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**Primary School Education in the Time of COVID-19 –
A Literature Review**

Bachelor's Thesis

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Intercultural Teacher Education

2021

University of Oulu Faculty of Education

Primary School Education in the Time of Covid-19 - A Literature Review (Alex Brina & David Delahunty).

Bachelor's Thesis, 50 pages

March 2021

The impact of the COVID-19 global pandemic which originated in Wuhan in 2019 has had an unprecedented impact on everyday life over the past year. This is especially true for both students and teachers across the globe, with UNESCO (2020) estimating that school closures had affected over one and a half billion students across the globe at the end of 2020. Due to the pandemic teachers were suddenly forced with little warning, or training to adapt their teaching and pedagogical approaches from face-to-face teaching to distance and hybrid teaching. This thesis examines, via means of a literature review, how well primary school teachers were prepared for this shift, the role of technology in their teaching and the evolution of teaching practises during this shift to distant education. Additionally, support mechanisms available for teachers during this shift to distance teaching were also examined.

The theoretical background of the thesis first explores two educational trends, providing a definition, brief history, and different models available. The first educational theory is Computer-Based Education, a framework in which technology serves as a learning tool, facilitating learning through different practices, apps, and multimedia content; the second is distance education, which can simply be defined as “any form of providing education to students who are separated by distance (i.e., who are not physically present in the same space) and in which the pedagogical material is planned and prepared by an educational institution ranging from the first examples of correspondence courses arriving to today’s technology-based synchronous and asynchronous courses.

The first research question shows how, despite a very limited number of exceptions, the literature available and the surveys conducted in different areas of the world report a certain degree of insecurity among teachers in switching from face-to-face to distance education for different reasons, such as lack of training, confidence or appliances. The thesis follows with the exploration of the role of technology in distance education and how the teaching practices evolved during social distancing, highlighting how tools such as videoconferencing became widespread in the teaching practices. Concerning changes in teacher education according to the standards of distance education, some pre pandemic frameworks are provided in order to prepare teachers better for ‘emergency remote teaching’ despite the literature on the topic is still limited.

In addition to examining the issues facing teachers, several support mechanisms and educational technology solutions were also identified at the regional, national and community level. The private and public sectors have also provided a multitude of Educational technology solutions which teachers have also had the opportunity to utilise in the shift to online teaching.

Keywords: Computer Based Education (CBE), COVID-19, Distance education, EdTech, Literature review, Primary education.

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1. Introduction

The discovery of a new COVID strain in Wuhan, China at the end of 2019 (COVID-19), has since led to an unprecedented global situation for educators and students alike. Working, social and school environments have all undergone fundamental changes, and have been taken “online” using a variety of platforms and mechanisms that have fundamentally changed how people work, interact, teach, and learn. According to UNESCO, at the end of April 2020, educational institutions shut down in 186 countries, affecting over 1,500,000 students worldwide, which accounts for approximately 74% of total enrolled learners on the planet (UNESCO, 2020a).

As a result of the pandemic and the various phases of “lockdown” and school closures that have occurred in primary schools due to the pandemic, teachers and educators across the globe have faced an unprecedented challenge in transitioning from traditional face-to-face teaching to having to adopt “quick fix” technological solutions and pedagogical approaches to teaching classes solely via distance learning, or in other words online (König, Jäger-Biela & Glutsch, 2020; Teräs, Suoranta, Teräs & Curcher, 2020). This paper focuses on distance education, however, it should be noted that depending on the country in question, in some cases teachers were, and still are asked to conduct hybrid classes, where distance and traditional teaching are conducted simultaneously.

The challenges of adopting new technologies and different pedagogical approaches to teaching is not a new phenomenon and a common one for all teachers and educators. Investment in educational technology has been on the increase in the past years, however, this investment has mainly focused on improving Internet connectivity, interactive toys used in the early phases of schooling, and devices such as tablets, laptops, robotic kits, etc. investment aimed to develop children and adolescents’ digital and coding skills and focuses on strengthening 21st-century skills identified for future working life (European Union, 2019).

Additionally, this focus can also be seen in national curricula. For example, Information and Communication Technology (ICT) competence is specifically included in the Finnish national curriculum's national goals for basic education and transversal competencies (see Finnish National Board of Education, 2016; Lähdemäki, 2019). However, despite this investment and focus, the integration of transversal digital competencies into the classroom still faces challenges (Saarinen et al., 2019), and pre-COVID methods used in learning still largely focused on books, notebooks, and handouts, with digital tools are too often used just for completing assignments. Also, while teachers may be better trained than previously with regards to digital subjects, approximately one in five

teachers indicated that they did not feel prepared for or would need more professional development regarding ICT use and digital competencies (European Commission, 2020, page 103).

As teacher students, and future primary school teachers ourselves, we were particularly interested in investigating primary school environments, and teacher preparedness for the shift to distance learning and the use of technology and technological tools to achieve this, at this level (grades 1-6), as very little focus has been paid to teachers' capacity and readiness to quickly adapt to this new technological setting. For example, according to the OECD (2020), in Finland, an average of 19% of teachers report a high need for professional development in this area, and only 21% feel well prepared for distance teaching.

Distance education invariably offers more challenges teachers of primary school students to tackle, such as limited attention span among the pupils, wildly fluctuating reading and writing levels in the early grades, and a lack of self-direction offers challenges that are not so prevalent for students that have already completed primary school education. Additionally, as Teräs et al. (2020) point out, forms of online learning have been criticized for not following sound pedagogical principles, and that choices relating to online learning and education technology may have far-reaching consequences in the future regarding power relations, student equity and inequality, and other as yet unknown effects.

The aim of this bachelor's thesis is to investigate how the COVID-19 pandemic has affected and influenced classroom teaching, and teachers during this transition to adopting technology to teaching online, the evolution of teaching practices due to this need to adopt to technological solutions, and the types of support systems and learning solutions that are available for primary school teachers during this transition.

The main research questions guiding our enquiry are:

- How prepared are teachers in using distance learning?
- What is the role of technology in distance learning and how did teaching practices and teacher education evolve?
- What types of support materials and distance learning solutions are available for primary school teachers?

This thesis takes the form of a literature review of current literature and other relevant online resources to identify the major themes related to the research questions and utilises theories of Computer-Based Education (CBE) and distance education. This literature review is also rooted in a constructivist

philosophy, as it supports the claim that multiple, contradictory, but equally valid accounts, or multiple realities of the same phenomenon can exist. In line with constructivist principles, more emphasis has invariably been placed on qualitative findings, as focus is placed on contextual understandings, shared human experiences, and meaning making of teachers' interpretations and contextuality and the creation of meaning guide the researcher to construct and reinterpret this review from an "insiders" perspective. (Onwuegbuzie & Frels, 2016).

This thesis is composed of five sections. Section one, (the introduction) has already been introduced where we discussed our motivation and goals for the thesis. The following section (section 2) introduces and discusses our theoretical framework where theories of Computer-Based Education (CBE) and distance education are introduced and discussed. Section three introduces our chosen methodological approach which takes the form of a literature review. In section four we present and discuss our findings and the answers to our research questions based on our review of the relevant literature. In section five we conclude the thesis with a discussion, where we summarise and discuss our findings, and provide our conclusions and recommendations based on our findings.

2. Theoretical background

The following section provides an overview of our theoretical background. Theories of Computer-Based Education (CBE), and distance education were selected as the most appropriate theories related to the phenomena at hand. These theories are introduced, and a brief history of these theories and appropriate models are introduced and discussed.

