MUSIC MAKING SOFTWARE PROGRAMS FOR CHILDREN FROM AGES FIVE TO TWELVE

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Tiivistelmä – Abstract

This research classifies the qualities in the existing music creation software programs that enable them to be operated by young users. This is done through comparison of the literature on musical development of children and the examination of the existing software. For the research were selected three fundamentally different pieces of music creation software that potentially provide a wide variety of features. The selected programs are GarageBand, Songsmith and Groovy Music.

Each of the three programs has its own strengths in benefiting children's musical development in different ages. What all programs share is the ease of use and a clear interface. Icons of the functions help navigating the software with less effort. Each of the programs offer an easy start up, after which the user can find more settings and possibilities as he or she advances.

The three pieces of software described in the study each have something new to offer for the field of music education. The ease of creating new music without the conventional know-how or ability to play an instrument can be very inspiring for users of any age. The software programs may also work as a gateway for other musical interests. It is also possible to study music theory independently with a help of software program.

Asiasanat – Keywords: software, children, music, GarageBand, Songsmith, Groovy music, music technology

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CONTENT

1. Introduction

The aim of this research is to provide information for EU-project UMSIC about the music making software programs for children from ages 5 to 12. Usability of Music for Social Inclusion of Children, UMSIC in short, is an international research project aiming to develop an abreast, reasoned and accessible music creation software in order to research ways to support children's social inclusion. The project has basis in the increasing amount of research evidence of the positive effects in the early promotion of musical competences.

The final product of UMSIC in its tangible form is a mobile device with a functioning and versatile music making software. The software will be used on a palm computer equipped with network functions. Final software will have both stand-alone and networked environments. The learning and music making material will be designed age sensitively so that the content takes in to account the existing skills of the user. Informal communication with peers in open networked interactive environments will be encouraged.

In this research I attempt to classify the qualities in the existing music creation programs that enable them to be operated by young users. This will be done through comparison of the literature on musical development of children and the examination of the existing software. For the research I selected three fundamentally different pieces of music creation software that will potentially provide a wide variety of features.

I first go through the children's musical developmental stages, then extract the attributes of the existing music making software, and finally attempt to find similarities between the two. In the end of the study I conclude the observations.

2. Musical development of children

2.1. Development in first months

Child's auditory system starts developing already in the womb and is functional four months before birth. Fetuses beyond 28-30 weeks react to external acoustical stimulation, especially maternal speech sounds. Prenatally heard sound environments and repetitive sound sequences such as musical pieces or recurrently read fables may be recognised by the born baby, creating similar affections to those experienced in the womb. (Lecanuet 2003, 24-25.) For example a mother who sings during last months of pregnancy equips the fetus with primitive musical data. This phenomenon contributes to transferring musical abilities of parents to their offspring. (Sloboda 2005, 267.)

As the inner ear is mostly mature at birth, the auditory system develops rapidly for the first two years and gradually up until ten years of age. Young infants respond better to higher pitched noises than of low frequencies. Infants can detect frequencies of 4000Hz and above with same or even better sensitivity than adults, but the detection of variances in low-frequency region develops during the first years. This process of maturation of senses goes hand in hand with the development of central nervous system and auditory cortex. Also the physical measures of the outer ear and ear cavities change hearing qualities in later years. (Fassbender 2003, 68-70.)

One of the first developmental tasks for infant's auditory system is learning how to separate perceivable patterns from their sound environment. This in general means the ability to separate speech from the background noise and to separate words within the speech. These skills are acquired after the infant's first months and keep improving from that on. The frequency separation moves through similar stages. (Fassbender 2003, 76-77.) Same abilities have to be developed for musical content before reproducing music oneself is possible.

In all, an infant can acquire basic capabilities to differentiate and process global patterns of musical stimulation in very early stage. After only first months infant is able to distinguish small variances in frequency, amplitude, and the harmonic spectrum. The separation of sound elements is detected by an infant in terms of duration, length of pauses, and tempo. Direct

speech and rhythmic cues further enrich the stimulation and help to further develop infant's auditory system. (Papousek 2003, 88-101.)

