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Didaktik informed teaching arrangements in preschool exemplified by multivocal music teaching using digital technology as a tool

Holmberg, Ylva

https://orcid.org/0000-0002-4606-5112

ylva.holmberg@mau.se

The digital era has changed how children experience music. Few studies have been undertaken from a didaktik perspective with a focus on digitalized music teaching in the preschool setting. The *purpose* of the article is to develop knowledge of what can characterize music teaching using digital technology as a tool in the preschool from a didaktik perspective. In a research and development programme involving 19 preschools/departments, preschool teachers co-planned, conducted, and co-evaluated music teaching. The empirical material consists of 19 co-plans, 3.5 hours of video and 18 co-evaluations of music teaching. The analysis used an abductive approach. First, an empirically based analysis highlighting words in relation to didaktik questions was undertaken, followed by a theory-based analytical path using music didaktik concepts. The results show that music teaching using digital technology as a tool can be divided into two main tracks: one in which recorded music serves as a basis, and the other as a facilitator of music creation. Although music teaching using digital technology as a tool poses knowledge-, experience- and technology-related challenges for teachers, the digital age nevertheless opens up opportunities for creating and preserving music in preschool. The analysis culminates in two didaktik models for "multivocal digitalized music teaching".

Keywords: Didactics, digital, multivocal, music, preschool teaching.

1. Introduction

Of all 1–5-year-old children in Sweden, 85% are enrolled in preschool (Skolverket 2020). Swedish preschool places itself in a Nordic tradition with welfare state ambitions that are highly ranked in international listings (OECD, 2017). In 2010 the concept of teaching in preschool was introduced in the Education Act (SFS 2010:800) and in 2018 the teaching component was strengthened in the curriculum for preschool (SKOLFS, 2018:50. Preschool teachers are now expected to direct children's attention in goal-directed actions and processes. The content of that teaching refers to the Education Act: "such goal-oriented processes that, under the guidance of teachers and preschool teachers, aim at development and learning through the acquisition and development of knowledge and values" (Skollagen, 1 kap § 3). Teaching is to be planned and conducted based on the interest shown by the children and their everyday activities, experiences, and knowledge (SKOLFS, 2018:50). Prior studies of music and preschool education in Nordic and Swedish preschool research have usually focused on learning rather than on teaching (Holmberg & Vallberg Roth, 2018). Biesta (2017) points out that learning is an individualistic term that refers to what individuals do. It is the individual who learns. Teaching, on the other hand, is a relational concept that presupposes a relationship between someone teaching someone about something (Biesta, 2011). Little research has been done in the field of Early Childhood Music Education concerning the actual teaching and theorization process (Young, 2016). There seems to be a knowledge gap and therefore a need to clarify how (music) teaching can be conducted in preschool.

In our digital age, children grow up with and are increasingly exposed to various digital devices and innovative technologies. "Technologies can be framed and analyzed in terms of artefacts, practices and social arrangements" (Lievrouw & Livingstone, 2008). In the present article, digital technologies can be exemplified by music from or made in computer boards and apps, in music teaching activities in preschool settings. The presence of technology, both at home and in the school, is becoming ubiquitous, dramatically changing over the past few years how children experience music (Rajan, 2014). As early as 2001 (p. 78), Prensky called students the "digital native" generation because of all the time they spend on the internet, videogames, iPhones, and iPads. The notion of the "digital native" was later questioned by, for example, Selwyn (2009) who claims that empiric research shows that young people's interaction with digital technology varies considerably.

Even though the education system is criticized by Selwyn (2013, 2017) for inviting the use of digital technologies in an unthoughtful way, in many countries, the infiltration of technology into preschool continues to evolve (Sullivan & Bers, 2018, p. 227).

Kjällander highlights the "digital interface". She cites the example of a one-year-old who may have problems completing a puzzle due to inadequate motor skills and how preschool teachers see themselves as able to "coax them into certain physical activities using an initial digital introduction" (Kjällander, 2019). The results indicate that children prefer to produce media over consuming them, and that children "challenge the purposes, objectives and didaktik design of apps and preschool teachers in order to create their own areas of application and learning pathways" (Kjällander, 2015, p. 2), a process that can be linked to music through a greater focus on creation of music rather than spoon-fed teaching. One popular app genre offers the opportunity to play musical instruments. For example, elementary school music teachers favour *Garageband* for music composition in the classroom (Rajan, 2014). Reimers (2003) and Riley (2013) highlight the importance of giving children the opportunity to compose. For example, Reimers (2003) notes that composition is one of three pathways through which music can be experienced (the others are performance and listening). Riley (2013) points to the advantages of allowing children to create music starting from a very early age.

The references above suggest that digitality in music education can offer alternative tools and experiences. The curriculum (SKOLFS 2018:50) stipulates that children should be offered both teaching and music, which together become music education. Music is cited in two places in the curriculum, including one mention in relation to digitality:

> Education should provide children with the opportunity to experience, portray and communicate through various forms of aesthetic expression, including images, design, drama, movement, song, music, and dance. This means children should have the opportunity to construct, design and create through the use of various materials and techniques, including through digital and other venues. (SKOLFS 2018:50, p. 9)

This statement can be interpreted to mean that one primary role of the preschool is to offer children the opportunity to construct, design and create, for example, music, including through

methods such as digital technology. According to the curriculum, preschool teachers are responsible for ensuring that every child "be allowed to use digital tools in a manner that stimulates development and learning" (SKOLFS 2018:50, p. 15). Preschool teachers must also "provide an environment in which children can develop their ability to communicate, document and convey perceptions, experiences, ideas and thoughts using various means of expression, both with and without digital tools" (SKOLFS 2018:50, p. 15). Currently, however, building music teaching using digital tools on a scientific foundation is problematic since the combination of fields in relation to teaching is relatively unexplored. What, then, can characterize music teaching using digital tools at the preschool level?

2. Literature review

To gain an understanding of prior research relating to music, digital technology in the preschool, we conducted a search in Eric EBESCO in September 2019. The search covered the period from 2010 (when the first iPad became commercially available) to 2019. A total of 31 articles appeared when the keywords "music" and "iPad" were combined. The keyword "iPad" was then combined with "technology and/or digital", "preschool and/or early childhood". Finally, combining "music" with "tablets" resulted in 15 hits. The articles generally focus on learning rather than on teaching. The articles below are arranged based on the age of the children in focus.

2.1 Preschoolers, music and digitality

Concerning research on digital technologies in educational settings, Nilsen (2018) points out that very few studies are carried out in preschools.