2.1 Computer-Based Education (CBE)

The first topic of the theoretical overview is Computer-Based Education (CBE), often referred to with different synonyms such as Computer-Assisted Learning (CAL), Computer-Assisted Education (CAE), or Computer-Aided Instruction (CAI) to name the most popular ones; in this work, the term that will be used among the many existing is CBE, as it is the broadest and most inclusive among the available synonyms (Cotton, 2008, pp. 514-515). As its name suggests, CBE indicates the use of a computer to provide Education. CBE draws on knowledge from different fields such as learning, cognition, Human-Computer Interaction (HCI) amongst others (Ward, 2002a, p. 17). In CBE, the computer is used for educational purposes, with hardware and software, as well as the complementary devices, being key components of the educational experience; in this setting, CBE “assists individuals in learning using multiple representations of information for a specific educational purpose” (Ifenthaler, 2012, p. 713).

Another definition provided by Poole and Sky-McIlvain insists on how the term describes digital systems, hardware, and software, that are designed to assist in the learning process, with emphasis on targeting specifically the needs of the individual student and tailored to different teaching methodologies, with a focus on the subject matter (Poole & Sky-McIlvain, 2009, p. 142). Sharma adds that the role of CBE is to “optimize the learner’s route through a content field based on his personality, cognitive characteristics, and diagnosed state of readiness” (2017, p. 102), adding that the term also can include the application of tools of educational technology for a variety of circumstances (2017, p. 102). According to Lajoie, CBE is also considered to be a valuable tool that provides opportunities for fostering meaningful learning (2000, as cited in Ifenthaler, 2012, p. 713).

According to Edutech202, CBE is “an automated instructional technique in which a computer is used to present an instructional programme to the learner through an interactive process on the computer” (2012). The definition by Edutech202 continues describing it as “an instructional technique in which the computer instructs the students and the computer contains a stored instructional programme

designed to inform, guide, control and test the students until a prescribed level of proficiency is reached” (2012), with the machine responsible for the learning process, the instruction, and the step-by-step assessment of the learner (Audu & Agbo, 2010, as cited in Usman & Madudili, 2020, p. 260). Eyo, similarly, defines CBE as an offline or online self-learning technique, in which the computer serves as a tool to facilitate and improve the educational process through multimedia (2018, pp. 53-54). In short, in CBE the computer is considered to be the key component of the educational environment (Ifenthaler, 2012, p. 713), and it could be defined as “the type of instruction aided by a computer-controlled display and a response entry device which uses a combination of text, graphics, sound and video to enhance the learning process through interaction, to achieve certain instructional goals and improve educational outcomes” (Usman & Madudili, 2020, p. 260).

2.1.1 A brief history of Computer-Based Education (CBE)

According to some (Ifenthaler, 2010, p.3), the dawn of the digital age can be dated as far back as 1623 with the invention of the first calculating machine by Wilhelm Schickard, but in more recent times, CBE has origins in Pressey’s 1925 multiple-choice machine and the punch-board device, which anticipated today’s network-supported tutorials of today. The function of Pressey’s multiple-choice machine was to provide the learner with instruction, test them, provide immediate feedback, and record each attempt as data (Mann, 2009, p. 1). In the late 1950s, the development of the first integrated circuit by Noyce and Kilby gave for the first time an important role in education to computer technology, followed up in the following years by the development of the microcomputer, a device capable of reproducing various multimedia files, with a graphical interface and that could be operated with input devices (Ifenthaler, 2010, p.4). In the 1960s and 1970s PLATO (Programmed Logic for Automated Teaching Operations) was the first computer system to be used for programmed instruction, and it is still regarded as one of the most successful attempts of technology applied to education (Lockee et al., 2008, p. 189).

In the two following decades multimedia learning environments (Mayer 2001, p. 4), and simulations, games, and microworlds (Plass & Schwartz, 2014, pp. 729-730). Despite detractors warned about the dangers of the computer, parents and children rapidly embraced the new machines, seeing their educational potential, anticipating even schools (Ifenthaler, 2012, p. 714). Following up, schools reacted and made significant efforts to improve what would have been defined as the students’ *computer literacy*, the capability of working with machines for pedagogical interests (Seel and Casey 2003, pp. 37-38). In the new millennium, computers became a regular part of the school environment

and with a well-defined place in the educational system in education: in Finland, for example, The Finnish National Curriculum Framework in 2004 was insisting towards social constructivist ideas, significantly enforcing the role of computers in education in the country, turning computers and computer networks into essential constructivist learning tools, with a seemingly more important role to be covered in the future (Koivisto, 2014, pp. 243-244).

Despite focusing on a computer-based model for education for this thesis, it must be acknowledged that the trend is now of “ubiquitous computing” (Laru, Näykki, & Järvelä, 2014, p. 78), which refers to the widespread use of smart devices, tools that are becoming always more affordable and, consequently, more common. As education is inevitably expanding to these new technologies, it must be mentioned that Technology-Enhanced Learning (TEL), which Goodyear and Retalis described as an attractive, broadly defined term which includes a wide range of hardware and software that facilitate learning making it more effective, efficient, and enjoyable (2010, p. 8), could be used as a new umbrella-term in place of CBE, of which is considered to be a synonym (p. 1). Acknowledging the trend of an always more technology-based education, CBE has been chosen in place of TEL for this literature review for a wider range of available literature and theoretical models focused more specifically on computers.

2.1.2 Computer Based Education models

CBE systems can be of two different basic types: tutor or tool (Levy, 1997). In the tutor type, the computer has the information to be learnt and controls the learning environment, while in the tool type the computer simply aids the teaching process, normally by focusing on one specific learning task and aiming to improve it (Ward, 2002b, p. 19). Within the tutor classification, there are four modes: drill and practice, tutorials, simulations, and games (Gloor, 1990, as cited in Ward, 2002b, p. 19). Nazimuddin (2014, pp. 185-186) provides an extensive description of the different instructional modes that can be found in CBE, defining further the four modes mentioned above and adding five more: discovery, problem solving, inquiry, author and logo.

1) *Drill and practice* – In this mode, the computer leads the learner through a set of examples to develop the use of a certain skill or acquire a certain piece of knowledge. The correct responses are reinforced and, only upon successful performances by the learner, the computer will proceed further in the instruction. Sharma (2017, p. 102) shows that drill and practice software is similar to a digitalised version of the worksheets and flash cards that are used in classrooms.

2) *Tutorials* – In this mode, the information is presented to the learner in small units followed by a question. The learner's response is then analysed by the computer which provides appropriate feedback in return. In this learning scenario, different branches or pathways can be programmed in each of the units to target the learner in appropriate ways, letting them set their own pace. Tutorial software, as Sharma notes (2017, p. 102), is similar to the drill and practice one, but not only does it allow the learner to practice, it also provides a teaching component.

3) *Simulations* – As the name suggests, the learner faces scaled-down approximations of real-life situations, events or phenomena. In this scenario, students can interact and manipulate models of reality and experiment with them (Anyamene et al., 2012) through a computer that represents the operation of a system in a real-life situation (Audu & Agbo, 2010). This model provides an approximation of reality that does not involve the expense of real-life or its risks (Reffell & Whitwort, 2010), but instead, it offers learners the possibility to interact with simulations where the reality may be too expensive, too dangerous, or too time-consuming (Thang & Wong, 2010).

4) *Games* – In this mode, the learner is challenged by the computer or by other learners to reinforce a certain piece of knowledge recreationally. Game software can be based on achieving the highest score, challenging the computer itself or other learners (Yusuf & Afolabi, 2010). This scenario aims to motivate learners to revise the instructional materials and interact with them (Usman & Madudili, 2020, p. 261).

5) *Discovery mode* – An inductive approach is followed in this mode, with tasks presented to the learner to be accomplished through trial and error, similarly to laboratory learning, to reach a deeper understanding of the results obtained from discovery. In this approach, a large database of information is involved, concerning a certain content area, with the learner challenged to analyse, infer, and evaluate on the basis of the data obtained (Sharma, 2017, p. 103).