Sensorimotor development is one of the gateways of learning in general. In the first year of infant's life most of information is gathered as an observer. Many of the observed movement has a certain tempo to it. For infant this information is used to construct guidelines of movement in general, as for example walking and talking require temporal consistency in order to work. Concious temporal decision making has been proved to exist on infants of only four month of age. (Pouthas 2003, 115-119.)

2.2 Early years

In musical development certain phases can be distinguished. The phases rely on the cognitive foundations of each developmental stage and can evolve partially overlapping, as on contrary some abilities can mature ahead of others. (Hargreaves 2003, 154-155.) Musical stimulation has been also proven to profoundly contribute to later cognitive functioning. The reason for this may be the versatility of the data that musical stimuli characteristically contains. (Sloboda 2005, 266-267.) David Hargreaves has created a model which is build on age-related development. The five phases in developmental order are sensorimotor, figural, schematic, rule systems and professional. (2003, 154-155.) (Table 1.)

Phase	Age	Singing	Graphic representation	Melodic perception	Composition
Professional	from 15 on				Enactive and Reflective strategies
Rule systems	8-15	Intervals, scales	Formal-metric	Analytic recognition of Intervals, key stability	'Idiomatic' conventions
Schematic	5-8	'First draft' songs	Figural-metric: Multiple dimensions	Conservation of Melodic properties	'Vernacular' conventions
Figural	2-5	'Outline' songs	Figural: Single dimension	Global features: Pitch, contour	Assimilation of Cultural music
Sensimotor	0-2	Babbling, Rhtyhmic dancing	Scribbling: 'action equivalents'	Recognition of Melodic contours	Sensory, manipulative

Table 1. Five stages of musical development. Hargreaves and Galton 1992

Sensorimotor phase takes place in the first two years of life when the majority of development has to do with acquiring physical skills and co-ordination. In this phase infant learns how to attain control of the body. As the infant is not yet capable of understanding

abstract symbolism the stage is largely presymbolic. The child has an eagerness to sing and perform, which is expressed as babbling and rhythmical dancing. In this phase a child can recognize melodic contours and the composition is centred around experiencing and learning how to produce sounds and rhythmical sequences. (Hargreaves 2003, 156-158.)

Around the 18th month infant begins to understand symbolic cues. This gives the child the ability to comprehend objects and events that are not in immediate surroundings. This is the beginning of figural phase which lasts up until the age of five. As the child learn to speak new content and spontaneous ideas are introduced to singing. (Hargreaves 2003, 156-159.)

Spontaneous singing usually starts emerging around the first 18 months. First songs can be loose imitations of existing heard tunes, or improvised repetitions of syllables and changes in tonality are sparse. The child finds new ways to use his or her voice as the vocal abilities develop alongside with physical development of the child. The singing changes its form and the spontaneous singing transforms into more conformed form after child's first three years. Tonal melody and pulse become more regular and structured in singing before age of six. (Paananen 2003, 28-30.)

Typically the lyrics work as a guideline for a song and most 3 to 5 year-old tend to rely on lyrics. Improvised singing in this phase is also commonly based on series of words and make up lyrics and syllables. Singing cultural songs requires an all-rounded skill set consisting of accurate pitch control, understanding of the song's tonality and rhythmic pulse. Most children in this phase cannot yet reproduce songs with ease, as the competences have only began to develop. (Hargreaves 2003, 158-162.)

Children reach the next phase in around age of 5 to 6. In schematic phase the conventions used by adult musicians are introduced to the child's selection of musical tools. Singing more complex melodies becomes possible as tonal skills and physical vocal control develop. In studies where children were asked to write down a short melody, some children of six years were able to distinguish more that one dimension of musical properties such as duration and pitch. (Hargreaves 2003, 162-164.)

Child's cognitive development relies on previously learned skills and gained knowledge. Steadily internalized concepts become self-evident and actions become automated, effortless. As these solid skills require less and less capacity, more difficult tasks can be performed. (Case 1992, 368-671.)

