Soundtrapped?

Socio-material perspectives on collaborative teaching within the music classroom

Introduction

This article draws on a classroom project to explore the complexities of collaborative teaching within the music classroom. A professional team, consisting of in- and pre-service teachers, researchers, and a professional musician, collaborated to facilitate digital music-making at a lower secondary school in Norway during pre-service teachers' practicum placement. The use of music technology (the *Soundtrap* software) in the project was grounded in the participating in-service teachers' wish to expand on their professional competence in the music classroom, initially addressing the increasing digitalisation of school music education. Our analytical focus, however, is on team collaboration, emergence, and materiality. We experienced the *Soundtrap* software as a major material agent shaping the project to such a degree that participants appeared to be 'soundtrapped'.

The recent changes in Norwegian teacher training programmes serve as a backdrop to this study. The 2017 reform transformed the teacher education offered in Norway into a five-year degree programme, including an integrated master's degree. This reform aims at professionalising teacher education and minimising the commonly described 'theory-practice divide' within the field (see for example Zeichner, 2010; Korthagen, 2010) by means of an inclusive and participatory approach that increases collaboration with a wide range of stakeholders (Advisory Panel for Teacher Education, 2020). While a solid body of teacher education research on

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university-school partnerships does exist (Daza et al., 2021; Livingston & Flores, 2017; Lillejord & Børte, 2016), research on such partnerships within the subject of music specifically, is scarce.

The following questions guided the study:

- How did collaborative planning and teaching of a digital music-making classroom project unfold?
- In which ways did material, structural and educational conditions influence collaborative processes?
- How did the pre-service teachers cope with the complexity of the classroom collaboration?

By posing these questions, the researchers aimed to explore how a multifaceted group of music educators were able to collaborate and learn under a specific set of circumstances, impacted by institutional, educational, technological, material, and cultural conditions. Thus, the focus of this article is not pointed at the ways in which teaching digital composing can be carried out in the music classroom. Rather, we examine how the complexities of teaching and collaborative (digital) environments may influence and shape in-service and pre-service teachers' pedagogical activities, processes, and thinking in the music classroom.

A socio-material approach (Fenwick, Edwards & Sawchuk, 2011) serves as a natural framework for the study and article. More specifically, we draw on complexity theory, and in particular the concept of *complex systems* (Cochran-Smith et al., 2014). Such an approach allowed the researchers to study the relations and actions observed during the project as part of an interconnected whole with no clear beginning or end. Our study is therefore also situated within an emergentist epistemology (Osberg et al, 2008). In keeping with this emergentist stance, the findings of the study have been organised into three interrelated reflexive viewpoints: *emergence, enabling constraints,* and *entanglements*. The affordances (Bell, 2016) constituted by the entanglement of the social and the material were of particular interest, as we found the DAW, *Soundtrap*, to take up much of the attention during the project.

A socio-material perspective

A basic tenet of socio-materialism is that there are no clear distinctions between social phenomena and materiality. By extension, human and other-than-human practices, and objects are therefore seen as embedded in a "turmoil of relationships" (Fenwick et al., 2015, p. 83). The social aspects of socio-materiality refer to symbols, meanings, and cultural discourses, while the materiality side includes both natural and technological aspects, organic as well as inorganic material. A socio-material approach is therefore relational, as it treats human beings and things as interwoven and interdependent, and maybe even inseparable (Orlikowski, 2010; Barad, 2007). From a socio-material perspective then, researching human action and collaboration in the music classroom as separate from artefacts, surroundings and technologies would be reductionist, as would describing technical and technological issues and entities as separate from their circumstances and affordances. The classroom practices observed in this article were therefore not seen as given, but rather as practices that emerged through the relations between entities, people, and technology (Cecez-Kecmanovic et al., 2014).