6) *Problem-solving mode* – In this scenario, the students are instructed in how to communicate with the computer and how to solve a proposed problem, and afterwards they engage in a two-way interaction with the computer itself via programming. Depending on the responses, the computer proceeds to provide further information, as well as providing suggestions and hints towards the success of the task.

7) *Inquiry Mode* – In this application, the system directly responds to the inquiries of the student with answers that were stored in it beforehand by the instructional staff. This model can be referred to as

dialogue level, as it involves sophisticated interaction between the learner and the computer itself (Torruam & Abur, 2013). The learner questions the machine and responds, with the software reacting appropriately (Adeshina, 2015).

8) *Author Mode* – In this mode, the computer provides some sort of aid to the learner in form of word processing, which is why it is also called “word mode”, as “processing programs have been considered as general-purpose programs having unlimited applications” (Manion, 1985, p. 28). Among these applications, there is computer-assisted writing, electronic editing through blank spaces, or as a tool of language manipulation (p. 28).

9) *Logo* – Finally, mode consists of a simple programming language which can be used to produce drawings and designs on a screen. Logo is an example of an educational programming language, created by Feurzeig, Papert, and Solomon in 1967 (Abelson, Goodman, & Lee, 1974); nowadays, with coding entering in schools, it could be substituted by other more recent learning languages or applications, leading to more advanced uses such as Osmo (Carver & Atkins, 2021, p. 97). In relation to Logo, Seymour Papert coined the term *constructionism* to advance a new theory of learning, based on the claim that “children learn best when they use tech-empowered learning tools and computational environments, take active roles of designers and builders; and do it in a social setting, with helpful mentors and coaches, or over networks” (Harel, 2016). Such programming languages expose students to computational thinking, a “a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use” (Wing, 2006, p. 33), which is also in line with many aspects of 21st century competencies (Lye & Koh, 2014).

2.2 Distance Education

The second topic of the theoretical overview is distance education, which Kaplan and Haenlein define as “any form of providing education to students who are separated by distance (i.e., who are not physically present in the same space) and in which the pedagogical material is planned and prepared by an educational institution” (2016, p. 443). Moore, Dickson-Deane, and Galyen echo this definition, stating that the term “describes the effort of providing access to learning for those who are geographically distant” (2010, p. 130). Distance is not a term connected to space, but it can include time as well, as “in addition to being separated by space, distance learning students can also be separated by time; that is, they may learn at their own pace, in accordance with their schedules” (Kaplan & Haenlein, 2016, p. 443). *Asynchronous* distance learning is the term used in such cases of

separation by time, while alternatively, in the case of simultaneous study, the term used is *synchronous* distance learning (Kaplan & Haenlein, 2016, p. 443).

Distance education can also be referred to as “distance learning” or “distance teaching”: the three terms are often used interchangeably and are considered synonyms, but, according to Moore, Dickson-Deane, and Galyen (2010, p. 130), the former is preferred. In fact, according to Keegan (1996, p. 43), distance learning and distance teaching are both halves of the process of distance education, with the former emphasizing the students' perspective of the process and the latter meaning the process of course development; in short, the term “distance education” is an umbrella term including methodologies that involve education from a distance. A different opinion is supported by King, Young, Drivere-Richmond, and Schrader (2001) do not support the interchangeable use of the terms distance learning and distance education: distance learning is referenced more as ability, whereas distance education is an activity within the ability.

Moore, Dickson-Deane, and Galyen (2010, p. 129) show how the literature on the subject has been using inconsistent definitions of distance education. Moore's definition (1990, as cited in Moore, Dickson-Deane, and Galyen, 2010, p. 129) focuses on the introduction of computers in educations and the education delivery methods, with an instructor located in a different place and time from the learner and providing instruction through printed and electronic media. Dede (1996, p. 1) continued on the definition by comparing traditional education with distance education and referring to the latter as “teaching by telling across barriers of distance and time”, additionally highlighting the key opportunities provided by the emerging media. Eventually, with the new millennium, the term then evolved to include other forms of learning such as online learning, e-learning, technology-mediated learning, online collaborative learning, virtual learning, web-based learning, etc. (Conrad, 2006).

It can be concluded that distance education is based on an asynchronous or synchronous interaction between an instructor and a learner which do not share the same space, time or both of them; while the learning process could be facilitated and enhanced by a wide range of media (Kaplan & Haenlein, 2016, p. 443), the key component is the bidirectional interaction at a distance between instructor and learners, as instructors must be involved in providing instruction as well as receiving feedback from the learners (Tsai & Machado, 2002, p. 2).

2.2.1 A brief history of Distance Education

Taylor divides the process of distance education into five individual generations respectively (2001, pp. 2-3), which are not necessarily linear, exclusive or discrete (Reushle, McDonald & Postle, 2009, p. 59):

1) *First generation model*: it is based on the so-called correspondence models, where the education happens in form of a two-way written communication between an educator and a student. To this model belongs what is believed to be the first example of a distance education course: provided by Sir Isaac Pitman in the 1840s, the teacher taught a system of shorthand by mailing texts transcribed into shorthand on postcards; the students would return the transcriptions to the teacher for correction and feedback, which was the real innovation in the system (Tait, 2003, p. 1);

2) *Second generation model*: it is based on various forms of multimedia together with pre-existing learning material, aided by new media. Tools such as audiotapes, videotapes, materials for computer-assisted learning, and interactive videos are used alongside printed and written material.

3) *Third generation model*: it is based on the systems of distant education in the truest of the word. Tools such as radio, television, audio-conferences, videoconferences, and audio graphic communication make possible knowledge transfer over distances. This model is also the one that despite offering distance education in the literal sense of the word, offers the least deal of flexibility.

4) *Fourth generation model*: in this model, flexibility in learning is offered, as it is based on interactive multimedia systems, Internet access, and computer-mediated communication. This generation, with the aid of the new technologies and their availability among the masses, has attained a much higher level of interaction between individuals; the Internet together with multimedia content allowed the learners to get more independence and flexibility in the learning process, facilitating communication between educators and learners as well.

5) *Fifth generation model*: this is the most recently elaborated model by Taylor, and it is connected to the new, emerging technologies. This model of distance education is mostly a derivation of the fourth generation, which aims to capitalize on the features of the Internet and the Web. This model includes a wide sense of flexibility for the learner, offering quality materials and at a lower cost.

As Taylor's classification belongs to two decades ago, it misses out on important technological developments, despite the fifth generation foresaw the key role of the Internet in educational

development. Based on research conducted by Laru, Näykki, and Järvelä (2014), it could be theorised that we are already in what could be called the sixth generation of distance education brought by mobile devices and social media. In fact, “the attributes of these devices, including portability, connectivity and context-sensitivity combined with sound pedagogical ideas can transform learning from being a merely productive knowledge acquisition process to an active social interaction activity” (Liu & Milrad, 2010, p. 1). Milrad and Multisilta (2009, p. 1) use the term of “mobile social media” to refer to this new generation of “ubiquitous computing” (Laru, Näykki, & Järvelä, 2014, p. 78), which could provide unprecedented possibilities for distance teaching and learning.

2.2.2 Distance Education models

Distance education models can be classified in different ways, according to the delivery methods, pacing models, or mode of delivery (Viewsonic, 2020).

Delivery methods refer to how distance education is planned and carried out, which could be either online, using internet-based tools and multimedia, or via correspondence, involving an exchange of teaching materials, assignments, and examinations through the mail between the educator and the learner. Pacing models refer to the way distance education is controlled and how quickly courses can be completed; distance education could be paced, with the speed of progression controlled by the institution or the educator so that all participating students complete the work at about the same time, or self-paced, with the speed of progression controlled by the learners themselves, which are provided with a large amount of freedom and independence. Finally, models of delivery refer to the way the content is delivered to students and how they subsequently engage with it. Synchronous learning refers to distance education carried out with educators and learners interact from a distance at the same time, in real-time, often aided by chat or video-chat software; on the other hand, asynchronous learning refers to situations in which the interaction is not in real-time, but it is handled through on-demand learning materials or other types of multimedia; a final option is a mixed method of delivery which involves both synchronous and asynchronous interaction between educators and students.

