JÖNKÖPING UNIVERSITY
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University Teachers' Perspectives on the Use of Educational Technology in the Research Supervision Process

A case-study on the supervision process of students during their final thesis at the Jönköping University in Sweden

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Abstract

Educational technology has been proven to potentially impact higher education institutions, but the true extent of this potential often remains vague. In times when higher education and research become increasingly relevant for the economic welfare of society, research supervision itself emerges as an important field of research.

This qualitative research investigates the teachers' view and approaches to the use of educational technology during the research supervision process of undergraduate and graduate students at the Jönköping University. Through the application of the TPACK framework in higher education, we gained a better understanding of the teachers' personal values when using educational technologies in their supervision process. Furthermore, we are contributing an empirical example of a TPACK application in higher education while shedding light on the decision-making of supervisors when using or not using educational technology.

We conducted seven interviews with research supervisors and answered the questions of (1) how educational technology is used during research supervision and (2) why educational technology is used or not used during the supervision process. The findings showed five main use cases for educational technology. We observed that supervisors mostly used educational technology when collaborating with their students whereas they preferred a more analog or hybrid approach to technology for executing individual tasks like reading and commenting. Educational technology has a supporting role for supervisors, and it is creating personal value to them through convenience, reading comfort, increased efficiency and effectiveness. For further research we suggest investigating how the personal value for teachers can be accounted for in the existing TPACK framework, and the possible benefits the application of the original or an extended version of the TPACK framework has for the field of information system research.

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1 Introduction

The possible impact of integrating technology into teaching is not just a recent topic of study. More than 85 years ago, Frederick Devereux (1933, p. 1) wrote about the potential of technology to transform the learning process. And Devereux is not alone in proclaiming changes in education resulting from technological advances (Mishra, Koehler, & Kereluik, 2009). Ever since then, researchers (Mishra, Koehler, & Kereluik, 2009; Reiser, 2001; Wang & Reeves, 2003; Zawacki-Richter & Naidu, 2016) have studied major technological advancements in educational technology throughout the centuries, ranging from the use of audiovisual instruction and instructional media (1900s until 1970s); the emergence of the personal computer and the internet (1980s until 1990s); and most recently, networked computing as well as Distance and Online Education (2000s until today).

Today the terms "educational technologies" or "learning technologies" are used to describe the study and practice of facilitating learning and improving performance by creating, using, and managing technological processes and resources (Mishra et al., 2009). Lai and Bower (2019) provide a comprehensive list of current technologies, including e-learning, online learning, MOOCs, mobile learning, computer games, augmented reality (AR) or virtual environments.

As each new technology was promoted as the next possible panacea for educational problems, people rarely thought carefully about the previous failures involving older technologies (Wang & Reeves, 2003). Differences have long persisted between the well-proven potential of technology-enabled learning and the less consistent realities of technology use within university teaching and learning (Henderson, Selwyn, & Aston, 2017). There is much research elaborating on the positive potential of educational technology (Harris et al., 2010; Henderson et al., 2017; Kirkwood & Price, 2005; Kukulska-Hulme, 2012; Parra, Raynor, Osanloo, & Guillaume, 2019; Pensel & Hofhues, 2017). However, some researchers also describe evidence where educational technology has failed to fulfill the expectations of stakeholders, such as teachers, students, and administrators (Blin & Munro, 2008; Henderson et al., 2017; Lagemann, 2000; Selwyn, 2007; Wang & Reeves, 2003).

When looking at the evolution of the discipline of educational technology and the work researchers have done within the discipline, one can think of having moved through three "ages," each building on the previous one, and each characterized by fairly unique assumptions and activities (Winn, 2002, p. 332). We are now at the start of a fourth age, in which "researchers in educational technology study students working in complete learning environments" (Winn, 2002, p. 335). In these learning environments, it is often said that teachers are the driving force for implementing and developing digital teaching and learning (Cuban, 1986; Pensel & Hofhues, 2017; Wang & Reeves, 2003).

Observing an increasing pace of technological developments also means that if technology is always changing and jumping from one "revolutionary" invention to the next, then, in the time it takes to learn how to use that technology, it would have already become obsolete (Mishra et al., 2009). In this highly dynamic environment, the consequences for teachers are manifold: teachers who do not keep up with the latest educational technologies […] will almost certainly fall behind, and unfortunately, stay behind (Mishra et al., 2009). Furthermore, Parra et al. (2019, p. 69) says that teachers struggle with "the ever-changing and overwhelming nature of the wide variety of resources, from apps, programs, tools are available". Often, the use of new technology faces resistance from educators who believe that these technologies perhaps do more harm than good

(Mishra et al., 2009). Additionally, if we look at the relationship between the personal use of technology by teachers and their professional technology use, Kukulska-Hulme (2012) points out that often "academic staff do not wish to participate in professional development, as they do not associate it with sufficient personal benefit" (Kukulska-Hulme, 2012, p. 248). This opens up a new way to improve the adaption of educational technology by teachers by addressing the dimension of personal benefit.

As research becomes increasingly recognized as vital to innovation and national economic growth, research education has become a matter of more concern for both government and public (Pearson & Brew, 2002). The completion of a postgraduate research program, traditionally at a post-secondary institution, leading to a master's or doctorate degree, is regarded as a distinguished achievement, and thus requires substantial supporting and supervisory elements (Nasiri & Mafakheri, 2015). Healey and Jenkins (2009, p. 6) independently advocated moving more curricula in the direction of "developing students as participants in research and inquiry, so that they are producers, not just consumers of knowledge". Research literature shows evidence (Healey & Jenkins, 2009; Anne Lee, 2008; Lubega & Niyitegeka, 2008; Maor & Currie, 2017; Pearson & Brew, 2002), that research supervision is taking on an important role in conducting quality research now and by future generations of researchers, all of which are guided and taught by research supervisors, who usually happen to be university teachers and academics.

Concluding these manifold changes in the area of educational technology in higher education, the reviewed literature suggests an important relationship between technology, pedagogy and content. Educational technology has proven its potential to impact the higher education institutions. However, the potential often remains vague and is left unrealized due to improper implementation. In existing research, the perspectives of teachers were often dismissed or under-evaluated. We experienced the same, as we found it difficult to find evidence on the use of educational technology by teachers in higher education, as well its complex relationship to content and pedagogy. In times when higher education and its role in producing research becomes increasingly relevant, research supervision emerges as an important research field in which to investigate the role of "educational technology" from a teacher's perspective. The next paragraph elaborates on research problems of educational technology used in research supervision and looks closer at existing theoretical frameworks.

1.1 Problem

In the past decade, higher education research supervision has changed to become more participatory in nature (Fenge, 2012; Alison Lee & Danby, 2012) — a process where research students now have greater autonomy in developing their research agenda and work more collaboratively with their supervisor, instead of a top-down approach. This style of supervision is beginning to incorporate more information and communication technologies (ICTs) (Carpenter, 2012; Le, 2012). Maor and Currie (2017) found a new type of supervision pedagogy, which embraced the notion of creating communities of scholars and resulted in teamwork. This more participatory supervision involved the concepts of connectedness, more intense supervision, and group supervision.

The changing nature of supervision was also observed by several researchers and their respective studies (Donnelly & Fitzmaurice, 2013; Green & Bowden, 2012; Maor & Currie, 2017; Stubb, Pyhältö, & Lonka, 2014). Maor and Currie (2017) summarized that the characteristics of research supervision were shifting from a product-oriented (thesis production) to a process-oriented

undertaking and from an individualistic to a community-centered approach where students were further developed as professionals in their field. Furthermore, there appears to be a shift from the master apprentice model to one in which the supervisor facilitates and negotiates rather than directs or instructs (Maor & Currie, 2017). The overall direction seems to point from a formerly individualistic approach to a collaborative research approach.

Although there are several ways through which research can be supervised using traditional means; technology has introduced other forms of supervision (Lubega & Niyitegeka, 2008). In an Australian and international study, Danby and Alison Lee (2012) developed a new online network space which included discussion forums, chats, video conferencing, linked homepages, and collaborative writing spaces to combine technology with pedagogy as practice-in-action to improve the supervision relationship (Maor & Currie, 2017). In their own qualitative research with academics who currently supervised doctoral students, the authors reported the use of email and mobile phones for communication and exchange of information, web meetings when unable to meet face-to-face or if distance supervision was involved, and the use of the Internet for information seeking and sharing, as well as research databases and university specific software (Maor & Currie, 2017, p. 7).

However, based on the findings of Maor and Currie (2017, p. 11), the authors reported barriers and challenges for teachers in the use of educational technology in supervision. The challenges had both personal and professional dimensions. Some participants claimed that doing supervision "online" seemed like "adding another complexity to an already complex relationship". Another issue reported by the authors according to their interviewed supervisors was the potential for longer working hours, the perception of always being available to respond to students' questions via technology, and the extra vigilance required to maintain a work-life balance. There was an expectation amongst students that their supervisors would be readily available, at least via technology. Most teachers had daily or at least weekly contact with their students. "Some supervisors reported sensitivity on the part of their graduate students in receiving feedback, and that written feedback could appear not only more harsh, but also overwhelming to see many revisions and comments, and importantly, demotivating" (Maor & Currie, 2017, p. 12). Finally, "poorly implemented institutionalised use of technology was reported as a commonly experienced barrier and often influenced negative attitudes towards technology" (Maor & Currie, 2017, p. 12). One example is the mandatory administrative forms of research supervision, such as online templates, which were reported as difficult and time consuming (Maor & Currie, 2017).

The way students communicate with their supervisors and the relationships that they develop have considerable impact on their research journey (Maor & Currie, 2017). The same authors describe that "as more students take up distance and part-time research opportunities, supervisors will have to meet their needs with more online resources to match the opportunities provided to those on campus" (Maor & Currie, 2017, p. 13).

Taking into account the strong relevance and interconnectedness of pedagogy, content, and technology, a prominent theoretical framework to understand the relationships between these three components is the "technological pedagogical and content knowledge (TPACK)". The TPACK framework was developed by Mishra and Koehler (2006), and is one of the frameworks of teacher knowledge that has received significant attention from other researchers. It has three main constructs: content knowledge (CK), pedagogic knowledge (PK) and technology knowledge (TK). However, apart from looking at each of these components in isolation, the authors also look at them in pairs: pedagogical content knowledge (PCK), technological content knowledge (TCK),

technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPCK).

TPACK has been used in a multitude of research within different educational fields, such as pre-school, college, higher education and teacher education (Bachy, 2014; Bennett, Agostinho, & Lockyer, 2015; Benson & Ward, 2013; Bibi, 2017; Mourlam, 2017; Niess, 2011; Soomro et al., 2018; Tanak, 2018). However, it should be highlighted that much of the existing research has not been done in the context of higher education. Mourlam (2017) agrees when he found that the majority of TPACK-related research branches that have emerged covers pre-service and in-service teacher TPACK development. An area of inquiry explored to a lesser extent has been TPACK in higher education. Higher education institutions present unique contexts for TPACK and its development as the institutional demands are often quite different than other similar educational settings (Mourlam, 2017). In comparison to teachers at primary or secondary schools, there is a great deal of heterogeneity in both teaching practice and faculty profiles in a university setting (Bachy, 2014). Benson and Ward (2013, p. 154) agree that "higher education pedagogy adds an important dimension to quality teaching at the college and university level".

The empirical evidence and analysis of previous research in this field exposes a research gap when it comes to the integration of technology, pedagogy, and content within the process of research supervision in higher education. The changing nature of research supervision makes a relevant and current research case, where the formerly mentioned three components could be analyzed in a practical environment and from the teachers' perspective. Kukulska-Hulme (2012) also mentioned that academic staff do not always see the personal benefit in using educational technology for research supervision. However, existing literature points out the positive impact of using educational technology to improve research quality and supervisor of the research process. Hence, the limited availability of empirical evidence on the personal benefit of educational technology in research supervision by university teachers should be addressed. TPACK provides a useful theoretical framework to design new research of its application in the context of higher education.

1.2 Purpose

The purpose of this research is to investigate the teachers' view and approaches on educational technology used in the research supervision process of undergraduate and graduate students. By investigating the teachers' perspective, we want to gain a better understanding of the teachers' personal benefit from using educational technology in the supervision process. This contributes empirical evidence on how university teachers can make more informed decisions on using educational technology for their research supervision. Furthermore, we contribute an example of the practical use of the TPACK framework in higher education.

1.3 Research Questions

1) How is educational technology used for research supervision by university teachers at the Jönköping University?
2) Why is educational technology used or not used for research supervision by university teachers at the Jönköping University?

1.4 Delimitations

For our research, we follow a case study strategy with qualitative methods in the context of Information Systems in higher education. In this context we chose to conduct our study at three schools of Jönköping University, due to their reputation for doing high-quality research and the fact that every program finishes with a bachelor or master thesis. Furthermore, the selected schools are known for their positive attitudes towards adapting to recent educational technologies, and also offering courses specializing in technology and education.

When analyzing the use of educational technology in the supervision processes of our participants, we explicitly do not focus on analyzing the process itself nor do we investigate how the nature of supervision has changed from their perspectives. This is because the focus lies in finding out the individual ways of how supervisors use educational technology and what their reasons for doing so are. In cases where they have decided against its use, we were also interested in understanding their reasons underlying this decision.

We bound our case to the snapshot of the spring semester 2019 and focused exclusively on the perspectives, thoughts, motivations, and perceptions of the teachers' and not of the students or other stakeholders. We further do not specify an educational technology to investigate the purpose and reasons of teachers thinking. Focusing on specific technologies reduces generalizability and limits the use of the results in a world where a specific technology quickly can become obsolete.

1.5 Definitions

Educational Technology: The study and practice of facilitating learning and improving performance by creating, using and managing technological processes and resources (Mishra et al., 2009, p. 48).

Supervisory Process: "Supervision process involves several people undertaking different tasks together at different levels to accomplish a specific goal and in guidance of each other. The supervision process involves usually the client (research funding body), the supervisee and the supervisor. These people have different roles they undertake during the supervision process which directly or indirectly affect the final goal" (Lubega & Niyitegeka, 2008, p. 352).

TPACK framework: Technological pedagogical and content knowledge (TPACK) is one of the frameworks of teacher knowledge that has received significant attention from researchers (Mishra & Koehler, 2006). In this framework, content, pedagogy, and technology intersect with one another, forming complex relationships rather than being considered as three separate bodies of knowledge. Mishra and Koehler (2006) believe that TPACK is the basis for effective teaching with technology that underpins a teacher's overall pedagogical decisions (Bibi, 2017). The framework consists of seven parts, derived from the three main components and their respective intersections. Mishra and Koehler (2006) described these seven elements in a definitive article.

Content knowledge (CK) is knowledge about the actual subject matter that is to be learned or taught.

Pedagogical knowledge (PK) is deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims.

Technology knowledge (TK) is knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies, such as the Internet and digital video. This involves the skills required to operate particular technologies.

Pedagogical content knowledge (PCK) is concerned with the representation and formulation of concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology.

Technological content knowledge (TCK) is knowledge about the manner in which technology and content are reciprocally related. Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology.

Technological pedagogical knowledge (TPK) is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies.

Technological pedagogical content knowledge (TPCK) is an emergent form of knowledge that goes beyond all three components (content, pedagogy, and technology). TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones.

Post-secondary level: "relating to or denoting education at a level beyond that provided by schools, typically that provided by a college or university"[1].

