Teachers as designers

Analyses of pedagogical patterns and their use

Elisabeth Rolf

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Abstract
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My research is positioned within technology-enhanced learning (TEL) and learning design (LD) and additionally incorporates design research. Besides literature providing background and knowledge, all frameworks utilised for the analyses are found in these research fields. The research is qualitative and includes directed and summative content analyses. Data are presented in the form of a set of pedagogical patterns, audio recordings and written material generated by teachers during workshops.

The results show that adapted frameworks are appropriate for distinguishing pedagogy and digital competence. The detailed findings point to a varied approach to pedagogy in pedagogical patterns and a limited use of the digital competence repertoire, both of which are considered compatible with a focus on spreading the use of technology in education to less experienced teachers. The findings concerning the use of the created pedagogical patterns show that teachers may be inspired by the ideas they present and consequently, they may choose to adopt them to some extent, or use them as springboards to designs that show little resemblance to the original patterns. However, some teachers are not inspired by them or use them in this way. Indeed, teachers take varied approaches to design work, in line with professional designers’ work processes.

This compilation thesis thus contributes to existing scholarship by using a novel approach to the perception of teachers as designers.

Keywords: pedagogical patterns, learning design, pedagogy, digital competence, design.

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Till Fiffi och Bibbi
It has been really rewarding to have the opportunity to think about issues related to teaching. I have found it rather strenuous to meet the deadlines set for demanding tasks, but now that the hard work is over, I feel grateful for having had the chance to conduct research in my favourite field. Thanks to all of you who have been around and have supported me in different ways:

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Sammanfattning


Avhandlingen syftar till att komplettera den nuvarande uppfattningen om läraren som designer genom att analysera innehåll och användning av pedagogiska mönster med stöd av en multimetodisk forskningsdesign. Dels analyseras innehållet i sjutton pedagogiska mönster med avseende på den pedagogiska ansatsen och på elevers möjliga digitala kompetensutveckling, dels analyseras andra lärares användning av dessa pedagogiska mönster vid skapandet av lektioner och lektionsaktiviteter. Användningen analyseras på två sätt: 1) I vilken utsträckning idéer i pedagogiska mönster återanvänds och 2) det slags designarbete som utförs vid användning av mönstren.

Min forskning är positionerad inom fälten Technology-enhanced learning (TEL) och Learning design (LD) och innehåller dessutom designforskning. Förutom presentation av tidigare forskning inom dessa områden redovisas de ramverk som används för analyserna. Forskningen är kvalitativ och innehåller riktade och summativa innehållsanalys. Data består av en uppsättning pedagogiska mönster, ljudinspelningar och skriftligt material som genererats av lärare under workshops.


Avhandlingen bidrag är att konceptet läraren som designer studerats utifrån nya tillvägagångssätt.
Abstract

Recent research has claimed that learning designs can strengthen the teaching profession by acknowledging teachers’ role as designers as they use these to disseminate good teaching ideas about digital technology to colleagues in schools and universities. However, the promises attributed to learning designs are based in particular on teachers producing learning designs, rather than on analyses of them or their use. This dissertation attempts to bridge the gap. Specifically, it aims to expand the current perception of teachers as designers by analysing certain details involving the content and use of pedagogical patterns, through applying a multi-method research design. In order to analyse the content of pedagogical patterns, the pedagogy and the digital competence training of students are discerned. In order to analyse the use of these pedagogical patterns in the creation of lessons and lesson activities, the extent to which ideas are re-used as well as the types of design work performed when using these patterns are addressed, too.

My research is positioned within technology-enhanced learning (TEL) and learning design (LD) and additionally incorporates design research. Besides literature providing background and knowledge, all frameworks utilised for the analyses are found in these research fields. The research is qualitative and includes directed and summative content analyses. Data are presented in the form of a set of pedagogical patterns, audio recordings and written material generated by teachers during workshops.

The results show that adapted frameworks are appropriate for distinguishing pedagogy and digital competence. The detailed findings point to a varied approach to pedagogy in pedagogical patterns and a limited use of the digital competence repertoire, both of which are considered compatible with a focus on spreading the use of technology in education to less experienced teachers. The findings concerning the use of the created pedagogical patterns show that teachers may be inspired by the ideas they present and consequently, they may choose to adopt them to some extent, or use them as springboards to designs that show little resemblance to the original patterns. However, some teachers are not inspired by them. Indeed, teachers take varied approaches to design work, in line with professional designers’ work processes.

This compilation thesis thus contributes to existing scholarship by using a novel approach to the perception of teachers as designers.
1 Introduction

To prevent people from getting infected by the fatal SARS-CoV-2 virus, schools and universities in Sweden – and throughout the rest of the world as well – have in 2020 and 2021 been forced to transfer teaching to online environments. All of a sudden, teachers have had to learn how to make effective use of technology in order to continue providing their students with learning opportunities (Bergdahl & Nouri, 2021). Continuous education would not have been possible without the affordances provided by technology.

On the other hand, at the start of my research in 2016, it was known that Sweden’s 23 per cent use of technology in schools was overshadowed by neighbouring Norway’s 71 per cent and Denmark’s 63 per cent (European Commission, 2013). The alarming underuse of technology in Swedish schools was further emphasised by the nature of the use. Indeed, technology was mainly being used by teachers to prepare activities, such as browsing for information and finding resources to scaffold their teaching. Surveys conducted by the Swedish National Agency for Education (2012, 2015) reported that teachers were claiming to have insufficient skills to use technology for pedagogical purposes. In addition, the comprehensive PISA report (Organisation for Economic Co-operation and Development, OECD, 2015) explained that countries that had invested considerably in technology were ‘see[ing] no appreciable improvements in students’ achievements in reading, mathematics, or science’ (OECD, 2015, p. 3). European surveys clearly indicated a need to support the use of technology in teaching for learning purposes (Bocconi et al., 2013; Burns, 2013).

If we view the school as an ecological system, new, unknown factors such as digital technology need to be adapted to it. Technology’s chance of survival is determined by how well this adaptation takes place. However, courses for teachers organised by education providers often have little effect on the use of digital technology in schools (Zhao & Frank, 2003). Teachers’ participation in the change process is instead important because teachers can create meaning in the demands of authorities and the surrounding society (Bennett et al., 2018). Therefore, the development of technology use should be led by teachers, but supported by governing bodies through, for example, infrastructure and hardware.
Such a plan was implemented by the city of Stockholm. In 2013 the city decided to launch a one-to-one project that would equip every student in the city’s upper secondary schools with a laptop, in order to ensure that all students would have access to a technological device for learning purposes. Among a variety of complementary projects in support, the city commissioned Stockholm University to promote the use of technology in upper secondary schools, resulting in the I Use IT project. This initiative aimed to encourage wider technology use in schools by disseminating the ideas of teachers with considerable relevant experience. The acclaimed design pattern format (cf. Goodyear, 2005) was chosen as a tool that could convey good ideas to colleagues and at the same time increase teachers’ digital skills.