Kaplan & Haenlein (2016, p. 444) focused on the online delivery method and elaborated a classification of distance education applications according to time dependency and the number of participants: MOOCs, SPOCs, SMOCs, and SSOCs. MOOCs and SPOCs belong to the asynchronous mode of delivery: MOOCs (Massive Open Online Courses) are open-access online course (i.e., without specific participation restrictions) that allow for potentially unlimited participation, which

often provide elements of interactivity to foster student/student and student/teacher interactions, despite this latter element not being mandatory; SPOCs (Small Private Online Courses) are online courses that, as opposed to MOOCs, only offer a limited amount of places, therefore requiring some form of formal enrollment, possibly even a tuition fee; On the contrary, SMOCs and SSOCs belong to the synchronous mode of delivery: SMOCs (Synchronous Massive Online Courses) are open-access online courses (massive) online courses which require all students to be present, at a distance, at the same time, for example due to a participation to a live streaming or real-time group work; SSOCs (Synchronous Private Online Courses), on the contrary, involve a limited number of participants compared to SMOCs, with instruction requiring real-time participation.

3. Methodology

A literature review was selected as the most methodology for this thesis as it is an excellent way of synthesizing research findings to show evidence on a meta-level and to uncover areas in which more research is needed, which is a critical component of creating theoretical frameworks and building conceptual models (Snyder, 2019). Additionally, as Snyder (2019) points out, literature reviews are particularly useful when the aim is to provide an overview of a certain issue or research problem, where this type of review is conducted to evaluate the state of knowledge on a particular topic. It can be used, to provide an overview of a certain issue or research problem, and/or to evaluate the state of knowledge on a particular example, to create research agendas, identify research gaps, or simply discuss a particular matter, as is the purpose of this thesis.

The literature review also represents an appropriate method for this research, as the literature reviewer chooses from an array of strategies and procedures for identifying, recording, understanding, meaning making, and transmitting information pertinent to a topic of interest. Conducting a literature review is equivalent to conducting a research study, as the literature review represents a formal data collection process wherein information is gathered comprehensively with the information that the literature reviewer collects representing the data (Randolph, 2009; Onwuegbuzie & Frels, 2016).

Relevant literature is essential for all research disciplines and all research projects, with previous research utilised to map and assess the research field, to motivate and justify the aims of the study, the research question, and hypotheses. Additionally, Gall, Borg, and Gall (1996) argue that the literature review plays a role in seeking new lines of inquiry, gaining methodological insight, and identifying recommendations for further research. Hart (1998) also contributes additional reasons for reviewing the literature as it distinguishes what has been done, from what needs to be done, while also discovering important variables relevant to the topic and areas for future research. These are all goals of this thesis, particularly with regards to identifying recommendations for future research as this thesis will form the basis for a more in-depth study at the master's phase.

A literature review is a systematic examination of the scholarly literature about one's topic. It critically analyses, evaluates, and synthesizes research findings, theories, and practices by scholars and researchers that are related to an area of focus. A literature review can broadly be described as a more or less systematic way of collecting and synthesizing previous research (see Baumeister & Leary, 1997; Efron & Ravid, 2019; Tranfield, Denyer, & Smart, 2003). An effective and well-

conducted review as a research method creates a firm foundation for advancing knowledge and facilitating theory development (Webster & Watson, 2002)

By integrating findings and perspectives from many empirical findings, a literature review can address research questions with a power that no single study has. Conducting a literature review is a means of demonstrating an author's knowledge about a particular field of study, including vocabulary, theories, key variables and phenomena, and its methods and history, while also informing the researcher of influential researchers and research groups in the field., with some modification, the literature review is a "legitimate and publishable scholarly document" (LeCompte, Klinger, Campbell & Menke, 2003, p. 124).

Onwuegbuzie & Frels, (2016) maintain that all studies that contain a review of literature involves the conduct of two studies: a study of the previous knowledge and the primary research study conducted by the researcher(s), and the primary research study conducted by the researcher(s)—with the literature review study being embedded within the primary research study This literature review takes these two forms and additionally forms two functions: it takes the form of a standalone review, as it is a self-contained document and independent work in itself, and in essence, this first part of the research ends with this thesis. This first part of the study comprises an extensive review of the literature and provides a broad overview of the current knowledge about a particular topic. Secondly, being a bachelor's thesis, the review itself is not followed by a research study, however, it does serve as the basis for proposed future research, which will take place at the master's level.

4. Research Findings

This section provides answers to, and a discussion of, our research questions based on the literature review. Namely, how prepared were/are teachers in using distance education? What is the role of technology in distance education and how did teaching practices and teacher education evolve during the COVID-19 crisis? What support mechanisms are available to teachers? and what EdTech solutions are available for teachers.

4.1 How prepared were/are teachers in using distance education?

The first research question to be investigated concerns the degree of preparedness the teachers had when the development of the COVID-19 crisis forced schools to switch from face-to-face teaching to distance education. Teachers have been hit quite dramatically by the global pandemic: it has been calculated that around 63 million primary and secondary teachers around the world have been affected by school closures in 165 countries due to the pandemic, while still having to ensure that learning continues for nearly 1.5 billion students (UNESCO, 2020a, 2020b). Following national lockdowns, teachers had to adapt to online teaching, familiarizing themselves with different digital tools and resources and implement new approaches to education (Eickelmann and Gerick 2020). As teaching practices changed, teachers also had to find ways to maintain contact with their students to account for the social integration of their learning groups (König, Jäger-Biela & Glutsch, 2020, p. 610).

Teachers had to become able to condition all instructional components, taking care of instructional methods, lesson content (e.g., materials and media to use during lessons), use of instructional time related to the time of application use, as well as psychological and social factors that might affect professionals finding themselves into a sudden, forced change (Rasmitadila et al., 2020, p. 92). In such a crisis as the one caused by the outbreak of COVID-19, it is important for teachers not only to have the necessary knowledge and skills to operate through technology but also confidence in online teaching for a successful experience (König, Jäger-Biela & Glutsch, 2020). A study carried out in Germany during the outbreak showed that teachers in their early career belonging to the generation that Prensky defined “digital natives” (2001) did not seem to have developed sophisticated digital skills, in general, to operate with technology (König, Jäger-Biela & Glutsch, 2020, p. 610). A reason advanced for this may be that many schools are still behind with the transformation process concerning ICT processes in the educational system: according to the researchers, it is necessary for digital tools to be first systematically introduced to students and implemented into everyday teaching

and learning processes to be used effectively in teaching. The study carried out in Germany shows that the pandemic uncovered what the consequences will be if schools fail to stay up to date with the fundamental ICT transformation process, translating into unprepared teachers; it is then crucial to provide learning opportunities in professional development for teachers and training for future teachers (König, Jäger-Biela & Glutsch, 2020, p. 610).

Evidence from a study concerning the policy “Suspending Classes Without Stopping Learning” operated by the Chinese government shows that teachers had difficulties associated with lacking online teaching infrastructure, general lack of experience, the information gap, and the complex environment at home (Zhang et al. 2020, p. 2). Moreover, the responses to a survey conducted in the United States showed that teachers had to deal with similar problems connected to the lack of experience and confidence in teaching through technology, they were not in possession of the necessary equipment (e.g. stable broadband internet); another issue was the lack of mentoring and support, which was needed by a large number of the teachers responding to the survey, with only one-third of the interviewed subjects feeling confident in the new setting (Judd et al. 2020).

