University of Tartu
Faculty of Social Sciences
Institute of Education
Curriculum: Educational Technology

Elo-Kai Kurel

TEACHERS' APPROPRIATION PRACTICES OF EDUCATIONAL TECHNOLOGY: A CASE STUDY IN TARTU INTERNATIONAL SCHOOL

MA thesis

Supervisor: Emanuele Bardone

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Abstract

Teachers' Appropriation Practices of Educational Technology: a Case Study in Tartu International School

The new learning paradigm and educational policy guidelines in Estonia highlight the importance of digital competence and the use of educational technology in the schools. This makes the educational technology devices used by the teachers in the lessons, and factors influencing their choices, an important research topic. The aim of this master's thesis is to identify teachers' appropriation and tinkering strategies of educational technology tools. The focus is on how teachers make educational technology work for them, specifically on technology appropriation: how teachers adopt and adapt technologies. Qualitative research, a case study in Tartu International School was conducted, within 13 teachers filled a technology use diary, and later the lessons of six teachers were observed, and based on the lesson observations, the teachers were interviewed. The results indicated that the teachers consider students' smartphones as any other teaching tool: the teachers have grasped the benefits of using students' smartphones for teaching, it has been proven to be convenient and the teachers take advantage of that. The smartphone has become a part of students habitudes and identity, therefore it is reasonable from the teachers to appropriate it for teaching and learning purposes. Appropriation of educational technology occurs when the teacher seamlessly integrates technology in her/his practice.The reason for using technology in the lesson is not the aim to use technology, but the meaningful use to facilitate learning.

Keywords: appropriation, educational technology, meaningful use of technology.

Table of Contents

Introduction

Education has been influenced by the developmental leap in technology. The use of educational technology has spread to many countries, including Estonia. The main aim of using educational technology is to facilitate teaching and learning (Kumar, 1997). There is little research about the appropriation of educational technology and this paper is a valuable addition to the literature.
In this study, we observed how teachers appropriated educational technologies in their lessons. We conducted this research in the form of a case study and during the investigation we developed our understanding of a meaningful and seamless use of educational technology in the teaching process. We conducted the case study at Tartu International School, where all the teachers were part of the first sample and kept a diary about technology use in their lessons. The second sample was chosen based on the diary responses and my general every day observations. We observed the lessons of six teachers, which were video recorded and complemented by interviews later. The interviews were the basis for the analysis. I was a part of both of the samples, and the thesis is written from a perspective of a reflective practitioner (Schön, 1983). The aim of the study is to find the different technology appropriation strategies the teachers use to make educational technology work for them in meaningful way.

Background of the study

I work in Tartu International School (TIS). It's a small, but growing learning community. The school was founded in 2001 on the initiative of a group of foreign parents. In the first school year, the school had seven classes with altogether only seven students. This school year, 2017–2018, 45 children are attending the school. The school has 13 teachers, which of 9 work full time and 4 part time.
TIS is a basic school, it means we have students from ages 6 to 15 (grade 1-9). Basic school is compulsory education in Estonia. The language of instruction in TIS is English, which means that

most of the students are studying in a foreign language. Since the number of students is small, we use the system of compound classes.

The school's curriculum is constantly updated, and from September 2017, TIS is implementing the International Baccalaureate Curriculum, Primary Years Program (PYP) in grades 1-6. The PYP curriculum is based on topic-based learning that integrates all subjects.

TIS is a private school that is owned by the Non-profit Association (NGO) Tartu International School. The NGO is directed by the Management Board and it is responsible for development of the projects of the association. Besides the school, the NGO also has another branch, Tartu International Kindergarten. The kindergarten was founded in 2007. This school year the kindergarten had 22 children and 6 employees. The Management Board employs the executive leaders for the school and kindergarten, determines school fees, and verifies the budgets for the school and kindergarten. Until spring 2017, the school and the kindergarten were located in different buildings, but in May 2017 both moved into our new schoolhouse.

I joined TIS in 2003 as a Mathematics teacher. Since the school is small, I have had different positions besides teaching. I also belong to the management board of the NGO, which is voluntary work. For couple of years I have been the school's educational technologist.

In the recent years, IT has developed rapidly, and the technology that is supporting learning is increasingly absorbed into school, to classrooms and to the learning processes. At the end of the 1990s, the Estonian foundation Tiger Leap started to fund educational technology for the schools. It also included the wage cost of a IT specialist (Laanepere, 2010) whose task was to take responsibility for the school's IT system and hardware maintenance. When many schools started buying the IT support in from other companies, the teachers and the students had no longer the possibility to get help from a technology expert at the spot (Laanepere, 2010). Thus, there was a need for an educational technologist who is is primarily a methodologist and teacher (Allemann & Mets, 2012).

Our school faced the same issue, we bought the IT support in from another company and we didn't have any IT specialist, neither a educational technologist on the spot. There was no opportunity to receive professional help for educational technology on the spot.

I have always been interested in using and integrating technology meaningfully into teaching. When I started working as a novice Mathematics teacher, we had only some desktop computers to use, but I still tried to find some online games to use in the lessons. For teaching geometry I tried to use a primitive computer program called GeomeTricks. When GeoGebra, an interactive geometry, algebra, statistics and calculus application, intended for learning and teaching mathematics and science (About - GeoGebra), was released in Estonia, I participated in a e-learning training about how to use the program in the lessons and started to use this application in my lessons.

At that time more and more programming in the schools was promoted. I was interested in the topic and in 2013 participated in an e-training course about programming at school. We started a pilot club about programming in our school, I was the instructor for the club.

In 2007 a pilot project about Lego Robots was conducted in Estonia (Tiigrihüppe Sihtasutus aastaraamat 2007). After that, to promote robotics in the schools, Estonian schools had an opportunity to apply for the funds to buy the equipment for robotics lessons. Our school also applied and the first Lego Robotics sets (WeDo and Mindstorm EV3) arrived in 2014. Before that I had had a training about Lego Robots and we opened a programming-robotics club under my guidance. During 2014-2016, I took part in different in-service trainings to get to know the new digital resources for education (Programming for 21C classroom, Programming in schools (Scratch and App Inventor), Smart Electronic Widgets (Makey Makey, LittleBits, Philips Hue) and Robotic widgets (Bee Bot, Ozobot, Edison). These trainings were mainly connected to programming in schools, but I was also thinking how to integrate technology to regular lessons and how other teachers could do it, especially how to integrate mobile technology. I attended an e-learning training for in-service teachers about smart devices in teaching and learning, and also invited another teacher from our school.

I was the person in our school who was supporting other teachers use of technology, computers, programs, projectors, tablets, copy machine etc. When I saw something, for example a training, an app, a web page, that could be useful for other teachers, I notified them.

It was apparent, that like other schools in Estonia (Pruulmann-Vengerfeldt et al., 2012) we needed an educational technologist to address on a particular course as well as on its software

capabilities, who would help in setting up a lesson and advise on the integration of ICT tools in the learning process. In 2014, when I became the educational technologist for TIS, it was a logical step for me. It was a new position for the whole organisation. I didn't have any job description to rely on but I started with developing the e-learning at school, coordinating the integration of ICT in the curriculum and supporting, advising and assisting teachers in the use of ICT in their teaching. I felt that not all the staff members were aware of many opportunities to use educational technology (smart electronic and robotic widgets, tablet and computer apps, electronic educational environments) to support and to facilitate learning. In 2014 we organised several DigiDays during the holiday where I together with another colleague introduced different learning apps and environments to our teachers. I also talked to the teachers to find out what is hindering them the most in using technology in the lessons. I found out that at that time the biggest problems were the lack of proper hardware and the quality of wifi. It was a technical problem and easy to solve. Based on these observations in 2015 an internet connection through fiber-optic cable was established and new laptops were rented. These measures improved the situation and using technology in the lessons became a routine for these teachers who were ready and interested.

In 2017, when we were writing the digital development plan for our school, I understood that there is still room for improvement. I realised that our aim was to achieve pedagogically a seamless blend of teaching and technology. Technical opportunities were present, we had a good quality wifi, laptops for the teachers and students, projectors, tablets, educational robots, etc. To reach this goal, I needed to understand how my colleagues are using technology, and the way they are doing it. I felt that I needed more knowledge in order to gain this information and improve the situation, and I began studying at the educational technology program at the University of Tartu. I attended a course, Creative Re-Use in Educational Technology, and got acquainted with the concepts of tinkering and appropriation. During the conversations with my supervisor, Emanuele Bardone, who was also the lecturer for the course mentioned above, I understood that these concepts can give a frame to my research. I was lacking a general outline for the implementation of technology into teaching and learning by our teachers, but trough

exploring their tinkering and appropriation of technologies in the class, I would receive information about general use of technologies in the lessons.

Tinkering is described by Turkle (1991) as a problem solving method, which doesn't follow a plan, but rather plays with an element, leading or not leading to the next idea. I see appropriation here as the result of tinkering, and, like Dourish (2003), as a process in which a user integrates a technology into his or her ongoing practices and may invent new uses. These concepts gave me an idea to investigate our teacher's creative use and repurposing of different technologies and tools. During the study, my understanding of the teacher's technology use would enhance, which possibly can be useful for the whole organisation in further improvement of varying teaching and learning methods.