> A large number of studies focus on potentially positive effects connected with children's use of technology, which is often based on preconceived and uncritical ideas of technology use as a motivating factor for learning. When digital technologies are implemented in educational settings, the process is often characterized by uncritical notions about the role and function of said technologies. (Nilsen, 2018, s 120)

Ferrari and Addessi (2014) write about didactic experiences concerning the interaction between 3–5-year-old children and a Continuator. First the child plays a sequence and when the child's fingers

are removed, the keyboard plays a similar passage, but with something changed. The exercise is based on taking turns, repetition, and variation. The results are a consequence of the interaction between the child and the piano/software. The authors write:

> The use of the Continuator in daily activities underlines how new technologies should be considered important not only as tools or devices which are useful for teaching, but also as a means of creating new didactic strategies and methodologies able to qualify and determine the learning process. (Ferrari & Addessi, 2014, p. 182)

In a different study (Lagerlöf, 2015), three six-year-olds are subjected to video analysis from a sociocultural perspective as they interact in front of a synthesizer and as they use new music technology (MIROR-Impo) based on the advances made by Ferrari and Addessi. The results show how musical roleplay emerges and how the children use knowledge acquired outside school to fill the gap that arises when technology does not work. Lagerlöf (2016) takes a sociocultural perspective when she shows that the teacher has a very important role no matter how well-developed music apps may be. Music education is at heart a matter of supporting children to become active participants in different musical cultures, both as listeners and performers.

Rajan (2014) conducted a study exploring how children experience music in their digital world and has used the results to encourage music listening and music creation among the youngest children. The results suggest that the experience of holding and playing an instrument – an authentic musical experience – cannot be replaced by exploring an instrument through an iPad. Burton and Pearsall (2016) focus on music-based technology that is frequently used in the preschool setting. The study focuses on learning rather than on teaching and shows that four-year-olds prefer easy-to-navigate apps with high visual stimulation and familiar music. Although the children engaged in social interaction, "outward music behavior" (Burton & Pearsall, 2016, p. 75), which can be interpreted as activities such as singing, movement and playing an instrument, was absent. Engesnes, Danboldt and Hagen (2017) observe the encounter between 5–6-year-old children and three music-related apps (*Air Harp, Bloom* and *Singing fingers*). Their results show that the apps inspire musical exploration and play.

2.2 School children, music and digitality

If we shift our focus to schoolchildren, several researchers share the same theme of using iPad apps to compose music. Williams (2014) describes how the members of a band, "iPadists", are working on an alternative approach in relation to traditional symphony orchestras and choirs, and notes that music creation on iPads is perceived as less praiseworthy than music creation in other musical contexts, usually because iPads are not viewed as a genuine instrument: "At best, it is only *like* a musical instrument, but certainly not worthy of study by serious musicians" (Williams, 2014, p. 94). When we view some instruments as being better than others, there is a risk that certain instruments will be marginalized and perhaps in such cases, specific styles may also be linked with that instrument. Riley's (2016) article shifts the focus to the classroom, in which she describes iPads as dynamic tools for musicians and educators. The virtue of apps, according to Riley (2016), is that users can compose music, even without formal knowledge of music. Six apps, including *Garageband*, are analysed from the perspective of teacher reflections to provide guidance for teachers about which apps can enable preschoolers and schoolchildren to improvise, compose and/or arrange music.

In summary, several scientific articles have been published within the field of music and digitality in preschool. The studies referred to above are focused on music and learning rather than on music teaching. There is a relative lack of studies focused on music teaching using digital technologies as a tool in the preschool that also include co-planning, teaching and co-evaluation.

Nilsen (2018) also pinpoints that "instead of repeating the rhetorical discourse of tools that will revolutionize education (state-of-the-art), researchers should focus on state-of-the-actual and scrutinize what is happening in the educational system when tablets and apps are introduced and used" (p. 129), which brings us to the purpose of the current article, which focuses state-of-the actual.

3. Aim and research question

The purpose of the current article is to further knowledge of what can characterize music teaching using digital technology as a tool in preschool from a didaktik perspective. In this research and

development programme, preschool teachers co-planned, conducted, and co-assessed didaktically informed digital music teaching. The study delves into the following question: What can characterize music teaching with digital technology as a tool in preschool?

4. Theoretical resources

Theoretical resources in the study include didaktik, more specifically music didaktik, and multivocal music teaching.

4.1 Didaktik

The word "didaktik" derives from the Greek didaskein, which means to teach. "The word didaktik can therefore be explained as the 'art of pointing something out to someone'" (Doverborg, Pramling & Pramling Samuelsson, 2013, p. 7). Jank and Meyer (1997) hold that didaktik can be viewed as having two sides. In part, didaktik can be described as "the teaching reality as it is", but also as a "suggestion as to what better education should be" (Jank and Meyer, 1997, p. 47). The use of words such as "should" or "shall" can be interpreted as advocating traditionally prescriptive didaktik. In the present article, we refer to critical didaktik (cf. Biesta 2011; 2017; Broström 2012; Brante 2016), which can be interpreted as preparing individuals for an open and unforeseen future (Vallberg Roth, Holmberg, Löf & Stensson, 2019). In this context, for example, the modal verb "can" is used instead of "shall", which may create space for alternative didaktik reasoning (Vallberg Roth, 2020). In didaktik questions, "shall" is linked more to traditional normative didaktik, while we link "can" to critical didaktik. "Can" opens the possibility of alternatives to the choices that are made and we do not purport to establish once and for all "what must be taught" or "what characterizes…", but instead focus on "what *can* characterize teaching content". In this way we relate to a critical-reflective form of didaktik that refers to the German concept of Bildung. The present article spells "didaktik" with a "k" in recognition of a central and North European tradition. In this collaborative research project, didaktik questions have served as analytical questions. The didaktik questions (in the present study mainly "what" and "how") have helped to shift the focus of music education from learning to teaching among the participating preschool teachers.

4.2 Music didaktik and multivocal music teaching

The concept of multivocal music teaching was inspired by Dysthe (1993), but in the present context can be viewed as further developed and tested as a tool for critical reflection, which may include the perspectives (versions) of various actors, diverse scientific grounds and proven experience (Vallberg Roth, 2020). An earlier study (Holmberg & Vallberg Roth, 2018) presented multivocal music teaching where the multivocal aspect is rooted in the many dimensions of music, as well as the three aspects of music as a subject, like harmonizing voices, resembling multiple perspectives and variations of convergence. The present article can be viewed as a further development by exploring what traits may characterize multivocal *digitalized* music teaching in the preschool.

According to Nielsen (2006) there is a connection between meaning in music and how people perceive it. The experience of music is dependent on the connection between the music and the person experiencing it. Based on this reasoning, Nielsen (2006) views music as a "multispectral universe of meaning" and in this way, music offers a diversity of experiential opportunities with multiple dimensions:

> The structure of music only includes certain dimensions in a cohesive spectrum of meaning and introduces into/is rooted in other deeper meanings, such as of a motor-kinetics, emotional, spiritual, existential nature. (Nielsen, 2006, p. 136)

When we relate this understanding of music to music didaktik in the preschool, we are able to view these dimensions as points of departure for music teaching. This could be one way to qualify music as content.

From Nielsen's (2006, p 110) perspective, music is a teaching subject that can rest on a basic subject foundation that encompasses art-, skills- and science-related aspects. Music teaching in the preschool can build on the science of music. However, perhaps music is not primarily a science but rather an art – something that is not based on intellectual-verbal ability, but rather something that appeals to our senses. Before the experience can be placed in the centre, music needs to be created and produced and we can highlight a skills aspect, elements of practical experience such as

playing an instrument, singing, and dancing. Keeping Nielsen's (2006) theory of musical didaktik in mind, perhaps now, fourteen years later, digitality can be viewed as a complementary skills-related element. Nielsen (2006) notes that scientifically based concepts need to be considered in relation to experience, as for example the interaction between the scientific and artistic aspects of the subject. Language helps to elucidate many aspects of music, and the preschool teacher must master the terminology of the science of music as it applies to musical phenomena when making choices before, during and after the teaching situation (Holmberg & Vallberg Roth, 2018).