Considering the music teachers wanting the project to contribute to their professional development, we understand socio-materially oriented research as something that can "reconceptualize professional learning to embrace its inherent messiness, its embodied materiality and its historical and cultural dynamics" (Fenwick & Nerland, 2014, p. 1). To be able to describe and analyse the inherent messiness in our material, we draw upon educational complexity theory (See Fenwick, Edwards & Sawchuck, 2011; Cochran-Smith et al., 2014; Davis & Sumara, 2010; Osberg, Biesta & Cilliers, 2008). Complexity theory is a socio-material perspective that examines how phenomena emerge in a web of relations, and not in linear and causal ways (Fenwick & Dahlgren, 2015). In this study, we have particularly drawn upon the idea of *complex systems,* which encompass independent, yet interacting actors (Burnes, 2004), such as a classroom of children, or a team of professionals (Fenwick, Edwards & Sawchuck, 2011). Complex systems are open, but also boundaried, and intersect with other systems.

In this project the interactions with and through *Soundtrap* had multiple layers, and each of them could be seen as happening in several dimensions at once: As part of 9th grade music teaching, of the everyday life of a lower secondary school, of the job market for freelance musicians, of a

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commercial music software market, as part of teacher education in music, of part of the generalist teacher education practicum placement, or as part of a teacher education research project. The inherent complexity of the setting thus made the interactions diverge in multiple, dynamic, and non-linear ways, not only within the team's immediate surroundings, but also into other contexts, such as the university teacher education courses in music as well as further professional development courses for music teachers. Describing our digital classroom composing project as a system therefore means that we can perceive the team of professionals involved, their collaborative efforts, the software and material and/or virtual entities as an interconnected whole, in which their "behaviours exceed the sum of its parts" (Fenwick, Edwards & Sawchuck, 2011, p. 22).

Complex systems change and evolve, they are self-producing and therefore also emergent (Cochran-Smith et al., 2014; Fenwick & Nerland, 2014). From an educational perspective, Osberg, Biesta and Cilliers (2008) call for an emergentist epistemology, in which education is not the result of achieving pre-defined learning outcomes, but rather the "results (…) of participating in the creation of an unfinished universe " (ibid, p. 215). Education, then, is never settled or fixed, but always in creation. And it is exactly this emergentist perspective that serves as a foundation for this article.

Action research design and research setting(s)

The empirical study was designed as action research – a methodology that adopts a particular kind of practitioner inquiry (Cochran-Smith & Lytle, 2009) which takes place in a practical context and involves a systematic and iterative exploration and evaluation of alternatives. Action research can therefore produce research-based understandings of practice and suggestions for addressing more relevant issues outside the specific action research context (McNiff, 2013).

In keeping with our emergentist foundation, action research is characterised as emergent and context dependent. Furthermore, the iterative character of action research and, by extension, its inherent disorder, connects action research to complexity: "Action research has always, by very virtue of its approach, operationalised emergent processes and it hasn't shied away from complexity" (Phelps & Hase, 2002, p. 518). Thus, the study aimed at addressing 'real-world

problems', intending to produce action and knowledge in participatory and cyclical ways (McNiff, 2013). The study set out to jointly plan, carry out, reflect on, replan, and iterate a classroom music education project involving a collaborative team consisting of in-service teachers, pre-service teachers, and a musician. When approached, the participating music teachers immediately displayed a wish for professional development in digital music-making.

The classroom work took place at Emerson Hill lower secondary school: A suburban, mid-sized school with a strong background in music education. Emerson Hill has a well-equipped music room with a few adjacent, smaller group rooms. Each class contained up to 27 pupils. The vantage point of our study is the collaborative teaching of music-making activities with a digital audio workstation (DAW). A DAW is a music production software that allows users to record, edit and produce sound. Some consider a DAW as an "instrument in its own right which impacts upon the conception and organisation of musical ideas" (Marrington 2017, p. 77). More specifically, a DAW is a graphic representation of music on a computer screen, where the musical material is organised visually, and in layers, on a timeline. *Soundtrap*[1], is designed for making music online (Lind & McPherson, 2017; Ruthmann & Hebert, 2018; Frankel, 2021). *Soundtrap* users can create their own loops as well as sounds, rhythms, riffs, or melodies, and even podcasts. The education version of *Soundtrap* has a collaborative function and includes a teacher admin panel that enables the teacher to create pupil assignments and grants them access to pupils' projects.

Data generation

The team participating in the study consisted of three teachers, one musician, four generalist pre-service teachers and two researchers/educators, who are also the first two authors of this article.