As my research moved forward, I turned my attention to the data, the design patterns created and the use of patterns involving students’ activities. This dissertation hence synthesises the research reported in articles involving descriptions of the character of the design patterns created by the participants, the content of the pedagogical patterns identified and the use of these pedagogical patterns by other participating upper secondary teachers. The dissertation can thus help increase knowledge about how teachers work as designers.

1.1 Research context
The thesis is aligned to research within technology-enhanced learning (TEL), a generic umbrella term for research that aims to support the use of technology in education to enhance student learning and, as a result, student outcomes (Goodyear & Retalis, 2010). Given that technology can never strengthen students’ learning on its own, it needs to be integrated into the overall learning objectives (Beetham & Sharpe, 2013; Selwyn, 2016). What is being enhanced is however seldom explicitly addressed in TEL research literature, although the following understandings have been identified (Kirkwood & Price, 2014, adapted from p. 7):

1. increased technology use;
2. improved circumstances/environment in which educational activities are undertaken (e.g. increasing flexibility and accessibility);
3. improved teaching practices;
4. improved student learning outcomes, whether measured quantitatively or qualitatively.

However, the concept of teachers as designers is increasingly being applied to research previously associated with TEL. Research associated with teachers as designers includes interventions that aim to support teaching with technology. Examples include online resources to support certain learning approaches (Pepin et al., 2017), the development of design principles (Cremers et al., 2017) and the improvement of e-rubrics (Company et al., 2019). Some researchers refer to both concepts in their research
on, for instance, design principles (Kali et al., 2018), design support tools (Michos & Hernández-Leo, 2020) and technological pedagogical content knowledge (TPACK) (Papanikolaou et al., 2017).

Within TEL research that often refers to teachers as designers, there are thus examples of tangible support in the form of resources that help teachers reflect on how technology can be used for learning purposes and provide structures for the representation of teaching and learning activities. A well-known example is the TPACK framework (Mishra & Koehler, 2006), which teachers may use for their lesson planning. TPACK is a model that supports teachers in reflecting on the relationship between technology, pedagogy and content when creating designs for learning (Mishra & Koehler, 2006). It helps teachers articulate their representations by considering pedagogy, technology and content equally. Studies related to TPACK have informed my research, being part of TEL and teachers as designers research. However, the ability to share the designs is not a priority for the developers, which is central to my research. Learning design, on the other hand, accumulates research on the creation and sharing of teachers’ designs.

Learning design (LD) has been associated with TEL since the 1990s, like TEL mainly in connection to e-learning (Scott et al., 2007). However, today references to LD have expanded to include any use of technology in teaching, thus also considering blended or hybrid learning (Bennett et al., 2017). Specifically, research within LD aims to develop knowledge of how to design for learning. In the Larnaca Declaration on Learning Design it is proclaimed that LD aims to ‘assist educators to describe effective teaching ideas so that they can be shared with, and adapted by, other educators’ (Dalziel et al., 2016, p. 1). As technology has evolved, researchers are able to support technology use in teaching through the development of specific tools. Online tools allow teachers to create and design learning experiences in the form of learning activities, entire lessons or entire courses that other teachers can take part in as soon as the designer has clicked on save and share (Dalziel et al., 2016; Hernández-Leo et al., 2018; Laurillard, 2018; Law et al., 2017). Furthermore, upon using these tools, teachers create learning designs and are thus considered designers.

The specific framework for creating learning designs in this thesis is design patterns for educational purposes. These were also originally developed to support e-learning (Goodyear, 2005), but today they support any use of technology in education. Design patterns, like any other learning design, provide a structured format for educational ideas and are intended to be shared and used. Repositories of design patterns are found in printed collections as well as online (Bergin et al., 2012; Goodyear & Retalis, 2010; Köppe et al., 2016; Mor et al., 2014a). In the context of this thesis, design

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1 Examples from the book are available at this link: [http://csis.pace.edu/~bergin/PedPat1.2.html#earlybird](http://csis.pace.edu/~bergin/PedPat1.2.html#earlybird)
patterns that concern teaching and learning are termed ‘pedagogical patterns’, as elaborated in section 1.4.

A starting point for this dissertation is that research within TEL and LD has to date reported on the creation of different design support resources and tools, including their successful implementation in educational practice in intervention studies (e.g., Asensio-Pérez et al., 2017; Garreta-Domingo et al., 2018; Henriksen et al., 2018; Kali et al., 2018; Pepin et al., 2017). Intervention studies apply equally to research on pedagogical patterns (Conole, 2012; Derntl & Calvo, 2011). Figure 1 describes studies in the learning design domain in which designers articulate teaching ideas in different structured formats for storage in an online or printed repository. The writers of design patterns are mainly identified as teachers in higher education (e.g. Goodyear, 2015), although online design support tools may also reach K-12 teachers (e.g. Laurillard et al., 2018) or both educational levels (e.g. Álvarez-González et al., 2017; Dalziel, 2011).

Figure 1
Schematic figure of the first phase of teachers’ design processes

The I Use IT project, which functioned as a foundation for my research, reflects such a process. It took the form of a workshop series in which upper secondary teachers were encouraged to use design patterns for the dissemination of good teaching ideas involving technology in education. In the first phase, design patterns were created and saved on a wiki for further sharing. However, this dissertation is not primarily focused on this phase of teacher’s design process and therefore no in-depth analysis of the collaborative work of participants is reported (and nor were interviews conducted or surveys handed out for further analysis). Instead, the artefacts in the form of design patterns that were created to be shared at the workshop series provided the data for my analyses.
By recognising a second phase, the concept of teachers as designers can be further developed and deepened. In addition to the first process, the use of the existing learning design generates a new artefact in the form of a design for teaching. In a second phase, teachers are hence provided with learning designs that they can use for creating their own designs and later bring to the learning environment (Figure 2).