Another study conducted in the African continent showed similar results, with the survey showing two broad types of responses from the interviewed teachers (eLearning Africa & EdTech Hub, 2020): on the one hand, the first group wanted help from the government in the form of additional training, materials, and technology, requests hard to meet in an emergency; on the other hand, the second group of interviewees realized that external support was unlikely to be provided in the short-term, so they decided to find their own solutions to the problems they were facing. Moreover, the teachers identified as the main problems in distance education “capacity building, personal development and training” (71% of the responses), “affordable and accessible electricity and connectivity” (49%), “access to effective infrastructure and technology” (44%), “access to appropriate ICT devices” (30%), “a good learning environment at home” (23%), and “access to learning materials and an appropriate e-curriculum” (11%) as the main obstacles. Another issue among many teachers was the “lack of appropriate training to conduct and integrate distance learning in their teaching” (53% of the responses), exposing a gap in training and professional development.

A study conducted among teachers in Malta (Busuttill & Farrugia, 2020, p. 225) showed the same recurring features of the aforementioned ones: asked, whether they feel they have adequate skills to produce multimedia resources, half of the teachers, affirmed they agree (40%) or strongly agree (9.3%) with the statement, while 15.2% and 9.3% of respondents respectively claimed to disagree or strongly disagree. Despite half of the responses show an appropriate degree of readiness towards

distance education, close to one-third of the participants (30.5%) feel they neither agree nor disagree with the statement, which leads to questioning the level of preparedness and digital literacy of the teachers involved, as well as teachers' self-efficacy and confidence in the use of technology.

Finally, the preliminary results of a study from the University of Oulu based on teachers' in-depth interviews seem to contrast the results from the presented studies (Suorsa, Dindar, Hermes, Karppinen & Näykki (2020, p. 150). The results show that, despite moving from contact teaching to distance education was experienced as a challenge by schools in terms of management, tools, and interaction, teachers were able to develop teaching practices in accordance to the new situation, interact with the school community, as well as students and their guardians.

4.2 What is the role of technology in distance education and how did teaching practices and teacher education evolve during the COVID-19 crisis?

This chapter will investigate the role of technology in distance education, with specific attention towards the COVID-19 crisis for what concerns changes in teaching practices and teacher education as well.

The role of technology has already been partially shown when exploring the theoretical framework of the thesis, in which it was shown that different authors consider computers as the tool that allows an instructor and a learner, who are distant from each other, to effectively communicate (e.g., Moore 1990, as cited in Moore, Dickson-Deane, and Galyen, 2010, p. 129; Dede 1996, p. 1; Kaplan & Haenlein, 2016, p. 443) Moreover, the history of distance education is in close contact with the development of different media, ranging from basic correspondence to the educational possibilities offered by smart devices (e.g. Taylor, 2001, pp. 2-3; Laru, Näykki, and Järvelä, 2014; Kaplan & Haenlein, 2016, p. 444; Viewsonic, 2020). In addition to what has already been reported, Gotschall (2000) argues that the concept of technology-enhanced learning, or CBE, in accordance with the term used in the thesis and with Goodyear and Retalis statement of the two terms being synonyms (2010, p. 1), is formed on the concept distance education, with technology being a tool to transmit lectures to distant locations as audiovisual presentations.

A similar claim by Conrad (2006) supports the idea of distance education including other forms of technology-based education, echoed by Liu and Wang (2009) stating that the progression of communication technologies and media, with specific regard to the internet, contributed to transforming distance learning into e-learning. The quick, unexpected, and forced transition from

traditional face-to-face teaching to ‘emergency remote teaching’ (Bozkurt & Sharma, 2020, p. ii) forced schools around the world to implement distance education through technology, where possible, to grant continuity in education. As a report from The World Bank shows (2020), several countries implemented different learning systems as a reaction to schools being closed due to COVID-19. China was one of the first countries forced to adapt to the new situation: an online learning system was implemented as early as February 2020, consisting of holding simultaneous online learning exercises to ensure that students would not be interrupted. In Finland, following school closures, distance learning, digital learning environments, and solutions and, where necessary, independent learning, were implemented. In order to support the switch towards technology-based education, e-Content Repository, which publishes pedagogical by specialists for working in e-learning environments. The main tool on which distance education in the time of the coronavirus pandemic was the Internet, as it allowed the fruition of courses both synchronously and asynchronously.

A technology-based framework that was used in distance education was videoconferencing through different apps such as Zoom and Microsoft Teams, apps that had a remarkable growth at the outbreak of the pandemic (Case, 2020). A study by Marie Martin showed the benefits of videoconferencing in different sectors, included education, already at the beginning of the XXI century and how it can be a solution for pupils that cannot attend schools physically (2005, p. 400). In a case study from an island in Ireland, in particular, Martin shows how videoconferencing transformed the learning experience of a seven-year-old boy with severe special needs, as he could not attend school regularly due to the isolation of the school itself, which involved sea crossings to be reached. The Learning Support teacher, prior to an actual meeting with the pupil, conducted weekly lessons by videoconference from a school on the mainland. The support teacher quickly mastered the technology and adapted her teaching strategies to the online environment, reporting that sections of the lessons were delivered more effectively by videoconference than they would have been in a face-to-face setting; moreover, she mentioned that she was more focused during a distance lesson compared to a traditional one, with the pupil having fewer chances of distraction, hence making significant progress (Martin, 2000, as cited in Martin, 2005, p. 400).

In developing countries, of which only 25% were prepared for distance learning (Miao, 2020), the education systems implemented a variety of distance learning solutions, along with educational content over publicly accessible platforms (Berger & Lee, 2020). The solutions ranged from more traditional “low-tech” platforms, in the likes of lesson scripts adapted for transmission via radio and SMS to reach students living in remote areas of Ghana, Liberia, and Sierra Leone who had little or

no internet connectivity (The World Bank, 2020), to more technology-based methods of delivery. In Jamaica, lessons were provided through educational TV channels, as well as through printed learning kits for the students who did not have an internet connection. Similarly, Indian teachers, in addition to providing content over digital channels like WhatsApp, television, YouTube, and other educational apps, used textbooks, worksheets, and assignments delivered through home visits and open-air classes which were held keeping in mind the safety guidelines of social distancing (ibid).

The coronavirus pandemic, as already presented, made it necessary to switch to distance education through technology-based tools, forcing teachers to adapt to the new environment and to the new delivery methods; in this final part of the chapter, the focus will be switched to how teacher education responded to the crisis. As schools were closed by local governments, universities shared the same fate, with the impossibility for lectures and seminars to be held on campus. The quick move to online modes of delivery translated into significantly intensified workloads for the staff, with uneven impacts, as some universities had already developed online and mixed methods courses before the pandemic, while in other institutions lecturers struggled to get acquainted to the “new normal” (Allen, Rowan & Singh, 2020, p. 233).

Teaching at a distance in videoconferencing and internet-based environments can be a major paradigm shift, which is why distance educators need to be rigorously prepared in the distance education medium in which they will be teaching. As Mary Burns highlights (iNACOL, 2010, as cited in Burns, 2011, p. 183), web-based instructors should possess “technology skills, including the ability to use synchronous and asynchronous tools such as discussion boards, chat tools, and digital whiteboards; be able to promote interaction between instructors and learners; demonstrate strategies to encourage active learning, interaction, participation, and collaboration in the online environment; provide regular feedback, prompt responses, and clear expectations to learners; and be able to implement and deliver online assessments that are both valid and reliable”; forming such profiles through teacher education could provide more responsive teachers in case of new adoptions of emergency distance education.

Philipsen et al. (2019) provide a study concerning lifelong professional learning for teachers after the immediate emergency situation, that is, a comprehensive and actionable framework of components of teacher professional development (TPD) for online and blended learning (OBL). The framework spans through six findings: design and develop a supportive TPD programme and environment for OBL, acknowledge the existing context regarding OBL, address teacher change associated with the transition to OBL, determine the overall goals and relevance of TPD for OBL, acknowledge TPD

strategies associated with the transition to OBL, and disseminate knowledge, skills, and attitudes about OBL and evaluate the TPD. As it is now known, the pandemic created conditions for TPD for OBL which were far from those considered in their study but, with a commitment to systematic professional development concerning teaching practices being still necessary, the proposed framework could be a helpful tool for personal TPD (Abaci et al., 2020).

