping sound samples ('worked' was interpreted by the research team as implying a piece of music with recognisable musical conventions and qualities). Within a classroom context, the software had been most useful when the laptop screen was projected onto the classroom interactive whiteboard. Overall, pupils were reported as being enthusiastic throughout the process (though this began to ebb away towards the end of the fieldwork). In summary, he reported, 'I'd download it, it's a good little program'.

4.5.2.2 Teachers' perspectives on JamMo: findings from Jyväskylä, Finland

The views and backgrounds of the two participating music teachers were gathered with a questionnaire (see Annex 8.6.3).

The teachers' previous experiences of ICT in educational use

Teacher 1 (male, 50 years of age) had worked as a music teacher for 27 years, and Teacher 2 (female, 47 years of age) for 25 years. Both teachers were familiar in using computers in the classroom. However, neither had used mobile devices in educational purposes. Teacher 1 was familiar in using sequencer or notation software in the classroom and in free time, such as GarageBand or Sibelius. Teacher 2 was not familiar to this kind of software at all. Both teachers used computers and mobile devices as phones in free time. Teacher 1 was neutral about being familiar with mobile games. Teacher 2 was not familiar to these games at all. Both teachers were somewhat familiar with computer games.

The teachers' opinions about JamMo as an educational tool

Teachers (T1, T2) were asked about each *JamMo* element whether these games or tasks had been suitable for the whole class and for the target child with ADHD in the class. Both teachers regarded composition game *3-6* (pair work) suitable for the whole class (T1 rate: 4; T2 rate: 5) as well as for children with ADHD (T1 rate: 5; T2 rate: 4). The whole class was motivated in this game in both schools (T1, T2 rate: 5) as well as the target children with ADHD (T1 rate: 4; T2 rate: 5).

In similar, orientation game (composition game level 1) *7-12* was regarded suitable for all the children (T1 rate: 5; T2 rate: 4) and for the children with ADHD (T1 rate: 5; T2 rate: 4); and all children with (T1, T2 rate: 5) or without ADHD (T1, T2 rate: 5) were motivated in this game.

Similar ratings were obtained about the suitability of the workshop *7-12* with *JamMo* sequencer as an educational method for the whole class (T1 rate: 5; T2 rate: 4) as well as for the children with ADHD (T1 rate: 5; T2 rate: 4). T1 regarded, that the pairs and the groups in the class (rate 5) and the child with ADHD (rate 5) were motivated in the workshop. T2 was neutral about the pairs and the groups being motivated in the workshop (rate 3), and somewhat disagreed that the target boy with ADHD was motivated in the workshop (rate 2).

Both teachers completely agreed (ratings: 5), that they liked *JamMo 3-6* as well as *JamMo 7-12* as an educational tool of teacher. In similar they completely agreed on easy access of *JamMo 3-6* as an educational tool for the teacher. Also *JamMo 7-12* was regarded easy-to-use as an educational tool (T1 rate: 4; T2 rate: 5).

The two teachers agreed that *JamMo* had affected positively in the social interaction of the class at the three *JamMo* lessons (T1 rate: 5; T2 rate: 4). Both teachers completely agreed (ratings: 5) that *JamMo* had had a positive effect on the social interaction between the children with ADHD and other children (non-ADHD). In general, the class had collaborated well with *JamMo* (T1 rate. 5; T2 rate: 4). However, T2 agreed, that only some students' collaboration had been successful (rate 5); T1 somewhat disagreed in this statement (rate 2). Both teachers agreed that the collaboration between the children with ADHD and their pairs in pair work situations with *JamMo* had been successful (ratings 5). T1 also agreed about the collaboration between the children with ADHD and their peers the small group situation (workshop discussion) (rate 5); T2 was neutral about this statement (rate 3). Both teachers disagreed in the negative statement, that the collaboration between children with ADHD and other children was not so successful than at music lessons in general (T1 rate: 2; T2 rate: 1). Both teachers completely agreed to prefer using *JamMo* or similar application in the future in the music class (ratings 5).

In the open question about preparing oneself in *JamMo* lessons, T1 described having read the written lesson plans and instructions the researchers had delivered to the teachers, and having participated in the training, which was organised by the researchers. In similar, T2 described having participated in the training and studying the instruction materials, but also mentioned that she had had *JamMo* in use about for a week at home. T1 had used *JamMo* about 1 hour and T2 about 3 hours before the lessons.