In the recent years, Estonian teachers' technology use has been analyzed in several studies. The reports of Estonian teachers' technology use have been published by Pruulmann-Vengerfeldt et al. (2012) and Prei (2013), but these provide only a general review. I couldn't find any research about Estonian teachers creative use or appropriation of educational technology. In Belgium, Derboven, Geerts, & De Grooff (2017) conducted a study of teachers' appropriations of the virtual learning environment used at the KU Leuven Association, adapting the platform to their specific communication needs. The case study carried out by Derboven, Geerts, & De Grooff (2017) made me ponder about our teachers' technology appropriation strategies. The objective of this research is to conduct a case study among Tartu International School teachers' to identify teachers' appropriation and tinkering strategies of educational technology tools. In this thesis, I focus on how teachers make educational technology work for them. Specifically, I focus on technology appropriation: how teachers adopt and adapt technologies, and fit them into their daily practice by developing specific practices to meet their own needs.

To conduct the research, I chose qualitative methods to discover the opportunities for appropriation arising from the use of technology, as it is something which can't be generally identified by quantitative methods. For the method of the thesis I chose grounded theory, which results in verbal descriptions and evaluations that explain what is the situation or the phenomenon being investigated. Grounded theory method is very suitable for my study, as it allows the creation of a theoretical framework for explaining the data collected, allows me to evaluate the

situation by looking at the subject which is being examined from the inside. For data collection all the teachers filled the diary for two weeks, then we conducted lesson observations and finally interviewed the teachers whose lessons were observed.

Based on grounded theory, the appropriation and tinkering strategies of tools may emerge, but in addition, I'm open to other interesting findings. I hope that this work is applicable for further research, and possibly for providing some recommendations.

Literature Review

The method of the thesis is grounded theory, and tinkering and appropriation of educational technology form the frame for my research. By investigating these concepts, I hope to gain a general overview of our teachers technology use. In order to understand the teachers' tinkering and appropriation practices of educational technology, the concepts of "educational technology", "tinkering" and "appropriation" must be first understood. The first one gives us a field and the others the general approach. In this chapter, I will explain the concepts from my perspective, as well as provide a short overview of previous studies.

Educational technology

To comprehend teachers' educational technology appropriation, I had to understand what is meant by the term "education technology". It was defined by Januszewski & Molenda (2008), as follows,

> "Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (p.1).

This approach focuses on four components as Hlynka & Jacobsen (2009) describe them:

1. educational technology is not a tool, but study and practice;
2. the purpose of educational technology is to facilitate learning and improve performance;

3. teacher and learner are creating, using and managing technology; and
4. technological processes and resources are the tools we work with.

Various researchers don't interpret educational technology as just a combination of two concepts, education and technology (Kumar, 1997; Sampath et al., 2007) but as a combination of different processes, technique and methods. It also contains tools, media and computers. The term "education technology" is a combination of education and technology, in which the first part of the word refers to a didactics and the other part to information technology (Piir, 2010). Technology is treated as a teaching tool, not an objective (Pata, 2011). The main goal of educational technology is to increase the efficiency of learning (Kumar, 1997) and to change the learning process systematically, which results in more effective, flexible and interesting learning (Laanpere, 2012).

Tinkering and appropriation

The concept of tinkering was described with the French word "bricolage" by Lévi-Strauss (1962) as a skill of using whatever is at hand and recombining them to create something new. Teachers are very often tinkering to solve problems. They are using creative problem solving methods, which do not follow a plan; playing with an element, leading or not leading to the next idea (Turkle, 1991). Turkle (1992) applied this to programming- She writes

> "The bricoleur resembles the painter who stands back between brushstrokes, looks at the canvas, and only after this contemplation, decides what to do next" (p.5).

This idea is a nice metaphor for how educational technology has evolved in the past decade. Teachers have options for content creation, communication, sharing, and community building. Educators all over the world tinker a lot as they explore digital technologies that are now available and probe how they might be useful in an educational context. Sharples et al. (2014) define bricolage, with regard to educational technology, as exploring the technologies and practices in creative ways to reach the educational goal. Teachers tinker with the technologies and tools to find the possibilities to create their learning and teaching activities.

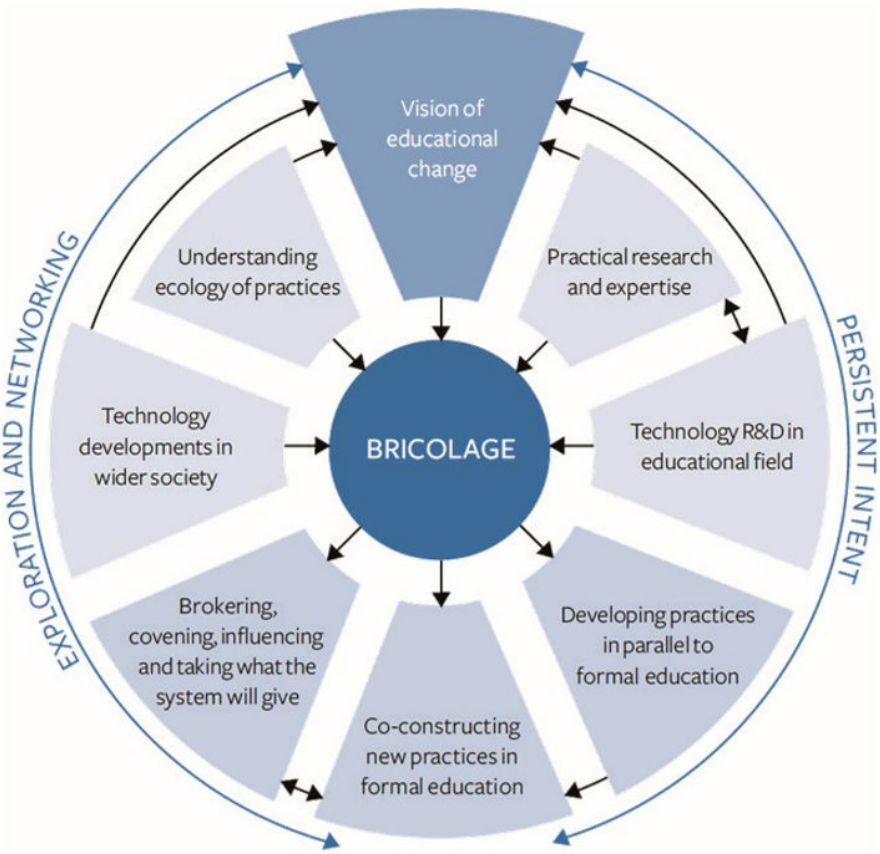

Figure 1. The role of bricolage in the innovation process for technology-enhanced learning (Scanlon et al., 2014).

Scanlon et al. (2014) visualise bricolage as shown on Figure 1. It presents a process of bricolage that involves the collection of technological elements and social practices that has the aim of achieving educational goals.

Educators plan and design their learning and teaching events, which is by its very nature both mental and practical activity (Clark & Yinger, 1987). Research in the field of learning design has made comparisons between the way design professionals, such as architects, approach a design problem and the way teachers design learning environments for their students (Laurillard, 2012).

If a person is open to playfulness and the creative use of technology, he/she can use the results of his/her own tinkering of the lessons.This is called appropriation. Tinkering is the process which doesn't have a plan, it depends on the context and is unpredictable (Bardone & Shmorgun, 2013). It can happen when,

> "one gives up on the idea of following a predetermined path, and thus entrusting himself/herself to the creation of a new one, previous habits do not dissolve into thin air, but they may be re-purposed" (Bardone, 2014, p.14).

In his auto-ethnographic reflection Bardone (2014) describes his *modus operandi* in learning the Estonian language. He was tinkering with digital tools and started to appropriate these over time. In the context of language learning he was appropriating digital practices, which involved the use of technology: taking pictures of signs and labels in Estonian with an iPod, sharing some of these pictures as visual notes in Facebook, adding a caption to the visual notes with which to practice written Estonian, tagging his Estonian teacher in the visual notes that brought up a linguistic problem worth discussing, collecting visual notes on Pinterest on a specific board along with a one-word description for each visual note as a memory aid, connecting a blog to the Pinterest board dedicated to Estonian language to skim the visual notes. The way he was using certain technological tools was adapted and repurposed to new purposes of use (Salovaara et al, 2011). The teachers develop similarly their own ways of technology adoptions and bring them to a wider use, not only that intended by its design (Salovaara, 2012). In other words, they adopt and adapt technologies, fitting them into their working practices with the process of appropriation (Dourish, 2003). Delaney (2010) states that, appropriation is the process of incorporating a new technology into an existing (work) context.

Carroll et al. (2001) present appropriation as a process where technology is transformed in appropriation, by differentiating between technology-as-designed and technology-in-use. These are also the three main components of the model: technology-as-designed, the process of appropriation, and technology-in-use, presented in Figure 2.