**Figure 2**
Schematic figure of the second phase of teachers’ design processes

![Figure 2](image)

This design phase formed part of my research and included other upper secondary teachers who were provided with created patterns and were encouraged to design for their own teaching. Teams’ discussions during the design stage and their designs for teaching were collected as data to be further analysed. Hence, the second phase provided additional data.

A third phase, which is not addressed in the thesis, involves the design for teaching and its implementation in the learning environment.

### 1.2 Research problem, aim and research questions

The argument regarding the content and the use of learning designs can be articulated as follows: if the research community is convinced that teachers need help in sharing and using learning designs, then it may be desirable to know more about what is being produced for these purposes. There are publications that in different ways address these matters, but in general I perceive a lack of knowledge. My dissertation thus contributes by adding knowledge to an overlooked area of research.
Different aspects may be of interest for learning about the characteristics of pedagogical patterns and other learning designs. Elements related to discrimination (e.g. gender, age, ethnicity) or the curriculum may be relevant in certain contexts. I have decided to concentrate on pedagogy and the possible development of students’ digital competence, which are important aspects of teaching with technology.

There is also a lack of research about the use of learning designs, including pedagogical patterns. Therefore, an understanding of the use is considered an important contribution to research on teachers as designers. Likewise, teachers design work when using pedagogical patterns is incorporated in my research.

**Pedagogy**

Given that TPACK intends to support an individual teacher’s reflections regarding technology, pedagogy and content, all three aspects should be detectable in TPACK designs. Pedagogy is accordingly described in teachers’ designs (Boschman et al., 2015; Koh & Chai, 2016). In contrast, Nguyen and Bower (2018) explain that teachers seldom express pedagogy in their TPACK designs. How they understand pedagogy, on the other hand, is not reported. This compilation thesis will provide an explanation and plausible reason for these discrepant results by examining the pedagogy of the pedagogical patterns.

Moreover, an incentive for examining pedagogy in learning designs is pointed out by Masterman and Manton (2011). If a learning design is to be used, teachers need ‘to have sufficient information about the pedagogic intention underlying that design in order to make an informed decision about its usefulness’ (para. Discussion).

**Development of students’ digital competence**

Research on the use of digital technology in education is vast, but studies focusing on how teachers’ learning designs may help students enhance their digital competence have yet to be conducted. As students’ use of technology increases their opportunities to develop their digital competence, it is important to understand the latter’s nature (Beetham, 2013; Fraillon et al., 2014; Littlejohn et al., 2012). This claim has been even more strongly emphasised by Siddiq et al. (2016), who argue that it is ‘surprising that a detailed view on how teachers actually emphasise the development of learners’ digital information and communication skills in classrooms is lacking’ (p. 2).

**Use of learning designs**

The use of learning designs has been studied by Pareto and Willermark (2019). They have shown that even incomplete TPACK designs can exhibit a complexity that allows them to be implemented in the classroom after iterations. However, the same teachers were found to both create and enact the designs, which is in accordance with the
TPACK concept. This thesis instead focuses on the use of pedagogical patterns by upper secondary teachers other than the creators, that is, technology-experienced teachers.

**Teachers’ design processes**

Another aspect of the use of learning designs concerns the characteristics of teachers’ design processes when given the opportunity to use a finalised learning design. Accounts of teachers’ design processes are available at length, as further described in section 3.3. For instance, in Boschman et al.’s (2015) study, teachers explained in their interviews that they preferably consider what is practically feasible for their designs. Moreover, Bennett et al. (2017) conducted interviews to understand the design processes of teachers in higher education. These processes were described as simultaneously analytical and creative.

Both of these publications call for extended research into teachers’ design processes (Bennett et al., 2017; Boschman et al., 2015). Moreover, Bennett et al. (2018) devotes a complete article to the need of understanding teaching as design. One of my studies has answered the call by using knowledge of design processes gathered in traditional design research, not by conducting interviews, but by analysing the design work of teachers.

**Research aim**

The aim of my research is to understand how teachers work as designers by analysing details pertaining to the use of pedagogical patterns, that is, content and use. The following research questions (RQs) are posed:

1. What characterises the pedagogical patterns created by upper secondary teachers and, more specifically, their inclusion of:
   a. the pedagogical approaches expressed in the patterns?
   b. the digital competence training for students made available in the patterns?
2. How do teachers as designers use pedagogical patterns, specifically in terms of:
   a. the provided ideas and solutions?
   b. the design processes of upper secondary teachers?

**1.3 Overview of publications**

To support teachers’ sharing of good teaching ideas involving the use of technology, technology-experienced upper secondary teachers were invited to learn how to apply design methods for describing problems as well as how to overcome them, involving technology related to their practice in the form of design patterns. The work of the teachers resulted in a collection of design patterns from which patterns deemed pedagogical were distinguished. To examine that extent to which design patterns can
communicate understandable and relevant content to future users, the research first focused on understanding the content in terms of pedagogical approaches and digital competence training, thereby addressing RQ1. In the second part, the question of how upper secondary teachers can use pedagogical patterns was emphasised, thereby focusing on RQ2. Table 1 provides an overview of the two parts.

Table 1
Overview of the research process

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Articles</th>
</tr>
</thead>
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1.4 Clarification of concepts and terms

Given that the educational field devoted to learning design (LD) is relatively young, it is still in the process of being defined. Different terms for the same concept are thus
used by different authors. The design language hence differs (Law et al., 2017) and relevant concepts and terms are brought to discussion here. A summary of the applied concepts and terms is provided at the end of this section.

The original term *design patterns* is the generic term used for the framework. When the approach was introduced to education, different terms emerged, involving pedagogical, instructional or educational design patterns (c.f. Bergin et al., 2012; Mor et al., 2014b). Nevertheless, many researchers in the field of education continue to use the original term *design patterns*, even though they could just as easily use *pedagogical patterns* or similar. Accordingly, I have used the terms interchangeably in my four articles. In the thesis, however, I refer to the patterns developed within my research as *pedagogical patterns* when ideas that are aimed to support learning.

An agreed term for the artefact that is designed through the use of pedagogical patterns or design support tools has yet to be determined. Persico and Pozzi (2015) claim that a design for learning should constitute the design artefact, while Dalziel et al. (2016) prefer a *learning design*, as is used in this thesis.

A specific term is also needed for a design that is created on basis of a learning design, as described in the second design phase of teachers. McKenney et al. (2015) suggest the term *design for actual use*. However, I deem the term Augustsson (2021) uses for a design to be brought into a learning environment more suitable: *design for teaching*. Consequently, a learning design created by a teacher may very well be used by the same teacher. In such cases, the learning design is simultaneously a design for teaching. This complication, fortunately, does not need to be addressed in this thesis.