[1] Taken from https://en.oxforddictionaries.com/definition/post-secondary, on 18.02.1019

2 Literature Review

"A review of prior, relevant literature is an essential feature of any academic project. An effective review creates a firm foundation for advancing knowledge. It facilitates theory development, closes areas where a plethora of research exists, and uncovers areas where research is needed." (Webster & Watson, 2002, p. 13)

Building on Webster and Watson (2002), we started our research by conducting a literature review to identify relevant themes, research challenges, and knowledge gaps. The literature review was primarily conducted in Scopus, building on the considerations and limitations mentioned in the introduction. Supporting sources were the database of Jönköping University's library (Primo) and searches on Google Scholar. We also followed references found in papers which appeared relevant to our research objective. For the literature review we established a first set of criteria in order to navigate through the most relevant knowledge:

- **Criterion 1:** Appearance in peer-review journals which are related to the research streams Information Systems (IS), Management and Social Sciences to cover topics which are relevant throughout our Master courses, provide a multi-disciplinary literature review approach, and meet a high level of quality.
- **Criterion 2:** No preliminary restriction in time or location of the research, in order to get a holistic picture of the developments and trends within educational technology.

Starting at the most abstract level, we searched for the terms "technology-enhanced learning" and "educational technology" and tried to get an understanding of the historical evidence of technology used in education.

2.1 Use of Technology in Education

When looking at the progression of technology used in education throughout the 20th century, it is worth taking a look at Reiser's (2001) overview on educational technologies between the 1900s and 1990s. Wang and Reeves (2003) as well Zawacki-Richter and Naidu (2016) extend this list for emerging educational technologies since the 2000s, by taking into account alternating institutional and individual research over the past 35 years from articles published in the journal Distance Education.

Table 1: Historical development of educational technologies

Decade(s)	Theme	Technologies
1900s	School Museums provided visual instruction	Portable museum exhibits, three-dimensional photographs, slides, films, study prints, charts
1910s	Instructional films	Motion picture projector
1920/30s	Audiovisual instruction movement; tech advances led to increased interest in instructional media	Radio broadcasting, sound recordings, and sound motion pictures; incorporation of sound and media
1940s	Use of audiovisual technology for military forces and in industry during World War II	Training films, film projectors, overhead projectors, slide projectors, audio equipment, simulators, training devices
1950/60s	Instructional television for educational purposes	Educational television channels, educational broadcasting
1970s	The terms "educational technology" and "instructional technology" are used in place of "audiovisual instruction"	Minor developments in educational use of technology, improvement of instructional media technologies
1980s	Computer as an instructional tool, microcomputers available to public	Microcomputers
1990s	Rapid advances in computer technology and the Internet for higher education	Personal Computers, Internet, distance learning courses used asynchronous Internet-based technologies
2000/10s	Networked Computing; Distance and Online Education	Virtual universities, collaborative learning and online interaction patterns, interactive learning, MOOCs[2], OERs[3]

Another perspective on educational technology is provided in the literature review conducted by the article of Winn (2002). He describes four "ages", through which the work of researchers in the discipline of educational technology went. (1) Firstly, the age of instructional design with a focus on content, where the main goal of educational technology was to make stand-alone instruction as good as instruction delivered by a teacher (Winn, 2002, p. 333), for example using computer-assisted instructions (Gagne, 1988; Kulik, Bangert, & Williams, 1983; Kulik, Kulik, & Bangert-Drowns, 1985). (2) Secondly, the age of message design with a focus on format, which educational technology researchers continued (and continue to this day) to study how the format in which content is presented to students interacts with student characteristics to produce learning of varying quality and permanence (Winn, 2002, p. 333). Levie and Fleming (1978) mention "the mass media, particularly television" as driving technology in this age. Another change factor in the second age was the development of computer hardware that could show graphics and produce sounds, thus increasing the control designers and students had over the material (Winn, 2002, p. 333). (3) The third age of simulation had a focus on interaction at its core, that allowing students

[2]A massive open online course (MOOC) is an online course that has open access and interactive participation by means of the Web. MOOCs provide participants with course materials that are normally used in a conventional education setting - such as examples, lectures, videos, study materials and problem sets. Taken from https://www.techopedia.com/definition/29260/massive-open-online-course-mooc on 26.02.2019

[3] The term OER (Open Educational Resources) was first defined by UNESCO in 2002 as "any type of educational materials that are in the public domain or introduced with an open license" and can "range from textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audio, video and animation." Taken from https://pressbooks.bccampus.ca/facultyoertoolkit/chapter/oer-definition/ on 26.02.2019

a measure of control, with guidance (Johansen & Tennyson, 1983), over how they studied; resulting in significant learning gains (Winn, 2002, p. 334). (4) Lastly, within the current age, researchers in educational technology study students working in complete learning environments. Whereby learning environments can either be entirely natural, or they can be artificial, existing only through the agency of technology (Winn, 2002, p. 335). Many current educational research projects (Gordin, Edelson, & Pea, 1996; Malarney, 2000) study social interaction as a promoter of learning, often through the agency of learning communities created through the Internet (Winn, 2002, p. 335).

For the 21st century, Mishra et al. (2009, p. 48) provides a good definition for educational technology as "the study and practice of facilitating learning and improving performance by creating, using and managing technological processes and resources". While not always explicitly using the term "educational technology", other researchers have also confirmed the dominant presence of technology in the educational sector.

A more recent study conducted by Hsu et al. (2012) examines the technology-based learning (TBL) research trends between 2000 and 2009 from five major journals. Their analysis shows that the technology-based learning context has become a common setting where educators are expected to deliver their instructions via technologies no matter the learning group or academic domain. The current study also shows that topics such as "digital game and intelligent toy enhanced learning" have gained more attention in the recent five years. This implies that students today are facing more advanced gaming experiences and educators have likewise started establishing a similar learning environment to help students maintain their attention on the learning tasks (Hsu et al., 2012, p. 367). The authors identified trends in the United States from 1999 to 2003, which were: "lifelong learning, improvements in technology, demand for high level skill workers, pervasiveness of computers, globalization, new ways of learning from new technologies, and improvement of the learning quality via the technology" (Hsu et al., 2012, p. 355). By analyzing student's attitudes towards technology, Kirkwood and Price (2005, p. 270) talk about the "use of ICT for teaching and learning in the early twenty-first century". Iriti, Bickel, Schunn, and Stein (2016) refer to new and emerging technologies available for use in education as "learning technology", for which it is critical to evaluate the degree to which its usage contributes to learning and teaching. And lastly, Bond, Marín, Dolch, Bedenlier, and Zawacki-Richter (2018, p. 1) recognizes a growing "digitalization of higher education (HE) institutions" and investigates in the same article how educational technology is being used by teachers and students.

Recognizing that a wide range of educational technology evaluated in research publications, ranging from results in the areas of teacher training, student-centered learning technology, to learning at institutions of higher education; we then limited the results to the context of "higher education". The second phase confronted us with a wide range of specific technologies and a variety of used terminology to describe the phenomenon of technology used for learning and teaching.

- **Criterion 3:** Limit the results to the context of "higher education" to ensure that the range of returned results is more specific to the type of education we are doing research on.

Educational technology in higher education affects many different stakeholders: students, faculty, teachers, researchers, administration, IT staff. Although a diverse group of people and institutions are involved, it is often said that teachers are the driving force for implementing and developing digital teaching and learning, and for this reason, technical as well as pedagogical guidance, is recommended (Pensel & Hofhues, 2017). Additionally, it is also suggested that "studies should

target teachers' views on teaching, learning, and the use of technology in their subjects, and how these views interrelate" (Jääskelä, Häkkinen, & Rasku-Puttonen, 2017). We agree with this suggestion and accordingly decided to add another criterion to our literature review:

- **Criterion 4:** Focus on the teacher's perspective on teaching, learning and the use of technology in education to credit an often underappreciated group of relevant stakeholders.

This phase of our literature review contributed many relevant theoretical concepts and keywords in relation to educational technology: instructional design, content, message design, format, simulation, interaction, learning environments, and collaborative learning. However, using all these keywords exceeded our scope due to limited resources and the sheer number of articles available. To continue limiting the scope and only use the most relevant results, we added two more criteria:

- **Criterion 5:** Literature must include the keywords "educational technology" or "learning technologies", as these are the most commonly used terms to describe the phenomenon we are interested in.
- **Criterion 6:** Use of articles with highest number of citations on Scopus and Google Scholar by means of an ordered result list.

In the course of this research, we will use the terminology "educational technology", which includes similarly used terminologies "learning technology", "Information and Communication Technology (ICT) in teaching and learning", "technology-enhanced learning" and "technology-based learning".

2.2 Potential, Benefits, and Teacher Problems in Educational Technology

While many authors take a positive attitude towards educational technology (Harris et al., 2010; Henderson et al., 2017; Kirkwood & Price, 2005; Kukulska-Hulme, 2012; Parra et al., 2019; Pensel & Hofhues, 2017), there is also a strong body of researchers who critically reflect on the use and impact of educational technologies (Blin & Munro, 2008; Henderson et al., 2017; Lagemann, 2000; Selwyn, 2007; Wang & Reeves, 2003). The potential of computer technologies to revolutionize university teaching and learning has long been celebrated by education technologists (Selwyn, 2007). However, differences have long persisted between the well-proven potential of technology enabled learning and the less consistent realities of technology use within university teaching and learning (Henderson et al., 2017).

Potential and Benefits

The potential of digital technologies to enhance student learning has been well established. Benefits include the enhanced diversity of provision and equity of access to higher education, alongside the increased efficiency of delivery and personalization of learning processes. Much enthusiasm has also surrounded the development of digital technologies along increasingly personalized, remote, adaptive, and data-driven lines. Digital technologies of this nature are clearly integral to the future of university education around the world (Henderson et al., 2017).

Furthermore, digitization was listed a driver for the transformation of education, as the authors Kirkwood and Price (2005, p. 258) say that "words, sounds, still and moving pictures can be stored, integrated, conveyed, and presented in digital media for easier use and re-use, while communication via computers and telecommunications is becoming widespread. Increasingly, aspects of teaching and learning are being mediated through ICTs, both on and off campuses".

Also, campus-based universities now provide programs of study for students who are geographically remote (Kirkwood & Price, 2005).

Many universities in western countries are adopting a blended learning approach: that is, a merging of face-to-face and technology-mediated learning. Independent learners can now be more flexibly supported: they can locate, retrieve and interact with educational resources and engage with teachers and fellow students in ways not previously possible (Kirkwood & Price, 2005).

Advancements in technology such as social media, online social networking, and mobile technologies are also considered popular everyday tools and services that are also potential or de facto resources for education. They enable not only online learning but also offline learning — through digital resources such as e-books downloaded to mobile devices and accessed at the learner's convenience (Kukulska-Hulme, 2012).

Critical Opinions and Teacher Problems

Critics like Lagemann (2000) state that educational research has not been a great success in supporting the implementation of instructional innovations; in fact, it has had little influence on educational practice in general. Even 17 years later, this does not seem to have changed, as Henderson et al. (2017, p. 1578) confirmed that "digital technologies are clearly not 'transforming' the nature of university teaching and learning, or even substantially disrupting the 'student experience'".

Selwyn (2007) states that despite huge efforts to position computer technology as a central tenet of university education, the fact that many students and faculty make only limited formal academic use of ICTs during their teaching and learning is less discussed by educational technologists. He further elaborates that "the formal use of computer technologies in many areas of higher education could best be described as sporadic, uneven, and often 'low level' (in stark contrast to the often imaginative and informal uses that students and faculty make of technologies like mobile telephony and other personal digital devices)" (Selwyn, 2007, p. 84). He quotes Moule (2003), who said that classroom uses of potentially powerful information technologies are seen to often take the reduced form of 'mindless activities' that do little to alter the expectations, assumptions, and practices of higher education teaching. The advent of the Internet heralded predictions that e-learning would transform and disrupt teaching practices in higher education (Blin & Munro, 2008). In their article however, the authors confirm the absence of significant disruption, as it is evidenced by their preliminary findings and is supplemented by their experiences as practitioners working in the university (Blin & Munro, 2008).

However, Wang and Reeves (2003) found that teachers were easy targets of critics regarding the failure of technology integration in classrooms. People were much more prone to attribute implementation failure to the motives and self-interests of teachers rather than to contextual variables, poor leadership, or gaps in supportive infrastructure (Cuban, 1986).

The authors also criticize that as each new technology was promoted as the next possible panacea for educational problems, people rarely thought carefully about the previous failures involving older technologies (Wang & Reeves, 2003). These problems are manifold and can be analyzed when looking at the teacher's perspective again. Because undoubtedly, as the ultimate practitioners, teachers are one of the key contributors to the success of integrating new technologies into learning and instruction (Wang & Reeves, 2003).

As indicated by Harris et al. (2010), in-service teachers need learning experiences in: (1) selecting and using learning activities and technologies in a more conscious, strategic, and varied manner; (2) instructional planning that is more student-centered, focusing on students' intellectual, rather than affective, engagement; and (3) making deliberate decisions for more judicious educational technology use (Niess, 2011). Mishra and Koehler (2006) add to this list, that quality teaching, hence requires developing a nuanced understanding of the complex relationships between technology, content, and pedagogy, and by using this understanding, develop appropriate, context-specific strategies and representations.

Kukulska-Hulme (2012, p. 248) points out another challenge for teachers, based on the relationship between the personal use of technology by teachers and their professional technology use, saying that "academic staff do not wish to participate in professional development, as they do not associate it with sufficient personal benefit. The author also states that the "professional role model" to students is one of the main roles of the teacher (Kukulska-Hulme, 2012, p. 252). As such, the teacher as role model should know how to make best use of the powerful tools that learners carry around with them at all times, and be able to demonstrate appropriate academic uses or talk knowledgeably about effective practices enabled by those tools (Kukulska-Hulme, 2012). This leads to the argumentation, that "faculty engagement should go beyond technology adoption in their teaching to adoption in their own professional learning" (Kukulska-Hulme, 2012, p. 248).

Parra et al. (2019, p. 69) nicely summarized a list of reasons why teachers struggle to use technology in the classroom: "1) a lack of functional knowledge about the actual technology utilized in schools and school districts; 2) the beliefs that technology represents a distraction and social media use is problematic for K12 students; 3) the ever-changing and overwhelming nature of the wide variety of resources, apps, programs, tools available."

Some researchers go one step further and state that "teachers will have to do more than simply learn to use currently available tools; they also will have to learn new techniques and skills as current technologies become obsolete. This is a very different context from earlier conceptualizations of teacher knowledge, in which technologies were standardized and relatively stable" (Mishra & Koehler, 2006, p. 1023). Ultimately, there seems to be a consensus between researchers, that keeping up with technology requires continual learning and education. Teachers who do not keep up with the latest educational technologies (talking motion pictures, overhead projectors, cell phones, etc.) will almost certainly fall behind, and unfortunately, stay behind (Mishra et al., 2009).

With the emergence of educational technology in the form of mobile devices, social media and networks, Healey and Jenkins (2009, p. 6) advocate moving more curricula in the direction of "developing students as participants in research and inquiry, so that they are producers, not just consumers of knowledge". The Higher Education Academy in the UK (Healey & Jenkins, 2009) put forward the idea that "universities need to improve the research-teaching nexus, and to help realize this goal, all undergraduate students should experience learning through, and about, research and inquiry" (Kukulska-Hulme, 2012, p. 253). In this increasingly challenging learning environment for both teachers and students, how students communicate with their supervisors and the relationships that they develop have considerable impact on their research journey (Maor & Currie, 2017). Another major challenge will be that as more students take up distance and part-time research opportunities, supervisors will have to meet their needs with more online resources to match the opportunities provided to those on campus. Forums, where these new technologies are shared among supervisors would facilitate this transfer of knowledge (Maor & Currie, 2017).

With this form of electronic supervision, supervisors and supervisees are able to develop a strong attachment to each other through constant collaboration and communication. Technology tends to create a neutral platform for all stakeholders involved in the supervision process (Lubega & Niyitegeka, 2012).

Backed up by the literature review and the above results, research supervision emerges as an exciting research field to continue investigating the role of "educational technology" from a teacher's perspective. Literature provides evidence for complex changes in the higher education environment which are subject to further research to better understand its complexity. For this we further added a literature review criterion:

- **Criterion 7:** Limit the existing result list to "Research Supervision" and "Supervision" in higher education. Furthermore, include new search queries specifically for literature using the above keywords within a timeframe of predominant digitalization, namely between 1980 until 2019.