2.3 Development from the age of six years on

In Hargreaves' grouping the next phase, rule system, is reached in the age of eight and lasts up until age of fifteen. During this phase children can learn to fully comprehend the conventional musical concepts of music and attain skills such of adults. The represented musical ideas can now have content outside of child's own life and tangible experiences. Singing becomes interval and scale oriented and the Western tonality becomes internalized. Perception of music gains analytical qualities, and skills for composition of music become gradually more versatile. (Hargreaves 2003, 164-165.)

Professional phase, the last of phases may be reached in mid-teens. The musician now has a wide variety of skills to work with and is able to independently modify the conventional manners in order to serve the personal objectives. This level may only be achieved by systematic practice and does not apply but to musically centred people. (Hargreaves 2003, 165-167.) The commonly viewed professionalism in terms of music is complex mixture of technicality and handling of an instrument, and of expressive talent (Sloboda, 2005, 267). It is also possible to possess strong musical understanding with out skills to perform music.

3. Music making software programs

In this chapter I go through the three software programs that were chosen for the study. Each program features a different way to create music and is thereby aimed for different target group. The one thing common with the programs is the potential usability by young children. The properties that contribute to the ease of use are the main subject matter to be extracted. As the programs differ greatly I have not grouped the observations in similar sections but explained the functioning of each program as an unity.

3.1. GarageBand

Apple's GarageBand is an application designed for easy creation of music from sampled sounds and new content. The software comes equipped with a large library of software instruments and MIDI- and audio loops. Loops are short single-instrument recordings, which can be layered and repeated seamlessly on a timeline. Software also allows recording audio with an external microphone or any other sound source, making singing and playing instruments possible in the music making process.

The software has become notably popular since its release in early 2004. It comes as a part of iLife software bundle on Mac computers and offers an easy way for even beginners without any musical experience to create music. GarageBand offers many of the qualities seen on professional sequencer programs but with limited options. This way learning the program is much easier as there are less moving components.

The software has over 50 software instruments - often called virtual instruments - that can be controlled with a MIDI-keyboard or even with an ordinary computer keyboard. MIDI stands for musical instrument digital interface and is generally used in applications to send controlling data between devices and software programs. The sent data consists of numerical note values that can be changed by the user without losing any sound quality. Due to properties of MIDI data it is also possible to alter the ready made MIDI-loops within the GarageBand's editor or create new control data with a mouse.

Software instruments are either created by recording small samples of real instruments and playing them back on a cue, or through sound synthesis. Better virtual instruments can have thousands of recorded samples giving the virtual instrument a wider performance range. Software instruments using sound synthesis create the sound by layering multiple sound waves and often aim to produce unrealistic sounds. The software instrument library of GarageBand has a wide selection of common instruments ranging from pianos and keyboards to string instruments, percussions, orchestral instruments and banks of soundscapes, but also an impressive collection of synthetic software instruments.

Standard version of the program has more than a thousand sound loops. Loops are short musical ideas recorded as audio or compiled in MIDI. The quality of the loops is very high and the instrument range versatile, making it possible for the user to come up with creative combinations. There are also expansion sets available with more loops and sound effects. The tempo of the song can be adjusted freely and the loops adapt for the selected tempo automatically. Same applies for the pitch changes. Major changes in tempo and pitch decrease the sound quality of the audio loops, but MIDI-loops suffer no quality-loss in the process.