A learning design includes learning activities, which in turn may involve the physical organisation of the learning environment, the use of material, the timeline and so forth (Conole & Fill, 2005). The design constitutes a plan. However, the teacher cannot be certain that their execution strictly follows the plan, because unexpected events may require them to improvise. Furthermore, students may not execute the activities in the way the teacher anticipated. For the latter reason, Goodyear and Dimitriadis (2013) suggest replacing the term *learning activities* with *tasks* that signal the teacher’s intention. Although it may be appropriate to follow this advice, I maintain that *learning activities* is a fruitful term because it contains the elements described in a learning design.

As a consequence of research within TEL, learning has come to the fore and has brought with it the term *learner*, which is found in contemporary literature.

The rise of the word ‘learner’ is part of the emergence of what I have termed ‘the new language of learning’—a language which refers to students as learners, to teachers as facilitators of learning, to schools as places for learning, to vocational education as the learning and skills sector, to grown ups as adult learners, and so on. The ambition articulated in the language of learning can partly be understood as an emancipatory one, in that it can be interpreted as an attempt to shift the emphasis

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away from teachers, curricula, schools and other ‘input factors’ to the activities and identities of those who are supposed to benefit from this.

(Biesta, 2010, p. 541)

Given that we are all learners who learn something new every day (a Swedish proverb), the term learner is suitable for anyone learning in any environment, hence also in informal learning. In formal education, the terms students and pupils are however more appropriate. While writing my dissertation, I came to realise that I was affected by the usage of the word learner in the literature and therefore decided that I would henceforth replace it with student. Following this reasoning, the term learner-centred is replaced by student-centred.

1.5 Introducing the thesis’ author

I have had been working with digital technology since the late 1980s. After graduating as an upper secondary teacher, it became natural for me to bring a positive attitude towards the use of technology in education. As soon as devices and infrastructure were in place, I took every chance to make the technology useful for my students’ learning.

I have in addition served as a principal of two schools, but in those years the current requirement of technology use in teaching was not yet in place.

There are two questions related to the use of digital technology in education that have preoccupied me during my career: 1) Why is it difficult for some students to make good use of technology? 2) Why do not all my fellow colleagues see the value that technology can add to their teaching? The latter question brought me to the university and doctoral studies. Both questions remain unanswered, but my research has nevertheless been valuable because my studies have given me the opportunity to consider how to help teachers who are unaccustomed to using technology to catch up.

1.6 Structure of the thesis

The thesis is structured in a conventional fashion. First, a background section introduces the origin and the contemporary status of design patterns. Design support tools developed by researchers in the LD community are also described. The chapter ‘Theoretical perspectives and frameworks’, provides an account of the term pedagogy as well as the emergence of the concept of digital competence. The chapter finishes with an account of design involving the concept and perspectives regarding it, according to traditional design knowledge and educational research. The methodology section presents a multi-method research design and continues by demonstrating the complex process of data collection as well as the analyses of the data conducted. The results section not only provides a summary of my articles but involves additional findings that have not yet been reported elsewhere. This section is followed by a discussion chapter,
including a summary of contributions and suggestions for further research. A conclusion rounds off the dissertation.

In Appendix A, all 17 design patterns are reproduced. They have been translated by me with the intention of keeping the teachers’ writing styles intact.
The perspectives that form the core of my research are introduced in this chapter. Here, I attempt to navigate through different positions that are part of the LD, including the design pattern approach, which is introduced first. Given that researchers adopt different approaches to the use of technology based on their own focus areas, the knowledge gathered in the field is vast and diverse.

2.1 The design pattern framework adapted for a pedagogical pattern approach

A problem that was identified in the introduction is a lack of analyses of the pedagogical patterns created over time (Conole, 2012; Derntl & Calvo, 2011). This section seeks to examine the pattern approach in detail. It begins by describing the origin of design patterns, touches on some criticisms of these and then moves to a longer account of design patterns for learning purposes, that is, pedagogical patterns.

2.1.1 Alexandrian design patterns

Design patterns were originally created by the architect Christopher Alexander to enable the widespread proliferation of the knowledge attained by architects. The story begins in the 1970s, when a group of American architects sought solutions to problems they recognised in architecture. This resulted in a pattern collection published in A pattern language (Alexander et al., 1977). The book presented 253 solutions to architectural problems, from urban planning to interior details, that is, how to build cities, neighbourhoods and individual houses, alongside details regarding the entrances to houses and the placement of windows and interior doors. The purpose of these design patterns was to pass on the authors’ idea of a timeless architecture to future generations, as explained in Alexander’s (1979) second book A timeless way of building.

A common way of describing design patterns found in related literature is the following: ‘A pattern is a solution to a recurrent problem, in a context’ (Goodyear & Retalis, 2010, p. 15). The argument for the choice of ‘recurrent’ problem can be found in the following:
Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice.

(Alexander et al., 1977, p. x).

Design patterns can be characterised by the original structure as described (Alexander et al., 1977, p. x-xi) and used for the 253 design patterns:

- A picture
  - It shows an archetypal example of the pattern.
- An introductory paragraph which sets the context for the pattern.
  - It explains how it helps to complete larger patterns.
- To mark the beginning of the problem.
  - A headline, in bold type.
- To give the essence of the problem in one or two sentences.
  - The body of the problem.
- The longest section; describes the empirical background; evidence for its validity; the range of different ways the pattern can be manifested.
  - The solution, in bold type.
- The heart of the pattern; the field of physical and social relationships required to solve the stated problem in the stated context; stated as an instruction, so that you know what you need to do.
  - A diagram.
  - It shows the solution, with labels to indicate its main components.
- To mark the ending of the main body.
  - A paragraph.
  - It ties the pattern to smaller patterns that are needed to complete and embellish it.

Any researcher who applies the design pattern concept can construct a layout that fits the context. Often headings that are found in the original layout have been used; all contain a problem and a solution section (c.f. Derntl & Botturi, 2006; Knutsson & Ramberg, 2018; Niegemann & Domagk, 2005; Sharp et al., 2003).