Parthasarathy and Murugesan provide a brief set of recommendations for good practices in the transition to distance education that could be applied on any level of education, based on the reaction to COVID-19 (2020). The first recommendation is to choose an online product that is already available and with which the staff is already familiar with, such as Microsoft Systems or Google Classroom, exploring other online resources only later on. Secondly, they recommend using the same software to facilitate the students' experience. The third point concerns awareness of the IT resources and services, to provide reliable technical support and uninterrupted teaching. The fourth recommendation involves the promotion of blended learning in the form of digital tasks or materials to access prior to a lesson, to have both teachers and students familiarizing with the available tools. The fifth recommendation concerns motivating and training people to adopt digital tools gradually, to provide enough time to the staff and students to get acquainted with the new tools. The final recommendation involves investments in IT resources, inviting schools' management to consider reasonable funding to finance the adoption of new digital technologies.

As a final reflection, the quick shift to technology-based education has found a certain deal of criticism, which should be mentioned in the interest of completeness. Critics have labelled this emergency remote teaching as "experimental": in fact, according to an article in Quartz magazine, COVID-19 was reported to be responsible for the world's biggest educational technology experiment in history, which might reshape schools, the idea of education, and what learning looks like in the 21st century (Anderson, 2020). As Williamson, Eynon and Potter report, these "efforts to datafy the student experience of education during the pandemic need to be understood as an extreme manifestation of longer-term aspirations to render education legible as numbers through increasingly pervasive technologies and techniques of surveillance" (2020, p. 113). The idea of a long-term educational technology experiment and increasing concerns data privacy and the use of data for student profiling could represent a topic to be explored in future studies, as it goes beyond the scope of this literature review.

4.3 What types of support and distance learning solutions are available for primary school teachers?

The challenges faced by primary school teachers due to the COVID-19 are unprecedented, however, in addition to the unprecedented challenges the unified response to finding solutions to the problems brought about by the pandemic has also been unprecedented. Governments, regions, multinational corporations, and teaching communities have all come together and offered a variety of initiatives and potential solutions to the problems facing teachers due to distance teaching and supporting their students over the past year or so, since the outbreak of the pandemic. Based on the literature review a huge variety of support and distance learning solutions were identified, which can be broken down into four distinct categories:

1. *National level support*: mainly provided in the form of legislation changes and financial support.
2. *Regional support*: from entities such as the European Union (EU) which has initiated several projects and support systems for teachers to avail of with regards to distance learning.
3. *Teacher support communities*: at both local and international levels, which mainly consist of social media groups and
4. *Educational Technology (EdTech) solutions*: which provided technological tools and training for teachers to utilise during the switch to distance teaching.

Unfortunately, it is beyond the scope of this paper to provide a comprehensive list of all such initiatives globally. The researchers decided that given the researchers' backgrounds as teaching students in Finland, the focus of the following section would be on support mechanisms available to Finnish primary school teachers to facilitate the shift from traditional pedagogical models to online/distance learning one.

4.3.1 National level support

It is safe to say that every government in the world has been forced to adapt and/or amend legislation to address the challenges posed by the pandemic. Additionally, additional funds have in many cases been made available by governments and local authorities for schools to ensure that teachers and students receive the best possible support during the changes brought about by having to shift to distance or hybrid learning.

In Finland, the main organisation responsible for national-level support for schools and teachers is the Ministry of Education and Culture (MOEC). The MOEC implements policies and decisions taken by the Government and prepares amendments to statutes and legislation necessary under its responsibility. The MOEC has had several support functions during the pandemic, with one of the main ones being to provide information on the organising of basic education, preparation for exceptional teaching arrangements, and recommendations and advice for teachers on how to arrange and organise contact teaching (Ministry of Education and Culture, 2020). Temporary legislative amendments to the Finnish education act were initially taken in June of 2020, and these amendments have been monitored and updated throughout the previous and current school years, based on the pandemic's progression. (see for example Finnish Parliament, 2020: Ministry of Education and Culture, 2021).

Another important role filled by the national authorities to support teachers in Finland by the national authorities has been the awarding of financial assistance in the form of government grants. These grants have been made available and used to offset the effects of the pandemic at all levels of education in Finland. A sum of EUR 80 million was allocated for primary schools aimed at providing students and schools with the support needed to address the challenges associated with primary and lower secondary education during the distance learning period. The Government also proposed that EUR 112.3 million be provided as increases in central government transfers to local government for basic public services to support children, young people, and families during the coronavirus crisis. These funds were allocated to social services for children, young people and families, and mental health services for children and young people (Finnish Government, 2020).

It could be argued that the main purposes of these regulation changes and additional funding are not directly related to assisting teachers themselves, as the language used focuses on the students' arrangements and well-being, and teachers are rarely specifically mentioned in national level discourses concerning support and professional development during the pandemic, and this is something that could and should be explored more in the master's thesis. However, based on the researchers' own experience of working in schools in Finland, in many cases, the funding received by schools and municipalities has provided support for teachers in the form of extra training and in some cases the hiring of additional staff.

4.3.2 Regional level support

The European Union (EU) has several initiatives ongoing with regards to supporting educators and providing them with project funding, learning platforms, and access to tools to assist with the transition to online learning. The COVID-19 crisis has led to more technology-supported change in teaching over the last year than in perhaps the previous twenty (see OECD, 2020; World Economic Forum, 2020) and that digital technologies play, and will continue to play a key role in supporting teachers and learners in the future (see Digital action plan, 2021).

The EU is keenly aware of the need for teacher support, as in a recent EU survey on online and distance learning, almost two-thirds of teachers indicated that they had never experienced online teaching before the pandemic, with a multitude of challenges indicated ranging from lack of technology to pupil engagement (School Education Gateway, 2020).

The EU has a multitude of projects and initiatives related to education, however, for the purposes of this paper, the focus will be on two of the main forms of support for teachers in the European Education Area (EEA) regarding distance learning resources for educators: online learning platforms and EU funded projects.

Online learning platforms.

The EU has several online learning platforms available for educators, such as:

1. *The school education gateway*: which provides support for online teaching and professional development for teachers through MOOCs and online training courses. (<https://www.schooleducationgateway.eu/en/pub/index.htm>)
2. *eTwinning*: A community of almost one million teachers working in schools of a European country, where educators can communicate, collaborate, develop projects, and share ideas (see <https://www.etwinning.net/en/pub/index.htm>).
3. *Learning corner*: which provides materials, games, and opportunities to network with other teachers. (https://europa.eu/learning-corner/home_en)
4. *The European Institute of Innovation and Technology (EIT)*: which provides support and focuses on technology and distance learning solutions (see: <https://eit.europa.eu/>)

A list of other platforms can be found at https://ec.europa.eu/education/resources-and-tools/coronavirus-online-learning-resources/online-platforms_en

One of the more interesting EU initiatives is the European Schoolnet Network. The European Schoolnet is a network of Ministries of Education which has enabled member Ministries to share experiences and challenges and to share policies and strategies linked to pandemic-related topics such as examinations, inclusion, and supporting online teaching. The European Schoolnet network shares coordinating and monitoring initiatives, providing guidance to schools and families, setting distance teaching and collaboration platforms, adding new resources and learning materials, providing free content from publishers and EdTech companies, daily lessons broadcast by national TV companies, supporting families with connectivity and equipment, hotlines, webinars, MOOCs and crash courses for teachers and parents (European Schoolnet, 2020).