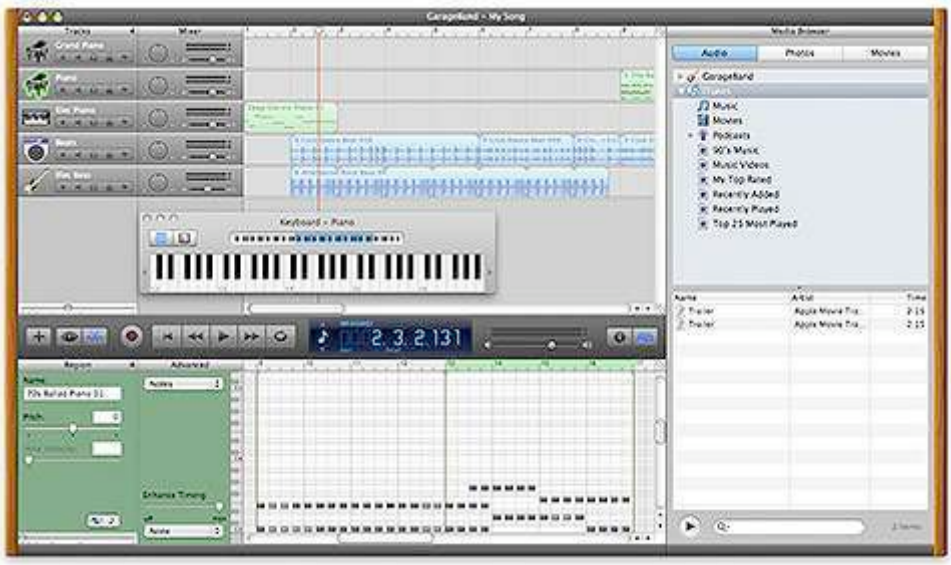
The usual procedure for building up a song could go as follows. Firstly the user selects a tempo and key for the song. Now an empty arrange window is displayed and the user can start dragging loops on the compilation, often beginning with a drum pattern or other rhythmical idea. The user selects to browse drum loops only and is given roughly two hundred beats to choose from. After selecting a beat the user drags the loop on the arrangement where it can be repeated or fine tuned to user's liking. Now the user chooses other instrument for the song and browses through other loop libraries. Often after the creation of the rhythmical background, harmonic and melodic instruments are added to form a song structure and mood for the song. Typically this is when a vocal track or a lead track would be recorded. Now the user is ready to mix the song by changing volume levels and panning of the tracks and by adding effects on the tracks.

Once the user feels that the song is completed he can create a mixdown of the song in just few clicks. In mixdown the song is turned into a single encoded file that can easily be played

back or uploaded online. GarageBand users have created several online sites for song uploading and sharing. Also troubleshooting and learning forums where beginners can find tutorials, both written and video, are numerous.

The user interface of GarageBand is uncluttered and there are very few distracting elements visible. Each track on an arrangement has a symbol of the instrument used on the track. Most frequently used menus also have a symbol indicator. Different functions are organized in groups and it is possible to hide the unnecessary parts of the tools and options. Hiding and revealing option windows is animated, which helps to understand where to look for the missing window. The basic interface is mostly visual with only a little of visible text. Menus for advanced functions are hidden until opened by the user. (Picture 1.)

The process of making music in GarageBand is constructive – building a track for each desired instrument and layering them on top of each other. All the parts of the music can be copied, pasted, duplicated or removed. Simple effects such as reverb, compression and equalizing can be adjusted separately for each track. All tracks have also individual volume and panning controls.



Picture 1. Interface of GarageBand

A new version of the software has been presented annually, with each update adding features and materials. Where ´08 version introduced a so called jamming function, the ´09 version comes with a new learning feature. The feature allows user to watch the tutor teaching the song, simultaneously having the visual information of how to play. The user does not need to know how to read music as the "notes" are show directly on the representation of the instrument.

GarageBand also enables video scoring. The movie is first imported into the arrangement and is then displayed on the timeline with the tracks of the song. GarageBand is designed to work fluently with iMovie, another software that is delivered in the same bundle as the GarageBand. This video editing software shares the simplicity of GarageBand and thereby enables the possibility of making audiovisual projects.

3.1.1. Use of GarageBand in research

GarageBand has been used in various research projects. This is evidently because of the easy-to-use interface and wide availability of the software. The sound material and loop libraries that GarageBand comes equipped with enable all-rounded use.

One of such research projects investigated the appropriation of GarageBand as a music creation software in an informal ad hoc environment. The age of the participants ranges from age 12 to 17. The research team got results that show GarageBand as a software that can create a "safe" space for creation experimentation, without fear of consequences of decision making. The interaction with the software as a medium was collaborative, unstructured and social.

3.2. Songsmith

Songsmith is a singing centred music composition software developed by Microsoft. The program was first published in early 2009 and was marketed with slogan: "Everyone has a song inside". Principally the software creates a background for any tune sung in the computer's microphone.