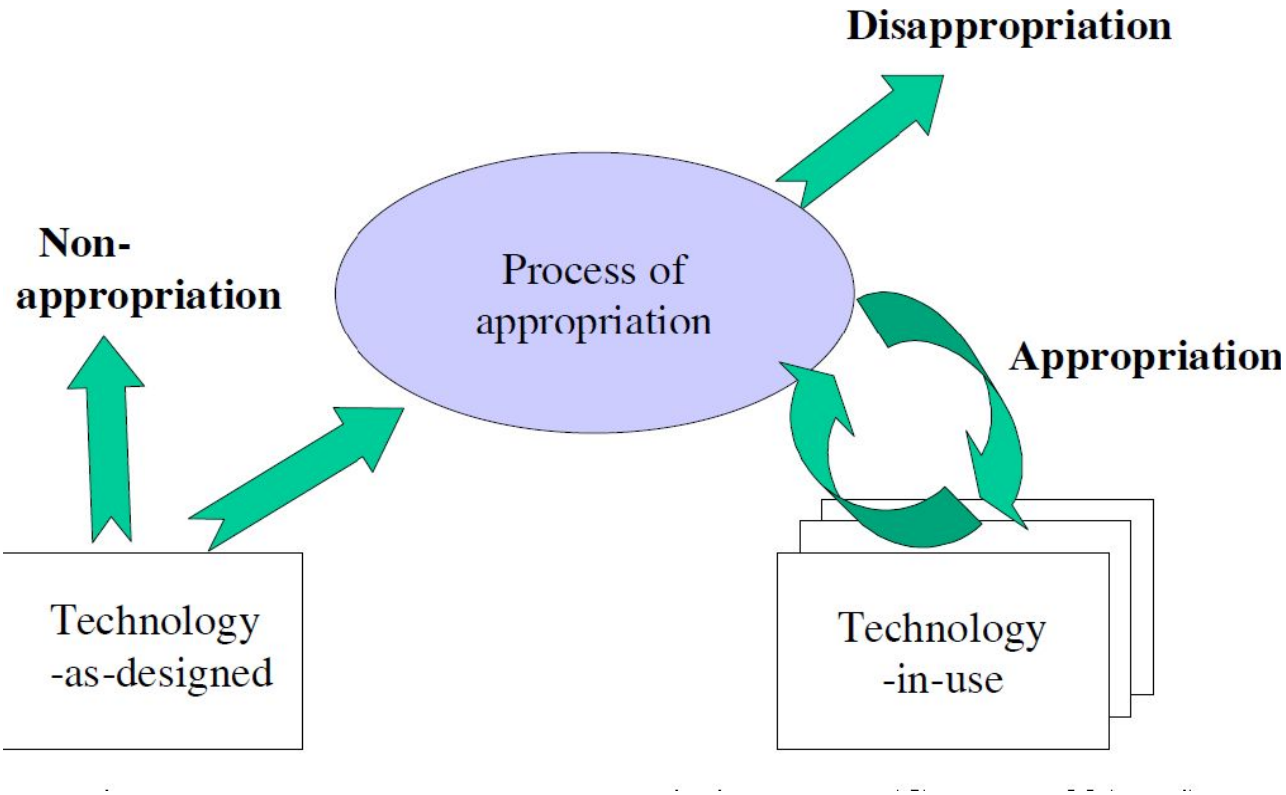

Figure 2. The process of appropriation of technology (Carroll et al., 2001).

Previous studies

Plethora of research is conducted on teachers' technology use (de Koster et al., 2011, Norris et al., 2011, Purcell, 3013, McKnight et al., 2016), attitudes (Yuen Fook et al. 2011, Wang 2014, AlTameemy, 2017), beliefs (Jimoyiannis & Komis, 2007, Kali et al., 2011, Bate, 2010, Loveless, 2011, Orlando, 2014), competences (Lavonen et al. 2006, Kubrický & Částková,2015), experiences (Efe, 2011, Veletsianos et al., 2016), readiness (Christensen, & Knezek, 2017) about educational technology, and technology integration (Walker et al., 2011, Li et al., 2015) into teaching. The work of Firmin & Genesi (2013) give an overview of history and implementation of educational technology.

The use of educational technology in schools has been studied also in Estonia before. Very often the research focuses on certain subject teachers.The main attention has been on factors affecting the teachers' technology use (Pruulmann-Vengerfeldt et al. 2012, Ohu, 3013, Prei, 2013, Kukk,

2015), beliefs (Sepping, 2016), attitudes (Timmi, 2017), readiness to use (Pärn & Pihlap, 2014) and competencies (Kalavus, 2012, Valk, 2013, Seepa, 2014) of technology.

I could not find a lot of research about teachers' appropriation of educational technology. McKnight (2013) studied software appropriation by teachers to support learning for children with special educational needs. She conducted three case studies in the UK, which show how appropriation of software by teachers at special schools support learners with different needs and abilities. Wen et al. (2015) conducted a case study in a school in Singapore on the appropriations of a representational tool in completing collaborative writing tasks in second-language lessons. They showed how the interactions between the teacher and the students shaped the use of educational tools. Derboven et al. (2017) describe a study conducted in Belgium about how university teachers appropriate virtual learning environment to suit their needs. Their case study showed that "some teachers design very specific learning activities using the virtual learning environment not by using the dedicated virtual learning environment tool, but by reinterpreting more generic tools" (Derboven, 2017, p.20).

Having examined the literature it is clear that there is no research on the topic in Estonia. Aforementioned studies about teachers' appropriation of educational technology are concentrating on appropriations of software, but in my study I was open to any kind of appropriations and integration of tools, whether physical or digital, software or hardware. Therefore, I decided to contribute to the qualitative research in the field of educational technology by studying teachers' educational technology appropriation.

Methodology

The structure of the study

The overall goal of the study is to explore teachers' appropriation and tinkering strategies of educational technology tools to receive information about general use of technologies in the lessons. Research in the field of implementation and adoption of technology is usually carried out

using qualitative methods to identify problems arising from the introduction of technology, changing routines, and conflicts that can not in general be identified by quantitative methods. To conduct the research I chose the qualitative strategy, and decided to apply the methodological approach called grounded theory (Glaser, 1978; Glaser & Strauss, 1967; Strauss & Corbin, 1990). This strategy allowed the process of appropriation and integration of different tools to be viewed from the inside, as we saw during the lesson observations, and as the teachers reflected it in the interviews. The research questions of this study focuses on understanding how individuals experience the process of appropriation and tinkering, and identifying the steps in the process (Creswell, 2012). Grounded theory provides more space for interpreting data and allows adaptation and the emergence of a research methodology (Dick, 2005). Based on the data obtained, I tried to develop a methodological framework for clarifying the data, focusing on comprehensive understanding of appropriation and integration of educational technology tools, while relying on a previously developed theoretical concept. When choosing a strategy, I considered that relying on grounded theory does not require to correspond data with existing theories, but theorization and new theory may grow out of original data (Cohen et al, 2007).
For producing data of good quality, I used triangulation, as using multiple methods to view a single object provides means to elicit data that may otherwise be overlooked (Huettman, 1993). I collected the data in three phases:

1. Diary entrances about teachers' technology use in the classroom
2. Lesson observations
3. Semi-structured interviews.

For data collection methods we used lesson observations and semi-structured interviews that were based on the observations. I conducted the lesson observations together with my supervisor Emanuele Bardone. The interviews, except the pilot, were led by me, and took place in the school, in the teachers' natural working environment. Direct contact allowed us to better identify the topics of our interest and, if necessary, clarify and reword if something still remain unclear. The resulting transcriptions from interviews were the substance of further analysis. I based on inductive content analysis when analysing the transcriptions and interpreting the data (Thomas, 2006).

An important factor is that I myself am also directly involved with the organisation. I had to consider the epistemological aspect of the study, the relationship between the researcher and the examinee: I am a colleague to the interviewees and acting as reflective practitioner of the research; moreover, it is a part of my everyday work as educational technologist. Due to this it was possible to evaluate the whole process in depth, based on several different sources of information and perspectives.

Sample

As Creswell (2007) indites "it is a purposeful sample that will intentionally sample a group of people that can best inform the researcher about the research problem under examination" (p.118). Since my study follows the strategies of a case study and grounded theory, I had two samples. First to fill the diary, I employed maximum variation as a sampling strategy to represent diverse cases and to fully describe multiple aspects about the cases (Miles & Huberman, 1994), and all 13 teachers of Tartu International School belonged to the sample.

To choose the sample for the lesson observations and the following interviews, I relied on the diary responses and my general every day observations. I chose the second sample using the sampling strategies appropriate for grounded theory: " the researcher chooses participants who can contribute to the development of the theory" (Creswell, 2007, p.128). In the process of compiling the second sample the valuable fact was that I myself am a part of the organisation and I possess information that an external researcher wouldn't have. I considered the amount of diary responses, the entries per teacher, the content and the variety of the entries. In order to obtain the widest possible sample I chose the teachers who teach in different stages of study, taking into account the representation of different subjects, the gender and age distribution of teachers. In total we observed and interviewed 6 teachers.

As the number of interviewees was relatively small and, in certain respect, not representative enough, generalizations on a broader scale can not be made. However, the data received was an important input to understanding the factors affecting the processes being studied and formed the basis thereof for further research. Unfortunately during the interviews, the saturation point of the

data, as "the point in category development at which no new properties, dimensions, or relationships emerge during analysis" (Strauss & Corbin, 1998, p.143), was not reached.