2.3 Research Supervision and Educational Technology

As research becomes increasingly recognized as vital to innovation and national economic growth, research education has become a matter of more concern for both the government and public (Pearson & Brew, 2002). The completion of a postgraduate research program, leading to a master's or doctoral degree, is regarded as a distinguished achievement, and thus requires substantial supporting and supervisory elements (Nasiri & Mafakheri, 2015). According to Gallagher (2000), another quality measurement of research education is the effectiveness of supervision/supervisors, next to timely completion, student satisfaction and adequacy of resources. Pearson and Brew (2002) give an exhaustive summary of the theoretical background of "research supervision". Connell (1985) states that supervision is not simply the cooperation of more experienced researchers with less experienced researchers. Instead, it has been described as one of the least discussed but most complex and advanced formats of teaching.

Building on this understanding of research supervision, we reviewed examples of how educational technology played a role in the supervision process. Four studies appeared relevant (Donnelly & Fitzmaurice, 2013; Maor & Currie, 2017). Firstly, Donnelly and Fitzmaurice (2013) explored the pedagogy of group research supervision through the lens of connectivism, where control is shifting from the supervisor to a research student who is becoming more autonomous. The authors noticed that the trend of blending the use of technology with face-to-face postgraduate supervision has been developing apace in recent years (Donnelly & Fitzmaurice, 2013). Donnelly and Fitzmaurice (2013) reported on using a blended approach to facilitate postgraduate supervision with the intention of reducing research supervisors' workloads and improving the quality and success of master's and doctoral students' research output. Their findings suggest that the supervision process was improved with a blended approach, as the administrative workload of the supervisor was reduced, and a dynamic record of the supervision process was created. Maor and Currie (2017) identified three types of supervision: (1) traditional (dyadic relationship between supervisor and student); (2) group (supervisor and multiple students); and (3) mixed (mixture of the two previous plus new technologies). The authors conceptualized the research process as an ecosystem with a myriad of stakeholders that would use online technology to develop a more participatory and less traditional pedagogy that would help students meet 21st century skill requirements. Thirdly, Lubega and Niyitegeka (2008) confirm, that although there are several ways through which research can be supervised using traditional means; technology has introduced other forms of

supervision. As such, group supervision and the blended supervision approach both emerged as prominent trends in the field of research supervision, enabled by educational technologies. Lubega and Niyitegeka (2008) discussed e-supervision as another example of how educational technology evolves within the field of higher education. Donnelly and Fitzmaurice (2013) describe the blended approach as using technology during face-to-face postgraduate supervision. Lastly, an Australian and international study (Danby & Alison Lee, 2012) developed a new online network space which included discussion forums, chats, video conferencing, linked homepages and collaborative writing spaces to combine technology with pedagogy as practice-in-action to improve the supervision relationship (Maor & Currie, 2017).

According to Maor and Currie (2017), most students were high users of ICT in their everyday lives, so they tried to integrate these into the supervision process. Supervisors and their students identified the need for an increased use of ICT and an integration of that technology with supervision pedagogy. The students needed more frequent communication and an accommodation of their family and work commitments (Maor & Currie, 2017). The vast majority used email and Skype, which increased the frequency of contact between supervisors and students, creating a more intense relationship. Most participants had daily or at least weekly contact. All participants used the Internet for information seeking and sharing, as well as research databases and university specific software. A few supervisors and students used online social media sites like Twitter, mainly to disseminate their research findings.

2.4 Changing nature of research supervision and the role of educational technology

As described in the previous section, educational technology is used throughout the supervision process in the form of a blended supervision approach, which integrates technologies such as group chats, video conferences, forums and collaborative writing spaces with traditional face-to-face interaction. Consequently, technology seems to play a role in the supervision process when it comes to communication and collaboration.

When looking at the available literature (Danby & Alison Lee, 2012; Donnelly & Fitzmaurice, 2013; Green & Bowden, 2012; Lubega & Niyitegeka, 2008; Maor & Currie, 2017; Pearson & Brew, 2002), it becomes apparent that the nature of supervision has been changing. In an exploratory study, Fenge (2012) highlighted significant insights into the value of group supervision within doctoral education. She describes the concepts of peer learning and group dialog, as well as receiving feedback from both students and group supervisors. Maor and Currie (2017, p. 1) summarize the changing nature of research supervision in the last decade as "more participatory in nature" and stated that it has become "a process where research students have greater autonomy in developing their research agenda and work collaboratively with their supervisor". Furthermore, the authors mention that a new type of supervision pedagogy emerged that embraced the notion of creating communities of scholars that resulted in teamwork. This more participatory supervision involved the concepts of connectedness, more intense supervision, and group supervision (Maor & Currie, 2017).

Donnelly and Fitzmaurice (2013, p. 4) explored the pedagogy of group research supervision and noticed that "blending the use of technology with face-to-face postgraduate supervision has been developing apace in recent years". They built their study on the principles of connectivism proposed by Siemens (2004):

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections are needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process

The authors argue, that these principles could be seen in practice at an individual supervision level, as well as in group supervision (Donnelly & Fitzmaurice, 2013).

In another Finnish study (Stubb et al., 2014), the authors derived four categories to describe the conception of research by students: product-oriented versus process-oriented and, on the other hand, person-centered versus community-centered. Analyzing this study, Maor and Currie (2017, p. 2) concluded that "the research journey in Finland was shifting from a product-oriented (thesis production) to a process-oriented undertaking and from an individualistic to a community-centered approach where students were further developed as professionals in their field". Traditional models of supervision revolve around a one-to-one model (master/ apprentice) where the doctoral candidate works with only one supervisor (Green & Bowden, 2012). Research supervision, in most academic spaces, has shifted from traditional models to that of a panel of supervisors with various areas of expertise (Green & Bowden, 2012). The shift to panel supervision can be seen as a response to the move towards team or project based research away from solitary research (Green & Bowden, 2012). Maor and Currie (2017) conclude a shift from the master apprentice model to one in which the supervisor facilitates and negotiates rather than directs or instructs. Table 2 summarizes the changing nature of research supervision as it compares the traditional model with the modern model.

Table 2: Comparison of the change of nature in research supervision

Traditional Supervision	**Modern Supervision**
Product-oriented	Process-oriented
Individualistic	Community-Centered
One-on-one Supervision	Co-Supervision/ Supervision Panel
Solitary Research	Project Based Research
Instruction and Direction	Facilitation and Negotiation

In their study, Maor and Currie (2017) elaborate both on benefits and barriers for the use of educational technology in research supervision. As benefits, they described the possibility to collaborate internationally by using virtual communication, having ongoing discussions in online communities and transforming their supervision relationships into more participatory ones by using wikis. On the barriers perceived by their participants, the authors reported that challenges had both personal and professional dimensions. Some of their participants claimed that doing

supervision "online" seems like "adding another complexity to an already complex relationship" (Maor & Currie, 2017, p. 11). Another issue raised by supervisors was "the potential for working longer hours and the perception of being always available to respond to students' questions via technology, and the extra vigilance required to maintain a work-life balance" (Maor & Currie, 2017, p. 11). They also state that "some supervisors reported sensitivity on the part of their graduate students in receiving feedback. Written feedback could appear not only more harsh, but also overwhelming to see many revisions and comments, and importantly, demotivating" and also that "poorly implemented institutionalized use of technology was reported as a commonly experienced barrier and often influenced negative attitudes towards technology" (Maor & Currie, 2017, p. 12). One example had to do with mandatory administrative forms of research supervision and the mention that online templates were reported as difficult and time consuming (Maor & Currie, 2017).

When reflecting on the role of ICT in their study on research supervision the authors noted:

> "As a result of the study, a more intensive relationship developed through increased contact between supervisors and their students that was facilitated by Web2.0 technologies. The supervisors began to change their supervision pedagogy by developing more participatory relationships through greater collaboration and communication using new technologies and increased their use of social networks such as Twitter for disseminating their research findings." (Maor & Currie, 2017, p. 12)

In their study on e-supervision, Lubega and Niyitegeka (2008, p. 357), conclude similarly, that "with this form of electronic supervision, supervisors and supervisee are able to develop a strong attachment to each other through the constant collaboration and communication." However, they add that "technology tends to create a neutral platform for all stakeholders involved in the supervision process". As such, the educational technology analyzed (i.e. chatrooms, online telephoning, e-mails, wikis/blogs, discussion boards, forums and e-research groups) played a significant role in the supervision relationship: "the supervisee and supervisor learn how to respect, appreciate and share knowledge between each other as a sign of commitment to the supervision process" (Lubega & Niyitegeka, 2008, p. 357).

Looking at this evidence, research supervision is both a recent and dynamic field of research, which qualifies for a field in which more research should be conducted. Educational technology plays an apparent role in the process of research supervision, mostly in communication and collaboration in international and distant settings, relationship-building between supervisor and supervisee, the way of how feedback is given, and lastly, how the supervisor administers mandatory task in the supervision process. The changing nature of supervision and the availability of more educational technology seem influence one another. The personal and professional dimensions in the challenges of using educational technology as a supervisor mentioned by Maor and Currie (2017) Considering in relation to the limited availability of empirical evidence of the personal benefit of educational technology in research supervision, creates an interesting research gap, which benefits from further exploration. In the next chapter we elaborate on the theorical frameworks, which are used to approach this research problem.

3 Theory of Frame of Reference

As we did our literature review on the status quo in educational technology and specifically research supervision, the framework Technological Pedagogical Content Knowledge (TPACK) was mentioned in various contexts. TPACK was the most quoted and popular framework which put technology into relationship with the concepts of pedagogy and content, in the context of education. When looking at theories focusing on higher education, only the recently developed framework Techno-Pedagogical Disciplinary Knowledge (TPDK), which builds on TPACK was found. Consequently, TPACK emerged as a theorical framework suitable for our research. In the following sections, both frameworks will be explained, and finally we will evaluate why TPACK resulted as a suitable frame of reference and how it can be applied during this work.

3.1 Technological Pedagogical Content Knowledge Framework (TPACK)

With over 7800 citations on google scholar, the most prominent theory is proposed by Mishra and Koehler (2006). The "Technological Pedagogical Content Knowledge" framework (TPACK) was first developed by Punya Mishra and Matthew J. Koehler in 2006, and is based on constructs from other researchers (Shulman, 1986). It has three main constructs: content knowledge (CK), pedagogic knowledge (PK) and technology knowledge (TK). Content knowledge (CK) is knowledge about the actual subject matter that is to be learned or taught. Pedagogical knowledge (PK) is deep knowledge about the processes and practices or methods of teaching and learning. Technology knowledge (TK) is knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies.

Apart from looking at each of these components in isolation, the authors also look at them in pairs. Pedagogical content knowledge (PCK) is concerned with the representation and formulation of concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology. Technological content knowledge (TCK) is knowledge about the manner in which technology and content are reciprocally related. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology. Technological pedagogical knowledge (TPK) is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies. Lastly, technological pedagogical content knowledge (TPCK) is an emergent form of knowledge that goes beyond all three components (content, pedagogy, and technology). Mishra and Koehler (2006, p. 1029) argue, that:

> "TPCK is the basis of good teaching with technology and it requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones".

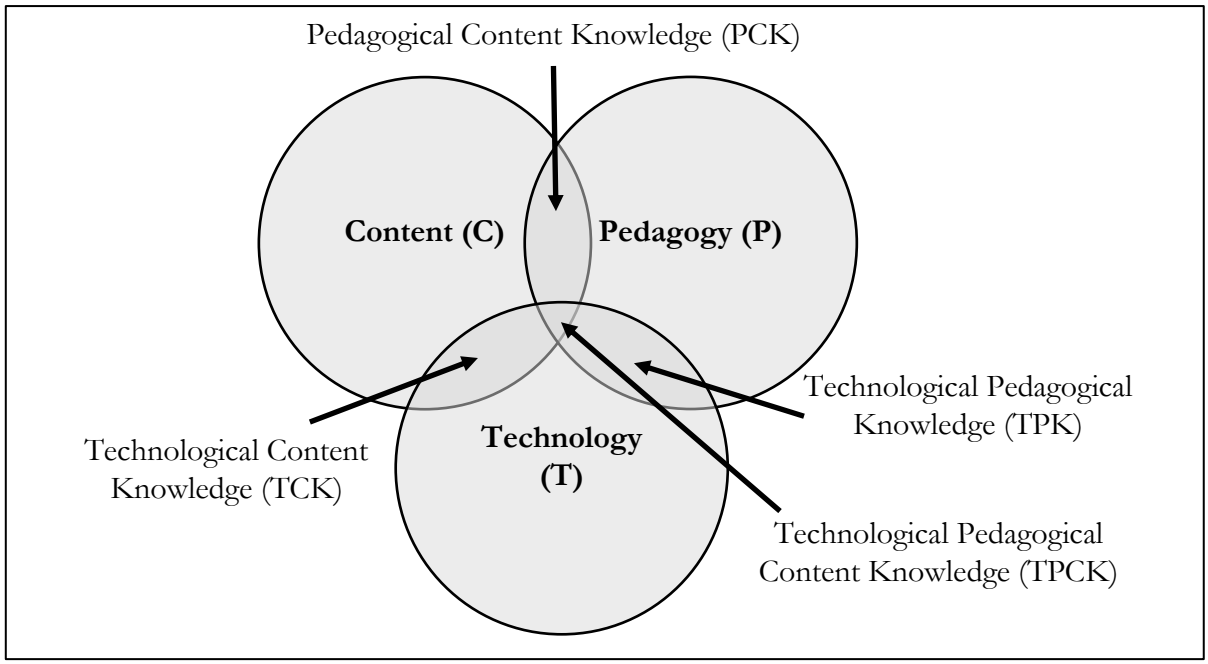

Figure 1: TPACK visualization according to Mishra & Koehler (2006)

TPACK builds on two existing and still prominent theoretical frameworks: "Pedagogy and Content Knowledge" (PCK) developed by Shulman (1986) and "discipline-specific pedagogical knowledge" (DPK) developed by Lenze (1995). Shulman (1986) proposed a relationship between the previously separate fields of subject knowledge and pedagogy. "Pedagogy and Content Knowledge" (PCK) exists at the intersection of content and pedagogy. Thus, it goes beyond a simple consideration of content and pedagogy in isolation from one another. PCK represents the blending of content and pedagogy into an understanding of how particular aspects of subject matter are organized, adapted, and represented for instruction (Mishra & Koehler, 2006). In Shulman's words, this intersection contains within it

> "the most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations—in a word, the ways of representing and formulating the subject that make it comprehensible to others" (Shulman, 1986, p. 9).

Lenze (1995) investigated the faculty's discipline-specific knowledge of teaching and therefore presented the foundation of seeing the PCK model through the perspective of higher education faculty. In her thesis, Berthiaurne (2007) provided a new conceptualization of DPK, one that is empirically rooted in university teaching, and provides a more accurate picture of pedagogical knowledge which is related to a specified discipline as compared to previous approaches. It brings together the professor's knowledge structures, beliefs, and goals related to teaching; the epistemological and socio-cultural characteristics of the discipline s/he teaches; and his/her views of knowledge and knowing, knowledge construction, and knowledge evaluation (Berthiaurne, 2007).

TPACK has many interpretations and uses in research. Niess (2011, p. 300) describes TPACK as a "framework for thinking about the knowledge teachers need for making instructional decisions with respect to integrating digital technologies as learning tools". Tanak (2018, p. 6), who uses the framework to design a TPACK-based course for developing science teachers' abilities to think in all TPACK dimensions, concludes that "the TPACK framework is a helpful model, as it can solve

the recent problems in TPACK caused by the difficulty in separating out each of the domains". Another study had the purpose to observe the TPACK awareness and adaptation among the faculty members at higher education institutions in Pakistan (Soomro et al., 2018). Mishra et al. (2009) suggest that using the TPACK framework helps educators reason out which technologies are worth learning; instead of learning every technology and then figuring out how to apply it. Instead, educators should be able to quickly evaluate new technologies in terms of how they will present content or facilitate pedagogy. Other authors strongly believe, that "investigating TPACK in real-life planning or teaching settings will open ways for researchers to look for new knowledge domains" (Bibi, 2017, p. 82).