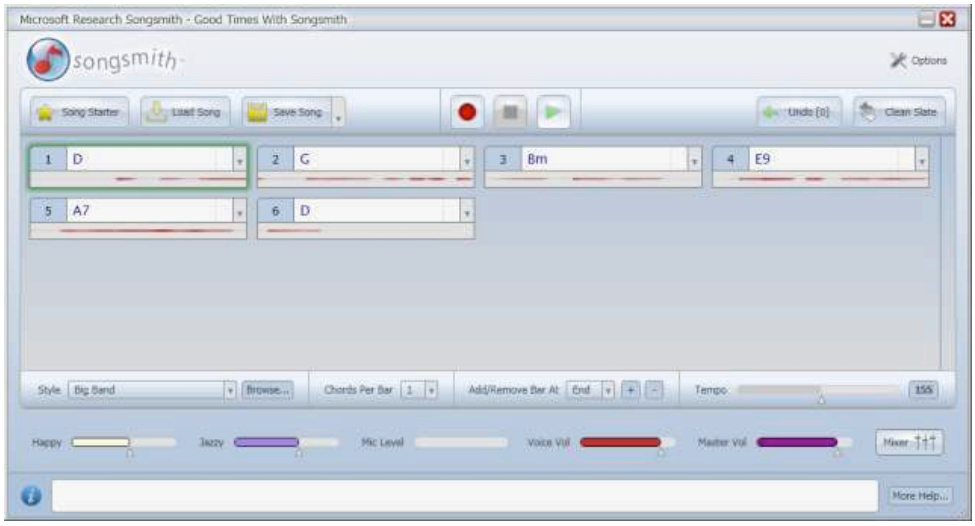
In the beginning of a session the user is first requested to select a song style and tempo for the song. There are 30 song styles to choose from, ranging from pop to rock to jazz and so on. Each music style has also a mood switch for softness and hardness. The tempo is set accordingly from 60 beats per minute up to 240 bpm. A sample of the music style with the selected settings is played through the decision making, but after the user has confirmed the selected options the program becomes quiet. The user now only needs to press a recording button to start recording.

As the recording begins, a count-in of two measures is played and a metronome keeps going. No other music is played in the recording mode and the user is to sing his tune freely on the rhythm. When the user is done with singing the tune he stops the recording and the program is immediately ready to play the tune back with a background fitted for the sung tune.

The software detects the frequencies of the recorded tune and thus calculates the key of the song and finds a suitable chord progression. The backing track is created with multiple algorithms calculating MIDI control values for the virtual instruments of the selected music style in relation of the recorded tune. After recording the tune the user is able to make changes in the predefined settings he made before the recording. In addition to changing the song style, mood and tempo, it is possible to alter the chord progression manually. It is also possible to re-record the tune on top of the generated background.

The user interface of Songsmith is clear and the controls are distinctive. Buttons are fairly large and it is easy to navigate through the primary options and commands. Options are controlled through various slides and pop-up windows. Primary commands can possibly be learned without being able to read, but many of the controls have written directions. In general the software is easy to use and to get started with. (Picture 2.)

The sounds on Songsmith are sample based MIDI instruments that serve the purpose of the program. Samples are of high quality but have a characteristic more of sound synthesis than of real instruments. This is however no problem for the intended use.



Picture 2. Interface of Songsmith

The finished songs can be saved in lossy Windows Media Audio (WMA) or lossless Waveform Audio (WAV) formats. MIDI exporting of the background is possible, which is a useful feature for advanced users. It is also possible to export the song into Windows' video editing software, Movie Maker, to create a music video for the song. At this time there is no direct way to share files online though, and no Songsmith forums can be found for file sharing. This can be due to the recent publication of the software.

Songsmith was created to be accessible to novices and to serve as a practical tool for more experienced music makers. As it is possible to quickly create simple chord progressions, the software could indeed interest a narrow population of musicians. More so the software offers musical entertainment for families with children, encouraging music making and singing in an entertaining way.

3.3. Groovy Music

Groovy Music is an educational music software package created by software company Sibelius. Software comes in three age defined sets and is aimed for 5-11 year old children. The software is designed to serve as a tool for teachers and parents in teaching music theory and igniting creativity of children.