Collecting data

Before we started with the data collection, we carried out a meeting in October 2017 for the teachers together with my supervisor Emanuele Bardone, concerning the forthcoming research. We introduced the goal, the instruments of the study, and the concepts used in the study. As our aim was to make the teachers consider the utilitarian aspect of the study, we explained that it's also beneficial to them. All the teachers agreed to take part of the research and were willing to contribute. They understood the importance and the usefulness of the study. During the whole research period all my colleagues were very supportive, helpful and understanding.

Diary.

During two weeks in November 2017 the teachers filled a diary about their technology use in the lessons. To get as many episodes as possible, I used the questionnaire option in our study information system (e-diary), because the teachers must definitely login the study information system when they enter their conducted lessons into the e-diary. I created questionnaires for each lesson during the aforementioned period, 60 questionnaires in total. If the teachers did not use technology in the lesson, no entry to the diary was required. In total 119 diary entries from 12 teachers out of 13 teachers were collected, one of the teachers didn't make any entries. For the diary entries, the teachers had to answer three questions:

1. What tool/environment/app… did you use in this lesson? (e.g. phone, computer, projector, Kahoot!, e-diary, iMotion, ...);
2. Why did you use it? What was the purpose? (e.g. motivation, start the lesson, exercising, ...); and
3. For what did you use it? How did you use it? (e.g. I showed a video from youtube for the introduction of a new topic, I took photos of student works with my phone to post on a blog).

We assumed that the diary was the first indication to see our teacher's technology use, and we hoped to find some tinkering and appropriation episodes. To understand the process of tinkering and appropriation, the context where they occur is very important (Oliver, 2013, Belin & Prié, 2012). Therefore we couldn't identify many technology tinkering and appropriation events. In the diary, the contexts was not described, but I still received important information to decide on the sample for lesson observations and later for the interviews.

Lesson observations.

During three months, from January to March 2018, me and my supervisor Emanuele Bardone conducted video recorded participatory observations, without concealing ourselves, trying to minimize the impact on the lesson actions. We video-recorded the lessons in the classrooms, with two tablet computers. In addition we took notes. We tried to place the video recording devices so that we got a reliable view of the classroom. Both of us took notes, and if we observed something of great interest, photos were also taken. Before each lesson observation I explained the students why are we there and what are we doing. Most of the lessons I observed together with my supervisor Emanuele Bardone. I could not attend three lessons observations, and later I relied on the videos, notes and reflections made by him. Together we observed in total 13 lessons: two lessons from each teacher, and three lessons from one of the teachers, because one of her lessons was a double lesson. We selected to record the lessons as videos, because then we had the opportunity to re-examine the video recordings. It permitted capturing multi-layered material. The recorded material gave us the opportunity to view situations repeatedly, focusing on different aspects of image and sound, for bringing out nuances that can not be detected without recording. An important aspect was also the reusability of the videos.

After all the lesson observations were conducted, we applied multimodal video analysis to prepare the subsequent interviews. We selected multimodality to analyse the data collected from the observations, considering the information exchange is based on a variety of ways. All of them contribute to meaning making, but the most important are the context and the environment, and the process of meaning making by people (Jewitt & Price, 2012). We repeatedly watched the recordings and focused on the moments where we could observe appropriation of technology or the opportunity for appropriation (Jewitt & Price, 2012). At that phase the integration of the tools

emerged from the data. We created a Google document for each teacher and shared it with each other. It functioned as a platform for describing the moments of our interest, and adding images and snips from the recorded videos.

Interviews.

All the six teachers who`s lessons we observed were later interviewed. Semi-structured interviews in a face-to-face setting were conducted in April 2018. Using this method the interviewer is prepared with a set of questions, but the interview plan does not completely constrain them. Instead, semi-structured interviews will motivate the interviewees to refine each topic as freely as they wish (Rubin & Rubin, 1995). This will be achieved depending on the course of the interview by asking open-ended questions, re-wording and clarifying the questions, asking additional questions, and encouraging the interviewee to elaborate the topic further.
The first interview was a pilot test as recommended by Yin (2003) and Creswell (2007) to refine and develop the research instruments, frame the questions, and shape the procedures. I was the interviewee and my supervisor, Emanuele Bardone was the interviewer, and had prepared the interview questions and the procedures. The interview was build up as a conversation, like several authors have indicated about qualitative interviews (Kvale, 1996; Rubin & Rubin, 1995; Witzel, 2000). As I have mentioned, the interviews were constructed based on the lesson observations, the interviewee was shown pictures or video clips of the lesson that were observed and the situation was described. Then questions followed. The remaining five interviews I prepared and led; in two of the interviews, Emanuele Bardone was also attending as a participating observer. Preparing the interviews was very time consuming. I watched all the videos of lesson observations several times, and tried to find all the episodes that would interest us. In some observed lessons, where technology was used very little, I approached the topic of our interest by finding incidents where technology could have been used for learning purposes. My goal was to make the teachers to think and elaborate on using educational technology, which may have led to discover tinkering and appropriation strategies. I described all the moments, I added images and snips from the recorded videos, and initial questions that emerged while watching the videos to aforementioned Google documents. Each interview had mostly original questions, but at the end I asked two questions specifically about appropriation (Salovaara, 2011):

1) Do you commit your time to making teaching easier through various instruments, even if it requires some effort or inventiveness; 2) Are you aware that in some situations it is beneficial to use devices in ways for which they may not have been designed.

The interviews lasted from 31 to 60 minutes, and were all video-recorded with a tablet computer. We decided to use this method of showing pictures and extracts from our observational recordings to the teachers during the interviews, because later on, when analysing the data, it was important to see what the interviewee is looking at. After all the interviews were conducted, I started with transcriptions. Transcription does not have to represent everything exhaustively in the text, as selective reduction of the data, in a way that the possibility of different analyses and interpretations is preserved, can be applied (Ehlich, 1993). After I had several times watched and listened to the recordings, I selected the segments of the interviews for transcriptions. After transcribing, I coded and analyzed the data using a grounded theory-based approach (Strauss & Corbin, 1998). Grounded theory design focuses on analyzing data in open, axial, and thematic coding (Strauss & Corbin, 1998). In the open, initial encoding, I identified the codes (key words) and tagged them. Then, in axial coding, I connected the codes which I had marked during the provisional coding with their corresponding categories and subcategories. At the last stage of coding, the thematic coding, I looked intently trough previously categorized codes to determine their links between specific topics.

Results

The purpose of this work was to find out TIS teacher's appropriation practices of educational technology. I was also open to other findings, such as how teachers use educational technology, how much they use it, and how open they are to tinker or invent new uses for technology.

In the following section I provide an overview based on research questions. I decided to present the results in a “story line” that connects the categories (Creswell, 2007), because to understand the appropriation, the context is essential (Firmin & Genesi, 2013). The results are illustrated by

quotations from interviews. The quotations from the interviews are presented in italics, to improve understanding, I added comments in brackets if needed. The prime findings are marked in bold.

Smartphones

Students' personal smartphones.

Unsurprisingly the most appropriated tool was the smartphone. The smartphones were visible in most of the lessons, and all the teachers mentioned the smartphones in the interviews. During the observations and later in the interviews I received confirmation to the emerged assumption that the teachers think of students' personal smartphones as teaching tools for them, like a whiteboard or a projector. The teachers regarded students personal **smartphones as the tools for teaching.** During the observation of Olivia's (all names used are pseudonyms) lesson, she had the students take a photo of their works with their own personal smartphones and send the photos to her email. After a while she explains why she needs the photos, *"I can screen it. That is why I am asking you."* I understood she wanted to project the pictures on the screen later.

> *This was the main purpose. So I have it and we can discuss it later, and everyone sees the same work. But the other reason is that many of them, although they make tons of photos, they don't know how to share them.*

In this case, the teacher was using the students phones to **get the images of students works**, to **project the pictures on the screen**, so everybody can see the same work at the same time. She pointed out another reason, she used the task to **teach students how to send photos** from their phones via email.

In the same lesson a student asked Olivia, what a "Kindle" is and the teacher explicitly says, *"You can look up on the net what a "Kindle" is."* At the same time pointing to the student's smartphone. She appropriates the students' personal phone for **finding the meaning of an unknown word**.

In Martin's Geography lesson with grade 7, the students had to do group work and search for relevant information about how to profit from volcanic activity from web. The teacher brought a

pile of tablets, although they remained on the table, since the students used their own smartphones. When I asked him, about the use of students own smartphones, he explained,

> *With the 7th graders and Geography quite often. /.../ I basically give them the topic and they have to research it themselves. So mainly we use the phones for research. For getting information. /.../ Also sometimes we have used Kahoot! /.../*

In these two examples the students personal smartphones **brought benefits to the teacher**, in particular by enabling to **research for information**, thus the teacher doesn't have to answer all the questions himself and the students **practice critical information searching**. Martin also mentions playing **Kahoot.**

Together with Martin we concluded, that it is **convenient** if the students use their own phones. The students are proficient in using their own phones, thus it is easy for the teacher to take advantage of that.

In Sandra's language lesson the students worked with a dictionary. First they mainly used the paper version but soon took out their smartphones. The students tended to use the smartphones for translations, while the teacher was encouraging them to use the paper version in the beginning. I asked if it was the teacher's policy and if she can see any benefits of the online version.