Teachers gave also feedback about *JamMo*'s positive and negative features. T1 liked the clarity of the user interface. T2 gave positive feedback to *JamMo* for providing suitable learning materials for different levels of expertise, and she also liked the great amount of different sound fragments and samples. She would have been interested to test singing games, too. T1 was critical towards system lag, mentioning that the touch screen was slow, which made dragging and dropping the sound sample icons difficult in *JamMo 7-12*. He also mentioned that some concepts were not familiar to the children, such as 'the sequencer', and these concepts should be explained to children.

4.5.2.3 UK-based community musicians' perspectives on JamMo: a focus group

Colleagues from the IOE, UCLAN and LUT gave a presentation and practical 'hands on' demonstration to 23 delegates attending a *Sound Sense* Community Music Seminar in Waterloo, London on 24.03.11. The theme of the seminar was '*Social Inclusion and community music – high tech to homespun: Music work with all ages, with a focus on those in challenging circumstances*' and so it represented a particularly pertinent opportunity to report on UMSIC and demonstrate *JamMo*. Delegates were drawn from professional community music circles, practising in contexts such as prisons and young offender institutions, pupil referral units, clinical settings, special schools, units for adults with learning disabilities, arts outreach workshops, and mainstream schools.

The presentation began with a brief overview of *JamMo* and a series of demonstrations of the *JamMo 3-6* composition games (in both standalone and pair game mode) displayed via a data projector (Figure 4.88). There was then around thirty minutes of free experimental play in which delegates used N900s and two HP touchscreen laptops to try out *JamMo* versions *3-6* and *7-12* (Figure 2.9). Copies of UMSIC information leaflets were distributed and posters and recent newsletters were displayed. At the end of the demonstration, 15 delegates completed short questionnaires (see Annex 8.6.6) on their first impressions of *JamMo* and the professional contexts in which it might be applied.

The feedback received was detailed and thoughtful. The participants were asked about their initial impressions of *JamMo*, its potential application in professional and practical contexts, its perceived benefits for clients and suggested improvements for the software. Initial impressions were generally positive and encouraging ('Great research. It will do well commercially.'; 'It gives children self-confidence, such as makes them feel like they can make music.'; 'Brilliant!'; 'I think it's a great idea and a positive use of children's fascination with computer games and mobile phones.'; 'I like the visual aspect of it as I think it draws children in.').

Any initial concerns focused on the cost of technology and the slow speed of the software (at this time, the software was still being developed resulting in slow processing power). For example, concerns were raised on whether refugee children would have the needed technology for running the software programme. A further concern was the software's connection to enhancing feelings of social inclusion, and how this could be measured, given that children can easily be isolated in front of a computer screen.

A great number of ideas for how *JamMo* could be applied in different educational contexts were provided. These included using *JamMo*: in smaller group sessions with one to three pupils; with children who exhibited emotional and behavioural difficulties; in more informal learning contexts out of the classroom; as a tool to develop self-confidence in children; as a learning tool for teaching singing; as a tool to attract toddlers toward music; as an additional and contrasting tool to hands-on instruments when introducing children to the concept of shared music composition in an electronic world; as a tool to create packing tracks; as tool to facilitate easier and more accessible music technology composition work; as a tool to understand composition techniques; and as a tool to introduce a sequencer to slightly older children.

Since the participants worked in a range of educational and community settings, a variety of benefits for different types of clients were offered. In particular, children who exhibit special educational needs (such as emotional or behavioural difficulties and those with limited physical ability) were considered as potentially gaining significant benefits from engaging in activities that use *JamMo*. The touch screen on the mobile phone was regarded as beneficial for children who have autism, as it has similar function to iPads that have been found to be working effectively with such children. A few of the participants mentioned that, although the software had been developed with specific consideration for children who are newly immigrant or have special educational needs, the software is applicable to all children despite their diagnosis or status. Yet, a few other participants mentioned that *JamMo* would be of particular benefit to underprivileged children and children at a high risk of social exclusion (such as migrants and those living in marginalised communities). Early years educational settings were regarded as ideal places for using *JamMo*, in particular when young children did not have access to hands-on melodic instruments or could not share compositions with others via any other route. In addition to using *JamMo* with children, adults up to the age of 65, and in particular those adults who possess cognitive impairment, were perceived to potentially benefit from engaging in music making with the *JamMo* software.