In the article on multivocal music teaching in preschool (Holmberg & Vallberg Roth, 2018), it is noted that the subject is often introduced using scientific aspects as a point of departure, but subsequently the emphasis is more likely to be on skills and/or artistry when actually teaching. Even though the focus is to varying degrees on the concepts related to the science of music, these concepts mostly emerge in relation to some form of experience (cf. Nielsen 2006). Varying musical dimensions and shifting aspects related to content can point to and offer alternative perspectives and variations of convergences; in other words, make music teaching multivocal. The article culminates with a focus on concepts and model testing that includes multivocal music teaching.

From the viewpoint of the research and development programme, the current article focuses on practical aspects of music teaching process itself (cf. Young, 2016); in other words, aspects that may characterize multivocal digitalized music teaching from a didaktik perspective.

5. Research methodology

The research portion of the programme "Multivocal didaktik modelling" intends, in a collaborative effort involving preschool teachers, administrators and researchers, to further develop knowledge about what could characterize. The collaborative research project is being conducted between 2018 and 2021 in approximately 45 preschools/departments located in eight municipalities in Sweden.

The empirical material used in the article derives from a didaktik informed teaching arrangement that was carried out as part of the R&D programme in 2018. At a nationwide seminar in the programme, lectures were presented for about one hour concerning the three aspects of the subject

of music, as well as the structural dimensions of music including meter, dynamics, rhythm, pulse, timber, form, pitch and tempo. The aspects and structural dimensions of the subject of music were exemplified based on a digital theme using a music creation app on a tablet computer projected on a big-screen monitor (see Figure 1)

Figure 1. One view of *Garageband*. The picture on the lower right shows a drum set. On selecting one of the drums you can change volume and texture by dragging the yellow dot

Garageband is an Apple product that makes it possible to record and mix recordings to produce a finished product. The app allows the user pointing instruments to be combined with audio recordings and loops. The touch instruments are relatively similar to real instruments, which means that users can play keyboard, guitar, bass and drums. The product also provides an opportunity to use sounds from different parts of the world. *Garageband* was chosen because it is a free iPad app and iPads were commonly used in the field. In this context participants also learned about *Soundtrap* for other teaching tablets.

The format focuses on music teaching and preschool teachers generated empirical material which they uploaded to platforms accessible to us as researchers; see Table 1:

Table 1. Preschool teachers co-planning, teaching and co-evaluation of music teaching.

Co-plan	27 documents
Implementation	6 hours of video
Co-assessments	24 documents

From the composite material, teaching that included digital technology was selected for the current article, which included 19 preschools/departments (42% of all preschools) in six out of eight municipalities; see Table 2:

Table 2. Empirical material generated by preschool teachers' co-planning, teaching and co-evaluation of music teaching involving digital tools.

	Digitally recorded music	**Digitally created music**	**Total**
Co-plans	14 documents	5 documents	19 documents
Teaching	2 hours and 35 minutes of video	58 minutes of video	3 hours and 33 minutes of video
Co-assessment	13 documents	5 documents	18 documents

The analysis at the computer level comprises word data and audio-visual data, which may be viewed as complementing one another in this analysis. The teaching is in the foreground in the analysis, but co-plans and co-assessment can be seen as interwoven to form a whole, supporting each other, rather than contributing in different ways. It is the teachers who define when it is a teaching session and what the occurring content is. But it is the researcher (from the documents or/and video recordings) who identifies what can be counted as an example of music teaching using digital tools. Every teaching session (including co-plan, teaching and co-assessment) is counted as one example.

The collaborative research project complies with the research ethics guidelines of the Swedish Research Council and was reviewed by the Regional Ethical Review Committee in Lund (2018-01-10) (https://mau.se/forskning/projekt/flerstammig-didaktisk-modellering/).

5.1 Abductively oriented analysis

Didaktik questions have been used as tools in practice, as well as in the analysis (because of limitations of space, I focused the analysis on "what" and "how"). The task of identifying traces and patterns relating to the purpose and questions of the study within the "word data" and "audio-visual data" can be described in terms of abductive analysis, alternating between theory-loaded empiricism and empirically loaded theory, where both are gradually reinterpreted in light of each other (Alvesson & Sköldberg, 2008; Tavory & Timmermans, 2014; Peirce 1903/1990).

For the *empirically based analysis* I conducted a thorough review: I read, listened to and viewed all of the material several times and partially transcribed (Duranti, 1997) some of the audio-visual data, while also highlighting (or coding by giving certain words and/or themes specific colours) prominent words in relation to didaktik questions. In a *theory-based analytical path*, traces derived from the empirical material have been analysed using music didaktik concepts from Nielsen (2006), in relation to the digital theme (see results: "Digital technology in the form of recorded music" and "Digital technology as a basis for music creation"). The theory-based analysis of shifting content-related aspects rooted in the teaching subject's three cornerstones and the dimensions of music culminates in a concept-testing focus on multivocal digitalized music teaching (see "Discussion and conclusion").

Examples are chosen from 10 out of 19 teaching sessions. Quotes and excerpts from transcriptions are selected in relation to how well they exemplify traces in the material in the least cumbersome yet simultaneously clear and illustrative manner.

6. Results

The results are divided into three sections: co-plans, teaching and co-evaluations. The presentation of co-plans can be viewed as a way of contextualizing the subsequently presented teaching and

therefore includes answers to several of the didaktik questions. The foundation of the results, however, is the actual teaching in the audio-visual material, where the didaktik questions condense to focus on how and what.

6.1 Context on the basis of co-plans

Given these didaktik questions, we can approach the co-plans by starting with the "what" question. To better understand goals in music teaching, let us refer to the relatively vague curriculum (SKOLFS 2018:50) in eight co-plans:

> The preschool strives to help each child to develop their creative capacity and their ability to convey perceptions, thoughts and experiences through a variety of modes of expression including play, images, movement, song, music, dance and drama.

Examples can be found of artistic, skills-related and scientific aspects of the subject of music:

> Experience and explore the different tempos (slow and fast) of music Skills, together, we create different tempos using *Garageband*, our bodies and/or musical instruments
> The scientific part, in which we learn more about the concept of tempo

Some preschool teachers define the goal in greater detail and specify aspects of the structural dimensions of music, such as tempo, meter, rhythm, pulse, and pitch. There are also teaching sessions that focus on the emotional dimensions of music, for example what emotions can be awakened through music, how it feels and the ability to express emotions and thoughts in words.

All music teaching is conducted indoors: on a rug. In some cases, the choice to be indoors is linked to the opportunity to use digital tools. The majority of teaching sessions are conducted in the morning due to the presence of more staff and it is the time of day when children appear to concentrate best.