As described above, multiple branches of inquiry using TPACK have emerged, such as pre-service and in-service teacher TPACK development, assessing TPACK, as well as the theoretical underpinnings of the framework as it has continued to evolve over the last 10 years. However, an area of inquiry explored to a lesser extent has been TPACK in higher education. Institutions of higher education present unique contexts for TPACK and its development as the institutional demands are often quite different compared to other similar settings (Mourlam, 2017). The existence of this knowledge gap is further supported, as few have thought about ways to operationalize the framework to solve the "wicked problem" surrounding the use of technology in teaching and learning, especially at the post-secondary level (Benson & Ward, 2013).

3.2 Techno-Pedagogical Disciplinary Knowledge Framework (TPDK)

Bachy (2014) incorporated the ideas of PCK, DPK, DPK+epistemology and the TPACK models into the techno-pedagogical disciplinary knowledge model (TPDK) to better capture the complexity of profiles of university teachers. It combines four dimensions: discipline (D), personal epistemology (E), pedagogical knowledge (P), technology (T). This new model is the first tool to allow advisors and trainers of university teacher to better understand teachers' strategies, particularly with regard to technology. With the rapid development of online courses, it is important that the pedagogical and technological areas be merged (Bachy, 2014).

The TPDK framework appears to be an emerging theoretical framework, which unlike TPACK also captures the complexity of university teacher profiles. The authors believe that "all aspects (educational, epistemological, technological and disciplinary) alter the teaching practices of the staff in different ways" (Bachy, 2014, p. 25). While the dimensions technology (T) and pedagogy (P) are equivalent with those from TPACK, Bachy (2014) adds the dimension epistemology and renames the TPACK dimension "content" into "discipline" (D). As a theoretical model for our research, the model was deemed inappropriate. Firstly, no empirical evidence is currently available on the use of TPDK and its practical application. Secondly, the explanation of the framework and its complex relationships seemed insufficient to fully understand it and extend TPACK meaningfully. For this reason, the TPDK framework will not be used as an extension of TPACK for the purpose of our research.

3.3 TPACK as theoretical foundation

In this section we familiarized ourselves how other researchers applied TPACK for the purposes of their research studies. In summary, we have seen that TPACK was used to understand teachers' decision making when using educational technology, create teacher profiles to uncover their thinking, and design methods for data collection, analysis and a critical discussion of the results.

As the creators of the original TPACK framework Mishra and Koehler (2006, p. 1046) believe that their framework "can guide further research and curriculum development work in the area of teacher education and teacher professional development around technology." The framework allowed them "to view the entire process of technology integration as being amenable to analysis and development work". And most importantly, it allowed them "to identify what is important and what is not in any discussions of teacher knowledge surrounding using technology for teaching subject matter".

In a more recent article, Mishra et al. (2009) promote the usage of TPACK to look at educational technology in a new way. These new perspectives focus on overarching cognitive skills, competencies, and creativity rather than technical understanding and functional knowledge of specific technologies. As such, TPACK helps educators to experiment with their own educational technology designed to meet specific, immediate needs (Mishra et al., 2009).

Harris et al. (2010); Niess (2011); Soong & Tan (2010) apply TPACK for the analysis of technology integration as suggested by Mishra and Koehler (2006). Harris et al. (2010) used TPACK to assist teachers with curriculum-based technology integration. They aimed to expand teachers' pedagogical content knowledge to include how to select and use a broad range of educational technologies appropriately within different content areas and teaching approaches. Niess (2011) considers TPACK as a dynamic framework for describing teachers' knowledge required for designing, implementing, and evaluating curriculum and instruction with technology. TPACK strategic thinking includes knowing when, where, and how to use domain-specific knowledge and strategies for guiding students' learning with appropriate information and communication technologies. In their paper, Soong and Tan (2010) proposed a TPACK-based design guide which aims to assist teachers when considering integrating technology into lessons for various content areas.

Benson and Ward (2013) conducted a case study of three post-secondary professors and their online classes, and created instructor level TPACK profiles to illustrate their TPACK practices. These profiles describe their participants unique patterns of technology, content and pedagogy as well as their intersections by visualizing their experiences, strengths and weaknesses through different circle sizes for each of the three TPACK dimension. They assumed that instructor TPACK profiles would shed light on how different levels of knowledge ultimately impact the overlap areas and the ability to use technology effectively for teaching and learning. The profiles could be useful tools for self-reflection and to identify professional development needs (Benson & Ward, 2013).

Another study by Mourlam (2017) set out to answer how TPACK in higher education settings can be characterized, in which the focus was on faculty TPACK development. For their study the authors also used the concept of TPACK profiles as a tool to understand university leadership, more specifically to better understand how TPACK profiles can be used, and how their use changes the organization and nature of development activities for teachers (Mourlam, 2017).

Soomro et al. (2018) used TPACK for the development of questionnaires and interviews during their data collection process. By reflecting on the dimensions and interrelationships of TPACK, the authors were able to gain insights into how faculties incorporate technology in their teaching and learning process. Similarly, Tanak (2018) used TPACK to design a questionnaire for the data collection of their study, which consisted of six TK items, six TPK items, six TCK items, and eight TPACK items. Their study proposes a TPACK based course that is both knowledge and

experience based. The results of this study can be used as a basis for designing a particular arrangement of courses to enhance student teachers' TPACK (Tanak, 2018).

In their paper, Parra et al. (2019, p. 69) further state that "explicitly sharing TPACK with current and future teachers provides a foundation of awareness that can lead to practice and expertise. Teachers who understand and can engage with the interrelations between these knowledge areas experience a greater capacity to make expert decisions about designing appropriate learning experiences for their students and classrooms".

We have seen in existing research, how powerful TPACK can be in conducting research about educational technology. Building on the empirical examples of the use of TPACK, we interpret this theoretical framework as a foundation to (1) design our research methodology, (2) guide the data collection phase and (3) analyze the collected data to draw insights which close the identified knowledge gaps. A detailed explanation of how the TPACK was used throughout this thesis work is provided in sections 4.5 and 4.6.

4 Methods

The following sections will give an overview of our research philosophy, research approach, and our research strategy. They are followed by an introduction into our chosen case, a description of our data collection, data analysis, and data validation.

4.1 Research Philosophy

The focus of this research is to explore how university teachers make use of educational technology. Hence, one of our challenges is to enter the world of university teachers and understand it from their point of view. We are trying to take into account the complexity of this challenge by collecting what is meaningful to our research participants in a social and organizational context of the research supervision at a university. Thus, we chose to follow an interpretive research philosophy since "interpretive research can help IS researchers to understand human thought and action in social and organizational contexts; it has the potential to produce deep insights into information systems" (Klein & Myers, 1999, p. 67). Alternative philosophies such as positivism, critical realism, postmodernism, or pragmatism did not suit the highly subjective, narrative and specific nature of our research. Following an interpretivist research philosophy allows us to acknowledge that our own interpretation of the research materials and data, and therefore our own values and beliefs play an important role in our research process. Our focus on the complexity, multiple interpretations, and sense-making makes our approach rather subjectivist (Saunders, Lewis, & Thornhill, 2016).

4.2 Research Approach

Following our interpretivist research philosophy, we need to operate within a natural setting in order to establish trust, access to meanings, and an in-depth understanding of the teachers' world in order to answer our research questions; which is sometimes referred to as a naturalistic philosophy (Saunders et al., 2016). In order to gain these deep insights, a qualitative research design was chosen. Since the data collection is non-standardized, it allows us to alter procedures and include emergent questions during our naturalistic and interactive research process.

In our study, we follow a mainly deductive approach to theory development while using the TPACK framework as our conceptional framework. However, to a minor extend, we also follow an abductive approach. The abductive approach enables us to integrate our own collected data for drawing conclusions and a higher degree of freedom in our explanation building and argumentation while modifying the TPACK framework to help us in further explaining our findings.

4.3 Case Study Research Strategy

From a strategic perspective, we chose to follow a case study strategy. Case study research is especially relevant when explanatory research is done and research questions such as 'how' and 'why' are sought to be answered. Another factor for the relevance of case study research for us is the required extensive and in-depth description of a social phenomenon which is needed to answer our stated questions (Yin, 2018). It helps us in gaining insights into how our participants interact with educational technology and what meaning they attach to it. Furthermore, it enables us to set

the use of educational technology into the context of higher education and more specifically, the research supervision process.

To reiterate, the aim of our study is to explain how and why university teachers use educational technology during the supervision process in the case of the Jönköping University and its schools, thus it follows an explanatory, embedded, single case approach.

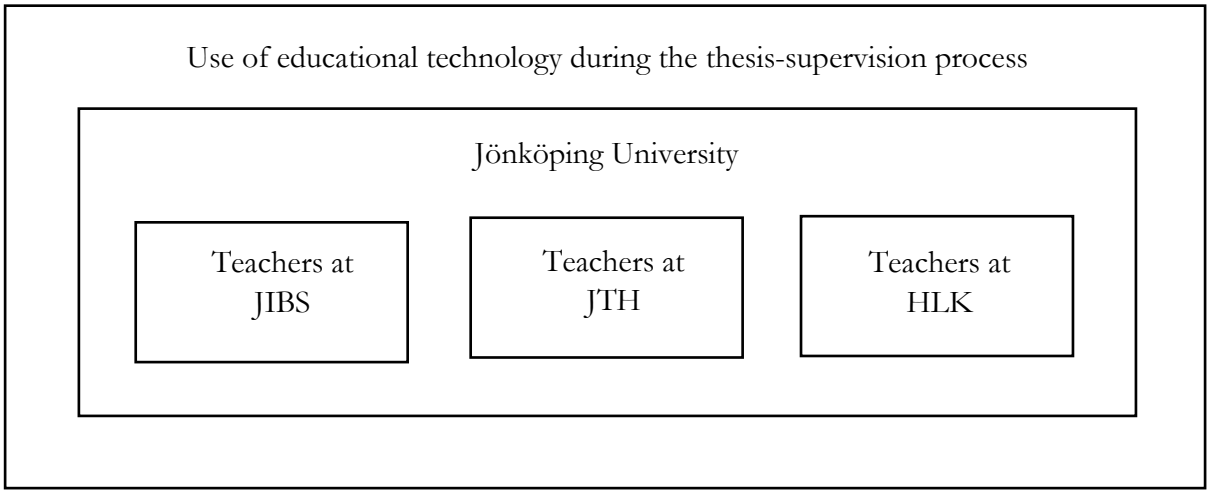

Figure 2: Case study context, case, and units of analysis

Our case definition is 'the use of educational technology during the thesis-supervision process at the Jönköping University' where our embedded units of analysis are the university teachers who are supervising the process at the selected schools of JU, as visualized in Figure 2. We bound our case to the snapshot of the spring semester 2019 and focused exclusively on the perspectives, thoughts, motivations, and perceptions of the teachers' and not of the students or other stakeholders. Furthermore, we only focused on three out of the four schools at JU, due to their individual context and connection to educational technology.

4.4 Case Description

Our study was conducted at three schools of the Jönköping University in Sweden. Each of the selected schools was chosen for its own reasons which we elaborate in the following sub-sections.

4.4.1 Jönköping International Business School (JIBS)

JIBS is home to 2111 students (out of which ca. 45 % are international), 113 faculty and staff (out of which ca. 30 % are international), 21 professors, 67 PhD students and 3 research centers[4]. In 2015, it became the first business school in Sweden which received both EQUIS and AACSB accreditations, joining a group of only about two hundred (or about 1 %) of the worlds business schools who have this double accreditation[5]. It has research foci on entrepreneurship and family business, and based on publications from 2002 – 2013, it has been ranked second globally and first in Europe in the domain of entrepreneurship research. JIBS has also been ranked as number one

[4] Taken from: https://ju.se/en/about-us/jonkoping-international-business-school/organisation/facts-and-figures.html in March 2019.

[5] Taken from: https://ju.se/en/about-us/jonkoping-international-business-school/organisation/accredited-education.html in March 2019

in Europe and number three globally in family business research, based on publications from 2001 - 2009[6].

The significance of high-quality research can also be seen in the eight graduate programs offered by JIBS, all of which conclude with the graduate students writing a master thesis. The master thesis is written in a course which includes coaching seminars for the students and a final public seminar in which the students must present and defend their thesis and act as the main opponent at another student's seminar (Jönköping International Business School, 2017a). To support the students during the writing process, the students are assigned to a supervisor or a pair of supervisors. These supervisors are mostly professors or PhD students who are knowledgeable in the domain that the students are researching in. JIBS also states in its strategy that it wants to provide a stimulating and supporting learning environment, where an international orientation and a collaborative approach are dominant in the activities (Jönköping International Business School, 2017b). The dominance of collaborative working, the focus on research quality, the presence of a supervised thesis process in all programs, as well as our access and insights into JIBS' thesis supervision process, make JIBS an interesting embedded unit of analysis to further explore how and why educational technology is used by their teachers during the thesis supervision.

4.4.2 School of Engineering (JTH)

JTH is among the leading engineering educators in Sweden. It is a member of the CDIO Initiative (alongside universities like MIT, Stanford University, Duke University, RWTH Aachen, and other world renown engineering schools) which is an innovative global cooperation between universities for producing the next generation of engineers. JTH is currently home to 3,100 students, 180 employees, 22 full professor, and 40 PhD students (Jönköping University, 2018).

Due to its proximity to current technologies, its technology related bachelor and master programs and research areas like IT alignment, JTH was chosen as an interesting embedded unit of analysis for our study.

4.4.3 School of Education and Communication (HLK)

HLK is offering programs in the areas of teaching, media and communication studies, international work, and human resources. It further has extensive activities within commissioned education towards professional training and is conducting research within the areas of Lifelong Learning, Media and Communication Studies, and Learning Practices inside and outside School (LPS). As of now, HLK has 3,400 students in its programs which makes it the biggest school at JU measured by enrolled students. It has 160 employees, 11 full professors, and 31 PhD students (Jönköping University, 2018).

HLK's educational research and its research in media and communication studies led to our decision to also include it in our study as the third embedded unit of analysis.

4.5 Data Collection

Our study used semi-structured interviews as its main data collection method by utilizing the TPACK framework as a guide to develop interview questions. We used the dimensions of the TPACK framework to create meaningful interview questions which we anticipated will give us important insight into the corresponding dimensions of the framework. Due to our stated research

[6] Taken from: https://ju.se/en/about-us/jonkoping-international-business-school/research/research-rankings.html in March 2019

questions, our focus was on the Technology (T) and on the Pedagogy (P) as well as its intersecting dimension (TP). Additionally, we use notes from the interviews, contact summaries, and documents like supervision course syllabi to triangulate our gathered data.

4.5.1 Sample Description

In order to get a picture of how and why educational technology is used at the different schools of JU, the selection of the right participants for our research was essential. We selected our participants by using criteria like academic position, reputation of using educational technology, supervision experience, the use of collaborative supervision approaches, research background and openness to trying out new methods and technologies. We tried to include diverse opinions into the sample from teachers who are positive towards using technology and others who are skeptical and critical towards technology. The selected participants were then approached by us via email, explaining our research aim, giving an overview of what to expect at the interview and the question if the selected participant is willing to participate in a face-to-face interview on campus. A description of our research participants can be seen in Table 3.

Table 3: Research participants description

#	Academic position	School at JU	Interview time
1	PhD Student	JTH	44 Minutes
2	Assistant Professor	JTH	48 Minutes
3	PhD Student	HLK	55 Minutes
4	Professor	JTH	45 Minutes
5	Associate Professor	JIBS	47 Minutes
6	Assistant Professor	JIBS	42 Minutes
7	Associate Professor	HLK	58 Minutes

4.5.2 Interviews

Since our goal was to find out more about the use and integration of technology, our approach for interviewing was guided by Preece, Rogers, and Sharp (2015). The interviews were divided into the 5 phases suggested by Robson and McCartan (2016), namely *introduction, warm-up, main body of interview, cool-off,* and *closure*.