Key to the authors of the original design patterns is that each pattern is part of a whole, so they together comprise what they call a ‘pattern language’ (Alexander et al., 1977) which also constitutes the title of their publication. Alexander and his co-architects explain that the language must be common to make the buildings ‘come alive’ (Alexander et al., 1977, p. x). Hence, it is further indicated that the pattern language of the collection represents a vision about towns and buildings being alive in coherence with a ‘timeless way of building’ (Alexander et al., 1977, p. ix). To explain ‘timeless’ further, Alexander offers some alternatives, such as beauty, wholeness and alive (Alexander, 1979). Thus, design patterns are based on a certain value and need to be important for users, other designers and society at large (Fincher, 1999; Law et al., 2017).
Researchers interested in design patterns mainly seem to understand the concept of pattern language in another way. A pattern language may be viewed as a collection of related patterns which exhibits relationships that make it possible to define categories (Dearden et al., 2002; Derntl & Botturi, 2006; Knutsson & Rambørg, 2018). A second possibility is to predefine the organising principle and the categories that illustrate the pattern language (Fincher, 1999; Niegemann & Domagk, 2005; Sharp et al., 2003). However, Law et al. (2017) explicitly regard pattern language as value-based and, in their case, as aiming to promote 21st-century learning.

Dawes and Ostwald have summarised published criticisms of Alexander’s theory, which they believe is ‘is intended to restore the intuitively developed and innately satisfying forms of traditional architecture’ (2017, p. 10). Although Alexander believes that each pattern can generate an infinite number of interpretations, his critics say that the patterns prevent radical interpretations because the desirable, timeless way of building limits the possibilities of building in other qualities and thus ‘accepts only one “right” way of building’ (Dawes & Ostwald, 2017, p. 12). The specific aesthetic thus excludes other perceptions of what constitutes good architecture and, furthermore, makes rigorous testing impossible. Based on this criticism, the theory cannot be considered scientific, although such claims were also made by Alexander.

Dawes and Ostwald believe, however, that the design pattern format can be of great use for architects in contexts where values and visions need to be communicated, as patterns may be able to package complex phenomena in a manageable format (Dawes & Ostwald, 2017).

2.1.2 Early pedagogical patterns for e-learning
Design patterns have not become successful in architecture circles (Dawes & Ostwald, 2017), although design patterns in object-oriented programming were very successful in the 1990s when Gamma and colleagues described known programming problems and offered solutions to them in a set of patterns (Fincher, 1999). The four researchers’ initiative was picked up by programming teachers, who saw an opportunity to similarly use design patterns to describe recurring teaching problems and offer proven solutions (Fincher, 1999). With the association of design patterns developed in technology design communities, design patterns for educational purposes did not unexpectedly become linked with digital technology (e.g. Goodyear, 2005; McAndrew et al, 2006; Niegemann & Domagk, 2005; Retalis et al., 2006; Winters & Mor, 2008).

In an influential article, Peter Goodyear (2005) made the pattern approach widely known by suggesting that design patterns have the potential to benefit e-learning by:

- Providing the teacher-designer with a comprehensive set of design ideas
- Providing these design ideas in a structured way – so that relations between design components (design patterns) are easy to understand
• Combining a clear articulation of a design problem and a design solution, and offering a rationale which bridges between pedagogical philosophy, research based evidence and experiential knowledge of design.

• Encoding this knowledge in such a way that it supports an iterative, fluid, process of design, extending over hours or days.

(Goodyear, 2005, p. 92)

These qualities are found in different variations in the literature regarding design patterns for education, indicating a confidence that significant contributions could be made in support of learning in the new era of technology in teaching. Echoing the original approach, in teaching the core features of design patterns were also communicated:

Design patterns distil the reusable elements of design from distinct cases, so that they can be immediately applied in new situations. A design pattern captures a recurring problem, the context in which it occurs, and a possible method of solution. They are derived from experience and backed by theory, abstracted one step away from the concrete yet still applicable to real-life situations.

(Mor et al., 2014b, p. 7)

As expressed in the citations above, the research community’s demand for theory and research-based evidence sought to characterise high-quality design patterns. Design patterns with such quality can be found in repositories on the Internet and in publications (e.g. Bergin et al., 2012; Mor et al., 2014a). To what extent they are used, however, remains unknown.

Several projects on design patterns for educational purposes were launched and finalised during this period. Three of these are briefly presented here to illustrate the researchers’ high hopes for design patterns.

**The Pedagogical Patterns Project**

The Pedagogical Patterns Project\(^2\) started in 1996 and has not really been formally completed, as the work on design patterns continues in another form. (Sharp et al., 2003). This project aimed to disseminate good teaching practices for supporting the learning of object-oriented programming by developing design patterns. The specific case was that object-oriented programming comprised a new approach to software development and thus required a new mind-set, drawing attention to the need for new teaching methods. The project appreciated design patterns for the pattern language, understood as a way of collecting related patterns that can solve related problems. The interdependencies were found by collaborative work, which furthermore allowed for better refined design patterns. An example from the project is the pattern ‘Nobody is

\(^2\) Pedagogical Patterns Project: [http://www.pedagogicalpatterns.org](http://www.pedagogicalpatterns.org)
perfect’. It is one of three patterns with the same objective: ‘You want to prepare the students for the world outside the course’ (Eckstein et al., n.d.):

**NOBODY IS PERFECT**

You are teaching a topic and your students are asking questions, which are beyond your acquired knowledge.

★★★

Students expect the one and only right solution to a problem from the instructor. However, on the one hand there is often no single answer, but many equally correct answers. And on the other hand you might not know what the best answer is. You cannot know everything. If you paper over the cracks, the students will stop relying on you in areas where you are knowledgeable.

★★★

Therefore, admit your limitations with grace. Do not try to be perfect. In particular, if you cannot answer a question, admit it. Be honest to the students, by telling them that you do not know the answer. Avoid searching through your material in front of the students. Unless you really know where to find the answer, it is unlikely you will find the correct answer in this short time frame.

Don’t create the impression that the question is overly difficult just because you don’t know the answer. This will hinder the students trying to speculate about the solution. Suggest that you will look up the solution, or explicitly ask the students whether one of them knows the answer to the question. You can also suggest to either work on the solution jointly with the students or start exploring with the students to find the answer.

★★★

It is much harder to implement this pattern in countries where the culture does not allow people to admit that they need help or where the students are regarded as impolite if they admit that they do not know the answer.

Use REFLECTION to foster the trust in the students’ own competency.  
(Eckstein et al., n.d.)