Usually, one preschool teacher is responsible for teaching two to eleven participating children (average: five participants). The selection of children who may participate varies. Sometimes the

group is arranged based on the idea that a certain number of participants is optimal. Grouping according to age is relatively common.

The videos of the teaching sessions are 2 to 34 minutes long, 11 minutes on average. The co-plans mention the digital theme of iPads, *Garageband*, *Loopimal* (an app that creates music loops that make animals dance) and a projector. The digital theme is mentioned in conjunction with the didaktik what, how and why questions:

> Dancing to music with video screened by the projector so that the children dance in the picture.
> The children participate and change instruments and tempo using *Garageband*.
> *Garageband* offers instruments and the combination with digital technology, virtual music-making.

6.2 Conducting music teaching

Two overarching empirically based traces can be ascertained based on music teaching (see Table 3). One trace (74% of all music teaching sessions using digital technology) pertains to digitality as expressed by recorded music as a basis for a varied educational focus. The other trace (26% of all music teaching sessions using digital technology) pertains to digitality as a basis for music creation and variation in relation to inspiration:

Table 3. Overarching empirically based traces.

Digital technology in the form of recorded music. Music as a basis for • movement • playing instruments • discussing feelings • painting
Digital technology as a basis for music creation. Music creation • inspired by instruments in the iPad • inspired by digital pulse • inspired by fairy tales

- inspired by ants
- as inspiration when exploring tempo

The following sections "Digital technology in the form of recorded music" and "Digital technology as a basis for music creation" focus on the results of the theory-based analysis. Traces derived from the empirical material were analysed using music didaktik concepts from Nielsen (2006) in relation to a digital technology.

6.3 Digital technology in the form of recorded music

The first main trace pertains to digitality as expressed by recorded music as a basis for movement, playing instruments, discussing feelings and painting.

6.3.1 "Baby Shark" basis for movement

Recorded music is sometimes used in education as a point of departure or source of inspiration for movement, i.e., the kinetic-motor dimension of music. On one occasion the focus is on the "designation of correct terms", i.e., the scientific aspect of the subject of music. Three children, about 1–2 years old, listen and dance to "Baby Shark" at various tempos. This teaching example shows not only the use of recorded music, but how it can be manipulated using an app. This opens up a number of alternatives in relation to adjusting parameters such as tempo, which does not require a live performance, but can be accomplished using recorded music.

6.3.2 Drum music as a basis for playing instruments

Recorded music can also serve as a basis for playing instruments. The following teaching session combines the analogue (playing the drum) and the digital (music from a phone). Participants include a preschool teacher and three children, about 3–4 years old. In the introduction, the teacher focuses the attention of the children on a scientific aspect of the structural dimension tempo:

> Teacher: *We're going to work on music and tempo. What do you think tempo might be? /…/Maybe it is a little hard to say what tempo is. /…/ I'm going to play some drums here on the telephone. Then we can use our bodies to help us follow the music.*

The teacher directs the attention of the children to the drums in the music from the telephone to help them listen for tempo:

> Teacher: *How do the drums sound? I'm going to do something to this tempo that we talked about and then we will see if you can notice any difference. I'm going to press a button here on my phone.* [The tempo increases.] *What happened? I press a button here. This changes the tempo.*

The format of the teaching session switches between the recorded music at a faster and slower tempo, and verbalizing and doing, which can be interpreted as movement between the scientific and the artistic. Next the teacher pauses to allow the children to bring out the drums. The expression of the shifting tempo transitions from movement to playing instruments:

> Teacher: *If you try to follow the drums that you hear on the phone, then what should you do with your hands? What are your hands doing now? Listen to the telephone.*
> Child 1: *Not fast.*
> *Teacher: You say it isn't going fast, so how is it going?*
> Child 1: *Slow.*

Then the teacher concludes the session by raising the initial question:

> Teacher: *Well done all of you. Now we've worked with tempo, right? Fast, fast, fast, fast and sometimes it was a bit slow.*

The example shows how recorded music can help the teacher who does not have drum-playing skills.

6.3.3 "In the Hall of the Mountain King" as a basis for discussing feelings

Music teaching can also focus on the emotional dimension of music. In one teaching example, the goal is to "discuss various feelings in conjunction with listening to the music". Eight children and one teacher are participating. We enter as the group listens to Grieg's "In the Hall of the Mountain King". The children are seated in front of a long sheet of paper rolled out on the floor on which they can place stones when they think the music is heavy and feathers when they think it is light.

When the music stops, they look around and reflect on what they think the music looks like. The teacher asks:

> Teacher: *What did you think about the music?*
> Child: *First it was a little heavy and then it became scary.*
> Teacher: *What made it sound heavy and what made it sound scary?*
> Child: *They hit like this, which made me think that they might be hitting a person.*
> Teacher: *And that is how you feel.*
> Child: *It was really scary.*

The focus is on listening, reflection and interpretation, while the conversation centres on the senses, the experience of the emotional dimension of the music.

6.3.4 "Popcorn" as a basis for expression through painting

One teaching session begins with six children about 4–5 years old sitting around a table. Each child has been given paper, four colours of paint and a brush. The structural dimension "tempo" is one content focus. The emotional dimension of the music is another. The preschool teacher uses the scientific aspect of the subject of music as a point of departure by asking what music is:

> Child 1: *Tones. We are going to paint tones.*
> Teacher: *Yes, we are going to paint tones. We are going to explore something called tempo. /…/ First we're going to listen to a piece that is really slow. And we're going to paint along with it. And we are going to paint how we feel when the music is slow.*

The teacher alternates between calm music and the considerably faster piece, "Popcorn". The children comment that when listening to "Popcorn" they draw quickly, which can be interpreted to mean that the children are painting based on how they experience the music. The teaching session concludes with the preschool teacher's question about what music the children thought was best for painting. Most preferred the fast music.

6.4 Digital technology as a basis for music creation

The second trace found in the results supports the potential of digital technology in music creation.

6.4.1 Garageband inspires

It would seem that the combination of the iPad with *Garageband* can in itself inspire creation of music. This teaching session includes three children and one preschool teacher. The main phase concerns the artistic aspect of the subject of music where exploration and sensory perception are key, but in which the teacher directs the attention of the children to music theory concepts. The music comes from an iPad, which captures the attention of the children. The teacher transitions from directing the attention of the children towards the structural dimension of the music, pulse, to dynamics instead. Instruments and dynamics are visualized by allowing one child at a time to select an instrument by "dragging" it into the field on the screen, where it begins to create sounds. When the instrument is placed toward the bottom of the screen it plays softly, while it becomes louder as it nears the top of the screen. The teacher moves the drum on the screen. She repeats the manoeuvre three times:

> Child: *Stop.*
> Teacher: *Now you children will get to try. Then you will get to decide where the drums should be and if they should make a loud sound or a soft sound. Grab the drum with your finger. Now you do it.* [The child drags an instrument into the screen.]
> Teacher: *Where should it be now?*
> Child: *There.*
> Teacher: *Up there so it makes a loud sound? Now let's see if we can clap along. Let's clap to the beat.*

One child asks for a slower tempo and the teacher changes the tempo of the beat. It is time for the next child to have a turn to create music and the children all sit down with their attention on the iPad. A pre-recorded beat comes up for the child who chose the music. She plays spontaneously using her arms to pretend she is holding a pair of claves. The teacher invites the children to play with the sticks as they did in the beginning. The teaching session can be interpreted as beginning from a skills-related aspect and then subsequently focusing on interweaving the

artistic with the scientific. In the main phase the digital plays a major role in capturing the attention of the children.