European Schoolnet network has a range of resources available to support teachers' professional development and collaboration, such as:

- a) *Future classroom Lab*: provides free resources, webinars, and activities for online teaching (<https://fcl.eun.org/web/guest/news/details?articleId=4854419>)
- b) *European Schoolnet Academy*: which provides a range of free Massive Open Online Courses (MOOCs) for primary and secondary teachers as well as other educational professionals. (<https://www.europeanschoolnetacademy.eu/>)
- c) *Scientix*: offers services to ministries, STEM teachers, or STEM organisations. (<http://www.scientix.eu/home>)
- d) *GoLabz*: aims to facilitate the use of innovative learning technologies in STEM education, by offering a sharing and authoring platform to access remote and virtual labs. (<https://www.golabz.eu/>)

EU funded projects

The EU has a multitude of projects focused on increasing educators' online teaching skills and this section aims at providing a brief introduction to some of these projects. Most of the projects listed are funded by one of the EU's main funding mechanisms: Horizon 2020, ERASMUS+, or the Marie Skłodowska-Curie Actions (MSCA).

1. *Creations project*: develops creative, engaging approaches to science education based on art. (<http://creations-project.eu/>)
2. *Penji protects the planet*: A game-based learning activity teaching primary and secondary students the importance of environmental sustainability. (<http://penjiithegame.com/>)

3. *CodeNsocial*: Provides access to ICT learning, programming, and basic technological skills, for those at risk of poverty and social exclusion. (<https://codensocial.eu/en/learning-platform>)
4. *Go-Lab*: Facilitates the use of online laboratories and inquiry learning applications for science education in schools. <https://nextlab.golabz.eu/initiative>
5. *Scientix*: promotes and supports Europe-wide collaboration among STEM (science, technology, engineering, and maths) teachers, education researchers, policymakers, and other STEM education professionals (<http://www.scientix.eu/home>)

More information on these projects and other Eu funded projects can be found from the Coronavirus learning resources: EU-funded projects pages at https://ec.europa.eu/education/resources-and-tools/coronavirus-online-learning-resources/eu-funded-projects_en

In addition to these initiatives, the EU has also initiated a Digital Education Action Plan (2021) which outlines the European Commission's vision for high-quality, inclusive, and accessible digital education in Europe. According to the plan, the goals of this initiative are to learn from the COVID-19 crisis, during which technology is being used at an unprecedented scale in education and training, and to make education and training systems fit for the digital age.

This action plan has two main strategic priorities:

1. Fostering a high performing digital education ecosystem, by developing plans, guidelines, and recommendations for member states regarding online learning, teaching, and ethics, and
2. Enhancing digital skills and competencies, by providing digital training and teaching competencies to both students and teachers, through accreditation and cooperation with civil society and technology companies. https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en

The EU outline that this action plan is needed, as access to computers and broadband varies widely across Europe (Eurostat, 2020), while the EU's research indicates that only 39% of teachers across the EU feel well prepared for using digital technologies in their daily work (see Digital education action plan, 2020).

4.3.3 Online communities

In addition to the opportunities available to teachers to be a part of teaching support communities at the EU level, there has also been a large amount of support available to educators through online, peer-support communities, hosted on various social media platforms, such as Instagram and Facebook for example.

A basis search for international and global teacher support groups and support materials provides a huge array of options, in for the most part English. These groups are of course options for Finnish teachers who have the necessary English skills to avail of and utilise these groups, however, this section will focus on online communities in Finnish, which should be accessible to most Finnish primary school teachers.

Some Finnish teacher Facebook support groups have been around long before pandemic times, (see for example the Facebook group “Alakoulun aarreaitta – Ideoita ja oivalluksia opetuksen tueksi” which has over forty thousand members). Teachers have, by and large, been collaborating in online environments within their own, as Wenger (1998) would refer to them as 'communities of practice,' based on their own professional backgrounds and interests. For example, there are several Facebook support groups available for Finnish teachers to join, collaborate and network with teachers with a similar background to them, with support groups available for primary school teachers, English teachers, language teachers, Physical education teachers, Art teachers, Science teachers, etc. All of these groups can provide support mechanisms for primary school teachers as all of these subjects are part of the primary school teachers' curricula.

One of the more interesting phenomena that have emerged since the pandemic has been the establishment of several other online communities with a specific focus on distance teaching (*etätyö* in Finnish). Several groups have been established over the past several months with a sole focus on providing ideas and support for teaching communities. While for the most part these groups still mainly focus on specific communities of practice, in many instances they are led by, as Vygotsky (1978) would refer to them “‘more knowledgeable others,’ or peers with superior knowledge of distant teaching and techniques, who share this knowledge with those less knowledgeable members of the group. Distance learning groups can be found for primary school teachers, with several other groups focusing on, for example, music education, physical education, and language teaching using distance learning approaches.

In addition to Facebook groups and communities of practice, many educators have taken to using other social media such as Instagram, and Pinterest to showcase their talents, and to provide inspiration and ideas for their peers. In many cases, these focus on the same ‘communities of practice’, and the posts are based on their skills and background. For example, several Finnish educators are using Instagram to highlight ideas and examples of handicrafts and in particular “soft materials” that teachers can use with students in distant learning situations.

These communities provide several advantages for teachers during the pandemic age, as they provide an easy reference point and source of information where educators can discuss and ask for assistance from peers who are familiar with the curricula and demands of that teachers’ class/classes. Rather than having to spend hours across various platforms and searching for solutions, teachers can simply state what they need, and members of that community will give their ideas and help with solutions on how to solve the issue(s) that member is facing. The wide variety of options available also allows educators to get ideas and inspiration from a variety of sources, and if the teacher is not happy with a particular group, or medium it is a simple procedure for them to leave that group or unfollow that person or group.

4.3.4 Educational Technology (EdTech) solutions

Finally, different tools and solutions were provided by companies and organisations, to aid both teachers and students in the sudden transition to distance education. An example is brought by Google, which was one of the first industry giants to react to the pandemic: in March, right at the outbreak, the company based in Mountain View offered, free of charge, access to a range of advanced features for the app Hangouts Meet, involving larger virtual meeting rooms and the ability to record meetings, promoting the use of Meets and Classroom together (Soltero, 2020); moreover, the company enabled participating schools to transform school-based Chromebooks into take-home devices to facilitate distance education (Solomon, 2020), as well as releasing suggestions to conduct fruitful interactions and learning sessions in the new online environment (Magiera, 2020).

Similarly, Apple (2021) and Microsoft (2021) proposed, through their respective K-12 internet portals, different discounts on the hardware used for education, as well as apps to use for both teachers and learners, with tutorials additionally provided. In a similar fashion, Huawei (2021) provided an End to End (E2E) solution using a Live Virtual Classroom, connecting teachers and students in what is promised to be an immersive Smart Classroom experience, despite the distances. A videoconferencing app that saw a large amount of success after the outbreak was, as shown in the previous pages (Case, 2020), Zoom. Zoom, in the words of the CEO Eric Yuan, decided to lift the 40-minute conference time limits for the K-12 schools free of charge, despite the feature normally comes at a price (Amrich, 2020).

In many ways Finnish EdTech organizations were in an advantageous position to provide a great deal of support to teachers, due to the Finnish Government's focus on, and investment in supporting the export of Finnish EdTech solutions and networks as part of its "education export" policy which has been actively promoted and encouraged for several years prior to the outbreak of the pandemic (see Delahunty, 2016; Delahunty, Phusavat, Kess, Kropsu-Vehkapera & Hidayanto, 2018). One example of different Finnish educational technology companies coming together to aid distance education can be found in Finland through the Koulu.me website (Education Finland, 2020). The website, launched at the beginning of the pandemic, was instigated by the innovation consulting company "SPINVERSE," and quickly snowballed to include several other companies offering their educational tools free of charge to both educators and students.