**The E-LEN project**

The E-LEN project³, funded by the European Union (EU), took place between the years 2002 and 2005 (Niegemann & Domagk, 2005). The project aimed to create a network of e-learning centres, that is, universities and organisations for ‘creating efficient and effective mechanisms and means for gathering and disseminating know-how, best practice knowledge in the e-learning field’ (Niegemann & Domagk, 2005, p. 78). To achieve this goal, the representatives collaborated in the development of 42 quality patterns for e-learning. The network was established, but the ambitions regarding the design patterns were not satisfactorily realised because the evaluation showed that the patterns needed further elaboration. It was explained that the solutions were not sufficiently based on empirical research findings. Moreover, each pattern was said to

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³ E-LEN website: [http://www2.tisip.no/E-LEN/](http://www2.tisip.no/E-LEN/)
be in need of attention. Therefore, it was concluded that the contributors should have used the agreed-upon guidelines more effectively.

Another concern regarding these theory-based patterns created in the project was raised by Scott et al., as follows (2007): ‘learning designers will regard such putative learning design patterns as authoritative and complete rather than as spurs to action for reflective participant observers’ (p. 1508). Whether these authors were proved right is unknown.

**The Pattern Language Network (Planet)**
The Pattern Language Network (Planet) was active during the years 2008–2009. Its aim was to support the sharing and use of successful examples of Web 2.0 technologies in higher education through the development of a pattern language. It was expected to have an impact on learning without requiring research-based evidence. Key characteristics of the project were approaches involving participatory design, user-centredness and iteration. During the project, a Participatory Patterns Workshop methodology was developed, as further elaborated in Mor et al. (2012). The methodology involved three full-day workshops, including homework. A crucial lesson learnt in this project was that the participants were not confident enough to write or refine patterns by themselves. They brought ideas but needed support to process them into patterns. Therefore, the creation of design patterns is not intuitive and instead requires the efforts of designers (Mor et al., 2012).

2.1.3 Contemporary research on pedagogical patterns
Efforts in assembling good experiences of the use of technology in education in design patterns are not limited to the past. The first research part of this dissertation is a clear example. However, there are today fewer contemporary publications focused on the subject.

Many design patterns written by previously mentioned projects and authors can still be found in the wiki Open Pattern Repository for Online Learning Systems4 (for a background, see Inventado & Scupelli, 2015). These patterns are available, not only for use, but also for further elaboration by anyone with an interest. However, no additions have been made to the repository since 2017.

The potential of the design pattern approach is still made relevant in contemporary research articles, providing the same argument about the potential to collect good ideas and articulate them in a format so that they can be shared. A recent example is given by Sun (2020), the author arguing that the pattern approach has the possibility of supporting the representation and sharing of task design in computer-assisted language learning (CALL). Another is the research conducted by Knutsson and

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4 Open Pattern Repository: [https://www.learningenvironmentslab.org/openpatternrepository/Main_Page](https://www.learningenvironmentslab.org/openpatternrepository/Main_Page)
Ramberg (2018), in which a pattern language was created by teachers in the 7th to 9th grades on the basis of perceived relationships, thereby defining different categories of patterns. An example of how available patterns can be used to support educational purposes other than the dissemination of good teaching ideas is provided by Fioravanti and Barbosa (2018). Through a systematic review of available pedagogical patterns, the two authors located 312 patterns relevant to the use of mobile technology. The purpose of the collection of patterns is to be able to inform the authors about problems that teachers experience in teaching, which in turn can support the development of mobile learning applications.

Nevertheless, not only have Alexandrian design patterns been criticised, but pedagogical patterns as well. The core argument is that pedagogical patterns are limited to accounting for an insular part of a learning experience and can therefore only function as a catalyst, or stimulus, for a complete design for teaching (Scott et al., 2007). On the other hand, it may be desirable for pedagogical patterns to be perceived as ‘stimuli’, because it is unlikely that a coherent lesson plan can be copied. One teaching context is never the same as another.

The purpose of the pedagogical pattern framework to contribute to an extended and pedagogically motivated use of technology in teaching has thus with few exceptions repeatedly been emphasised in the literature. Moreover, the approach involving structured design support for teachers is still relevant to research related to the Learning Activity Management System (LAMS) and Learning Designer, in which complete lessons and courses can be designed. These are introduced in the next section. First is LAMS, a design support tool that has been active for some years.

### 2.2 Learning design and design support tools

The most well-known tangible forms of support for the use of technology in teaching are, besides design patterns, online design support tools (Masterman & Manton, 2011). These tools are significant examples of LD research specifically.

LD is an offshoot of instructional design (ID). However, whereas ID is positioned as a science for educational planning in general, LD concerns research regarding teachers’ lesson planning (Seel et al., 2017). Persico and Pozzi (2015) explain that ‘while ID mostly focuses on methodological support to make the design process more systematic, LD researchers mostly work towards the objective of making already produced designs easier to share and reuse’ (p. 233). LD is moreover said to have a ‘mind-set where the emphasis is on the goal (i.e., learning) rather than the approach (i.e., instruction)’ (Wasson & Kirschner, 2020, abstract). In conclusion, LD strives to apply a bottom-up approach in which teachers create learning designs that can be used by other teachers. Three kinds of interventions with the purpose of supporting teachers’ planning have been identified:
1. Designs can be represented in systematic ways that formally document their pedagogic features.

2. Representations can be shared for other teachers to adopt and adapt to their contexts, to improve and share again.

3. Technology tools can be developed to support creation, representation, sharing and adaptation of designs.

(Bennett et al., 2018, p. 1017)

The first category aims to offer systematic support by providing different models. Examples are Learning Designer\(^5\) (Laurillard et al. 2018) and pedagogical patterns (Mor et al., 2014a).

Through research regarding the second category, the outcomes of teachers’ systematic approach – i.e. learning designs – are made available in textual publications or on the Internet, so that they can be shared and accessed and thus adopted or adapted. Both Learning Designer and pedagogical patterns constitute examples.

Research concerning the third category encompasses web-based applications, exemplified by Learning Designer, in which users may create and/or adapt learning designs. These are referred to as design support tools by Masterman and Manton (2011) in order to emphasise the creative element of teachers’ planning in an online environment. No dedicated software has yet been created for pedagogical patterns, although digital repositories are available.\(^6\)

The similarities and differences of pedagogical patterns and design support tools may be further explained. Pedagogical patterns provide a technique for the identification of a pedagogical problem and a suggestion for a suitable solution in a structured format. A pedagogical pattern hence describes a learning design that can be shared. Design support tools allow teachers to describe learning activities and complete lesson plans or courses in a structured format that is accessible online. Learning designs are thus created that can be shared.