6.4.2 Music creation inspired by digital pulse

Six 5-year-old children are sitting in a semicircle on a large round rug. This teaching session will alternate between the digital and the analogue, between pictures on an iPad and feelings experienced in the body. In front of them is a large white wall on which a red heart has been projected, which draws the attention of the children. A discussion about the image begins when the heart starts to beat and the teacher introduces the session by asking the children to feel their heart. After a while, the teacher stops the projected heartbeat, directs the attention of the children toward one of the structural dimensions of music and a skills-related aspect becomes apparent – perceiving and keeping the beat of pulse:

> Teacher: /…/ *someone said that if you want to make your own music, then you can clap. So what are you going to clap? Well, you clap to the beat of your pulse, that is what it is called.* [The teacher claps a beat on her legs as she speaks.] *The pulse determines how often you should clap. And of course you can create different kinds of pulse.*

The teacher continues to direct the attention of the children toward the structural dimensions of the music and introduces the concept that the pulse can have different tempos. Initially she relates this to the heart:

> Teacher*: /…/ When you become a bit stressed the heart beats really fast. But, when you are a bit quiet and calm, your heart can also beat slowly. That's exactly how it is with music too, it can go fast and it can go slow. /…/ The pulse in music is like the heart, just like a heartbeat.*

They examine their pulse on the wrist. The preschool teacher gradually transitions the lesson toward what can be interpreted as the main phase:

> Teacher: *I've found something on the iPad that can help us to measure our pulse. /…/ Here is the place where you can put your finger, because your fingers also have a pulse. /…/ It can help us to measure how fast or slow our pulse is…*

Figure 2. The teacher's pulse

The children get to see the teacher's pulse on the iPad (see Figure 2), and then, one child at a time, they are allowed to first guess whether they have a rapid or slow pulse before they get to try putting a finger on the iPad. Every now and then something goes wrong with the iPad, and it fails to respond to contact with the child's finger. After a while, one of the children says:

> Child: *Aren't we supposed to have music?*
> Teacher: *Yes, /…/ I have an assignment for you…*
> Child: *Should we take out the musical instruments?*
> Teacher: *Yes, that's what we're going to do. Here's the thing about music; first you have to find the pulse and that may be a little difficult.*

The teacher proceeds from individual pulses to the collective:

> Teacher: *Today you're going to use your body as an instrument. Because you already have an instrument inside you. Your pulse. /…/ Of course, we all have our own pulse, but the assignment today is to find what pulse we have together. So we have the same pulse. How will we do that? In music there are different tricks. You know how everyone in a large orchestra has to play the music together. How will they know how it should sound so that everyone plays at the same time?*

The teacher directs the attention of the children toward the challenge of knowing when something should start when many people are involved and the role of the conductor:

Teacher: *How do they know when they should begin playing?*
Child 6: *When they take out the sticks.*
Teacher: *Who takes out the sticks? Because you can use your body to show everyone, there is a conductor who does that.*
Child 5: *Or you can give a sign when it is time to begin singing.*

One child proves to have prior knowledge of the movements of a conductor and the kinetic-motor dimension of music emerges when the child demonstrates using clear conductor movements (Figure 3).

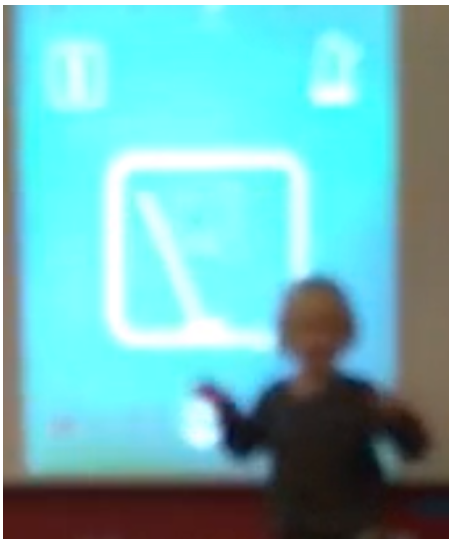

Figure 3. A child doing conducting movements in front of a metronome.

Teacher: *Yes, but have you seen a conductor? He does it like this.* [The teacher conducts in the air.] *The conductor gets to decide, so when they see him give the signal then it is time to begin. The conductor decides what pulse to use when they play. How fast they should play. Then he has... A few clues here, which are called notes. The black dots.*

And this is where yet another music theory concept appears – notes – and once again the digitality embodies the concept since the teacher is able to project notes on the wall. Numbers from a metronome appear on the wall and the teacher returns to the numbers on the iPad that were used to measure pulse:

> Teacher: *The one who originally decided how the piece should sound, the composer, has already created the notes and then the musicians have to determine how quickly to play them. And there are different ways that they can write this down. Do you see the numbers, one two three…*

The teaching session is interrupted because the audio from the iPad does not work. The disruption forces the teacher to become creative and she suggests that instead of waiting for the sound to work, they can create sound themselves. The teacher takes out another speaker and the sound flows out. Recorded claves emphasize the first beat of the meter through a different sound. One of the children stands up and spontaneously begins to dance, which the teacher takes note of:

> Teacher: *Good, can you think of a good way to follow along with our bodies too?* [Two of the children demonstrate the pulse, one by beating with their legs, the other by using their body to tick tock back and forth.]
> Teacher: *GOOD! Do you know what you did? The assignment: You found the pulse together. Good! Would you like to make it faster? Or slower?*

Then the metronome comes back. The children get to decide individually how fast the metronome should be set. Once all of the children have had a chance to try, the teacher gets their attention by directing the focus to the day's assignment, sharing the same pulse:

> Teacher: *Now Child 1 is the conductor, so no one can begin until Child 1 gives the signal.*

After a while one child begins to talk about counting backwards and the teacher takes advantage of the opportunity and introduces meter and the concept of four/four time:

> Teacher: *Yes, that's right, just like when you're counting. Here it says 4/4, that's when you count four beats to the measure, 1,2,3,4, that's how it goes. That's how they divided the pulse.* [The children all begin to count 1,2,3,4.]

The teacher shows a new picture on the iPad in which the pulse beats are marked in blue and the first beat in the measure is marked in yellow. After they try super-fast movements, the teacher

continues into what can be interpreted as a transitional phase. In this phase the analogue and digital are interwoven; the children play it with stones to a pulse from the iPad:

> Teacher: *Well, what do you think we are going to do with these?* [stones]
> Child: *Make music.*
> Teacher: *If we want to use these to create sound… How would we do that?*

Each child is given two stones and the teacher once again directs the attention of the children, in part to the common pulse and in part to the meter:

> Teacher: /…/ *You can keep the beat with them. But now we come back to the same thing, we have to decide so that we all keep the same pulse and we have to decide when we should begin. How do we do that?*
> *Child: 1, 2, 3 now!*
> Teacher: *Do you want us to play three beats to the measure?* [Then they play three beats to the measure, count to three and emphasize the first beat in each measure.]