All names are gender neutral pseudonyms chosen by the participants:

Role	Persons
Musician	Lennon

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[1] https://www.soundtrap.com/

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In-service teachers	Main teacher Charlie and co-teachers Skyler and Armani
Pre-service teachers	Hollis, Israel, Phoenix, and Ramsey
Researchers / educators	Quinn and Justice

Table 1. The collaborative team of the action research study.

The school was recruited-through a university-school partnership agreement. The purpose of engaging a musician for the project was to strengthen the connection between the school, teacher education, and professional music community. Thus, when the main theme of the project emerged, that of focusing on digital composing, it became necessary to find a musician with digital skills. Several musicians were interviewed, and the final decision to hire Lennon was made by the researchers and a representative of the school. The four second-year pre-service teachers self-selected for the project after a university information meeting. Informed consent was given by all the participants mentioned above, and the pupils in the music classes (including their parents) were informed of the project.

Data was generated between September 2019 and April 2020[2], during which the participants completed two cycles of collaborative planning, implementation, evaluation, and replanning (see Kemmis et al., 2014) to facilitate pupils' music composing activities. Each cycle of classroom activities centred around a composing project that utilised a DAW, which was then followed by reflexive focus group conversations with the entire team. Researchers also conducted group interviews with the pre-service teachers and held individual interviews with the main teacher and the musician. Research data includes classroom observations (researcher notes) (7), participant meetings (10), focus group conversations (2), semi-structured interviews (4), and participants' reflexive logs (28). In keeping with action research methodology, the joint reflection and discussion elements were conducted throughout the project, and the plans thus changed accordingly.

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[2] The classroom work finished in February 2020, and the last few interviews and focus group conversations were conducted online due to the pandemic.

Analysis

In our study, we have recognised Ell et al.'s (2018) dilemma when analysing socio-materiality: "We tried throughout to use complexity theory to inform our choice of analyses. This was challenging because each traditional way of considering the data appeared to contravene complexity principles" (p. 334). Since capturing a fluid and emergent body of data in fixed categories seemed to contradict the nature of complexity, we approached the data holistically. We therefore consider our analysis to be abductive. Abduction is often called *inference to the best explanation* or justificatory explanation (Peirce, 1992; McKaughan, 2008), and is characterised by a suggestion or a draft of a trustworthy and logical explanation of a problem (Nyeng, 2017). Our analytic approach was iterative and retroductive; the former refers to a constant shift between data generation and analysis, as well as between socio-material perspectives and the empirical data (Kennedy & Thornberg, 2018). The latter denotes the analysis of a well-known phenomenon (e.g., student placement or classroom collaboration) in new and productive ways (Ritz, 2020).

Initial analysis was conducted by all participants in meetings following activities in class. During these meetings, evaluations were made, and suggestions for the following class activity were discussed and decided upon. The structuring and presentation of data in this article is mainly based on the researchers *á posteriori* interpretations of the data, but some themes, such as reflections concerning a prospective Cycle 3 ('what if'), were developed jointly in team conversation. Group conversations provided the opportunity for participants to discuss, and, if necessary, challenge the researchers' interpretations and analyses (Ravitch & Carl, 2021).

Findings: Emerging insights

Inspired by complexity theory, we have categorised our findings into three interrelated reflexive viewpoints that are mutually constitutive: *emergence, enabling constraints,* and *entanglements*[3].

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[3] These viewpoints are inspired by complexity theoretical concepts, as described by Fenwick & Nerland (2014, p. 19): 'enabling constraints, non-linear dynamics and uncertainty, positive feedback, self-organization and the balance of order and disorder, and interconnected diversity'. We kept 'emergence' and 'enabling constraints' as concepts,

Emergence: Two cycles and a 'What if?'

> *... we didn't entirely know what we were supposed to be doing or what the outcome should be. That's something that has continued throughout. In a way, we take it as it comes* (Pre-service teacher Hollis, final group conversation).