After designing our interview questions, we conducted a pilot interview where we tested our questions, interview structure, technical equipment and our overall interview approach. The interview was conducted with our own thesis supervisor Osama Mansour. Osama is assistant professor in informatics at JIBS and has supervised many theses on bachelor and master level. This was a valuable source of experience to us where we could test our interview questions and interviewing technique on a participant with the same background and the same role as our upcoming interview participants. Due to a possible bias towards us, the data of our pilot interview was not used during the further continuation of our study. However, we used the gathered insights of the pilot interview to further improve and specify our interview questions to decrease ambiguity and to increase the intended information gain. Our openness to change and the dynamic research design enabled us to quickly incorporate improvements like the use of customer journey map elements and a merge between the customer journey and a rich picture. After the implementation of our insights from the pilot interview we proceeded to conduct the seven main interviews for our study.

In the first phase of our interviews, we introduced ourselves, explained our roles during the interview i.e. who is conducting the interview with the interviewee and who is in a passive role (i.e. taking notes), and we explained the purpose of the interview. Furthermore, we assured the interviewee of the confidentiality of the interview and the data that will be collected and ensured that we will keep his/her identity secret. Before starting with the warm-up phase, we asked the interviewee for his/her consent to record[7] the interview for analysis purposes and asked for permission to upload it (without a name) to online transcription services.

The interviews continued into the *warm-up* phase where we asked simple questions i.e. about the supervisor's academic position, experience in the role of a thesis supervisor and about his/her supervision philosophy and approach. Subsequently, we continued into the *main phase* of the interview. As a first step and in order to help the interviewee to recall his/her supervision process and to get a better understanding ourselves, we asked to guide us through their typical, personal supervision process. The description of the interviewee was used to create a visualization of the supervision process on a whiteboard. This visualization borrowed ideas from a customer journey map, such as the chronological flow of information and actions, touchpoints with stakeholders and technologies, as well as obstacles, pain points, and subjective motivations.

After getting an overview of the supervision process, we extended the visualization to create a rich picture (Monk & Howard, 1998) with the interviewee to gain a deeper understanding of involved stakeholders, their interactions and concerns, and to learn more about the goals of the supervisor. Subsequently, we used our TPACK related interview questions and the rich picture as guiding tool for further inquiries on where the interviewee perceives the involvement of educational technology, finding reasons for why educational technology is used or is not used to achieve his/her goals and to learn more about the personal value for the supervisor when using educational technology. For example, questions like "Looking at your supervision process, how do you use technology in each phase? Are there relevant relationships / dependencies between pedagogy and technology?" created insights into the technological (T) and technological pedagogical knowledge (TP) dimensions. It also contributed to answering our main research questions. Another insightful question was to ask the interviewee to rate his/her supervision style as being a dinosaur (not using any technology) and being high-tech (using as much technology as possible). For a list of our interview questions, please see the attached interview guide in the Appendix. To give an idea how our visualization looked like, Figure 3 shows a digitized version of the whiteboard at the end of our interview. The text in the visualization is not of importance at this point but rather the conceptual idea behind it.

The *cool-off* phase was used to shortly summarize the interview and, if necessary, use straight-forward questions to diffuse any built-up tension during the interview. During the *closure* phase, we asked the interviewee if any aspect was left out which seemed important to him/her, or that he/she wants to talk about, or tell us regarding the involvement of educational technology in the supervision process.

After the interviews, we took time to discuss the first impressions of the interview, gathered observations, first insights which we gained, and we discussed how to improve the interviewing process. Before leaving the interview location, we took photos of the whiteboard and digitized the visualization in Microsoft Visio to further add it to our data collection.

[7] The recording was done using a GoPro camera for video recording and a smartphone in front of the interviewee for extra audio recording.

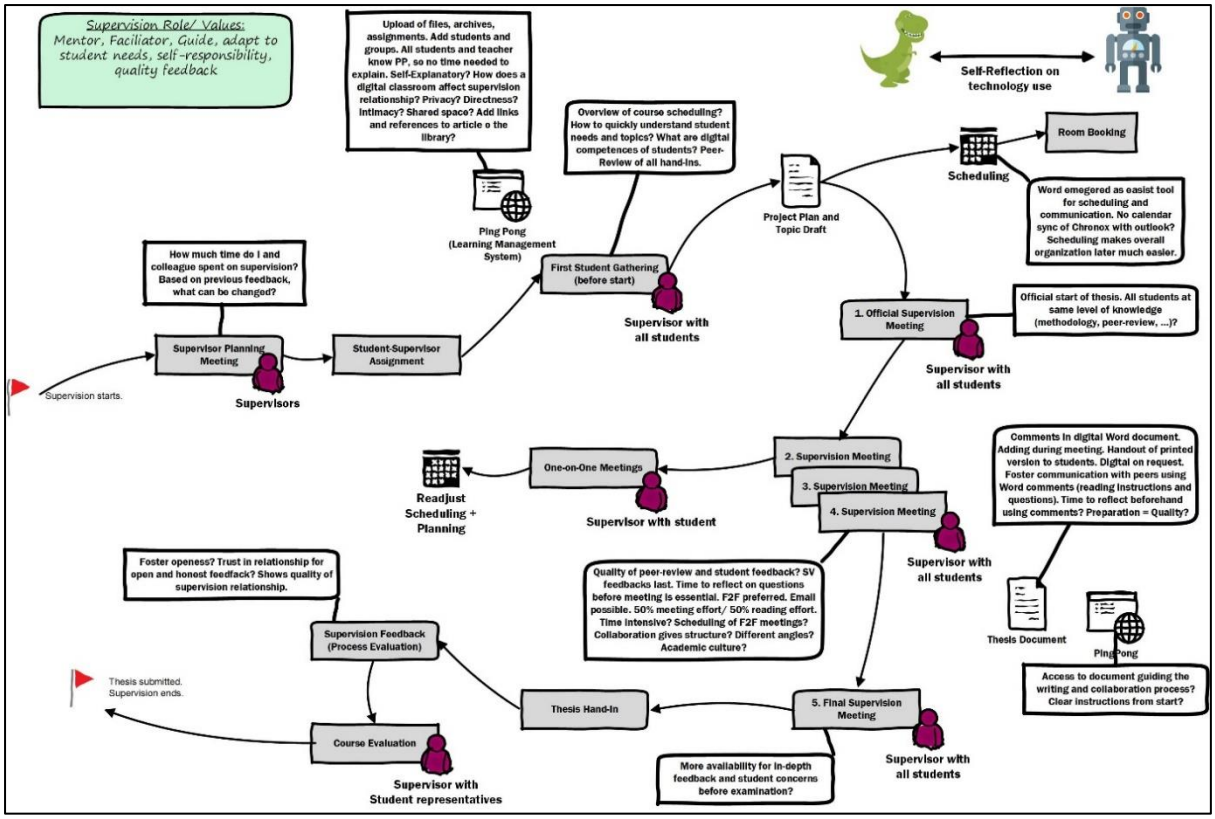

Figure 3: Visualization of a digitized whiteboard at the end of an interview

4.5.3 Notes, Contact Summaries, and Documents

During the interview, one of us was taking notes along the theme of our main questions (i.e. insights about the supervision process, mentioned technologies, personal benefits of using technologies and challenges/pain points when using or not using them). On the next day, we filled out a contact summary which helped us to summarize the main answers and insights of the interview while it was still in our memory. Additionally, we gathered documents like course syllabi and process descriptions for the supervision processes of different departments and schools. These helped us to put the supervision process into the context of the different schools, and also provided an additional source for our data collection on the supervision process.

4.6 Research Ethics

In order to conduct our research in alignment with our ethical standards and to secure the privacy of our research participants, the identity of our interview partners will remain anonymous. In order to reduce the risk of deanonymization, the participant description was kept to a minimum. At the beginning of our interviews, we assured our interview partners that the gathered data will only be used in context of this study and asked for permission to record the interviews with audio and video. Since some candidates felt uncomfortable with video recording, we only recorded the audio from these interviews. We also asked the participants for their consent to use an AI based transcription service where we made sure that no name of the participants was mentioned during uploaded audio recording. All created files were named in the order of our interviews without any mention of the participant's name to further protect their identity. To further take care of the health of our participants, we provided bottled water during the interview.

4.7 Data Analysis

After collecting our data, we used the online services of *Trint.com* to first get a machine generated transcript of our voice recordings. As a next step, we assigned the transcripts to both of us and went through the first interview transcripts again, correcting any mistakes made by the service, and commenting on any parts which needed further clarification. After the mistakes were edited, we switched our assigned transcripts to verify that they were now correctly transcribed. We digitized the whiteboard visualizations and sent the transcripts and digitized visualizations to our interview participants for verification.

As a first step, we familiarized ourselves with the collected and transcribed data, and followed the suggestion of Miles and Huberman (1994) to use our conceptual framework (TPACK) and our research questions to create an initial set of codes. After going through a first round of coding our transcripts, notes and rich pictures, we decided on dropping our initial codes since they were not helping us with our analysis at this stage of the process. However, we mapped our data to the TPACK dimensions in a later stage in the analysis, using it as our analytical framework. Subsequently, we chose to continue with our analysis by using our research questions and applying them to our data to generate meaningful themes as suggested by Taylor-Powell and Renner (2003). These themes where derived from our research questions and served as holistic coding theme. The derived themes are:

1. Reasons for using educational technology
2. Reasons for not using educational technology
3. The usage of educational technology

As a next step, we went back to the data and read through it again while creating categories in connection to our main themes. We used Microsoft Word and highlighted parts of our data in three different colors, corresponding to our main themes and used the comment function of Microsoft Word to further assign categories to sub-parts of our transcripts. A subset of the themes and categories can be seen in Table 4.

Table 4: Themes and connected categories (excerpts)

Theme	Categories/ Codes
Reasons for using educational technology	- Simplification of tasks - Value for students - Time savings
Reasons for not using educational technology	- Inconvenience - Lack of usefulness - Loosing focus/getting distracted
Usage of educational technology	- Document sharing - Communication - Reading

In addition to the three initial themes, we added two more themes, *the role of technology* and *the nature of supervision*. These themes were related to major themes in our literature review but were not subject to our research questions. Due to the lack of relevance in answering our research questions, we decided to exclude them from the further, in-depth analysis process.

After finishing this round of coding, we went through another round while increasing the granularity of our categories through the creation of sub-categories.

In the final step of our coding process, we analyzed all our derived sub-categories and merged them into more meaningful clusters of emergent themes which represented our data and are important to answering our research questions. To give the reader a better understanding of our categorization schema, we provided one example theme and its sub-categories in Table 5.

Table 5: Category clusters with themes and sub-categories

Theme	Categories	Sub-Categories
Reasons for using educational technology	Technology gives stakeholders access to current and past thesis progress	- Accessing and tracking the progress of current and former students - Reviewing previous comments and theses - Sharing progress with other stakeholders (Program Manager) - Validating previous conversations and arguments
Reasons for not using educational technology	It is harder to see connections while reading digitally	- Focus is limited to one part and missing bigger picture - Technology gets in the way of reading
Usage of educational technology	Share information and knowledge	- Sharing documents - Sharing relevant content, knowledge and information

The created category schema will be supported by our data and displayed in section 5 of our study. Our data analysis will be concluded as part of the discussion section in this study where we elaborate on our interpretations of the analysis part and on the connection to the TPACK framework.

4.8 Data Validation

Due to our interpretivist research approach, we used the criteria of credibility, transferability, and dependability as suggested by Lincoln and Guba (1985) to evaluate our research.

4.8.1 Credibility

In order to ensure credibility, we used our case study protocol as a link between our research questions and our data collection and used citations of our data within our analysis and our findings steps. This can be seen as our chain of evidence as suggested by Yin (2018). As a second measure to achieve credibility, we used member checking in our study. We sent our transcribed interviews and our created rich pictures to our interview partners for verification of its contents and its authenticity.

4.8.2 Transferability

Firstly, this interpretive study does not seek to produce universally generalizable results. The study only attempted to gain more insights into the world of supervisors and their use of technology and to deliver a basis for future research on the use of educational technology. Furthermore, the transferability can be viewed as dependent on the reader or as user generalizability, where the extent to which the findings are applicable to another situation is determined by the people (other supervisors) in these situations (Merriam & Simpson, 2000).

4.8.3 Dependability

According to Lincoln and Guba (1985), reliability - or in our interpretivist approach dependability - can be hard to maintain. This is due to the fact that human behavior is never static nor is the experience of many necessarily more reliable than what a single person has experienced (Merriam & Simpson, 2000). Or to rephrase it, the same data can be interpreted in numerous ways.

We took several measures in order to achieve dependability in our study. The first measure was to use a case study protocol as also suggested by Yin (2018). Secondly, we stored all our gathered documents, files, and data at a centralized location which was used as our case study database. Next to the gathered data, this database also contained our coding schemes in several iterations, analytical notes and our final theme collection. Hence, our goal was to be transparent on how we reached our interpretations, how categories where derived, and how decisions were made throughout the process.

5 Results

In the initial analysis of the collected data, we could derive three guiding themes which were relevant in answering our research questions. Each theme has multiple categories with multiple - sub-categories, which represent similarities between the interviewees' answers. This section describes the general findings in an organized manner but without further interpretation.

5.1 Functional usage of educational technologies

The five categories and their respective sub-categories on how educational technology is used by the participants during the supervision process are listed in Table 6.

Table 6: Category overview for the theme "Functional usage of educational technologies"

#	Categories	Sub-Categories
1	Share information and knowledge	- Share relevant documents between the students and the supervisor - Share relevant content, knowledge, and information
2	Interact with students and peers	- Interact with the reader in a digital way - Meeting or gathering area / "digital classroom" - Solve problems with the student collaboratively - Mix of physical and digital methods to reflect with students in face-to-face meetings
3	Produce feedback	- Give feedback in written format - Make comments and notes
4	Discuss and reflect feedback	- Complement technology with face-to-face interaction to discuss feedback with students - Create collaborative and active feedback culture
5	Manage the supervision process and its resources	- Organize documents and communication - Time management and scheduling - Book-Keeping/ project overview for stakeholders

5.1.1 Share information and knowledge

The primary usage of technology was to share relevant documents between the students and the supervisor. The participants had individual workflows, including e-mail, learning management systems (LMS) like Ping Pong, printing and scanning:

> "The document is usually sent through email. For the formal milestones like half-way presentation and final presentation, we use a Ping Pong submission page." (Interviewee 1)

> "…then I scan the text and send it to them or hand it over to them, if we see each other in person" (Interviewee 2)

> "Many times I have scanned it and sent it as an attachment in email so I would have it as a PDF or something anyway. " (Interviewee 2)

One participant provided a detailed document to guide the student through the initial phase of the writing process, thereby resolving any questions that would otherwise need to be discussed individually.