The child's counting to three can in part be interpreted as a count-down so that everyone should begin at the same time, and in part what the teacher does, to link everything together with meter; if you count to three, then you get three beats per measure. After a while the teaching session ends. Several music concepts come up, such as conductor and notes, as well as structural dimensions like pulse, tempo, and meter. The digital and analogue, and the scientific and skills-related aspects of the subject are all intertwined in this session.

6.4.3 Music creation inspired by "Three Billy Goats Gruf"

In this teaching session, four children and a preschool teacher participate, sitting across from each other with an iPad. *Garageband* is projected onto the wall in front of them. Earlier they had six teaching sessions during which, taking inspiration from the fairy tale "Three Billy Goats Gruff", they created music (Figure 4). They were allowed to select different instruments in *Garageband* and synchronize them to a common tempo. The teaching session begins with a focus on an artistic aspect, the experience of getting to hear the composition in its entirety for the first time. First the

children have the opportunity to recognize their melody loop (inspired by being one of the billy goats), press the play button, and listen. Then it's time for the troll:

> Teacher: *And this is what I've done, made it so that the troll has become friends with you. He has become your friend and a friend of the billy goats. He just says: Who is stomping on my bridge? He does not say that he is going to eat you up. So I have quieted him down so he can only be heard a tiny little bit…*

This, however, is not what the children want. An example of multivocality can be interpreted from one child's voice offering resistance; the child wants an angry troll and becomes the self-appointed spokesperson for the group of children:

> Child 1. *We want an angry troll. We want to hear everything.*

Figure 4. The tracks, each track representing one of the goats, and the troll.

Next the lesson takes on a new form. So far, the children have mainly listened and watched their visualized music in *Garageband*, but now they get up and turn toward the wall, where an image has been projected showing two feet on a person well known to the children. The video starts and the children try to imitate the feet and walk the same way. A skills-related aspect can be ascertained in which the focus is on following the projected feet.

Then they sit down on a bench and the teacher initiates the concluding phase of the teaching session, in which the children applaud their composition.

The teaching session can work as an illustration of multivocal music teaching. It can be interpreted as intertwining in part the artistic and skills-related aspects, and in part the digital and the analogue. Both the structural dimension of the music, meter, and an emotional dimension can be interpreted as emerging. The emotional dimension occurs in several different contexts; in part, the children's response to the teacher's changing the role of the troll, but also the feeling of having created something that their friends in the preschool can share.

6.4.4 Music creation inspired by ants

During a teaching session, the children and the preschool teacher explore "how ant music might sound" and they "test it out by playing and composing ant music". This teaching session addresses many musical concepts in which the focus is on the sensory, the artistic experience of sound from strings, while it can be interpreted that the teacher is conceptualizing the experiences from a more scientific aspect. Two children participate and the teacher begins by using an iPad to project an image from *Garageband* of the strings on a guitar onto the wall (Figure 5). The teaching session begins with a question:

> Teacher: /…/ *What do you see on the wall here? Do you recognize the picture? What does it look like? It looks like a guitar.*

Figure 5. Projection of the strings on a guitar

The teacher directs the attention of the children toward the guitar, and then shows one part of the guitar, the strings. The opportunity to see the vibrations of the strings while simultaneously hearing the sound they produce leads their thoughts to visualized music. One child plays on one string at a time, which appears on the wall as a thickening of the string. The teacher connects the strings and the guitar to an acoustic dimension and a more overarching concept, music:

Teacher: *You are playing music on the lines that are called strings on a guitar.*

However, this does not seem new to the child, who refers to experiences outside the preschool:

Child 1: *I know that. My grandma has loads of instruments.*

The teacher clarifies in her answer to the child that there is a difference between an analogue and a digital guitar:

> Teacher: *Does she have a guitar? Have you played music together with your grandmother? /…/ Then perhaps you played on a guitar like this, maybe not on an iPad?*
> Child 1: *Not the same.*
> Teacher: *No, it wasn't the same. Now the guitar is in the iPad. Now we get to try playing instruments on the iPad.*

The teaching session continues and a new image from *Garageband* is selected; now the strings and melody loop are no longer visible, but instead the chords. One of the children wants to change guitars:

> Child 1: *I want to have a different guitar.*
> Teacher: *You are right, there are different kinds of guitars, but now I would like to tell you about an assignment that you have.* [The teacher goes in to the smart guitar (Figure 6).]

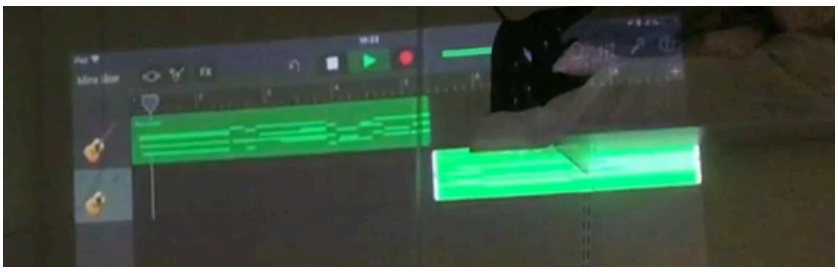

Figure 6. The smart guitar

The teacher turns the iPad upside down to redirect the attention of the children to herself. The assignment is linked to the overarching theme of the session, which is ants. The teacher directs the attention of the children to their belief that ants listen to music:

> Teacher: *I think that ants listen to music.*
> Child 1: *No.*
> Teacher: *And like a guitar.*
> Child 1: *No they don't.*
> Teacher: */…/ Don't you think they do it?* [Child 1 shakes her head.]. *But we do it. We often listen to music.*

Even if the children do not believe that ants listen to music, the interpretation can be given that in this situation, the teacher is giving the children an answer to an unexpressed "why" question; we are going to create music because the ants need something to listen to. Suddenly the red "record" button gains significance:

> Teacher: *But I was thinking that we can do this and try to make ant music so they have something to listen to. So we are going to record your piece now. We use this red button to record it.* [Child 2 watches with great curiosity.]
> Teacher: *Child 2, would you like to begin to record? Just press this red button and then play on the guitar strings.* [Child 2 play a little bit on the strings.]
> Teacher: *OK, you can take a break for a while. You saw that something happened here. You said: look. There was something that moved up here. It happened while you were recording. It turned green here. Now we are going to listen to child 2's recording, how it turned out.*

The teacher presses the play button and once again the music is visualized. Both children gaze intently.

> Teacher: *Wow, that was part of your piece! Now you will get to hear our entire ant piece. Child 1, press play, and we'll listen.* [Child 1 spontaneously begins to dance to the music.]

It can be interpreted that in this teaching session the digital and the analogue, as well as the three aspects of music, are all interwoven: art through experience, the science in the concepts presented by the teacher and skills related to playing the guitar on an iPad. Music concepts such as guitar and strings arise during the discussion and in this particular example, the teacher makes it clear that there is a difference between playing grandma's guitar and a guitar on the iPad. Mastering the iPad in the context of music, by understanding that you can press the play button and it turns red or green, can also be interpreted as a skills-related aspect.