This statement from the pre-service teacher captures the emergentist nature of the classroom events: Things were constantly moving, never fixed, always self-producing and changing, yet, recognisable. Fenwick (2010, p. 107) describes emergence as produced by a "series of dynamic, nonlinear interactions". She writes that "phenomena, events and actors are mutually dependent, mutually constitutive, and actually emerge together in dynamic structures" (ibid). The study progressed iteratively in two cycles after an introductory planning phase. In Cycle 1, the aim was to try out two DAW alternatives (*Bandlab* and *Soundtrap*) in the classroom before deciding on the final choice of software.

When the whole team met to plan the first classroom session, it was apparent that musician Lennon and main teacher Charlie had stayed in touch in advance of Cycle 1 to prepare the classroom work together. Lennon had made a lesson plan on behalf of the team. The suggested plan consisted of four steps: 1) Select and combine loops, 2) Play on top of the loops, 3) Edit and use effects, 4) Add voice if time. The plan was not questioned, and only subjected to minor adjustments along the way. Lennon's initial plan thus remained a template for classroom activities during both cycles.

Introduced by main teacher Charlie as a renowned musician "who is here to teach us about digital tools, because we are not so good with them" (Researcher note), Lennon ended up in front of the 9th graders, while the rest of the team tried to make themselves useful. Organising the classroom clearly demanded more contextual and pedagogical knowledge than is reasonable to ask from a visiting musician (Kenny & Morrissey, 2020). Being in front of a large group of adolescents seemed quite a challenge for Lennon, who sat "at the front of the room, explaining things like oscillator, effects and reverb. I think most of the pupils are lost now" (Researcher

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while 'interconnected diversity' was renamed 'entanglements', which we think is a more suitable characterisation of how project elements, people and materials appeared as reciprocal prerequisites for project events.

note). Lennon's prominent position side-lined the other participants, and the pre-service teachers seemed particularly lost: "They walk around, trying to involve themselves and find ways to be of use, but seem a bit helpless" (Researcher note). The researchers found the situation unsatisfying and wanted the pre-service teachers to get more involved in the actual teaching (DeMonte, 2013; Dorel et al., 2016). The issue was discussed with the pre-service teachers, then addressed in a joint team meeting.

Having already decided on using *Soundtrap*, the team appointed the pre-service teachers the main responsibility for planning and teaching the Cycle 2 events. Charlie, Lennon, and the others were to support and advise. To utilise teacher resources and ease the classroom management issues, smaller groups of pupils were created. The pre-service teachers were responsible for teaching pupil groups in separate rooms, while Charlie, Lennon, and the co-teachers moved between rooms to help if necessary. Participant reactions to the change varied: Researchers felt that the project was back on track, pre-service teachers were satisfied with an increased teaching load, while Lennon expressed confusion as to what their role as musician should now be, and Charlie seemed disappointed that the close collaboration with Lennon had been disturbed.

This description of these classroom events reflects the *self-organising* that took place. There can be different ways of understanding, (re)interpreting, modifying, or augmenting (Cochran-Smith et al. 2014, p. 7) activities and purposes in a complex system. Due to the various layers of the project, it was pulled in different directions, yet remained focused on the main task of facilitating a digital composing project in a school. The complexity of the team made it difficult to work collectively and collaboratively, thereby enabling "high-frequency, short-range, local interactions, the influence of which is enhanced, diminished, or changed along the way" (Cochran-Smith et al. 2014, p. 7). The initiatives shown by different participants (such as Lennon's lesson plan or the researchers' highlighting of the pre-service teaching), the local spinoffs and changes, are characteristic of a self-organising system, which again is a hallmark of emergence (Davis & Sumara, 2006).

We assume that the *intersecting of other systems* (Cochran-Smith et al., 2014), such as the school system, the professional music scene, and the university teacher education, contributed a sense of unsettlement and emergence to our project. The organisational and pedagogical changes from

Cycle 1 to Cycle 2 represented a shift in how the intersecting systems impacted the project. Lennon's initial elevated status reflects a well-known dynamic in so-called 'creative partnerships', where teachers tend to surrender to the artist's performative expertise, and therefore take on a rather submissive role (Author 2, 2013; Author 2 & Related Author, 2018; Author 1, 2014). By stressing the need for a more active pre-service teacher role, the researchers shifted the weight towards the priorities and values of the university system, and away from the school system and the professional music scene.