> *Students nowadays don't know how to use paper dictionary. They don't know the alphabet. Where the letters are. I think it's a little bit too much, they should be able to use this (paper dictionary) and to know how to use it. But this Google Translate. /.../ I don't recommend it, because there are so many mistakes. I always recommend this annaabi.ee, it's much-much better.*

She was very critical about the students ability to use the paper dictionary. I understood that her aim was to make the students practice using the paper dictionary. But still, she let the students use the online dictionary from the smartphones and she even recommends an online dictionary which is good in her opinion. So I asked her whether she approves the students using both version.

> *Yes, absolutely.*

She opposed using of the online dictionary, but because she saw its **usefulness**, she accepted students using it. We may argue, that she was appropriating the smartphone and the online

dictionary because it was **forced to her** by the students. Sandra was the only teacher who didn't use any technology, except CD-player once, during her lessons. She expressed her need to improve technology application into teaching, she said that she would need to learn.

Grade 9 Mathematics lesson with Martin started with checking the homework. The topic was trigonometry. One of the students needed to check a calculation, the teacher handed him a scientific calculator, but later during the lesson, the same student used only his phone and the scientific calculator lay next to his book. All the other students were also using their smartphones, and not the scientific calculators. The teacher was the only person using the scientific calculator. I witnessed the teacher encouraging the use of the scientific calculator, but the students still maintained using smartphones. The teacher's comment about the situation was,

> *I want them to get to used to the scientific calculator because they can use the scientific calculator in the exam. They can't use their own phones.*

When I asked for clarification to whether he meant that if there wouldn't be an exam he wouldn't mind the students using their phones, his position was clear:

> *No, they are used to them.*

Again the teacher was appropriating the smartphone and the **calculator app** in the phones, because the **students continued** using the smartphone app. He was trying to guide them to use the scientific calculator, because the smartphones are not allowed during the Mathematics exam, but a scientific calculator is allowed, and he wanted to be sure that the students are able to use the tool which they can use during the exam. Otherwise he did mind the students using their own phones, because they are **accustomed** to using them.

At the and of the Mathematics lesson the teacher asked the students' to **take a photo** with their phones of the homework exercise so they don't have to carry the heavy book home. In this case, the teacher was again appropriating the smartphone to **lessen the weight** of students school bags.

In my lessons I allow students to use their smartphones, if they prefer it. Very often I even encourage them to use the phone rather than the laptop, because it's much **faster**. E.g., when I have more than one level in the same group, than usually I conduct the lesson using Google Classroom. Every student has then basically its own tasks to follow. In these cases I see that opening Google Classroom in their phones is much **quicker.** Especially if they have already

downloaded the app. Besides, if I have assigned an online quiz in Google Classroom, it's **easier to tap the screen** of a smartphone than maneuver the mouse on the laptop screen. This issue occurred when students who were doing a quiz on laptop started to complain that it's more difficult with a laptop than with a phone.

Another teacher, Miia, mentioned she had students taking **selfies with the completed task given**, the assignment was to go a specific place and then as a proof take a selfie, and then sent the image to her or upload it to Drive. In this situation the teacher's purpose to appropriate the students phones is to **check the given task.**

I often tell the students, when they ask something, that the answer can be found from the internet, with the help of "the wise man in your pocket", meaning the smartphone. My aim is to develop their **information searching skills.**

As it became clear during lesson observations that the students' smartphones serve teachers as tools for teaching, I asked the teachers to elaborate on the topic. There were many different kinds of appropriations of students smartphones by teachers. I asked Olivia, if students personal smartphones turn to teaching tools for her, she explained,

> *Yes, definitely. If he or she won't have the phone, and in some cases, some don't have, then I ask them to go and fetch a laptop or go and take a tablet.*
>
> *I use it a lot in the older grades. Whenever I send them a clip or some sort of information I share it out over the Gmail or Stuudium or something like this and they get access rather than just screening it into the board, because kids work on different pace, and some want to rewind it or fast forward it and so on, so therefore I use it more, like independent using of the phone in the older grades.*

Martin responded to the question as follows,

> *I can't see why not. It can. Cause they have their phones anyway. So if I will tell how to use them, then I will benefit from it as a teacher.*

The teachers grasped the **usefulness** of students smartphones: **availability**, **faster to operate** than a laptop, the students being **accustomed** to their phones, the possibility of working **independently**, and **personalisation**.

Teachers' personal smartphones.

In Grade 1 Music lesson teacher Tiina explained the names of the notes in letter code. She wrote the letters on the whiteboard. After singing the notes, supported by the piano, the teacher opened a piano keyboard application that had the letter notes on in her personal iPhone and projected it on the screen of a TV-set. One-by-one, the students went to the iPhone to play a note by tapping the phone screen and told the name of the played note. When I asked her why she did not use the piano, she replied,

> *That was for a bigger group and to give an introduction. Because it's a bigger picture (screen) and everyone can see. And I can explain to everyone at the same time. /.../ it's different than piano. For first graders it is good that there are the letters (note names).*

Here, the teacher was using the phone application for educational purposes, she was appropriating the app, because she saw the benefits of being able to project it on a bigger screen and having the labels of the note names on the keyboards, so it's **easy** for the students to **follow the process**.

Tiina also works in a music school and she explained that she uses the same app with her singing students, to warm up their vocal chords. She has been tinkering with the app and has found ways to appropriate it. She mentioned that with this app she would have liked to use a smartboard. She was keen to commit her time to make teaching easier through various instruments, even if it required some effort or inventiveness.

I did not witness more apparent use of the teachers' personal phones, but Miia gave some examples of her use of personal smartphone in the lesson.

> *If I do a scheme on the board and I know that someone is absent, then I take the photo of it and then I put it on Google Classroom, so they can also see it. Or when we start some topic with a brainstorming, then we make a mindmap what we know about this topic at the moment, then I take a picture of it then we have finished, when we have got through this topic, then I show them the picture again and we will see if we learnt something new and can we now add something to the mindmap.*

Olivia also mentioned that she uses her personal phone sometimes to find information from internet.

Yes, I do. Especially with the words like that where I'm not sure. I also use my phone.

The main appropriations by teachers using their phones were taking pictures to use the **photos as visual notes**, **searching relevant information** connected to the lesson, **checking spelling**, and using the **phone itself as a teaching tool**.

YouTube: videos and music

Second most-favoured appropriated tool was YouTube. All the teachers used it in their lessons for various reasons.

Olivia used YouTube to play music while students were working. She explained that the background music helps the students to **stay focused** and the students **don't start chatting** with each other.

> *I use it very often. Especially this year when the the kids in the classes are so versatile. /.../ And I noticed whenever I put on some music, then they are much more quiet and they focus a bit more. This works basically in grades 1-9. /.../ Jazz music has been the keyword over here. I tried with different others but the jazz music is somehow different.*

She explains, that especially, when she teaches a versatile group, the music is advantageous. She had also noticed that Jazz music has the best effect. She has been *testing different music styles* and found out, that Jazz works the best. She was tinkering with playing the music during the lesson and now she appropriates **playing Jazz music as background in her lessons**.

Olivia also plays music from YouTube when she uses **gamification** in her lessons, e.g. when she uses the Jeopardy game in her lessons. Jeopardy is a popular answer-and-question quiz show on TV. It has been used in educational settings by teachers all over the world. Teachers can modify and choose the topics and the questions suitable for their teaching goal. She explained that she uses "thinking music". The music also **gives a clue** to the students of when the time is up. The volume of the music slowly raises towards the end of the time given for the question.

> *Sometimes at the end of a chapter I do a Jeopardy style lessons also and then I put on the "thinking music" and this is quite loud. So I use music also over there, not background any more, but sort of overall "thinking music".*

When she uses **background music**, then the volume is quite low, but when she uses **"thinking music"** it's quite loud and the volume raises, which gives a hint to the students about the time ending for a task.

I like to use music myself also very much, but I do it so that the students choose their own music and use headphones, in other words I appropriate the headphones for teaching. The reasons are similar to Olivia's: students **stay focused** on the work and it **avoids chatting**. It's a great help to students who sometimes **tend to disturb** the lesson: listening to music helps them to **avoid** these actions.

In addition, I use **mnemonics** songs for students to remember the formulas or terms. The method is very effective. One can find abundant number of such songs from YouTube.

> *I use these songs to remember something. In Mathematics, there are so many songs, for example Pythagorean Theorem, whatever, to remember things, and they really help. Sometimes they come in the break and they sing the songs /.../ YouTube is amazing.*

To have **calm atmosphere**, **facilitate concentration**, and to **help remembering information**, playing and listening to music, mostly from YouTube, is widely appropriated by our teachers.

All the teachers interviewed mentioned that they use videos in their lessons. In the lessons observed, we also witnessed the use of YouTube videos. In grade 1 music lesson Tiina put on a video of a new song from YouTube, where children were singing and there were also lyrics like in karaoke videos. Students started to learn the song together with the teacher, she was singing along with the students and the video.

Tiina explained why she chose the song.

> *That was the song that was chosen for a sing up day over the world for international schools. I was thinking is a nice touch.*

Picking that song had a **wider objective,** to show the global touch of the song.

I could notice that the video was **supporting** the teaching. But can the video replace the teacher? First Tiina, as a musician, had an opinion that it is possible. But then, thinking about the children, she changed her mind.