LAMS,\(^7\) a design support tool currently in use, was introduced 2003 (Dalziel, 2011). The teacher designs lessons using predefined objects or building blocks that are drawn into a workspace and arranged in the event order of the lesson or the lesson unit (Figure 3). Stored sequences can be redesigned by teachers to fit the actual context. Another feature of the tool is that students may access the online environment and work through assigned lesson plans.

\(^{5}\) Learning Designer: [https://www.ucl.ac.uk/learning-designer/](https://www.ucl.ac.uk/learning-designer/)

\(^{6}\) Open Pattern Repository: [https://www.learningenvironmentslab.org/openpatternrepository/Main_Page](https://www.learningenvironmentslab.org/openpatternrepository/Main_Page)

Learning Patterns: [https://meta.wikimedia.org/wiki/Learning_patterns](https://meta.wikimedia.org/wiki/Learning_patterns)

\(^{7}\) LAMS: [https://lamscommunity.org/](https://lamscommunity.org/)
A new version was released late in 2019 and sequences were still being added to the repository as of July 2021. Of 2,400 available lessons, more than half are Greek contributions, indicating a specific popularity among teachers in Greece. Many of the contributions have gained interest and are downloaded, but the extent to which they are used cannot of course be distinguished.

2.2.1 Further development of patterns
Even though it is possible to perceive that interest in pedagogical patterns has cooled somewhat, it is clear that LD as a field of research is alive and well. Moreover, design patterns have been incorporated into Learning Designer and the Integrated Learning Design Environment. In the following, these two design support tools shed light on how they are associated with design patterns.
Learning Designer

The Learning Design Support Environment (LDSE) was developed to allow educators to create, review, revise and share learning designs. It started as a project for elaborating how design patterns can be helpful for the dissemination of good teaching practice. For two reasons, researchers have opted to re-define the pattern approach, with the arguments that the original design patterns were a) not oriented towards learning outcomes and b) not explicit about their pedagogical properties (Laurillard & Ljubojevic, 2011). To remedy the first of these shortcomings, a new structured format was created to meet the requirements (Figure 4).

Figure 4
Screenshot of the LDSE pedagogical pattern template

<table>
<thead>
<tr>
<th>Title</th>
<th>Usually the working title for the pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>Structured summary of the following form: To what End by What Means; this will potentially be used by the search engine to make inferences about the functional orientation and character of the pattern.</td>
</tr>
<tr>
<td>Rationale</td>
<td>Pedagogical rationale providing learning theory justification that links learning outcome with the pedagogical method</td>
</tr>
<tr>
<td>Learning outcomes:</td>
<td>Higher Cognitive Skill learning outcome(s), most commonly of the following form: To Be Able To Perform/Apply/Resolve etc.</td>
</tr>
<tr>
<td>Sequence of Activities</td>
<td>Ordered and timed sequence of Teaching and Learning Activities, each interpreted for the type of Conversational Framework activity it represents</td>
</tr>
<tr>
<td>Type of Assessment:</td>
<td>How can we prove that the learning outcome is achieved</td>
</tr>
<tr>
<td>Time</td>
<td>Duration of the TLAs sequence that executes this pattern</td>
</tr>
</tbody>
</table>

Note. Laurillard & Ljubojevic (2011, p. 56)

The problem section of Alexandrian design patterns corresponded to the LDSE format regarding ‘learning outcomes’, while the solution corresponded to ‘sequence of activities’. The context was represented by the pattern as a whole. Hence, the explicit problem-solving aspect of patterns was abandoned.

Furthermore, the inability of design patterns to define pedagogy was another limitation identified. The Conversational framework was developed in response to deal with the limitation as it is able to visualise and represent the complexity of ‘what it takes to learn, and therefore what it takes to teach’ (Laurillard, 2012, p. 93). Its purpose was to depict the pedagogical properties of the design. Six types of learning were delimited through the continued elaboration of the framework: ‘Acquisition’ (i.e. to read/watch/listen), ‘Collaboration’, ‘Discussion’, ‘Investigation’, ‘Practice’ and ‘Production’ (Laurillard, 2012).

8 https://sites.google.com/a/lkl.ac.uk/ldse/
Eventually, the LDSE evolved into Learning Designer (Figure 5) and, accordingly, the explicit connection to the pattern frame ceased altogether, although it is still part of the concept (c.f. Laurillard, 2018).

Learning Designer is today a free online tool for blended learning, where teachers can author learning designs by selecting activities characterised by any of the six learning types and among elements such as topic, level, outcomes, activities, group size, duration, resources and distribution of activities (Laurillard, 2012).

**Figure 5**
Example of the Learning Designer interface

![Learning Designer interface](image)

*Note. Laurillard et al. (2018, p. 6), used with permission*

The details necessary to complete a learning design mean that designers require a considerable amount of time when using the tool. Nevertheless, as of July 2021, there were over 1,200 contributions, with new designs constantly added. It is not possible to view the number of downloads, however. Moreover, it is unknown how the learning designs are used by other teachers.

**The Integrated Learning Design Environment**
A group of researchers (Hernández-Leo et al., 2018) wanted to deal with certain shortcomings they had identified with LD, resulting in the Integrated Learning Design
Environment (ILDE). The disadvantages they claimed to have managed included the inflexibility of other tools and their inability to handle larger parts of teachers’ planning cycle. They described ILDE as:

- a community system that satisfies users’ needs in terms of effectively supporting the whole learning design life cycle (from conceptualization to deployment) and the practitioners’ community development. (Hernández-Leo et al., 2018, para. 5)

Flexibility was achieved by a user-centred approach via the involvement of participant stakeholders (representing higher, adult and vocational education) in a three-iteration design-based research project, eventually leading to the release of ILDE. The stakeholders explained, for example, that they wanted a future design support tool that would be easy to work with, allow access to a variety of tools and features and facilitate the emergence of a supporting community.

Four groups of tools are intended to guide the user through a complete cycle: ‘Conceptualize’, ‘Author’, ‘Implementation’ and ‘Project’. The Conceptualize tool is most relevant in the context of this thesis. Its purpose is to provide the teacher with a set of opportunities to reflect on their current practice and the needs of their students, and to sketch out an idea for the final learning design. The tool involves another four options: ‘Prepare’, ‘Sketch’, ‘Reflect and ‘Other’ (Figure 6). To reflect on the problem space of teachers’ practice, the tool provides different resources, as design patterns, for instance.