The collaborative explorations and interactions of the team in this study never reached the final state of order – on the contrary, our effort was always emerging, always in process, and always evolving from past decisions and experiences (Osberg, Biesta & Cilliers, 2008). Ending this project was thus merely a practical decision. The project could, in theory, have continued indefinitely, as there would always be more questions to ask, more to explore, and more to learn.

Enabling constraints: Conditions shaping the collaboration

> *I had an idea that it would be a bit difficult, or that there could be aspects that would affect the nature of the work. There were some limits that you (researchers) had to struggle with too* (Main music teacher Charlie, final interview).

As Charlie rightly pointed out, there were certain conditions affecting the study. We call these conditions *enabling constraints,* which, according to Davis & Sumara (2010, p. 859) are a set of limitations and boundaries that defines a field of play, but that also simultaneously creates other possibilities. In the following, we identify a series of enabling constraints, such as institutional, spatial, educational, and material prerequisites that shaped the collaboration within the project.

A noticeable constraint was that our work took place within the Norwegian state school system, in which the subject music is allotted less than five percent of school hours (Norwegian Educational Directorate, 2020). This sparse share of the curriculum can be seen as a result of a lengthy decline in the importance ascribed to the subject of music (Aróstegui, 2016). The project took place in a lower secondary school in a 9th grade music period, making the composing project part of the pupils' formal school music education for that year. We therefore had to ensure that it could be part of the pupils' formal assessment too. The overall scarcity of school

music education could also be seen to affect the participants' musical and technological skills, and therefore also the work in the music classroom at Emerson Hill: "I have no problem justifying the use of a program like that for three weeks. But I think that we could have gotten more musical benefits if everyone had been better at using the software" (Musician Lennon, final interview).

The pre-service teachers' practicum placement periods were used to generate data, which was beneficial as it connected the pre-service teachers to the project in a way that saved negotiations with the university regarding their time. An unintended consequence, however, was that research activities at times were subordinated to university practicum regulations and everyday routines at Emerson Hill. For example, pre-service teachers were, on several occasions, prevented from attending scheduled team meetings because they were assigned to teaching-related duties. Practicum is an old structure in teacher education, it is challenging for pre-service teachers (Fuentes-Abeledo et al., 2020), and bears within it a range of questions and reflections and for its participants (Thomas, 2017). In this way, challenges, and structures of the practicum placement, both pedagogical and organisational in nature, had a part to play in our collaborative project.

The size of the collaborative team was a recurring theme. Having 10 adults facilitating activities with 27 pupils in a limited space inevitably raised questions as to where to place oneself within the room, how to benefit from the use of adjacent rooms, who was doing what, and the roles of the people present. Bringing this number of participants fairly unknown to each other into the project was done by design, and educational choices as well as relations in the group were affected by these research choices (Kemmis et al., 2014).

The technological nature of the project, as well as the software itself, also represented major and challenging frames. The choice of digital composing activities meant that there were various technical requirements, which were affected by the municipal IT-policy. Pupils at Emerson Hill had their own municipality-provided laptop, which was connected to the municipal IT system via the school's Wi-Fi. Software options were therefore heavily limited from the start: Considering the municipality's cloud-based IT-solutions for schools, in combination with a strict download policy, an online music software compatible with the municipal user account systems was, in effect, our only alternative. This was again the background for our choice of an online DAW.

Still, this 'choice' of software enabled the participants' access from various devices, which again enabled pupils to work on their music projects from home. *Soundtrap* and its user interface also impacted the work carried out in the classroom: The pupils (and to a certain degree the teachers and researchers) had to learn how to use the software as well as how to make music with it.

Entanglements: The social and material dimensions

In this section, we take a closer look at the affordances constituted by entanglements between people and 'stuff', i.e., the relationships and interactions between people and things, and how dependencies (good or bad) can arise from those interactions (Der & Fernandini, 2016, p.17). We will start with the relations between the teachers and *Soundtrap*, before proceeding to the interactions between *Soundtrap* and other social and material dimensions of teaching.