> *Of course it can. There is like multiple choices, people who study the guitar and instruments and everything by YouTube or something. But it depends on the individual*

person. The first grade..., in army who is the leader of the soldiers, if he doesn't go then soldiers don't go. If I'm not singing, they don't sing. they are like small mirrors, you need to show everything what you expect from them.

She decided that the video could not replace the teacher:

I think not, because children read a lot of movements and body and everything else. Children or people are always a little bit lazy too, they need that small, gentle push.

Knowing that people can learn to play the guitar independently by following the video tutorials, Tiina judged that the video actually can replace the teacher, but when she started to think about own students, it was obvious to her that it's not possible with the children. They need a leader, an exemplar who guides and impels them. Showing the YouTube video to the students helped the pupils **make connections** between their own experience and global music. The teacher was in interaction with the video to be an **example to the students**, she was smoothly directing learning the new song.

Interestingly, Tiina was teaching the same song to grade 2-3 also, but didn't use the video this time.

They know this song better. And they have lyrics, and if you sing better you don't need lyrics as karaoke. It can be even disturbing.

Tiina was appropriating the music video to **learn the lyrics** with the 1st graders, who need more support with learning the song, but with the older students she decided not to use the video, because they are already proficient enough to learn the lyrics from the paper, and the video may even be distracting.

Sometimes technology is good, sometimes bad, they don't get the real picture of their own capabilities. And also, because their voice doesn't sound like the products of the companies, they can fall to the other level, they don't do anything, because I'm not sounding like that. /.../ I try to do it this way that I give you example, everyone listens how it goes, what is this, and then we are doing without any (technology, videos). If the teacher feels comfortable and confident then it's working.

She has noticed that if children don't hear their own voice while singing, it may appear to them that they are singing like professional singers and their self-image renders incorrect. She pointed

out that the teacher must be confident and be aware of the dangers, while using the music videos in the lessons and learning would have an effect. She uses music **videos for examples of the ideal** model, and then she continues practicing without the videos, which in some cases even may damage the learning. Tiina appears to use the music videos appropriations consciously and cautiously, she is aware of the dangers.

During grade 1 music lesson Tiina used also an animation she played from YouTube. First she shared out paper worksheets with the lyrics of a song in the animation and the main characters of the animation. Together they recalled who the characters were and what was the song about. Tiina explains why she chose this animation.

> *The song has got the prize. Oscar for film music. That song. That was very relevant right now. And the second reason is they had that (song) in the movie more than once and I'm always doing it this way, that if watch something then the music must be very representative, you must understand why we are watching it and why this song is important. That's the reason I give also lyrics and we sing it too.*

Very important for her was that the song is **relevant** right now and the song is played more than once in the animation. When she chooses the animations or other videos, music must be **strongly represented**, it must stand out. She is appropriating a children's animation in her teaching, because the animation is **significant at the moment and the music strongly reveals** in the animation.

Tiina explained the reasons and the logic behind choosing the videos.

> *Quality is the first reason. It must be important somehow. Or it's important in the musical literature or the historical point is very important, and the pop -musical point is very important, and also if it has good idea, or a good story, that gives children more open eyes.*

By selecting the videos, it is very important for her, that it is of **high quality**, likewise the music in the video must be **essential in musical literature or history.** She uses influential pop- music, which must have an **appealing idea or story**. Her aim is to **expand the horizons** of the students. Together we came to the conclusion that there is something broader behind using the videos in an appropriated way.

> *For me, definitely. I always have it, if you watch some kind of cartoon, I have songs and they have connection to how it's in the world and how it is with music and why did it happen, everything like that. Because it's in English language, so I think it supports also their studies, other subjects.*

Through the videos the teacher can **connect the lesson with the world**, as she again points out that the videos help the students **make global associations**. Another reason that Tiina points out is the **language:** the **videos support the development of English**.

Tiina was also critical about YouTube.

> *Sometimes I'm critical about YouTube videos. Like, If I search nursery songs, or something, then I see ladies who sing totally out of tune. I think for a young child, for the ear development it's so important that you sing properly. I need to check everything first. I have to be really critical. I'm looking at the ideas, and if it has good words, then I write a melody for myself. Then we sing only with me (no video). It takes lots of time to check the videos. You can't go to the lesson and just press the button. Lots of time goes into finding the right quality and a good performance.*

To use the videos in her lessons, she needs to **commit time** to making teaching varied. She **checks** all the videos she uses carefully. If she is not satisfied with the quality, she does not use the video, but may use the lyrics and the tune. She is **tinkering** with the YouTube videos.

Another teacher, Miia was using an uncommon 360 degrees animated video to illustrate her History lesson. It was about cave paintings. While the video is playing she had to maneuver the video with the mouse.

> *Yes, it's a 360 video, and of course it would be fun if the students would have moved it themselves, but for me, I wanted to illustrate the Stone Age people drawings, it wasn't the 360 video. It was just an extra value.*

She acknowledged that the video was peculiar, but the peculiarity of the video was not her main goal choosing it, it was the **content** that mattered, so she used the video in a way **appropriate for her.**

During Martin′s Geography lesson one student was watching a video and filling a worksheet based on the info from the video. He was using a laptop and headphones. It seemed that the technology was supporting his learning. I asked Martin to clarify it.

> *Yes. Otherwise he wouldn't be motivated. It motivates him greatly.*

So, the teacher pointed out that technology is especially helpful with some students. A preeminent reason is **motivation**.

> *Also the accessibility of different materials. You can access different materials really fast. For example, when he finishes one video, and then you can very quickly find another one that is in the similar topic, but another view. Variety of materials.*

He indicates that YouTube allows a **swift access to different, diverse materials**.

During a Mathematics lesson, Anna showed a video about the common multiple. She didn't just show the video, but at certain points she **paused the video** and **asked students questions** or **explained something herself** (something that she will do very often). Her explanation for asking questions from students is following:

> *I was checking if they know what the multiple is actually. Because factor and multiple, they get confused with this very much.*

So, she wanted to be convinced that the students **understand the content** of the video. She tries to make the video "her own" by **stopping the clip and asking questions** to understand students' comprehension.

At some point the clip explains a different technique to find the least common denominator. She says, *"This is his method. We do it differently. We do it as we have done it already"*.

The teacher was **grabbing a chance of teaching**, **integrating the digital piece with herself.**

> *Why I like to use videos when native speakers are speaking. Because then they pronounce these multiple correctly and whatever terms, where I may make..., they imitate my accent. But then they listen how the native speaker says it also. The video is a tool, I use the videos almost every lesson. So that they hear how the terms are said, the short videos attract them. I think they (videos) attract more than only me explaining and writing on the board. And I think it's good that they see this other way, that people use other ways.*

Like in Tiina's case, this teacher also points out the **language.** The students hear native speakers speaking and learn the **correct pronunciation**. She also argues that **videos are attractive** to the students and it's beneficial for the students to see that there are **different methods** in use.

The teacher does not show the entire video to the students, but scrolls it to the end, and before playing it, she asks, *"What does he always say at the end?"* Then she finds the scene where the person in the video says, *"Don't forget to practice!"*

> *Because it's not only me who is saying, that practice makes a master. He is very good in Mathematics, it's not only me, he is very good, and he says that you need to practice also, and they can not complain to him.*

Here the teacher appropriates the video for **motivational reasons**. She has the feeling that the person in the video is authoritative for the students and she thinks it motivates student to practice. She also takes the advantage of the fact that the students **can not complain to the person in the video.**

The teacher continues explaining the use of videos when she teaches several groups at the same time.

> *When I use Google Classroom, then the students look the clips themselves, but then I have... Very often they have to write the comment or answer a question about something. If I have more than one group, like make up their own problem, something like that when I can't stop the video because it's not synchronized.*

In this case she still makes the videos **"her own"**, by making the students answer questions, to write a comment, or to come up with their own problems on the topic.

In one of her lessons Anna has three different level groups. She uses videos in this lesson as well. Two students who have their own work (not the same work) follow the lesson from Google Classroom, where the videos are added. These two students start the lesson with the videos. The teacher explains how the videos **facilitates personalisation**.

> *This also is already... like, this is also routine for him. In the beginning of the Math lesson, then he calms down, I think that he is addicted to his phone actually, so I use it for the learning purposes as much as I can. Then he doesn't disturb the others also, he is*

watching his video, and then I can explain the others what to do, while he is hopefully concentrated on the video.

Here she mentions that watching a video at the beginning of the lesson is a **routine** for one of the students. It helps the students to **calm down** and **set his thoughts** to the lesson. In addition, it helps to **maintain discipline in the classroom.** The teacher is aware that it helps to avoid the situations, where certain student would disturb others.

GIF

I found from Martin′s science blog a GIF that demonstrates the inertia and Newton's I law of motion. The teacher used phones and other technical equipment in teaching. He had been playing with the available resources.

I thought about making a video. But I thought making a video would too, it would consume too much time, put it together and everything. And also there wasn't that much material to make a video, so basically I knew I can use, to make a GIF, do it like even when it's like half a second or one and a half second then its really easy and really fast. And it doesn't take much space as well. It's basically a moving picture. And also like today many kids use GIFs. A lot of gifs are in the internet, they are very popular.

Through tinkering the teacher found an effective means of **visualizing an abstract phenomenon**.