UNESCO (2020c), through a website dedicated to distance education, provided a list of educational applications, platforms and resources to help parents, teachers, schools and school administrators

facilitate student learning and provide social care and interaction during periods of school closure; similarly, the Global Business Coalition for Education promoted the REACT (Rapid Education Action) platform to “mobilize corporate resources and expertise to minimize the long-term impacts on the next generation” (van Fleet, 2020), featuring a different range of educational features and tools.

5. Discussion

This chapter will be dedicated to the discussion of the findings of the literature review concerning the research questions proposed in the introduction. Additionally, a short reflection is also provided where the possible implications of the research findings are discussed.

At the outbreak of COVID-19 and following national lockdowns and social distancing, teachers were among the first professions that had to switch to a remote work environment, dealing with the consequences of rapidly changing their work habits and teaching methods, adapting to teaching from a distance. As one could expect, the teaching profession changes dramatically when moved from the school environment to a technology-based one, without teachers and students sharing a common space. The first research question deals with how ready teachers were to move their jobs online, adapting to new tools which, inevitably, lead to a dramatic change of practices. The findings of the literature review seem to point out a scarce degree of preparedness among teachers in the areas of the world that were briefly examined with some example case studies, with similar results obtained between the countries.

In order to achieve a diverse set of results, sources and surveys from different areas of the world were included in the review, ranging between high- and low-income countries. As expected, teachers from both high- and low-income areas showed a low degree of readiness to the sudden change in their profession but, surprisingly, being “digital natives” (Prensky, 2001) and, therefore, more keen on using technology, did not seem to be of any help in adapting (König, Jäger-Biela & Glutsch, 2020, p. 610). In this latter specific case, there seems to be a correlation between scarce preparedness among teachers and schools falling behind in the digitalization process.

The issues concerning online readiness do not only involve a lack of confidence or training but, especially in lower-income societies, it involves a lack of the right appliances or a lack of stable internet to deliver the educational content. One exception to this however seemed to be Finland: in the preliminary results of a study (Suorsa et al., 2020, p.150), there seems to have been a higher degree of readiness among teachers in teaching online. A reason advanced for this degree of readiness concerns the degree of collaboration among teachers and institutions which characterises the Finnish educational system (Kelly, Merry, & Gonzalez, 2018, pp. 36-37)

Concerning the second research question, the role of technology has been explored in the theoretical overview, in which it was highlighted how often the concepts of distance education and computer-

based education often overlap (e.g., Moore 1990, as cited in Moore, Dickson-Deane, and Galyen, 2010, p. 129; Dede 1996, p. 1; Kaplan & Haenlein, 2016, p. 443). As already mentioned, technology played a huge part in the switch to distance learning during the coronavirus pandemic.

The Internet was the main medium on which distance education in the time of the COVID-19 crisis was founded, getting teachers and students closer. A crucial internet-based tool was video-conferencing through apps, which seemed to be the most immediate tool for teachers to try to emulate a classroom environment from their homes. Relying on technology has created a digital divide that was even more significant in the low-income countries: if teachers from high-income countries could rely on digital devices and a reliable internet connection, teachers from the developing countries had to opt for more traditional methods, such as worksheets and books, with the aid of radio, television or SMS where possible. Among the possibilities adopted, mixed methods were often a solution, with traditional tools and digital devices used at the same time.

Concerning the evolution of teacher training, the existing literature is still too scarce to consider how the crisis connected with the pandemic will affect it. Pre pandemic frameworks (iNACOL, 2010, as cited in Burns, 2011, p. 183), try to trace a profile for a well-prepared web-based instructor, with other frameworks (Philipsen et al., 2019) focusing on lifelong learning for teachers, postulating ways to update one's professional skills in implementing distance education.

With regards to support and solutions available to teachers during the shift to distance education, several actors were identified at the European and national levels. The change to online teaching has necessitated several legislative changes to facilitate the shift to distance learning, while national and regional governments have also been responsible for providing additional support mechanisms in the form of grants, projects, and additional funding. These funds and projects have been aimed at easing the transition for both students and teachers, and funding has been used for teacher training and the hiring of new staff to lessen the burden on teachers during COVID times.

The use of online/social media peer support groups was another means identified where teachers could receive support from peers with regards to online education. Hundreds of groups have emerged internationally in what has been in many ways an unprecedented response by teachers globally to assist their peers and colleagues, while domestic groups have also ensured that those teachers receive support and help that is curriculum relevant, also removing the potential obstacle of any language barrier. While these groups in many cases existed in pre-COVID times, there has been a marked increase in the number, and focus of these groups during the shift has been for 'more knowledgeable

other' (Vygotsky, 1978) where educators with superior knowledge of online and distance teaching assist less knowledgeable peers during the transition to online education.

As a closing note, it is important to reflect on the long-term implications of these research findings. The pandemic has changed mankind's global outlook, with tangible and long-lasting effects on everyone's daily life, therefore one could consider the inevitable lessons that could be learned. Luthra and Mackenzie (2020) provide a list of four lessons that education might take away from the pandemic, two of which intertwine with the research questions.

The first of these relevant lessons concerns a reinvented role for the educator, who should move away from the "knowledge-holder who imparts wisdom to their pupils" role, to be seen as a facilitator, helping their pupils to navigate the different tools available to build knowledge, with specific regard to digital. Internet-based devices. The other main lesson concerns technology in education and to see it not as an obstacle with a steep learning curve, but as a possibility to develop teaching practices, add flexibility to them and potentially bear benefits in accessibility to education for students. On the other hand, in the interest of completeness, interesting research opportunities could be provided by investigated the hidden agenda concerning the large, widespread use of technology in education (e.g., Anderson, 2020; Williamson, Eynon & Potter, 2020), as issues of data collection, student profiling and privacy breaches may involve the use of new technology-based tools.

6. Conclusions

The impact of technologies on education through the decades is impossible to ignore, as well as the possibilities of future implementations; an impact that became even more critical with the coronavirus pandemic, which transformed what were digital tools to “enhance” education into essential tools on which the continuation of teaching was based. Frameworks of distance teaching and learning that used to be only the foundation of correspondence courses became the “new normal” which teachers and students had to deal with.

The COVID-19 pandemic has brought unforeseen challenges to the world of primary school education. The almost overnight need to adapt to online and distance teaching by teachers has in many cases not been seamless. However, global, regional, and local educational actors have come together in an unprecedented nature to provide educators with tools and solutions to aid educators during this transition. Challenges relating to adapting different pedagogical approaches, the use of technology, and in many cases restrictions on access to this technology and internet access globally have resulted in an increased workload for teachers and students alike and has resulted in increased inequalities based on the digital divide. However, exploring these inequalities and increased workload for teachers was beyond the scope of the thesis, and this is something that we believe would necessitate further research at the master's thesis stage.

It was hard to foresee such a critical scenario for the whole world before the pandemic struck, which explains the certain degree of unpreparedness in technology-based distance education among schoolteachers, yet the lesson learned during these challenging months could lead to better preparation in ‘emergency remote teaching’ (Bozkurt & Sharma, 2020, p. ii). It is necessary to provide in-service teachers with the proper training in the use of digital tools for educational purposes, invest in the digitalisation of school, and in a reform of teacher training, which should emphasise educational technology more. Policy makers, institutions, schools, and students must cooperate for the future of education, in order to be ready to move teaching practices online effectively, with the hope to never have to face such a crisis ever again.

The effects on primary school teachers and teaching due to the pandemic will become more evident as the pandemic progresses and eventually comes to an end, as there is still relatively little academic research regarding the topic at the moment. Especially with regards to the long-term teaching and learning implications for teachers and students alike. This topic warrants further investigation, with more research certainly warranted on the explored topics, in addition to for example the long-term

effects on teacher and student well-being. We propose that these issues will be further explored at the master's level, where teachers' and administrators' own experiences can also be incorporated into the research.

7. References

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