From the very beginning of the project, the team's collective endeavour revolved around getting to know, learn, and master the software. Already from the start, teacher Armani uttered:

> *I'm totally incompetent when it comes to the technical side of apps and such things. Personally, I would like them to be shown to me and to work with them for a while, because I think I function best in the teacher role when I know what the pupils are doing.* (Co-teacher Armani, first meeting)

Even when team discussions explicitly dealt with other issues, such as collaboration, distribution of tasks, or specific preparations, software-related questions were always in the background, indirectly 'soundtrapping' the attention. *Soundtrap* became an entity that informed and affected every action, exemplifying what Orlikowski (2007, p. 1437) describes as a constitutive entanglement of the social and the material. It seems evident that participants' relations with *Soundtrap* affected actions and decisions heavily. *Soundtrap* thus held much power in the project, and the almost all-consuming efforts of mastering the software may point to a known fallacy of assuming that DAWs are easy to use (Bell, 2015). Charlie addressed this fallacy directly: "When introducing new systems, we expect them to be easy, because that is what the developers think. And this is how technical stuff gets between us and what we want to do." (Main music teacher Charlie, final interview)

If we assume that DAWs are not just tools, but rather instruments that amplify musicality (Brown, 2015), then *Soundtrap* is like any other instrument and will take time and effort to master, even if it can be considered as a good entry level DAW for pupils. In a critical discussion about the potential pitfalls of using DAWs in the classroom, Bell (2015) draws on the concept of affordance (Gibson, 1977; Gibson, 2006) to highlight how software and user interface allows and privileges certain musical actions, while hindering or even blocking others.

Recent research studies have highlighted the importance of the teacher in integrating technological tools in classroom activities in pedagogically sound and versatile ways to support learning (Ojala, 2017; Havre et al, 2019), suggesting that teachers should not only learn the skills of any given technical tool(s), but also "adopt a new way of thinking about music learning and instruction" (Akuno & Ondieki, 2017, p. 133). However, music teachers often consider the opportunities for acquiring sufficient professional digital competencies during their studies to be inadequate (Author 3, 2017). This highlights the need for supporting the development of teachers' digital skills, but also their *professional identities* as "digitally agentic and competent teachers" (Engeness, 2021, p. 99) capable of creating meaningful educational experiences in various (digital) learning environments for the benefit of their pupils (see also, Author 3; Author & Author, forthcoming). Enabling in-service teachers to take part in complex, multi-faceted, technology-rich, and collaborative environments therefore presents an important (Biasutti et al., 2019) and urgent challenge for teacher education in music.

Given their previous musical experience, musician Lennon and main teacher Charlie were, unsurprisingly, the only ones in the collaborative team who mastered the software well enough to recognise its affordances. In the interviews, they both reflected on what this piece of technology can do, and on how it could be tailored to suit the needs and aims of teaching and facilitating music-making with pupils. The rest of the collaborative team seemed more overwhelmed by *Soundtrap,* being able to overcome technical difficulties and recognise the pedagogical and musical software potential only to a certain extent (Väkevä, 2017). It seems like the degree of expertise had an impact on whether participants *used*, or were *being used by*, the technology, which is the double-edged sword of DAWs (Bell, 2015). Armani's initial wish of wanting to fully master the software prior to teaching it was never really fulfilled.

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Our classroom observations show that the social and the material dimensions were intertwined, and that material aspects were integral to human activity and relationships, within the school and music classroom. In other words, matter *mattered* (Fenwick, Edwards & Sawchuck, 2011, p. 31). Making digital technology an integral part of music teaching in our project inevitably gave rise to practical, technical and pedagogical issues (e.g. Gall, 2017):

> *One of the pupils did not bring his laptop. 'Would you like to borrow mine?' pre-service teacher Israel asks, and the pupil nods. Israel has to unplug the computer from the video projector, and manually write the assignments on the blackboard before handing the laptop over to the boy. Lennon volunteers to fetch an extra laptop. Two boys are making a lot of noise. One of them finally starts working, while the other puts on his jacket and leaves for an alleged appointment with the school physician. Lennon finally comes back with a laptop, but the battery is dead and Lennon has to find a power adapter and outlet. Finally, the pupil has his own laptop, but he needs to copy his work from Israel's laptop and over to this new one. Then the other boy also has to go to the doctor, and leaves. The pupils left in the room have to use three pre-decided loops, and then they can select three loops of their own. I have a splitter so I could have listened to their music, but I forgot to bring my headset.* (Researcher note)