Useful ideas for how *JamMo* could be improved were offered by the participants. The main suggested improvements centred around adding options for using different languages in the software in order to make it more accessible to immigrants (such as including options for Polish and Tamil). It was proposed that lyrics should be included in the singing game in order for the children to be able to learn the songs properly and this could also help them in improving their reading ability.

An additional element of including virtual instruments in the composition game that could be used in creating unique compositions from scratch was suggested. In relation to this proposition, it was also suggested that the word 'create' should be used instead of 'compose', as the type of compositions that the children did with *JamMo* resembled arranging to a great extent than actual new innovative compositions.

Subsequent to the workshop, the feedback received was delivered to the *JamMo* development team. They took it into consideration and adjusted the features that they were able to work on accordingly. The feedback that the team was unable to act on due to financial and time limitations are being kept in a secure place and will be acted on as and when the development of *JamMo* continues.

4.5.2.4 Educator's perspectives on JamMo, Zürich, Switzerland

Educators that participated in the study in Herborn welcomed the idea of recording singing, listening to the recordings and using them for instructing various aspects of children's use of their voice (i.e. speaking, pronouncing, singing, chanting, and other modes).

4.5.2.5 Reflections on the project by UMSIC project partners

Since UMSIC has been an inter-disciplinary 3-year project, UMSIC partners in the various fieldwork locations provided useful and thoughtful comments as reflective feedback throughout and in the end of the project under the umbrella term 'Lessons learnt'. Such feedback was gathered as field notes during UMSIC meetings and from email communication taking place between project partners.

The ethics advisor for the project commented that, despite the fact that it was not possible to address all the *JamMo* designs objectives, the project teams have been careful in proving the concept of the project across the board. The advisor recognised minor and major co-operative attitudes within the project that were managed well by the work package leaders. Furthermore, interaction between teams working for work packages 3, 7 and 9 was recognised as clear and as facilitating a comprehensive and integrated means of addressing issues related to the work packages that were inextricably linked.

The team members themselves stated that, provided the unexpected technological challenges encountered during the project, the quality of Finnish development team was exceptional and they rose to the challenge extremely efficiently by having come along way in a short space of time.

The research members generally noted that it is vital to work flexibly practical fieldwork research is being carried out alongside ongoing technological development. It is, therefore, essential to host collaborative activities (such as the school visit in London) in order to provide project partners with an opportunity to share ideas as a multidisciplinary team.

However, the project members also noted that there had been a limited budget for problem solving, resulting in difficulties in terms of opportunities for working with flexibility.

A further note was made by the UK project members who had attempted to carry out fieldwork with the younger age-group (*3-6*) at two different educational settings catering for specific immigrant groups (a play group for Polish children and a Primary school for Greek pupils). At the Greek Primary school, the Headteacher refused to allow the research team to carry out the sessions with the use of the N900 mobile phones/ handheld computers. She firmly stated that the parents of the children need to be asked specifically whether they allow their children to use mobile phones at school. The letter that had been sent to parents prior to organizing the sessions with the school had asked permission from the parents to allow their children to use mobile technology at school. However, the Headteacher said that the wording was not explicit enough for the immigrant parents to understand that mobile phones would be used during the session. This happened at a time when a research report on the harmful effects of mobile phones had just been published, likely to have influenced the Headteacher's decision. As a result of the negative attitude experienced at the school towards the project, the research team decided to conduct their fieldwork elsewhere. A similar experience was faced by the same research team at a Polish play group. The group leader and the parents of the children attending the play group said that they did not like the idea of using mobile phones during their play group sessions. They also stated that they did not like the idea of using a projector to play the games found on *JamMo* either. This approach was too similar to watching television. As a result, the research team decided not to pursue fieldwork at this setting despite the fact that, once the adults fully understood that their feedback on the game could be beneficial for its development, they showed a much more positive attitude towards the researchers. The incidents encountered at both places highlighted the fact that *JamMo* may not be suitable for children under the age of 5 or that their parents, carers and teachers may not be willing for their children to play with *JamMo*.

Overall, the research fieldwork conducted to date has suggested that the most important requirement related to ICT is having powerful enough computing resources to facilitate the chosen learning objectives. At the present, the selected mobile device (Nokia N900) is not powerful enough to perform all of the anticipated pedagogical design.