> "And I also have a one page document in which I explain them in many details what is expected to be in the introduction." (Interviewee 6)

Besides sharing documents, supervisors also used it to share relevant content, knowledge and information. One participant explained linking different sources of digital information as well as making references to physical books, which can be found in the library:

> "I could have my own documents connected to that. Like 'think about this when referring to articles referring to books authors'. Like tips. So I put that in the in the general archive as well." (Interviewee 3)

> "Basically, everything for the supervision will be an electronic file. For example, if I am suggesting an article for my students, then I will take the PDF of the article or the link from the library or the link where the article is available or something, and I will send it via email to the student. Or, you know, all the interactions for the texts of the thesis itself, so the student will send me per email, and I will send it back per email as well." (Interviewee 7)

5.1.2 Interact with students and peers

As many supervisors described highly collaborative supervision approaches with interaction between the supervisor and their students as well as between students in the form of opposition teams, technology was used to interact with the reader in a digital way:

> "If they want the whole group to focus on something else, they can add a comment. So we would like... We have a question for the readers. Should we go about this way or this way?" (Interviewee 3)

> "…the opponents will often have questions that they've written electronically. Sometimes I have done it electronically, sometimes I have not." (Interviewee 5)

Another participant used the learning management system Ping Pong as a meeting or gathering area and labelled it their "digital classroom":

> "it's [Ping Pong] kind of a storage area as well as a meeting area. I mean that when we don't meet. […]. So this is, I mean this is our classroom. That's where we keep all our material" (Interviewee 3)

Sometimes technology was used to solve problems with the student collaboratively:

> "if they have a problem and it's problem that they can't solve then they could just send me, they could send me programming code." (Interviewee 4)

The collaborative nature was also described when the supervisor commented together with the student in a physical meeting while leveraging technology such as big screens and digital commenting. This describes a mix of physical and digital methodology, which helped the supervisor to reflect with the student:

> "In the end of the meeting, I will send this file back to the student, with the observations that I did before and with the observations that we did together during the meeting." (Interviewee 7)

> "We will be using the file […] to reflect what we would be discussing during the meeting. So at least, we will have the file open in my computer, using a big screen, so then we both can read. Then my laptop is plugged. So, we have the big monitors. But the laptop is there. So then, I just open the file in my big screen and the student is beside me so we can both clearly visualize it. " (Interviewee 7)

Generally speaking, communication played an important role during the supervision process. We gathered multiple examples of how technology was used to communicate with the student or create a bidirectional line of communication:

> "I try to communicate as much as possible using text." (Interviewee 2)

> "I tell them or just give them a reminder, I always go and send a message through Ping Pong, e-mail of course." (Interviewee 3)

> "I just choose to send to this group and then they receive the email and I could just tell them to just remember to hand in your text by the 12th." (Interviewee 3)

> "For some students, I could have that they need to send me texts. Every second week or something like that and we would communicate through these texts." (Interviewee 4)

> "…we use Ping Pong. And of course we use mail to communicate and everything like that." (Interviewee 4)

> "…if they just have a quick question, they will send me an email" (Interviewee 4)

> "…when I know who I am going to supervise I would send them an initial e-mail." (Interviewee 4)

However, digital communication does not always replace physical meetings:

> "I could probably just provide through email […] but in some cases it's really important to discuss certain parts and to actually have the interaction and see that students are following and have this dialog." (Interviewee 1)

5.1.3 Produce feedback

Another important aspect of thesis supervision is giving the students feedback. The participants often used written feedback, where technology was the main medium to produce it.

> "…both the supervisor and the examiner will give comments on the text in Ping Pong and also the opponent. So all of us, we will give some text…" (Interviewee 4)

> "They can basically send me things through emails. If I give the feedback, the feedback is always in the PDF form as comments" (Interviewee 6)

Both technology and analog were used to make these comments and notes, which are the foundation for the feedback process:

> "I generally print out their text and then write by hand (laugh) and then do all the markings by hand" (Interviewee 2)

> "I use comments in Word. There are a lot of comments being made." (Interviewee 3)

> "I am using this [reMarkable reader] to do my notes, so, but then I transfer these to my computer. And I'm also sending this to the students." (Interviewee 7)

5.1.4 Discuss and reflect on feedback

However, the feedback was often complemented with face-to-face interaction to discuss the feedback, and collaboratively reflect on the written feedback:

> "So of course we have sort of physical meetings or we can have meetings through Skype and so on but most of the feedback is given through text" (Interviewee 2)

> "…and then we can go through the feedback and discuss it in person but I try to use text as the primary feedback instrument." (Interviewee 2)

> "They submit their project plan and I give them comments both, at the table, orally, of course and they also all receive written comments as well. " (Interviewee 3)

> "…they usually come to my room to my office and they ask me to have a look at it and if there's time, so sure. Just quickly email me, I'd look at it on my computer or if they have like a printout, I will look at it right away and make a few notes. But mainly it's about talking." (Interviewee 3)

When talking about working with supervision groups, the participants also used technology to foster the feedback culture in the group:

> "I'm kind of like sending reminders and also I'm encouraging them to ask the questions because then the entire group can benefit of receiving a feedback." (Interviewee 6)

5.1.5 Manage the supervision process and its resources

One last emerging sub-theme was the management of several aspects of the supervision process. Participants described the use of technology to organize documents and communication:

> "Yes, well in this case they're assigned to a Ping Pong activity. And I've created a Ping Pong group where we have our own document cabinet. We have our own chat." (Interviewee 3)

Additionally, time management and scheduling were use cases for technology:

> "I've created an archive for each session with dates on it." (Interviewee 3)

> "I go into Kronox, add on an hour and then write the students an email." (Interviewee 5)

And lastly, educational technology was considered as a form of "book keeping" and providing stakeholders an overview of all running projects:

> "It [Ping Pong] is bookkeeping in one way because you just check it that: 'Okay, you can go ahead' (Interviewee 4)

> "And of course then the program manager can look at - because the program manager by the way is responsible for the course. He or she can have a look at this and get an overview of all the running projects." (Interviewee 4)

5.2 Use of educational technology

The first emergent theme was the reasons why supervisors decided to use educational technology during their supervision process. Table 7 lists all four categories and their respective sub-categories which describe the participants motives to use technology in their supervision process:

Table 7: Category overview for the theme "Use of educational technology"

#	Categories	Sub-Categories
1	Gives stakeholders access to current and past theses progress	- Access and tracking the progress of current and former students - Review comments and validate previous conversations
2	Increases efficiency and effectiveness of supervision process	- Make communication and document sharing as efficient as possible - Easier and more organic way of editing - Quicker commenting - Simplify supervision tasks - Familiarity with technologies and tools reduces time needed for explanations and their usage by all stakeholders
3	Enables better collaboration	- Simplify the organization of document exchange and time management - Increase reading comfort - Easy access to students
4	Allows for personalization of supervision process	- Adapts to the supervisor's personal circumstances and provides flexibility

5.2.1 Technology gives stakeholders access to current and past theses progress

Our participants described how technology enabled them to access and track the progression of students which they currently supervise or have supervised in the past. Technology also allowed them to share their progress with stakeholders they are closely collaborating with, and who also play a crucial part in the supervision process:

> "…typically, the process is based on Ping Pong[8] more or less because as a program manager […] you can go in and have a look at it, where are all of the groups and you also have everything documented." (Interviewee 4)

> "…in a way I think that is kind of nice because if they use this ShareLaTeX[9], I mean as a supervisor you could get access to that and you could see their text develop if you want to." (Interviewee 4)

Some participants referred to special supervision cases, where the supervision period was particularly extensive or when incidents from the past became relevant. The participants argued that in these cases, technology allowed them to review comments and validate previous conversations:

[8] Ping Pong is the current learning management system which is used by all schools at Jönköping University
[9] ShareLaTeX (or now Overleaf) is an online application which uses the open source LaTeX text editor and allows high levels of collaboration between authors (https://v2.overleaf.com/)

> "If I have many groups it could make sense to have a look at: What were the comments that I gave them at the midterm or at the mid seminar." (Interviewee 4)

> "If they even had a final seminar that would have been four years ago. […] And in that case it is good because I could at least go back in Ping Pong and find: OK, so this is this group, now I remember." (Interviewee 4)

> "if you don't agree with the students exactly what was said at the mid seminar for instance, you could just go back and check, so that is good I think." (Interviewee 4)

5.2.2 Technology increases efficiency and effectiveness of supervision process

Another sub-theme could be summarized as an increased efficiency, which was visible in the way the supervisors communicated with their students or how documents were shared:

> "I think [a secret, closed Facebook group] is the most efficient way to communicate" (Interviewee 6)

Also, tools such as the "reMarkable reader" were easy to use and the process of reading and commenting on the students' thesis was perceived more organic and natural when using it:

> "It [reMarkable Reader] is more organic, you know, if you have the pen, the digital pen, in your hand then you can easily put an arrow here, you know, it feels more natural." (Interviewee 7)

One participant talked about advantages such as quicker commenting and task simplification:

> "I find [files] for myself, quicker. And that's also very, very important, because when we have so many students and so many things to do and […] everybody has, you know, the same deadline. So, I like to use [it] because, I feel it's quicker for me." (Interviewee 7)

> "technologies are providing us with good opportunities to simplify our tasks" (Interviewee 1).

The fact that both supervisors and students were familiar with the use of certain technologies within the supervision process brings a certain ease of use and effectiveness to it. One participant reported advantages such as time saved from explanations and a consensus in the use of technology:

> "I mean it's accepted by both teachers and students. So then they know how it works. They know how to put their text in a file cabinet or an archive. I know that too. […] I mean, I didn't have to explain anything." (Interviewee 3)

> "We all have consensus about how we use Ping Pong. So it's easy for all involved." (Interviewee 3)

5.2.3 Technology enables better collaboration

The previously described familiarity with technologies was also mentioned in the context of better collaboration by simplifying the organization of document exchanges, providing privacy, and managing time:

> "It's crucial having a platform like this [Ping Pong], that only me and the students in my supervision group can access. And I think it's crucial for them as well, because they know that whenever I have something important I need to share with them, they know where to look." (Interviewee 3)

> "It's [archives for every seminar] all there [Ping Pong] now. So they [the students] know exactly when they have a seminar in late April. It's there with a date [and] they know where to put their text." (Interviewee 3)

> "…I just was waiting to grab the texts for the first seminar. They were all there [in Ping Pong]. So it kind of tells me that they're familiar with it and they see the point of... Well whenever I want to hand something out I put it there. They know where to find it." (Interviewee 3)

One participant described the use of hardware in the form of a big monitor which increased the reading comfort when working face-to-face with their students:

> "I will have my notes and then I will show it to the student. I will be sitting here in my desk in my office, the student will be sitting beside me, we will use my monitor, which is big, and then we can clearly see and discuss things." (Interviewee 7)

Another relevant aspect was the easy access to students, when using the learning management systems Ping Pong:

> "I'd still start with Ping Pong because there I can easily get hold of my students" (Interviewee 3)

5.2.4 Technology allows for personalization of supervision process

While talking about why certain technological tools and devices were used, the participants frequently mentioned their "preferred way of doing things" (Interviewee 6) or similarly "I prefer to use this device [reMarkable reader]." (Interviewee 7). The participant elaborated on a personalized way of working with the reMarkable reader while working mobile.

> "I don't have to necessarily be sitting at my desk to read it, so I can be on my sofa as well or I can be inside the train or I can be in the bus or I can be in the airplane or I can be on the go, easily, and have it. Because I will not depend on the internet connection or anything so I can easily do it. So, for me there is these elements of being practical in these terms." (Interviewee 7)

Furthermore, technology was used to adapt to the supervisor's personal circumstances by providing flexibility in the supervision process; for instance using video calls instead of meeting face-to-face:

> "But [it] could be via technology as well. Could be. Because this can happen, some teachers are commuting and so sometimes they are not here." (Interviewee 7)

> "But, of course, [it] could be per Skype if the student is not here or if the teacher is not here or something like that." (Interviewee 7)

5.3 Non-use of educational technology

The second emergent theme were the reasons why supervisors decided not to use educational technology during their supervision process. Table 8 lists all four categories and their respective sub-categories which were found to describe the participants' motives to not use technology in their supervision process:

Table 8: Category overview for the theme "Non-use of educational technology"

#	Categories	Sub-Categories
1	Working with paper is more convenient	- Difficulties to navigate between thesis sections - Increasing thesis length makes commenting digital more difficult - Adapts to personal reading circumstances - Ability to work mobile from the bus - Easier to read and work with text on paper
2	Difficulty to see connections while reading digitally	- Focus is limited to one part and missing bigger picture - Printout complements the digital copy
3	Working with technology is distracting	- Loosing focus and hard to concentrate on digital - Technology gets in the way of reading
4	Reading analog is more time efficient	- Being more efficient when commenting and giving feedback in writing

5.3.1 Working with paper is more convenient

Some participants described their difficulties in navigating between the sections of the thesis, as they often needed to go back and forth, for example to compare a section with the research questions stated in the beginning. As such they felt it was easier to use printed documents and comment manually:

> "I think at least for me, I feel that sort of giving feedback using Acrobat or any PDF program is rather tedious and even if it's better in Word, it's still much harder to go back and forth and if I want to look at the method or the research question and compare it with what they have done." (Interviewee 2)

> "It's much easier when you have it on paper you can just sort of switch back and forth." (Interviewee 2)

> "…sometimes paper is easier because I can go back to the research questions and I can go back backwards and forwards. " (Interviewee 5)

The use of paper printouts was preferred, particularly as the amount of text increases toward the end of the supervision process. A printed version can then save valuable time:

> "But I'd like to read, when I have to read a lot of text, it's much easier to read it on paper than on the screen I would say. " (Interviewee 2)

> "Because I mean during the initial proposal and initial writing process, I might do it in Word, using the sort of commenting functionality in Word but the more text there is the more tedious I think it is to read." (Interviewee 2)

Some participants described their personal preferences when reading and giving feedback. Stating that the use of paper for them was more convenient, comfortable, and easy.

> "Convenience perhaps, I mean, just to be able to work with a text in a way that is as easy for me as possible" (Interviewee 2)

> "And when I'm home, I much rather sit in a comfortable chair and without the computer." (Interviewee 2)

> "I do most of my reading on the bus." (Interviewee 5)

The mention of inconvenience also occurred in the context of working on the bus:

> "It's inconvenient for me to use the laptop on the bus for instance." (Interviewee 2)

Some participants were working mobile, in which case the physical way of working with a thesis document instead of a computer was preferred:

> "The advantages for me to do it in a physical way is that it's much easier for me. When I go by bus or when I just sit down to just pick a pen and start making notes." (Interviewee 2)

> "I can read them on Adobe you know, and do it but then I have to have my computer and I'm sitting on the bus." (Interviewee 5)

5.3.2 Difficulty to see connections while reading digitally

Related to the description of the ability to better navigate with printed text, some participants decided against technology because working digitally limits their focus and makes them miss out on the bigger picture.

> "I would read one part without myself looking at the greater picture just to save the time and then by the end I might have missed things and I get the whole thesis where I might have said that, well, this part is well written now but I wouldn't have looked sufficiently at the other parts to see how everything fits together." (Interviewee 2)

5.3.3 Working with technology is distracting

Our participants described how the use of technology is sometimes challenging as they lose focus and concentration, for instance due to incoming notifications. Working without technology even brings benefits for the student as it helps some participants align with the feeling of responsibility in their role as thesis supervisor.

> "The challenge that I've noticed is that especially when I have a lot of things to do is that it's very easy, for me, to lose focus." (Interviewee 2)

> "[If you] try to do that in front of the computer then you watch if e-mails coming in and you're not concentrated." (Interviewee 5)

> "I print out stuff because I think the students benefit from me reading it. […] I think [it] comes from the fact that for me the paper is sometimes easier." (Interviewee 5)

> "It's about the focus and making sure that I pick up everything because for me I feel a sense of responsibility." (Interviewee 5)

For one participant, technology is even seen as an obstacle:

> "Technology gets in the way if I do it on the computer, which is why I prefer to write it out, print it out." (Interviewee 2)

5.3.4 Reading analog is more time efficient

Related to situations like reading on the bus with a printed copy, some participants also listed time efficiency as a reason for not using technology, and gave examples like commenting and giving feedback in writing:

> "For me it's very easy to print them [the theses] out and write, because it's time efficient for me." (Interviewee 5)

> "I'm not going to sit on the bus with my tablet, it's just not time efficient for me." (Interviewee 5)

> "And I think at least for me I feel that sort of giving feedback using acrobat or any PDF program is rather tedious." (Interviewee 2)

One participant preferred to comment on a printout and complement it with a digital copy only upon request of the student. Hence, the interviewee invests their time only once:

> "every time you read a text, every time you glance at a text, you notice something different. So that's why it's important for me to have the printout and actually make a few markers on it as well. So that's why they get the physical copy and that's why the physical copy sort of complements it if they want a digital copy and they need my notes from the seminar as well." (Interviewee 3)

6 Analysis and Discussion

In this section, we analyze the collected data from the interviews, notes, and official documents in greater detail. The findings will be mapped to the TPACK framework as our theoretical frame of reference. Furthermore, the findings and their analysis are discussed and used to answer our research questions. Finally, implications for practice, limitations, and directions for further research will be discussed.