This classroom snapshot shows how 'stuff' played a part of daily school life. In addition to regular 'stuff' like jackets, schoolbags, and blackboards, technical or technological issues related to user accounts, internet access, passwords, cables, earplugs, laptops, splitters, midi-keyboards, video projectors, whiteboards, and of course the software itself, became a large part of the classroom work. The team was constantly occupied with missing gadgets, and things that did or did not work, or worked differently than one had expected. Even the materiality of the school buildings and rooms impacted the project and its progress. Emerson Hill's educational conditions were limited by its old building and run-down rooms. Because of the nature of the activities, the classes were split, and some groups were positioned in the canteen, next to the music room. The canteen is a large walk-through area with a lot of possibilities for disturbance. One session was particularly noisy:

A girl with a computer goes up to the curly-haired girl's table and there's a lot of disturbance. Pre-service teacher Ramsey walks up to the table, the girl with the computer disappears. 'Can I listen to what you've done?', Ramsey asks the curly-haired girl. While Ramsey listens to her song, she sits with an uncontrollable hiccup-like laugh. A new girl suddenly enters and sits down at the table. Canteen staff with loud metal trolleys walk through the room. Pupils with rucksacks walk through the room. 'We'll go back to the music room,' pre-service teacher Hollis decides. (Researcher note)

The groups located in the canteen area struggled with their concentration and behaviour, and class management was challenging, especially for the pre-service teachers. Addressing these difficulties, a plain four-walled classroom in another part of the school building was acquired, and these new working conditions functioned much better. Musician Lennon confirmed our observations in an interview: "I learned an awful lot about how big an effect a room has." (Musician, final interview)

Highlighting 'matter' and the tangibility of 'stuff' (Leonardi, 2011) points to the affordances of materiality, that is, what actions are made possible through interactions with 'stuff'. The challenges encountered in our classroom project were not caused by architecture or gadgets alone, but of the human reactions to their materiality and their interactions with them, as well as with other humans nearby: "Objects do not possess sociality, people do, and it is through the embodied nature of intersubjective human social action that objects come to have contingent relevance" (Gibson, 2006, p. 185). To follow Gibson's argument, it was through the collaborative team's actions that the entity *Soundtrap* acquired meaning and relevance. As we have seen, the team was 'soundtrapped', meaning that *Soundtrap* and the 'stuff' related to the use of it monopolised the collaborative team's efforts and attention to a great extent.

Dancing in the disequilibrium

Complex systems are characterised by a movement between order and disorder so that they won't settle into a stable equilibrium, but also won't fall apart (Burnes 2004). Of particular interest to the researchers was how the participating pre-service teachers dealt with this inherent messiness and complexity. A novice teacher can 'learn to dance' in the disequilibrium (McCaw,

2020, p. 10), to "*productively* use this state of disequilibrium as a site of struggle, growth, and new understanding" (Cook 2009, p. 289). Pre-service teacher Hollis describes their teaching as explorative and emerging:

> *At the end of the day, we are the ones who are going to have to do this when we start working as teachers, so it was really great to get to do it now. And to test out what we prepared, to see whether it worked or not, and find out what we might have to change.* (Pre-service teacher Hollis, final group conversation)

As exemplified by Hollis' statement, the pre-service teachers in this study seemed to consider flux and unrest as natural, normal, and feasible, more so than the other participants. By revisiting the concept of affordance (see Gibson 1977, Bell 2015), we could say that even if materiality may be common to the people involved, the affordances are unique to the specific participants of the study (Leonardi, 2011). The complexity of the team's collaboration and their interactions with *Soundtrap* afforded different actions and responses: The in-service teachers had to make sure to follow up responsibilities regarding the school and the pupils' progress, while musician Lennon often stressed the need to follow the plan and of mastering the basics of the software. The pre-service teachers seemed more concerned with handling the software *well enough* and would instead concentrate on the pupils' creative work. The pre-service teachers therefore seemed more than willing to partake in the 'dance' of emergence and disequilibrium, thus welcoming the possibilities for the development of their professional identity and agency (Priestley, Biesta & Robinson, 2015) in a complex and messy, but still realistic, everyday setting:

> *It was a bit challenging. The pupils don't have the same starting point, which means that planning does not always match what actually happens, so you have to adjust. I was not sure about the outcome, but then again, we did it to figure some things out, didn't we?* (Pre-service teacher Phoenix, final group conversation)

As exemplified by Hollis' and Phoenix's statements, the pre-service teachers express vulnerability, understood as an openness to not knowing (Gilson 2014, p. 308), to being and doing wrong, and to putting themselves in unknown and perhaps uncomfortable situations to learn from (Jackson 2018; Kastner et al., 2019). In this way, they also signal that they are willing

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to take risks (Biesta, 2013) and to participate in the creation of an "unfinished universe" (Osberg, Biesta & Cilliers 2008, p. 215).

Soundtrapped: Final reflections

In this article we have described how a digital music-making project unfolded within a collaborative team consisting of in-service and pre-service teachers, researchers, and a musician within a 9th grade classroom. Through two cycles of collaborative planning and teaching, we found a series of material, structural, and educational conditions that impacted on and shaped the activities, relations, and collaborative processes. Classroom activities and the team collaboration were shaped by a series of enabling constraints, such as educational systems, the organising of teacher education practicum, municipal ICT policies, as well as the team size, to mention but a few. Material aspects, such as goods, gadgets, rooms, and technology had a particularly significant impact on human activity and social relationships. The entanglement of the social and the material was particularly evident in the way the music software 'soundtrapped' the attention of the participants and made the mastering of the software the main feature of activities. In other words, matter *mattered* (Fenwick, Edwards & Sawchuck, 2011, p. 31) in this project to a great extent. The pre-service teachers seemed to handle the complexity of the classroom collaboration well. Although seemingly caught in a state of disequilibrium, they demonstrated flexibility as well as resilience, and a growing ability to reflect on the complexities of teaching. This could indicate an emerging agency for them as teachers and collaborators (Onsrud et al., 2022) within complex settings.

Our analysis shows how the entanglement of social, institutional, historical, and material dimensions of education can provide a useful framework for emerging music teachers' professional development and highlights the role of teacher education programmes in helping pre-service teachers to prepare for encounters with complex and versatile educational situations. Instead of perceiving teacher education as a linear process, we comply with Ell et al. (2017) who propose understanding a 'teacher education system' that "refers to the multi-layered and loosely-boundaried group of people and things that contribute to the learning of teacher candidates" (p. 331). Peters (2017), among others, points at a demand for music teacher educators to be able to prepare students for an uncertain future. Performing agency as well as pedagogical improvisation

could be considered as important traits to facing the complexities of being a music teacher (Related authors & Author 1, 2019), and should be addressed actively in music teacher education.

By utilising socio-materiality and complexity theory, our research has aimed to enhance and expand Mantie's (2022) understanding of a 'post-world' music education research. The (perhaps unconventional) choice of a socio-material approach has provided analytical tools for capturing (although not fixating) some of the inherent messiness as well as affordances of contemporary music teacher education practice. The study indicates a need for teacher education to accept complexity and to prepare future teachers to engage with it rather than trying to control it by providing ready-made 'recipes' for pre-service teachers to apply in their teaching. An emergentist stance, however, does not equal non-commitment or a lack of preparation. Without a purpose, objective, or vision providing a direction and guiding the decision-making processes and actions taken in the classroom, educators could risk resorting to short-term problem solving. Still, encountering flexibility and openness towards the unknown is desirable, as demonstrated by the pre-service teachers in this study.

Ethical approval

The research has been conducted in adherence to Norwegian guidelines for research ethics in the Social Sciences, Humanities, Law, and Theology (NESH, 2022). The project was reported to the Norwegian Centre for Research Data, who found the data management and handling to be in accordance with data protection regulations (approval number 29419).

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