Online dictionary

In Mathematics lesson, Anna noticed, that one of the students didn't understand how to convert fractions to decimal numbers. While other students were given another exercise, the teacher invited the student to her desk. First she tried to find out whether the student knows what a decimal number is. When the student didn't respond, the teacher used Google Translate to **find the word "decimal number" in the student's mother tongue**. When the teacher asked her how is it in her native language, she did not respond. Apparently, the student does not know the word. The teacher elaborated on the aspects described,

I noticed that she didn't convert them correctly, and then I started to doubt that maybe she even doesn't make the connection what she has to do, what does she have to find.

> *Because, she knows, what decimals are, for sure, but to find this, because in the instructions it was said that convert into decimal. And then I tried to tell this "decimal" to her in her mother tongue.*

And she continues explaining, why she tries to translate the new terms into the students' native language.

> *I think she wasn't sure. I'm sure, she knew it. But that's why I do it, use this Google Translate, to find this word for some of the students, some don't need it, but some students need to know it in their mother tongue. Then they understand it better, the concept. When we have new terms, then I try to use Google Translate, I have actually a dictionary also, where I have Finnish, Russian, French and German. Book, mathematical dictionary, but I don't have Hebrew there, so this I have to find from the Google. And then we try to find the correct term. If we can't find it using technology, internet, then I ask them to ask from their parents at home.*

The teacher had to be resourceful, she had an issue and she was open to find the solution from somewhere: Google Translate, Dictionary, parent, internet search. In this particular case she managed to solve the problem by using Google Translate, thus she was appropriating it to her teaching goals, to to find the term in the students' mother tongue, so she would **understand the concept**.

Online quizzes and exercises

In the Mathematics lesson Anna plays a Kahoot about equivalent fractions. It's repetition for the students. Before starting with the Kahoot, she shows the students physical fraction bars. A picture of a similar tool is used in the Kahoot. She explains what tool is it,

> *For equivalent fractions. So here they actually can touch them, they can take them out. And then test what is equal to what. And they have done it when they were smaller. They know what it is. So they have played with this. At some level they need this physical thing also, it helps a lot.*

She starts the Kahoot, and if there are no mistakes, she moves on. If there are, then she **takes a chance to explain** the task. She makes use of the fraction bars.

> *I had this already, exactly similar tool that was used in this Kahoot, which I found, this was done by someone else, it was really quick for me to find it. I was thinking it was really good, because I have this one, so I can connect them with this that they know from when they were younger, so it was like all integrated. So this previous knowledge of them, now this was also repetition for them, this Kahoot, and to repeat the words like simplify, and reduce and extend.*

The teacher was **combining physical tools with technical tools**. Teaching and learning does not happen within the screen. **To get out of the oblong**, she finds a way for the students to study two different elements, one being a physical object and the other one located the screen. Everything is not happening within the oblong, the **physical world is also engaged**.

> *I think that this (fraction bars) is what brings that out from there (screen) to the real world. Math of course is very abstract, but if you can make connections to the real world, so this is what we would like them to...*

Anna continues to explain other ways she uses Kahoot:

> *I love Kahoot, and the students love kahoot. For example, sometimes I use it so that I choose a very difficult Kahoot for a new topic. And during this we actually learn this new topic. /.../ They may answer absolutely wrong, but somebody may get it somehow already and then we try do start discussing how was it and finally they know how to do it.*

She appears **repurposing the quiz** by using it reversely for **introducing and discovering the new topic**. She reveals how she came upon the appropriation,

> *I discovered it actually by accident by giving to the students a difficult Kahoot to do. And then I saw, aa, I can use it this way they will learn during. Let's learn how to do it.*

Kahoot is competitive, five best results are shown on the screen. Anna has found a way to avoid the negative aspect of competition.

> *Some students don't like it at all. They don't like Kahoot because it's competition. So what I discovered in Kahoot is that there is this team mode also. I have had students who didn't like Kahoot at all because of the competition side of this. But when I put it to team mode, they were so hard thinking, because they were fighting for their team.*

Anna indicates, that she is appropriating Kahoot to help students to **manage with the downside of competition**.

In Estonian class, for grade 2-3, Miia splits up the students into two groups. She sends one group to work at the library, one boy is working on given task at the computer the same time. He gets the feedback from the app instantly. He doesn't do everything correctly. When Miia returns to him, they check the answers together and clarify the language rules. She takes the opportunity to use the online exercise for teaching. Miia clarifies why she used these apps,

> *Some of them were made in Learning Apps, but this one is other page. I use this Taskutark, which has like this Estonian exercises put together based on topics, so I take them from there. And if I don't like it, the Learning Apps has this opportunity to modify any app is there.*
>
> *I was able to find ready made exercise already online, so this is a big bonus here. And also this is, now, to have some variety in the lesson as well, because we already did some exercise on paper slips and this student likes very much using a computer, he is very interested in computers, computer games.*
>
> *I wanted them to work in groups. This is also something that allowed to do this individual tasks well, because the computer already tells you like, was it correct or incorrect, so it's good for individual work.*

She points out that it was to have variety in the lesson and she **uses the knowledge of this particular boy's interest**, computers, to **motivate** him.

It was important for her, that the task was automatically checked and the student got feedback, so he was more **autonomous**. It was relevant to her that she could find a ready made task. Nevertheless the convenience of using the technology is not always the major reason.

> *No, definitely no! It's not the only reason. Sometimes it takes me like I don't know 3 hours to put together a good Google Classroom lesson with different links and so on the webquests they have to find information from videos and so on. Sometimes, because I see that's the best way of doing it and I spend hours on preparation.*

She might spend more time on the lesson preparation than the lesson lasts, to produce an online lesson, a webquest, because it is the **best possible result** for her. She is willing invest her time into investigation to find new methods and approaches.

> *I already have a good solution, so I decided not to use something else. But sometimes if I don't have the good solution, then of course, I'm willing to put my time into investigation.*

She analyzes all the aspects of the lesson, nothing is automatic.

> *The more you teach the, more experience you have, the more you are able to go through in your head also those things that does that kid have enough variety, and should I use technology, should I take this method or that method, where does someone sit, what motivates and what not. If you have a little of experience, then you might plan different and fun activities, but they do not actually work on the spot because you aren't able to think about the whole picture. Just think about teaching the subject.*

Miia considers methods, arrangement of the seats, motivation, variety, technology use. She judges miscellaneous aspects, to **design specifically her own lesson**.

> *I like this part of teacher's work, this time for me to be creative and put together your own lesson. And using someone else's materials, you have to make them your own in order to work.*

While helping the student to fix the words that were wrong, she made the online exercise which someone else had made “her own”. She took the chance to explain the language rules. She points out that she makes learning resources her own by **repurposing the teaching material**.

Whiteboard and the projector

All the teachers still used a whiteboard, although all the classes have a projector installed. In many cases I could observe integration of the whiteboard and the projector. We do not have neither a smartboard nor a smart projector. Using whiteboard and projector synthesis, the teachers made the teaching interactive. Anna comment using the whiteboard:

> *It's (whiteboard) a very good tool. I'm using it less now, when these projectors came and the computers. So I use it a little less now but it's still ... Sometimes I show answers on the screen, so we do not solve everything on the board. The geometrical drawings. I will do*

> *these special programs. I draw by hand much less. When they start drawing, then I still help them, but it's much less. And it saves time. For example, if there is a geometrical construction, I do not have to draw it myself, I have it already on the computer.*
> *When there are the drawing it's very easy to complement If you can visualize the problem, then it helps students, drawing make the problem easier.*

The Mathematics teacher describes the whiteboard-projector interaction as something that **saves time**, by using a geometrical construction that is prepared beforehand and then, during the class, **complementing it with necessary elements**. The whiteboard appears to be still an important teaching tool in mathematics The teachers explained that it's still inconvenient to write the mathematical formulas and equations by computer, it's not as fast as writing by hand directly on the board.

The Mathematics teacher also used **whiteboard-video-projector interaction**. While she paused the video for the clarifications, she added the **explanations with the marker on the paused video image**, which was projected on the whiteboard.

Teachers also applied the whiteboard-projector interaction by displaying students work (worksheet, book page) on the whiteboard and solving it by complementing the image on the screen. For example during Mathematics lesson, they started checking the homework. First, they were telling the answers orally, but after a while teacher Anna says aloud, *"Maybe I will put it on the screen. It's easier"*. The teacher also writes the correct answers and explanations on the board, next to the exercise. She explains her motive:

> *Why is it good to project the same worksheet or the book page, it's easier for them to follow. If I would write the exercise separately on the board, then maybe they're confused, where is this, where is exactly this exercise, but now they know. Aa, this is the one that alI have here, everything is there (on screen) so it also helps very much.*
> *For some of them it wasn't so easy to follow, so the screen helps them to follow.*

Described interaction facilitates students **following the lesson pace**. It **supports them comprehending** the worksheet and the projection concomitantly.

Discussion

The aim of this study was to determine teachers' appropriation and tinkering strategies of educational technology tools, how teachers make educational technology work for them. My interest was to learn how teachers adopt and adapt technologies, and fit them into their everyday work in the classroom. Based on the research question, I discuss in this section the most important research findings, bringing the arguments onto a higher level of abstraction, and report the limitations of the study.