6.1 Analysis Discussion – Mapping findings to TPACK

Mishra et al. (2009, p. 51) suggested, that the TPACK framework helps educators to reason about which technologies are worth learning. They argue that "educators should be able to quickly evaluate new technologies in terms of how they will present content or facilitate pedagogy". Niess (2011, p. 300) described TPACK as "a framework for thinking about the knowledge teachers need for making instructional decisions with respect to integrating digital technologies as learning tools." Furthermore, Soomro et al. (2018) noted that by reflecting on the dimensions and interrelationships of TPACK, they were able to gain insights on how faculties incorporate technology in their teaching and learning process.

We applied the framework similarly to make sense of our findings and relate them to the TPACK dimensions. The objective was to find patterns in the data and collect empirical evidence of how the framework can be applied in the context of higher education. Mapping the findings to the TPACK dimensions was both feasible and useful. The mapping of our findings can be seen in Figure 4.

Content was mapped to the research knowledge and field knowledge which the supervisor applies during the supervision process. Research knowledge was defined as knowledge about writing styles in academia, methodological knowledge of doing research and best practices from the supervisor's personal experience. Field knowledge was defined as subject matter from the supervisor's discipline and field of research. Additionally, knowledge which the supervisor himself/herself might not have, can be provided by the research community.

Pedagogy was mapped primarily to the processes of producing and discussing feedback, as this is the most frequently mentioned activity from our interviews with supervisors. For example, we considered the chosen feedback style as a pedagogical choice e.g. face-to-face, digital, or in a blended approach (e.g. discussing digital feedback). As such, aspects like the relationship, which is being built throughout the process, the way the supervisor interacts with the students, and how they collaborate are of relevance in this dimension.

Technology was mapped to all functional use cases we found for educational technology. Hence, the technological dimension is represented through the use of digital platforms (such as the learning management system "Ping Pong"), facilitating of communication through e-mail or social networks, commenting in thesis documents, and managing the supervision process and its resources. Technology also enabled the supervisor to monitor the thesis progress.

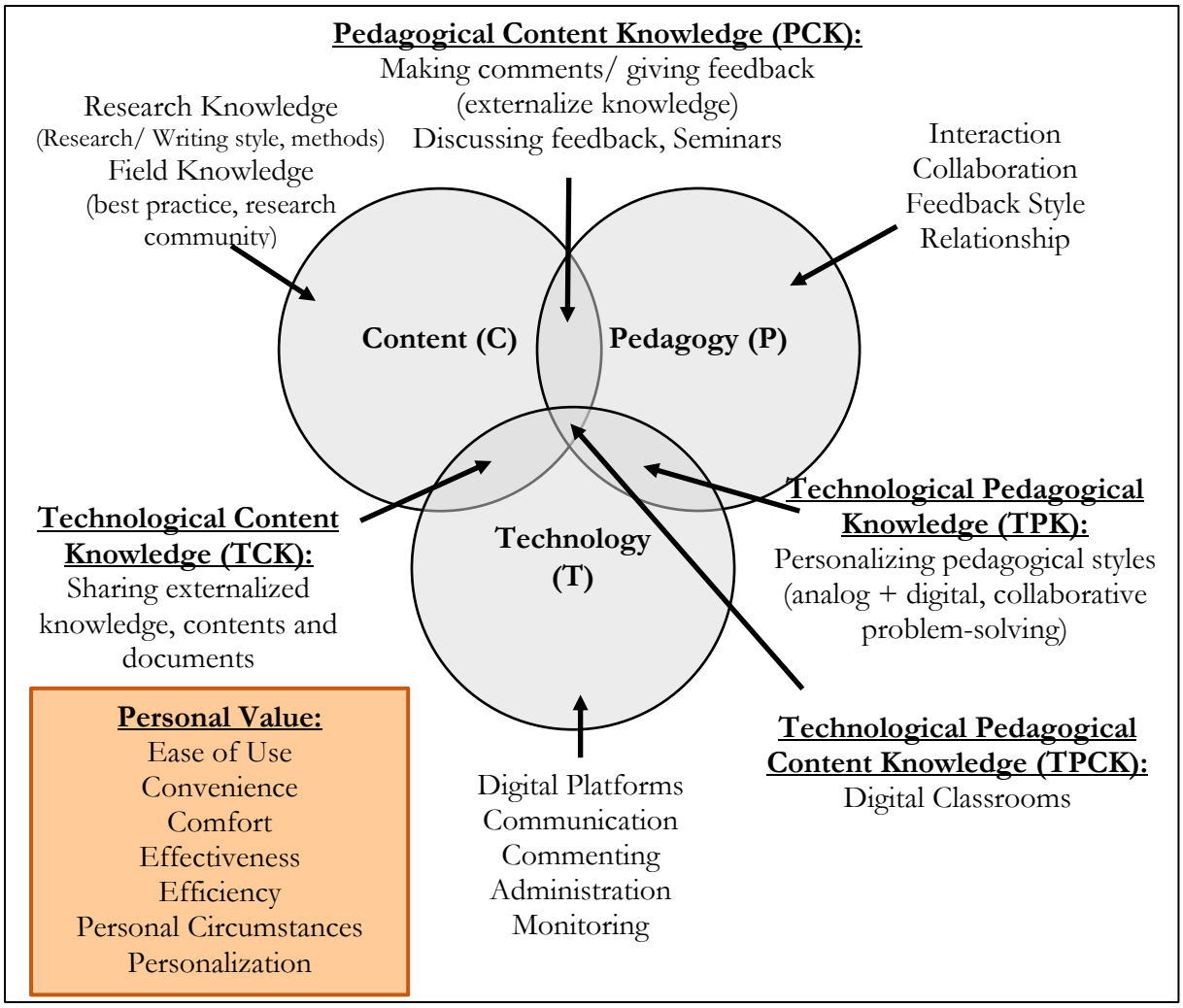

Figure 4: Mapping of TPACK on findings

Pedagogical Content Knowledge was mapped to making comments, giving feedback and discussing feedback. If content is the availability of knowledge, we argue that giving feedback requires externalizing this knowledge by applying it to the current thesis progress. The pedagogical choice influences how feedback is given and perceived, e.g. only digital, face-to-face, individually or in group seminars.

Technological Content Knowledge was mapped to the sharing of knowledge, content and documents. The externalized knowledge in the form of feedback needs to be shared with students, which is described by the TCK dimension. The supervisors we interviewed worked with Word or PDF documents to comment and share their feedback. Additionally, the software was used to guide the reader to give feedback for a certain part. Some supervisors shared relevant content such as guideline documents or links to literature resources in a digital way. Hence, technology can influence the effectiveness and efficiency during the supervision process.

Technological Pedagogical Knowledge was mapped to the personalization of pedagogical styles, such as mixing face-to-face interactions with technology (e.g. for virtual collaborative problem-solving or discussing digital feedback in person). The TPK dimension influences the collaborative nature of supervision by making choices about the use or non-use of technology for certain aspects of the supervision process.

Technological Pedagogical Content Knowledge was mapped to the concept of a digital classroom as described by one of our interviewed supervisors. In this digital classroom, stakeholders store all materials (such as documents and links) online and communicate digitally. This requires a conscious choice about the application of pedagogical methods to collaborate and communicate. The choice of technology needs to be aligned with pedagogy and externalizing contents. We consider this as a representative example of how the three TPACK dimensions influence each other and determine the design of the supervision process.

In addition to the categories which could be mapped to the seven dimensions of TPACK, we were left with categories which could not be mapped to the given dimensions without losing the main part of their meaning. These categories had in common that they all referred to the personal value which the supervisors were seeking. For example, the participants described the ease of use of technology when communicating with all students at the same time (e.g. using the LMS instead of writing individual mails), administering supervision tasks (e.g. time planning) and ensuring that students have a greater learning effect (e.g. more frequent feedback cycles combining face-to-face and digital feedback). This led to time savings, improved workflows and more efficient use of pedagogical methods. Our model represents these findings as *effectiveness* and *efficiency*, which potentially contribute to the perceived personal value when using technology. Effectiveness was often connected to the use of words like "easy", "simple" and "better". Efficiency was mentioned several times in connection to "time savings". These two factors also had implications for the supervisor's private lives, e.g. when saving time impacts their work-life balance. Even though these categories could be mapped to existing TPACK dimensions (T and TCK), they needed a separate, additional dimension to consider their importance to the supervisors and to be fully explained.

Similarly, the categories *convenience* and *comfort* were best reflected in the separate dimension "personal value". Convenience and comfort both impact pedagogical aspects (P) such as the feedback style (e.g. doing it analog on the bus; discussing feedback written or verbally, virtually or face-to-face). Technology was neither perceived negatively nor positively per se. It was perceived as "creating personal value", when it could be *personalized* and when it was aligned with the supervisor's *personal circumstances*. These circumstances include the supervisor's living and work situation (e.g. long commuting hours, working on-campus, off-campus or mobile). In each case, user-centric design of educational technology and the possibility of individual adjustments of functionalities both contributed to perceived convenience and comfort as part of personal value.

As all categories which relate to the conscious decision to either use or not to use technology (e.g. quickly communicating questions via e-mail, personalized reading behaviors when sitting at home or in the bus, using e-Readers or switching between digital and analog), also relate to the personal value to the supervisor, we assume a relationship between these two. In other words, the use of educational technology can potentially create personal value for the supervisor.

6.2 Results Discussion

After analyzing the findings with our theoretical framework TPACK, we continued to go deeper into the findings and relate them to our reviewed literature and research questions. According to the approach described by Miles and Huberman (1994) the objective of the analysis was to uncover both obvious and hidden relationships between themes and categories. These could be cause and effect relationships, contradictions within the data or logical sequences through time. Figure 5 visualized all identified categories in our findings and analyzes the relationships between them. By analyzing the findings and relevant quotes from the interviews once more, we used our proposed

TPACK mappings (see Figure 4) to match the relevant TPACK dimensions to our categories. This helped us understand which ways of thinking and other personal factors are influencing the decision to use or not use technology for an intended purpose.

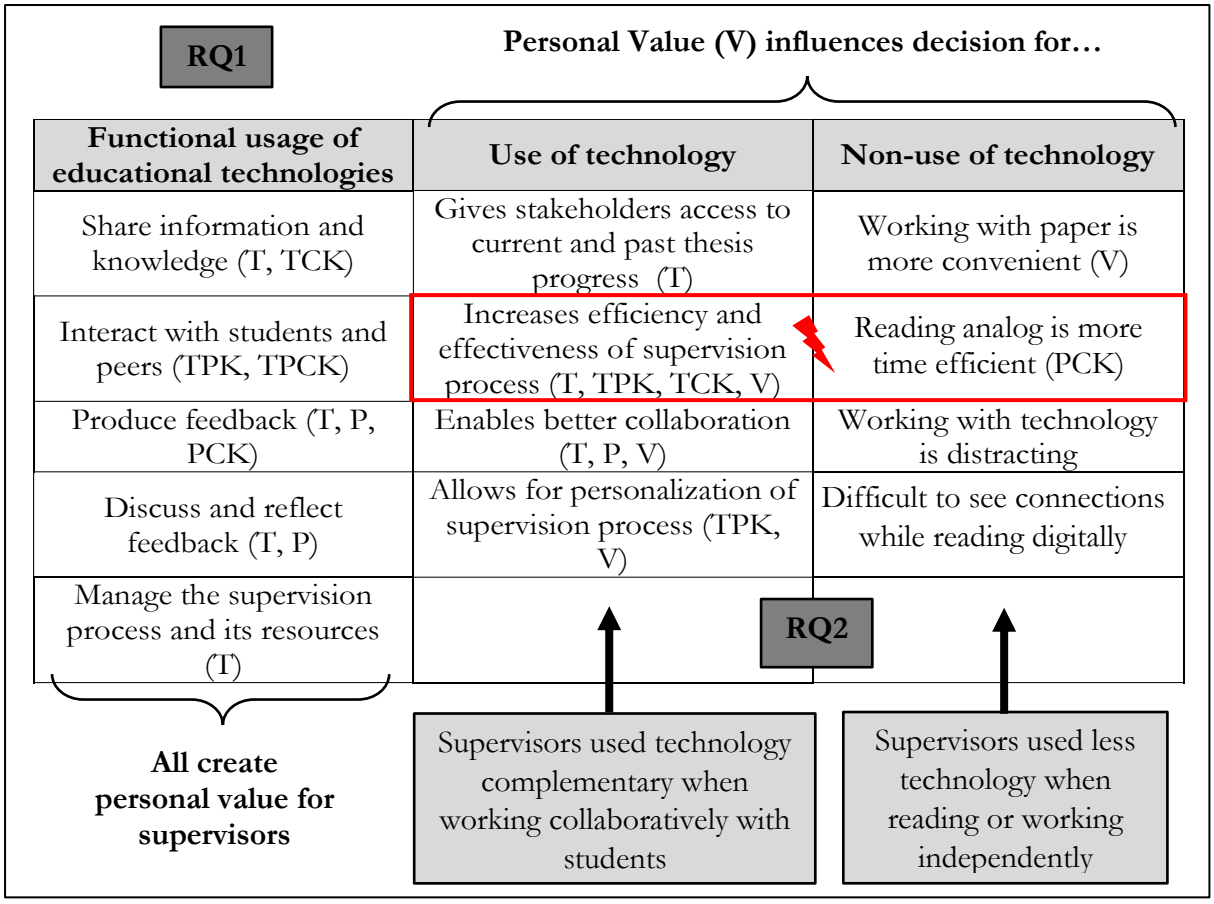

Figure 5: Overview of themes / categories and their relationships

The categories we identified in our findings could then be used to answer our two research questions.

The category "functional usage of educational technologies" is directly related to our first research question (RQ1):

> How is educational technology used for research supervision by university teachers at the Jönköping University?

Supervisors mainly used educational technology such as email, learning management systems and virtual communication to share information, documents and knowledge with their students. This relationship was bi-directional, as students were able to share information or documents with the supervisor and vice versa. The interaction between supervisors and their students is a crucial aspect of the supervision process and the supervision relationship. Another important use case for educational technology was feedback, both the production of feedback (e.g. writing comments) and the discussion and reflection of feedback with the students. The supervisors gave feedback in various forms such as sending comments in text-form and collaboratively implementing the feedback face-to-face with the help of devices like big computer screens. Lastly, the supervisors used educational technology for the management of their personal tasks within the supervision

process. The supervisors used it to organize their resources, time (supervision hours), to do scheduling, and to track the thesis progress of their students.

The categories "use of technology" and "non-use of technology" are directly related to our second research question (RQ2):

> Why is educational technology used or not used for research supervision by university teachers at the Jönköping University?

In general, we found that all supervisors used educational technology for the collaboration with their students, e.g. as a complementation in face-to-face meetings. For this reason, educational technology played an important role to improve the collaboration when physical contact was not possible or digital technologies could replace activities previously done analog (i.e. share comments or give reading instructions). However, when supervisors were working by themselves, they often chose not to use technology or would use a mix between digital and analog. These individual and mostly analog tasks included for example, reading and producing feedback in a handwritten form. We also observed that when supervisors rejected the use of technology, for example for reading, they still used technology in the beginning of the process or were generally open to using it under certain circumstances (e.g. to improve functionality or using new, better tools). Hence, the relationship between the use and non-use of technology seems ambiguous to us.