The software comes in three age categories, of which all have a different setting of content and visual surrounding. Groovy Shapes for ages 5 to 7 aims to teach children the basic music concepts. Musical elements, such as rhythms, melodies and chords, are represented as colourful shapes. This is a method to conceptualize music into a lesser abstract, more tangible symbols that can later be replaced with standard symbols and concepts of music theory.

In all three programs the user logins with an avatar character which is chosen in the first session. The program remembers what the user has done previously and what kinds of activities have been completed. In all three age groups the user is awarded for going through the exercises and receives bonus activities and sound effects to be used in compositions. This is also a way for the supervisor to keep track of the progress.

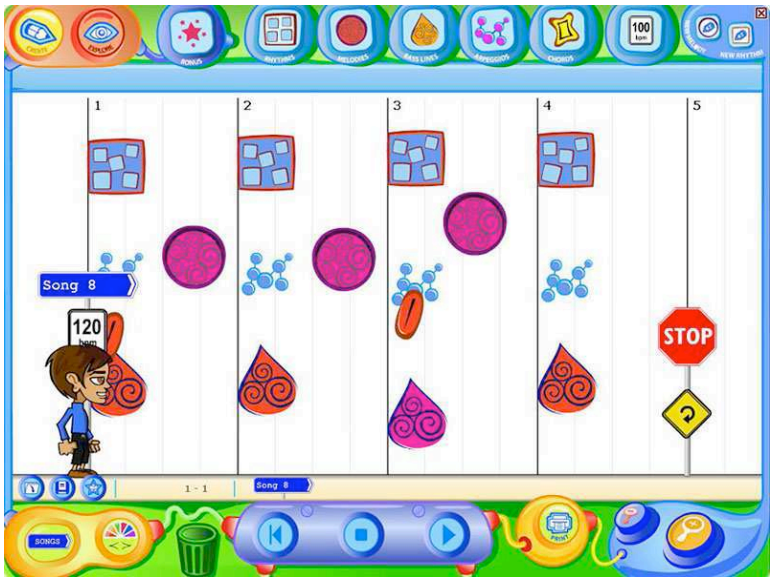
As the child works with the software, he is always given either a written or spoken feedback by the program. The tutor in the program also tells what to do in each of the exercises. Every time a task is completed, the software cheers the user and encourages to go on. This all adds to the interactivity and contributes to the sensation of succeeding.

In Groovy Shapes one of the game-like tasks the child is to assemble shapes on a timeline that is divided in even parts. On the left side of the screen the avatar character of the user waits until the assembly is complete and walks on command through the assembly. The shapes represent the elements of music and are played as the character moves past them, creating music as he goes. This is an elementary version of a sequencer application and gives the user a basic understanding of creating music in a constructive way. Similar setting is repeated in more detail and greater length in following age groups. Other parts of the Groovy Shapes go through musical concepts such as sound colour, dynamic changes, music terms and symbols. All of the instructions are given aurally by the software itself and no reading is required to use Groovy Shapes. (Picture 3.)

For ages 7 to 9 the setting is changed to a jungle. As the symbolism is still strongly applied, in Groovy Jungle the theoretical content is connected to musical notation. Concepts introduced in previous age group go deeper and are represented in common musical symbols. Groovy City is the last of the three programs. It is aimed for ages 9 to 11, and takes place in a

futuristic city. As in Groovy Jungle the sounds are taken from the wilderness, Groovy City sounds are more urban and industrial. Music theory is taught through visual examples and notation has bigger part than in previous age groups.

The user interface is very simple and easy to use. Big buttons and clear instructions make sure that the exercise can be carried out. The overall view is colourful and clear. Groovy Music uses General MIDI technology and sound material of 128 instruments, of which all are created through sound synthesis. Most of these sounds are not good and sound out of date. When multiple sounds are played together the result can sound tangled. Samples of music and instruments are however in audio format and sound good.



Picture 3. A composing game in Groovy Shapes

Groovy Music software package has been designed to support the standards for primary school music education in United Kingdom. Teachers are offered free lesson plans to use with each program. Program has also some features for class room use and it is optimized for interactive whiteboard.

Sibelius offers a forum online for uploading songs that are created with the program. On the website the composition can be seen with all the visual information and played back as it is on the software. On the forum users can give and receive feedback from other users.