It is apparent that the most appropriated tool was the smartphone. The teachers allowed or assigned the students to use the smartphones in most of the lessons observed. A significant finding was that the teachers consider students' smartphones as a teaching tool for them, that is, the students' smartphones are deemed as a teaching aid, justs like any other tool such as pencil and paper, whiteboard or projector. We observed this in several lessons, and the teachers also explained during the interviews - that in many teaching circumstances the students' smartphone is the most preferred option. If the student for some reason did not have a smartphone, then a tablet or a laptop were deployed. As shown above, the teachers appropriated the students' smartphones in many ways, which indicates that our teachers have grasped the notion: “With the abundance of knowledge the Internet provides, mobile phones become an invaluable pathway for that knowledge” (AlTameemy, 2017, p.436), and were using it in a beneficial and meaningful manner for teaching and learning.

O'Bannon & Thomas (2014) studied how the age of the teacher influenced the perceptions of using mobile phones in the classroom. They investigated the teachers use of different classroom applications (calculator, calendar, audio and video recorder, digital camera, internet access, texting/email, educational apps, etc.) based on their age. In my study, I have explicitly described teachers appropriation of students' smartphones as teaching tools and the study has identified that teachers consider students' smartphones as any other teaching tool. This particular topic seems suitable for deeper investigation of how the educators appropriate the students' smartphones, and what is the perception of using students' smartphones as teaching tools.

In two cases I encountered an argument that a teacher was forced by the students to appropriate the smartphones for teaching. One case was with the online dictionary and the other the scientific calculator. The reason in both situations was the same, the students were continuously using their smartphones, and the teacher, understanding the benefits for learning, allowed the action. We may argue that the teachers accepted that the smartphone is omnipresent and the students are effective users of their devices, they feel strongly motivated when allowed to use it also in the classroom (Norris et al., 2011). In 1989 Winner (1989) discussed the status of television, as a phenomenon that has a considerable part of people's daily life and cannot be unplugged, as it is "Deeply insinuated into people's perceptions, thoughts, and behavior, it has become an indelible part of modern culture" (Winner, 1989, p.12). I have the impression, that in 2018 the smartphone has the same status. Furthermore, it is portable, and in some cases people have claimed that it has become a part of their habitudes and identity (Salovaara, 2012, Kalmus et al., 2018). It appears that due to this phenomenon, the teachers used it in meaningful-learning context and thus were appropriating it.

In order to successfully incorporate educational technology into their lessons, teachers must be able to use the digital tools. And here I don't mean using this the tools in the narrow sense of getting familiar with how to how to interact with a tool or a device technically (turn it on and off, connect the device to another device, play a video from YouTube, create an online quiz, ect.), although this is also important. Appropriation occurs when the teacher seamlessly integrates technology in her/his practice (e.g. teaching, learning, etc). Furthermore, it is essential that the teachers choose the "type of technology that best suits their educational goals" (Firmin & Genesi, 2013, p.1605). It is important to stress that choosing the type of technology that best suits teachers' educational goals - in short, appropriation - is essentially a meaning-making process, which, as Salovaara (2012) claims, involves and is dependent upon what one *already* knows - the teacher's existing knowledge. Hence appropriation describes the process in which a person creates *meaningful* use. This implies that teachers' willingness to be engaged in creative explorations of possible meaningful uses is essential to integrate educational technology purposefully into teaching. In this sense the teacher should not be viewed as a mere user able to

interact with a device (e.g. turn it on and off, ..), but as an educator dealing with different options with potentially different pedagogical meaning.

During the research we noticed that the use of technological tools by teachers was smooth and integrated in the process of teaching and learning. This is a sign that the use was meaningful. Technological tools were considered as any other teaching tools and they simply faded into the background. This seems to suggest that teachers shouldn't use the technology for the sake of it, which might in the end simply result in meaningless use. Conversely, teachers' educational purposes must guide the use (Firmin & Genesi, 2013).

Meaningful use is always emergent, depending on the context, which has many variables: the teacher, her/his style, personality, knowledge, the particular class, particular student, ect. This is in line with what Firmin & Genesi (2013) argued: "technology use is dependent on the context of the situation and is closely connected with the users. In other words, the same technology can be utilized in several different ways depending upon the purpose of the one who is using the specific technology" (p. 1604).

To conduct the research I used a qualitative strategy, case study and grounded theory as my methods. The data was collected in three stages: teachers diary responses about their technology use in the classroom, lesson observations and semi-structured interviews. The study consisted of two samples: a) all the 13 teachers in Tartu International School filled the diary, and b) six teachers were observed in the classroom during lessons and later interviewed. The limitation of the study is that during the interviews, the saturation point of the data was not reached and generalizations can not be made. Although it is a qualitative case study, its outcomes may provide suggestions for further investigation into the matter.

Conclusion

As is often the case for qualitative studies, the results of this analysis are unique to the context of the study, the participants and the particular researcher, and it's difficult to make reliable generalisations. Nevertheless, the case study outcomes provide a reflection of a meaningful use of

educational technology by Tartu International School teachers'. Based on the results, suggestions for further investigation into the matter can be made.

The main motivation behind this study was that as the educational technologist of my school, I wanted to understand how my colleagues are using technology in teaching, in order to enhance the quality of the educational technology support for them in the future. To gain insight into the general use of technologies in the lessons by our teachers, I conducted a case study in our school and the chose appropriation of educational technology as the frame for the study.

From analysing the results, I can derive three main findings which describe the appropriation practices of educational technology by our teachers. Firstly, the teachers consider students' smartphones as any other teaching tool: the teachers have grasped the benefits of using students' smartphones for teaching, it has been proven to be convenient, and the teachers take advantage of that. Secondly, the smartphone has become a part of students habitudes and identity, therefore it is reasonable from the teachers to use it for teaching and learning purposes. Thirdly, appropriation of educational technology occurs when the teacher seamlessly integrates technology in her/his practice. The reason for using technology in the lesson is not the aim to use technology, but the meaningful use to facilitate learning.

As a result of the study, the broader goal of the Master's thesis was fulfilled. I got an overview of how my colleagues are using technology, and the ways they are doing it.

The present study reflects teachers technology use in one particular school, within the frame of appropriation. In the discussion above, I bring out the main findings, which give insight into teachers' educational technology uses. It is also important, however, to examine the topic further, by conducting more detailed studies of teachers' seamless blending of tools for teaching and how these tools may be appropriated in a meaningful learning context.

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Author's declaration

I hereby declare that I have written this thesis independently and that all contributions of other authors and supporters have been referenced. The thesis has been written in accordance with the requirements for graduation theses of the Institute of Education of the University of Tartu and is in compliance with good academic practices.

_____(signature)

05.06.2018

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APPENDIX 1. Appropriations and explanations/justifications

Findings are ordered alphabetically.

Smartphone	
Appropriation	explanation/justification
checking spelling	availability
research for information	check the given task
to develop the information searching skills	convenient
to find the meaning of an unknown word	easy to tap the screen
to get the images of students works to project the pictures on the screen	enables independent working
to practice critical information searching	facilitate personalisation
to take a photo of a book page to lessen the weight of students school bags	faster than laptop
to teach students how to send photos from their personal phones	faster to operate than laptop
using photos as visual notes	forced to the teacher, because students kept using it
	helps the students to follow learning process
	quicker to open Google Classroom
	students are accustomed to use the device
	usefulness

YouTube: music	
Appropriation	explanation/justification
helping students to remember facts using	avoids chatting

mnemonics songs playing Jazz music as background music in the lessons using music to give students a clue when time is up	calm atmosphere facilitate concentration helps remembering information helps to stay focused

YouTube: videos	
Appropriation	explanation/justification
showing animated movie for kids in educational purposes starting the lesson with a video as a routine stopping the clip and asking questions to help the students to learn the lyrics using a 360 degrees animated video, but showing only relevant parts using professional music videos as examples of the ideal model using video as an example of singing to the students	can not complain to the person in the video correct pronunciation facilitates personalisation has appealing idea or story helps to maintain discipline in the classroom high quality make global associations motivation music in the vanimation is essential in musical literature or history music strongly reveals in the animation supports teaching supports the development of English swift access to different, diverse materials

	the song is significant at the moment to calm students down to connect the lesson with the world to demonstrate different methods in use to expand the horizons to show the global touch

GIF	
Appropriation	explanation/justification
two GIFs (slow and fast) showed how inertia works	visualizing an abstract phenomenon

Online dictionary	
Appropriation	explanation/justification
find the word “decimal number” in the student's mother tongue	to understand the concept

Online quizzes and exercises	
Appropriation	explanation/justification
combining physical tools with technical tools (e.g. Kahoot and fraction strips)	introducing and discovering the new topic
repurposing the online quiz	it is at particular moment the best possible result
to manage with the downside of competition	repurposing the teaching material
to take a chance to explain the mistakes in online exercise	student is autonomous
uses the knowledge of this particular student's interest	to design specifically her own lesson

	to get out of the oblong, engaging the physical world

Whiteboard and the projector	
Appropriation	explanation/justification
complements geometrical drawing with necessary elements for solving the problem	facilitates students to follow the lesson pace
explanations with the marker on the paused video image	supports students comprehending
whiteboard-video-projector interaction	to save time

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