The decision to use or not use technology is related to the convenience and reading comfort it provides for the supervisor. The non-use of technology was explained by the insufficient reading comfort provided by current technologies according to our participants. Personal circumstances and preferences of the supervisors were also factors for why technology was used or not used.

Interestingly, 'efficiency' was mentioned in context of both, using technology and not using technology. It is perceived ambiguous in the sense that it helps and hinders our participants. In the case of reading and commenting, technology seemed to hinder efficiency because supervisors were dependent on their electronic devices and could not work on the go (e.g. in the bus while commuting). For other cases like sharing documents, technology increased the supervisor's efficiency because they could instantaneously communicate with a group of students without physical presence. Ultimately, if technology is designed properly, it is perceived positively again:

> "My part of the job is to read what the student wrote right? For that, I prefer to use this device (reMarkable e-reader). […] Because this… is done for that. So this is thought for that. And this gives us the paper feeling without losing all the practical elements of a digital file." (Interviewee 7)

Table 2 already summarized the attributes of the nature of supervision as process-oriented, community-centered, project-based, driven by facilitation and supervision, and sometimes co-supervised. Our findings relate to these attributes and underline the increasingly collaborative nature of the supervision process. Using technology for the close collaboration between supervisors and students is only one example. Negotiation and facilitation were important as well as they were mentioned by the participants in the context of group supervision and opposition between students. In this sense, the supervisor-supervisee relationship was also considerably important for the nature of supervision:

> "But that's because to me supervision is not about technology, supervision it's about relationships." (Interviewee 5)

> "We negotiate as a group, we negotiate. It's all about the negotiated solution to getting through the process and if somebody says to me 'listen this isn't working' then we negotiate our way through it, because that's what relationships are. Relationships require negotiations." (Interviewee 5)

> "[Using Ping Pong as gathering area] The first stage of collaborating with others is crucial." (Interviewee 3)

During the interviews we noticed certain correlations between educational technology and the more collaborative nature of research supervision. However, our research does not set out to answer in which way these two influence each other. Nonetheless, it seems relevant pointing out that other interviewees perceive that technology has a supportive and secondary role in the supervision process:

> "I am a strong believer in the fact that technology is not an end in itself. It's a means to an end." (Interviewee 5)

> "For me it's not about technology, it's about how can we get to the end as meaningfully as possible and how can it support us. And how can it hinder us. And if it can't help and only hinder, then we don't use it." (Interviewee 5)

> "If I perceive that there is a tool, that is more efficient or better, I would certainly use it. But as I said, since I consider it [technology] as a hygiene factor and if it works, I don't necessarily see the need to change it." (Interviewee 6)

> "So, the problem is not [the] technology at all. I think that technology is just helping the process. It's not being annoying or anything, on the opposite." (Interviewee 7)

These two sides of technology are an example of how technology in itself is not inherently beneficial. As a tool, the context in which it is used gives the technology its meaning and creates potential for being beneficial for its users. Also, referring to prominent challenges of supervisors when using technology described by Maor and Currie (2017), educational technology can act as an enabler for personal value: convenience can help maintain a work-life balance, personalizing the feedback process by merging face-to-face and digital interactions can help desensitize the student for just receiving written feedback. Furthermore, the personal value dimension can help design better IT-tools and IT-services, which are tailored to the needs of supervisors. And lastly, educational technology indirectly affects innovation and national economic growth, as stated by Pearson and Brew (2002).

6.3 Implications for Practice

Regardless of the mutual influence of the use of education technology and the change in the nature of research supervision, a strong supporting role of education technology to the supervisors has become evident. Our findings show that supervisors can use modern educational technologies to create personal value for them by increasing effectiveness and efficiency, reducing administrational work and enabling quick and easy communication. It allows the supervisors to focus on their main tasks and to create a more meaningful interaction with students which eventually contributes to an improved supervision experience for both students and their supervisors.

As mentioned earlier, we want to emphasize that educational technology cannot be the solution to all challenges during the supervision process just by itself. However, using TPACK prior to the start of the supervision as well as throughout the supervision process can help the supervisor to plan and design instructional activities and methods for improved results. With regards to our findings to RQ1 answering "how educational technologies can be used during the supervision process", we think that the supervisor can make conscious decisions on when to use technology and why. While doing so, the supervisor might identify new ways of using technology, which have not been considered before.

With the added perspective on the personal value of educational technology, we also see the potential to increase the comfort of doing supervision tasks, satisfying personal needs and counter current issues, such as achieving a better work-life balance. The fact that educational technology can increase the personal value could also lead to an increased intrinsic motivation of the supervisor and to an improved overall quality of the supervision process. All the aforementioned implications for practise have the potential to improve the overall quality of the supervision process. They indirectly increase the benefits for the students by doing higher quality research which can contribute to current economic and social issues of our time.

6.4 Future Research

Our findings give rise to questions for future research within the field of education research as well as information systems research.

6.4.1 Future research in higher education

Considering our findings on the importance of the personal value for teachers when deciding on using technology or not, the need for a new model arises. This new model should include the importance of the teacher's personal value and circumstances in the decision-making process for the design of teaching activities. Hence, we suggest further research on how the personal value for teachers can be accounted for in a new model or how it could be integrated in existing models to help teachers with the decision-making of using a certain technology or not.

Our analysis and the visualization in Figure 4 show a close relationship between the TPACK framework and the personal value for teachers. Hence, we suggest extending TPACK by an extra dimension "Personal Value (V)". We hypothesize that considering the personal value dimension as an extra dimension in the TPACK framework will enable new analytical insights and improved decision-making capabilities by looking at additional, intersecting dimensions.

6.4.2 Future research in information systems

Our findings have also implications on the design of educational technology. Information systems researcher can use our findings to derive guidelines to improve the user experience design for new applications, tools, platforms, or hardware within the application area of education. The fact that many participants opted for not using technology for the task of reading and commenting also implies that further research is needed on the usability of educational technology in this area and how to improve it.

As technology is not inherently beneficial, user-centric design is getting more important. It would be interesting to further research the role of technical features, different user contexts, and individual life contexts, and how they contribute to the creation of personal value. Here researchers should focus particularly on the teacher's perspective and the context of higher education.

For future research, we suggest the investigation of possible benefits in using the TPACK framework in its original or extended form (including a personal value dimension) for information system research. A comparative investigation with already established models such as the technology acceptance model (TAM) by Davis (1989) or its successor the unified theory of acceptance and use of technology (UTAUT) by Venkatesh, Morris, and Davis (2003) could shed light on the potential of its application in the field of information systems.

6.5 Methods Discussion

The explanatory nature of our research led us to follow an interpretive research approach and the use of a case study as our research strategy. However, due to time restrictions, access to participants and the individual connections and relevance to our research questions, we followed a single-case study design. This design is inferior to multiple-case designs for several reasons. We only had one opportunity to collect our data and there was no room for failure. Additionally, multiple-case studies come with analytical benefits which can be substantial (Yin, 2018). Yin (2018, p. 98) mentions that with multiple-cases "you have the possibility of direct replication. Analytic conclusions independently arising from two cases, as with two experiments, will be more powerful than those coming from a single-case (or single experiment) alone". Nonetheless, we were able to gain valuable insights into the world of university teachers during the supervision process and we were able to learn more about their attached meaning of using educational technology and the case study strategy and its methods and tools were very valuable for us in conducting our research.

In combination with the single-case approach, one could argue that a sample size of 7 interviews offers room for criticism regarding the generalizability of our findings. Guided by our qualitative, in-depth explanation seeking approach and an emerging data saturation after conducting seven interviews, we decided against conducting more interviews. Additionally, as described in section 4.8.2, our goal was not to reach a high level of generalizability but rather an in-depth understanding of the world of the supervisors at Jönköping University and to create a basis for future replication studies at other universities. We noticed that the first half during our interviews was methodologically necessary to retrieve relevant insights into the individual supervision process, it did not contribute much information to answer our research questions. Hence, the interview design needs to be further optimized for future data collection.

Our decision on using the TPACK framework as guidance and analytical tool turned out to be very fruitful. It offered us a very teacher-focused approach and enabled us to get an initial view on the teacher's perspective even before starting our data collection. Our experience suggests a potential application for information systems research where teachers' perspectives are the unit of analysis. However, as mentioned in the section 6.4.2, more research is necessary to find agreement of benefits or a possible superiority of TPACK to already established frameworks like the TAM or UTAUT in a teacher focused case.

6.6 Limitations

As we followed a qualitative research approach, mainly using semi-structured interviews as data collection method, and a small sample size of 7, our findings cannot be considered as statistically representative. However, our findings are representative for the teachers we interviewed and to a minor degree for the different schools at the Jönköping University.

Due to our focus on the research supervision process with its own unique structure and challenges, a transferability of our findings to other teaching activities has not been tested by us. Hence, more research on the implementation of a personal value dimension into TPACK needs to be done to confirm the transferability to other areas.

Furthermore, due to time restrictions during our study and a limited number of interviews, we do not consider our list of gathered reasons to use or not use technology as complete. Without collecting more data, our list can only be the starting point for future investigations and studies.

Finally, our findings were also not able to explain if educational technology influences the change in nature of research supervision or if the change in research supervision is driving the use of educational technology.

7 Conclusion

This study aimed to investigate the teachers' view and approaches on educational technology used during the research supervision process of undergraduate and graduate students. By investigating the teachers' perspective, we wanted to gain a better understanding of the teacher's personal value of using educational technologies in their supervision process. Building on our interpretivist research philosophy and qualitative research design using interviews, we aimed to answer two research questions:

1) How is educational technology used for research supervision by university teachers at the Jönköping University?

Supervisors primarily used educational technology such as email, learning management systems and virtual communication to share information, documents and knowledge with their students. It also enabled interaction with students and research peers, for example by creating digital classrooms. From the supervisor's perspective, educational technology supported both, the production of feedback (as of writing comments) and discussing and reflecting it with students. Lastly, it helped supervisors to manage the supervision process and related resources.

2) Why is educational technology used or not used for research supervision by university teachers at the Jönköping University?

We observed that supervisors use educational technology when collaborating with their students by complementing face-to-face methods with digital tools. When supervisors were working by themselves, they often chose not to use technology or they used a mix between digital and analog methods. Convenience, reading comfort, the possibility of personalization as well as personal preferences were identified as key drivers for making decisions in favor or against the use of technology. Ambiguously, educational technology was perceived both hindering and improving efficiency. Specifically for the task of reading, technology seemed to hinder efficiency.

All in all, a strong supporting role of education technology for supervisors has become evident. Our findings show that supervisors can use modern educational technologies to create personal value for them by increasing effectiveness and efficiency, reducing administrational work and enabling quick and easy communication. It allows supervisors to focus on their main tasks and to create a more meaningful interaction with students which eventually contributes to an improved supervision experience for the students and their supervisor.

To answer these research questions, we decided for a qualitative research design in order to gain deep insights and explore the individual and subjective perspectives of supervisors. From a strategic point of view, we followed a case study strategy which was particularly useful in our explanatory research and to answer research questions such as 'how' and 'why' which we ought to do. Our selected case was 'the use of educational technology during the thesis-supervision process at the Jönköping University (JU)' where our embedded units of analysis were the university teachers who are supervising the thesis process at the three selected schools of JU. These were the Jönköping International Business School (JIBS), the School of Engineering (JTH) and the School of Education and Communication (HLK).

We expected to discover reasons why teachers are using educational technologies to create personal value. Additionally, we expected to gain a clearer picture of the functional use cases of educational technology in the context of research supervision. While our expectations could be met by the outcome of this thesis, several questions arose during the research process. Skepticism

from teachers who thought they were not suitable as interview participants for our study due to only minimal use of technology made us consider interviewing teachers who consider themselves as users as well as non-users of technology. In doing so, we gained a more holistic understanding and could relate these seemingly opposing views to each other. Another question was how to balance the focus of this research between information systems research and education research. This resulted in a stronger focus on the role of technology as enabler of personal value for supervisors.

The value contribution of this study is the empirical evidence from a teacher-perspective on the personal value of the use or non-use of educational technology. Similar studies did mostly focus on technology used in university courses and not in the context of research supervision.

The chosen abductive approach to theory development and the decision to use the TPACK framework as our conceptional framework, which guided the development of our interview questions and the data analysis process, has shown effective and appropriate. TPACK, which aims at looking at technology, pedagogy and content and the relations between them, provided a useful structure to collect data and answer our research questions. Mapping our findings to the seven dimensions of TPACK also led us to the identification of another research gap: the importance of personal value as a factor for using or not using educational technology.

For future research we suggest investigating how the personal value for teachers can be accounted for in a new model or how it could be integrated in existing models (e.g. TPACK with an extra dimension on personal value). Furthermore, we suggest the investigation of possible benefits in using the TPACK framework in its original or extended form for information system research. As a more practical application in Information Systems, we suggest using our findings to derive guidelines to improve user experience design for new applications, tools, platforms, or hardware in the application area of education.

Referring to prominent challenges of supervisors when using technology, educational technology can act as an enabler for personal value: convenience can help maintain a work-life balance, personalizing the feedback process by merging face-to-face and digital approaches can help improve the supervision relationship and the communication of valuable feedback. The personal value dimension can help to design better IT-tools and IT-services which are tailored to the needs of supervisors. All the aforementioned implications have the potential to improve the overall quality of the supervision process, conducting research, and thereby indirectly contribute quality research on current economic and social issues. While it is important to point out that educational technology is no solution for all challenges in the supervision process, it has certainly a strong effect on research fields such as education, pedagogy and Information Systems.

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Appendix

Interview Guide

Table 9: Overview of interview questions

	Question	Theory	Objective	Artefact	Time
Warm-up	Introduction to our research and communication of the aim of the interview		Break the ice with the participant and make sure he/she understands the purpose of the interview.		2
	Warm-up: academic position, discipline, use of technology, experience with research supervision, research beliefs and philosophy		Acquire basic information about the interviewee.		4
Supervision Process	Describe the process of how you supervise research students from your personal perspective. Are there differences between bachelor and master supervision?	P	Create a visualization of the supervision process to analyze the value of EdTech in a more concrete form.	Supervision processes, process elements of rich picture	8
	Who are the stakeholders / participants of your supervision process? Who are you dependent on? Who is responsible? Who is involved?		Identify main elements of rich picture.	Stakeholders and interrelationships in rich picture	4
	Looking at your supervision process, can you add major pedagogical concepts you use in each phase?	P	Get an understanding of the degree of pedagogical knowledge of the participant.	Supervision processes + methods	4
	Looking at your supervision process, how do you use technology in each phase? Are there relevant relationships / dependencies between pedagogy and technology?	T, TP	Get an understanding of the degree of technological knowledge of the participant.	Supervision processes + technologies	6

Reflection	Looking at your used technologies and pedagogical concepts, what did you perceive as positive / useful? *[ease of use, benefits, productivity, quality, student feedback]*	TP	Participant reflects on their supervision process from positive and negative sides.	Concerns and challenges in rich picture	8
	Looking at your used technologies and pedagogical concepts, what did you perceive as negative/ challenging? *[productivity, effort, knowledge, administration, outcomes]*	TP			
	Which of your identified benefits and challenges are the most relevant [important] to you and why?	TCPK	Get participant to evaluate his/her findings and relate them to other points, creating a deeper understanding of the status quo.	Priorities and focus in rich picture	5
Personal Value	Looking at these changes and concerns of research supervision, how does technology create value for your work as supervisor?	T	Get an understanding for the role of educational technology in creating personal value.	Concerns for rich picture; definition of personal value for measurement	6
	What are influencers, triggers, factors, reasons or concerns behind the value creation through technology in supervision?	T	Get a more in-depth understanding about the relationship between value and technology.	Concerns for rich picture	4
Cool-Down	Is there anything else that's on your mind regarding what we have talked about? Do you have any recommendations for us regarding sources, topics or other things to look at?				4
	Would you be interested in participating in a possible focus group on this topic at the end of March?				1
					56