Project fieldwork has reminded researchers of the need to test educational software for long enough and as many times as is required for the product to be become mature. This is a particular issue for software intended for use with children with learning difficulties. Software stability was an issue throughout the much of the fieldwork conducted to date. Some children criticized the N900 phone version of *JamMo* for being too slow, crashing suddenly, getting stuck and not saving their products. The Ubuntu laptop version was much found to be much more stable, however, there were still crashes and this did disrupt both education and research. The random musical subtheme selection in the *JamMo 3-6* composition game (i.e. when returning to a 'city' composition theme, children would not necessarily be presented with the same sound fragments as the last time they used the screen) made discussion work hard. This was because teachers and pupils couldn't compare the themes back and forth. A further key requirement highlighted during field work was the need to be able to save and retrieve products from one session to the next. Some children had difficulties in the singing game *3-6* since it was not always clear when they should start singing. Additionally, children singing unfamiliar songs required additional support in learning the lyrics. A further requirement identified during the course of the fieldwork was a function to change the pitch and tempo to suit voice type. Some children did not find important navigation icons during work with the *7-12* composing game. The teachers criticized the presence of concepts perceived to be unfamiliar for pupils such as ‘a sequencer’ in *JamMo*. They also reported the N900 touch screen to be too insensitive.

Again following fieldwork, researchers have been reminded that the musical materials provided on games such as *JamMo* (specifically sound samples/fragments and backing tracks) have to be of good quality to keep children engaged and excited, since many young people’s expectations are very high these days. This had been anticipated during the design phase of *JamMo* and, whilst recording live musicians performances and editing musical materials formed a lengthy process, it was certainly worth doing.

Even though the *JamMo* software was limited by technology at times, it was useful as a means of promoting high quality discourse and reflection on music. Researchers reported having had a number of engaging conversations in the classroom with a high standard of musical vocabulary and level of analysis. Children respond very well to being involved in the educational process as 'co-researchers' and beta-testers. Researchers were clear that the software remained unfinished and that children's feedback was valued. As a result, they tended to overlook crashes and bugs and offered many good ideas and suggestions. Fundamentally, they were pleased to be involved in exploratory activities.

The UMSIC experience has suggested that there are some basic educational issues that should be considered in the design mobile music applications: 1) Schools may differ in their learning cultures, and these differences are reflected in mobile learning. Some researchers have found that children may need to be ready to collaborate in general within their learning before being ready to collaborate specifically with mobile devices; 2) Other researchers have articulated a need for clear task instructions to precede action, and for a clear rationale to exist as to whether children work with musical instruments or mobile devices; 3) Many children appear to respond enthusiastically to compositional tasks, particularly when they are structured and formed in suitable portions.

It seems that children are used to self-assessment and monitoring in their learning and that this is naturally extended to their experiences in mobile learning. Moreover, our research fieldwork has suggested that teachers are much more ready to use new learning environments than some years ago. As a result, we would suggest that there has been a positive change in attitudes towards new technology in music education.

Tips for music educators for developing mobile applications

- See the software in use with children - many problems can be identified/solved very quickly this way!
- Keep a good communication channel between the researchers in the classroom and the development team - and all other stakeholders.
- Have a multi-disciplinary team whose expertise can cover the whole music-education-technology-software development-research cycle.
- Study interaction methodology in multidisciplinary contexts!
- Apply professional software engineering know-how on how to manage such a process.
- Make sure that the focus is on continuous process improvement, rather then a waterfall-model in which progress is seen as sequentially flowing downwards process (like a waterfall) through several phases.
- Specify in detail, what children are expected to learn about music and with the software, and how each of the games correspond to these aims.
- Construct games and interactive settings that do not need any verbal instructions that are implemented within the software.
- The software developers cannot always predict how long programming will take – in a three-year-project three different games is too much to be field-tested as well
- Don't try to make your tool do too much. Keep it simple and make sure the technology can support your aspirations.
- Clear graphics are important in a small screen.
- Touch screen delay is too long for making music in real-time.

- Start with classroom realities and work out how the technology can assist/support - don't start from the technology and then 'impose' this on the classroom context.
- Involve children in the design and evaluation process.
- Remain flexible - be aware that your dreams and aspirations will have to be tempered by the realities of the technology, time available and classroom/curriculum requirements.
- Technical preparations of field tests (music lessons) take time.
- Educating the teacher to use the software in a pedagogical situation is essential, and the teachers' voice is important to be listened to.
- Teachers should get familiar with the software before the lessons, and prepare the lessons well.

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