In general Sibelius' Groovy Music software is very easy to use and offers some great tools for teaching musical concepts and notation. The visual design is colourful and distinctive, with big buttons and few written instructions. The tireless tutor helps the user to go through the exercises at an individual speed, which gives the user the change to work on his own. Mostly the exercises seem like fun tasks and little games that discreetly teach a valuable lesson.

4. Analysis

Each of the three programs has its own strengths in benefiting children's musical development in different ages. What all programs share is the ease of use and a clear interface. Icons of the functions help navigating the software with less effort. Each of the programs offer an easy start up, after which the user can find more settings and possibilities as he or she advances.

4.1. GarageBand

GarageBand is the most advanced software of the three. Even though GarageBand is relatively simple software to use, it is a gateway to more extensive sequencer and music making programs. As only the basic functions needed to create a piece of music are visible at all times, the software offers tweaks and options for more advanced users.

Creating music using loops is a constructive way to make music. It teaches the relation of rhythmic and harmonic patterns giving extensive field of possibilities to mix and match different styles. As the software enables recording singing and playing, it is also possible to bring together user´s own performance with the compiled background. This gives numerous possibilities of group work and collaboration, also prolonging the time of interest for the program. New musical material can be created by the user, and the quality of the recording is improved as the user becomes more skilled.

The user does not need to be able to create everything by oneself, but can create only as much as wanted. As the skills mature the software offers more challenges for times to come. The process of music making may change as the user´s skill advance. Skilled GarageBand user will already be well aware of the more professional music making practises by the time that the limitations of the software insufferable.

4.2. Songsmith

The Songsmith software encourages singing in a new and modern way. Singing is one of the first and easiest ways for child to create and perform music, and it starts naturally for most. The difference with Songsmith and other software is that in Songsmith you sing first, and discover the whole musical piece afterwards. This process can be very encouraging and fun, and makes singing seem more like a game or play. New ideas for tunes may rise from the possibility to change the backing track style to something else that the user would otherwise have thought of.

As the songs are recorded and saved it is possible to go back to songs created earlier. This way the user can recognise the progress looking back to older songs. Previously created songs can also be re-recorded afterwards, making it possible to improve the songs further.

The software is mostly a one purpose tool, and probably will not alone be enough to satisfy musical wants and needs of a keen young musician. That being said, the program can be stimulating, enriching and fun music making tool for anyone. For many singing a tune, let alone improvising one, may be too much to ask for, but Songsmith may well lower the threshold.

4.3. Groovy Music

Groovy Music has a lot of potential to function as an instructor in music theory and practises. One of the best aspects for using computer as a tutor is that computer never tires and the user can keep working and practising as long as it feels good. Also the tutor always remembers to award the user after each success, both verbally and with extra material for songs. Possibility for learning the software without reading opens the possibility to use the software for the youngest users. The tutor helps past difficult tasks and suggests ways to move forward when the user faces problems, which is a great addition to usability for young users.

The game-like features make learning music fun and helps to build a positive image around studying music. The picture-book-like interface is inviting and suites for the intended audience. The basic sequencer works with colourful shapes and small pictures that each have

a sound attached to it. Figurative concepts are later given universal names and function in music. This may well be a more inspiring way for children to learn music theory than older conventional ways.

The software is designed to serve as teacher´s aid through the elementary school and it offers extensive and age sensitive entity to learn and explore the Western musical standards. The option to share the created music with other users online, makes possible to give and receive feedback. The feedback can be rewarding, encourage music making, and benefit social development.

5. Conclusion

Technological applications are developing fast and many children become competent computer users at young age. These two pieces of information combined equal to the possibility of using technology as an aid in teaching. It has already began and will inevitably grow as a trend.

The three pieces of software described in the study each have something new to offer for the field of music education. The ease of creating new music without the conventional know-how or ability to play an instrument can be very inspiring for a user of any age. The software programs may also work as a gateway for other musical interests. It is also possible to study music theory independently with a help of software program.

The selection of software programs is already extensive and widely available and is constantly growing. The awareness of the programs is nevertheless relatively minimal. Software applications will never take away the need of teacher based eduction but may already benefit the school environment.

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