6.4.5 Music creation as inspiration when exploring tempo

During one teaching session, music creation is achieved by exploring various changes in tempo. A preschool teacher presents the lesson and three children, about 5 years old, participate. The iPad serves as the basis for creation, with a focus on sensory and artistic aspects.

The teacher begins the session by discussing *Garageband* and what can be done in this app, which captivates the children:

> Teacher: *Today we're going to work with* Garageband*, which lets you make your own music.*
> Child 3: *Really?*
> Teacher: *Yes, really! Exactly.*
> Child 1: *How do you do that?*
> Teacher: *Exactly, how can that be done? As you see here, there are different symbols. Here you see how you can move it.* [The teacher drags an instrument into the middle of the screen.]

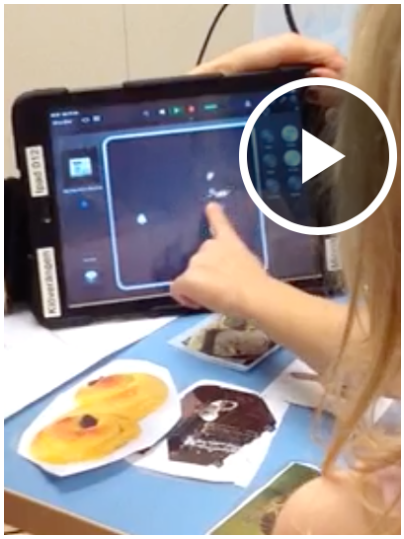

Figure 7. The children drag different instruments into the square to make music

The children appear to show recognition and the teacher begins to name the instruments and symbols: base drum and hi-hat. The children are obviously fascinated and refer to the instruments by name:

> Teacher: *And we dragged in a shaker.*
> Child: *A base drum.*
> Teacher: *Base drum, that's this one, right? Those are cymbals.*
> Child: *I've played the cymbals.*

The teacher takes this opportunity not just to refer to the instruments by name, but also to use an exploratory approach to direct the attention of the children toward one of the structural

dimensions of music, tempo. The children move the instruments somewhat randomly (Figure 7) and the teacher names the different instruments.

By moving the instruments and thereby causing changes in the music, the music is also visualized. Not only does the teacher mention tempo in passing, but she also shows how it can be read by changing the tempo from 160 to 80. The tempo is read and corrected using a metronome, which appears to be fascinating, and they try adjusting the settings and listening to different tempos. This is also a clear example of how digital technology can be helpful. As a child you don't need to master motor skills while playing an instrument to change tempo; you can still play with the tempo itself. The teaching session can be interpreted as being driven by the curiosity of the children in regard to creating music. While maintaining a focus on the artistic aspect, the teacher intertwines the more scientific aspect by also directing the attention of the children to the various musical instruments and to one of the structural dimensions of music. In this case, the focus is on the digital rather than the analogue.

6.5 Reflections on co-evaluations

In the co-evaluations, the preschool teachers reflect on their lessons from the perspective of the didaktik questions. Reflection on digitality can be linked to the didaktik "what" question. Based on the idea of music as a participant, not intentional but with the power to influence (Holmberg, 2014), the selection of music becomes important to the teachers. The recorded music is considered crucial for the results. The teachers also give consideration to what instrument may be most appropriate for the teaching session:

> In the planning phase, the focus instrument was the piano – after having reviewed the children's earlier documentation and reflections about ants, one child expressed the following: "There are a lot of tunnels and ants in an ant hill. There is also ant music and it sounds like a guitar." /…/ the instrument was changed from piano to guitar.

The digital component also poses its own challenges:

> The technology fell short of our expectations: poor sound and the recording skipped. /…/ We educators will find better recording software.
> The original plan was to surprise the children by bringing a keyboard in to the department, /…/ But since the keyboard did not work at the time, the plan was revised. Instead, the educator brought a bucket of stones…
> The existing wireless sound system did not work and was temporarily replaced with a cable system. The cable did not work at the time either.

Every now and then the technologies did not live up to the teachers' expectations. Challenges with digital technologies in music teaching seems to be mainly about poor sound and equipment that doesn´t work (software, keyboard, wireless and/or cable sound system). It can be interpreted that the potential of digital tools for preschool teachers who are less musically skilled becomes apparent in one reflection in the example of tempo, which is demonstrated by using a "button" rather than by actually playing the guitar.

7. Discussion and conclusion

Digital competences are included in the Swedish preschool curriculum. For the preschool teacher it can be complicated to navigate, and knowledge and critical professionalism both in and about music teaching as well as technology is needed. What then can characterize digitalized music teaching at the preschool level from a didaktik perspective? One characteristic may be the *multivocal* relationship between digitality and the three aspects of the subject of music (Nielsen, 2006). Concerning the analogue component, the digital theme can contribute to and demonstrate audio-visual music teaching. Digitality combined with other sensory impressions can add "visual music", as exemplified by the vibration of guitar strings or the pulse of the heartbeat. Digitality can provide experiences of a range of other instruments as a basis for music creation linked to an artistic aspect. The digital component can also pave the way for multivocal forms of music creation. It is clear that the digital component can promote creation of music that can also be recorded and saved – in contrast to much of the analogue music-making at the preschool level, which mainly includes rhythm instruments, melody loops and pitch. In relation to the scientific aspect, the digital component is able to furnish words (names) for instruments that the preschool normally does not possess. Digitality can also provide access to equipment that makes it easier to focus attention on

the structural dimensions of music through concepts such as pulse, tempo and notes. Digitality in the preschool setting can also endow concepts with life so they can be experienced, heard, grasped, visualized, discussed and revisited. The digital component in music teaching can also be viewed as a complement to Nielsen's (2006) other skills-related aspects such as song, movement and playing instruments.

In contrast to the study by Lagerlöf and Wallerstedt (2018) where preschool teachers wrote relatively vague formulations concerning learning objectives, some preschool teachers in the present study defined the goal and specified aspects of the structural dimensions of music. One reason for this could be the nationwide seminar where the three aspects of the subject of music, as well as the structural dimensions of music, were introduced. The aspects and structural dimensions of the subject of music were exemplified based on a digital theme using a music creation app on a tablet computer projected on a big screen. Both the content of the seminar and the use of technologies can have contributed to the relatively clear goal formulations.

The present study shows how digital music as a foundation, just as in more analogue-oriented music teaching, can foster open and diverse teaching activities such as movement, playing of instruments, discussions and painting. This can be placed in relation to a study by Burton and Pearsall (2016), who focus on learning rather than on teaching and show that the apps that the children prefer do not encourage open musical responses such as song and movement, which otherwise can be considered to characterize music in the preschool.

One main track, digitality as a basis for music creation, is consistent with the findings of a study by Sullivan and Bers (2018, p. 344) as to how music can "be fostered through the use of new technologies" and that working with iPads does not necessarily entail passive screen consumption. On the contrary, the present study, in line with the findings of Riley (2016), shows that one advantage of apps such as *Garageband* is that teaching can culminate in the composition of music, even without formal music training.

The present study shows examples of (cf. Engesnes, Danboldt & Hagen, 2017) how digital technology in music teaching can inspire curiosity in children. Kjällander (2019) shows how

preschool teachers use the digital component to "entice" the children. For example, a child can begin to solve a digital puzzle before doing an analogue puzzle. Therefore, even though Rajan (2014) shows that the experience of holding and playing a tangible instrument cannot be replaced by an iPad instrument, perhaps we can apply similar reasoning to music creation. Music creation in the iPad can encourage and entice children to continue digital music creation, as well as future music creation and interest in playing instruments. Perhaps future "iPadists" will view iPads as "real instruments" (Williams, 2014) worthy of further study.

The present study, compared with many other studies, has focused on the analysis of a relatively large selection of qualitative data. Nevertheless, this study makes no claims to be comprehensive and needs to be considered in light of a relatively small sample, for which reason generalizability is limited. Concerning generalizability, the ambition is situated generalization (Larsson, 2009); "situated" in the sense that it is not predictable but realized when interpretation is appropriate in other cases (Fejes & Thornberg, 2009). Generalization in this context is the possible application of the research, giving the user possibilities to generalize and the reader to determine whether the text is meaningful. The credibility of the present study can be demonstrated by three types of triangulation. Word and audio-visual data can be seen as *data triangulation*. Written documentation like co-plans and co-evaluations and film can be seen as *method triangulation*. The fact that many researchers and participants are involved in the R&D programme can be seen as *researcher/participant triangulation*. Multivocal music teaching has been tried previously (Holmberg & Vallberg-Roth, 2018) and the present study can be seen as conceptual replication. Multivocal music teaching is now repeated with variation and supplemented with digital tools.

This article clarifies the relationship between the analogue and the digital and how they can in part be divided, and in part intertwined. The collective analysis culminates in the testing of a concept and two didaktik models in terms of "multivocal music teaching" in the preschool. The digital technology is more or less intertwined. In the first model the digital technology is vaguely intertwined, seen as threads, coming and going, and highlighted from time to time (see Figure 8).

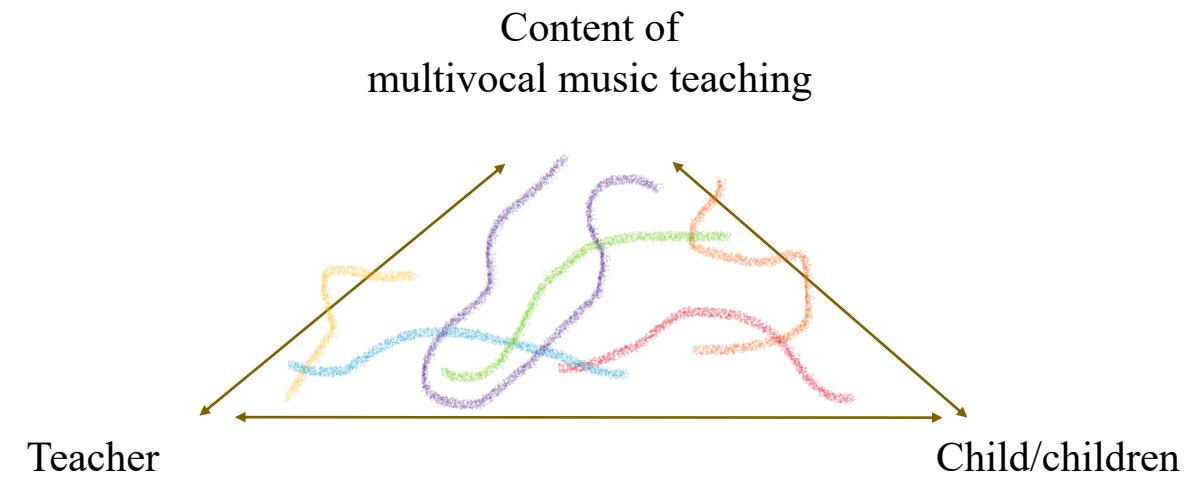

Figure 8. Didaktik triangle illustrating the relationship between teachers, children and the content of multivocal music teaching, where the digital technology can be highlighted from time to time and is illustrated as lines.

In the second model the digital technology can be seen as more intertwined, like a raster (see Figure 9).

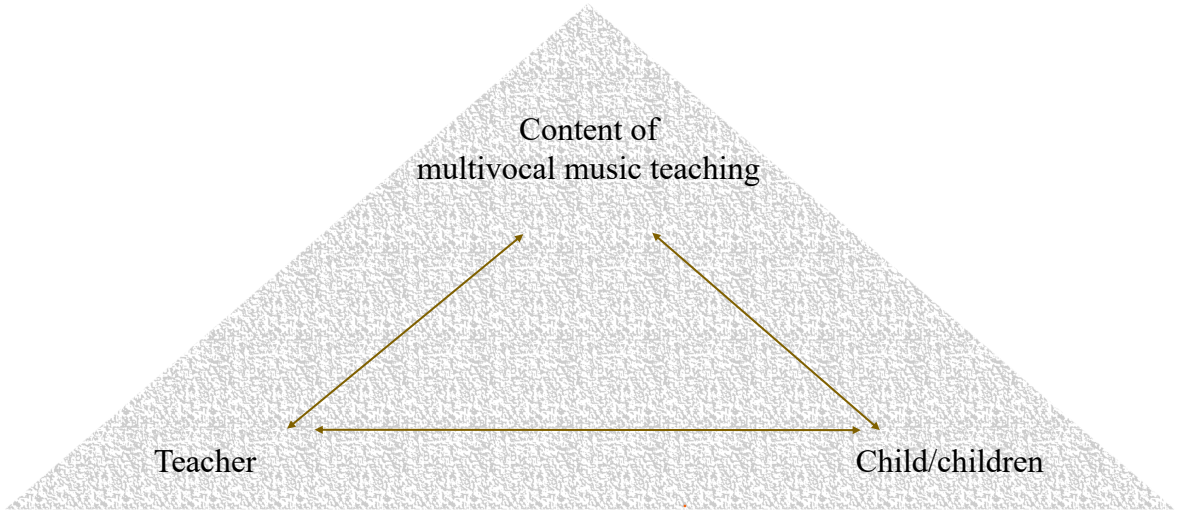

Figure 9. Didaktik triangle illustrating the relationship between teachers, children, and the content of multivocal music teaching which can be viewed through a raster of a digitalized world.

It becomes clear that digital tools can contribute and serve as a complement to analogue music teaching. Varying musical dimensions and shifting aspects related to content can point to and offer

alternative perspectives and make music teaching using digital technology as a tool beneficial. The study suggests that multivocal music teaching using digital technology as a tool opens up both opportunities and challenges. Malfunctioning cables coupled with the lack of experience and knowledge of apps and the subject of music can pose a challenge. On the other hand, the digital age opens up greater and more opportunities for creating and preserving music in the preschool world. Multivocal digitalized music teaching in the preschool needs to be further explored through future studies.

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