**Figure 6**
ILDE workspace demonstrating the choices the designer can make, including the ‘Design Pattern’ option

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9 https://ilde.upf.edu
The ‘Design Pattern’ option has a condensed format, involving the sections ‘Name’, ‘Problem’, ‘Context’, ‘Solution’, ‘Examples’ and ‘Data and References’ (Figure 7). Each section is given an explanation so that the contributor can understand their purpose.

The researchers’ evaluation of ILDE’s ‘Conceptualize’ tool proved satisfactory, with ratings on a five-point Likert-scale of around 4.0 for ease of use and overall usefulness (Hernández-Leo et al., 2018). The researchers also reported that ‘Design Patterns’ was among the most used features.

The collaboration of designers is made possible through ILDE because the tool features Google Drive applications that allow a group of users to cooperate in the development of various phases of the design cycle. Moreover, learning and teaching analytics have recently been added to the ILDE tool (Michos & Hernández-Leo, 2020). Teachers may for example be informed of patterns regarding their use of the features available. However, some participants invited to learn how to use ILDE dropped out, supposedly because they were not ‘comfortable with the overall approach and activities’” (Garreta-Domingo et al., 2018, p. 1119).

Figure 7
Screenshot of the ‘Design Pattern’ workspace in ILDE

The overall impression is that ILDE represents a complex tool that takes considerable time for teachers to grasp. As of July 2021, there were 740 designs available. However,
most of the later contributions are not learning designs, but rather display adverts for shops, games, digital devices and more. Such a misuse of an ambitious tool is of course unwanted and shows the need for platform maintenance.
3 Theoretical perspectives and frameworks

The argument for starting the I Use IT project was that the creation of design patterns would contribute to an improved use of technology in schools. Although the intervention per se was not studied, it provided my research with pedagogical patterns that could be examined further and used by teachers unfamiliar with the project.

The content of the patterns was analysed in terms of both pedagogy and students’ development of digital competence. It was considered fruitful to distinguish the inherent pedagogy, in order to learn what guidance a specific pattern provides in terms of enactment. Furthermore, understanding what digital competence patterns can develop in students was considered important to discern. At the start of the project, it was stated in the national curricula of the time (Swedish National Agency for Education, 2013) that students would develop digital competence. The argument that teachers are designers is further accounted for by providing perspectives on how teachers carry out design work.

3.1 Pedagogy

Owing to cultural differences, there are differences in how to approach teaching and learning from both a scientific and a practical perspective. On the one hand, there is the Anglo-American tradition, while on the other, there is the Central European and Scandinavian tradition (Hamilton, 1999; Hudson, 2016; Wyse et al., 2016), henceforth exemplified by the Swedish perspective. In summary, the first perspective studies pedagogy and didactics, or didaktik which is suggested as a term without negative implications (Hamilton, 1999; Hudson, 2016; Wyse et al., 2016). The second perspective studies curricular and instructional design.

The term pedagogy, for instance, has different meanings between the two educational cultures. In Sweden, pedagogy is generally concerned with learning and consequently with learning theories, while didactics is the domain that is related to teaching. By contrast, the Anglo-American definition relates pedagogy to teaching. Merriam-Webster, for instance, defines pedagogy as the ‘art, science, or profession of teaching’ (Merriam-Webster, n.d.), whereas the Oxford English Dictionary (n.d.a) adds to the same definition ‘the theory or principles of education; a method of teaching based on such a theory’, which can be assumed to refer to instructional theories. In sum, the
concepts somewhat overlap and it is hardly possible to claim that the difference is maintained in every aspect of research on teaching and learning. For instance, research on instructional theory has received greater interest since the 2000s in Sweden (Mickwitz, 2015).

Specific to the Anglo-American tradition is that instructional design provides teachers with methods and strategies in the form of guidelines for teaching to suit a certain learning objective (Zierer & Seel, 2012). The autonomy of teachers is nevertheless an aspect that influences the final decision on how to enact teaching. Didactics, applied by practising teachers in Sweden, support planning in such a way that teachers explicitly are encouraged to reflect on key issues including what the teaching should address, why this choice is relevant and how the teaching should be carried out (Lindström & Pennlert, 2019).

Regardless of the prevailing perspective on teaching and learning in teachers’ working contexts, teachers rarely reflect on learning theories (Bennett et al., 2015; Nguyen & Bower, 2018; Säljö, 2015). Instead, teachers tend to rely on their accumulated experiences. These experiences, summarised as ‘beliefs’ are based both on teachers’ personal epistemological assumptions and on values expressed in the curriculum, and forms an image of learning and teaching, of students and educational context that affect the pedagogical decisions that teachers make (Livingstone, 2016; Tondeur et al., 2017).

The connection between practice and theory is widely accepted (Phillips & Soltis, 2015; Schunk, 2012). Despite culturally different understandings of ‘pedagogy’ (and different emphasis on related concepts), ‘pedagogy’ in this dissertation therefore includes an understanding of practice as a reflection of learning theories. Thus, learning theories can be distinguished by analysing learning activities designed by teachers as suggested by Conole et al. (2004, 2012).

3.1.1 Frameworks that depict learning and teaching

That pedagogy may be discernible in learning activities is confirmed by the work of Dobozy and Dalziel (2016). These authors aimed to demonstrate how pedagogical perspectives – behaviourism, cognitivism and constructivism/connectivism – can be articulated in the design of learning activities, convinced that ‘epistemological and ontological assumptions that guide a lecturer’s belief about good teaching are most often aligned with specific learning theories’ (p. 10). To prove their idea, they created different activities that they argued were based on different perspectives.

In order to infer pedagogy in pedagogical patterns, Krathwohl’s (2002) revision of Bloom’s taxonomy supports teachers’ identification of one of four knowledge aspects (factual, conceptual, procedural, metacognitive) and one of six cognitive objectives (remember, understand, apply, analyse, evaluate, create). Given that the two
dimensions together aim to target intended learning outcomes, the framework is not suitable for inferring pedagogy.

Bower et al. (2010) have developed ‘online pedagogies’ and explain how four kinds of pedagogies are related to activities that can be performed by using Web 2.0 technologies. (Table 2). However, the framework is not useful in my research context as it simplifies the pedagogical content of learning activities. Technology can be used for different purposes and in different ways and thus also change the pedagogy that in the framework is reserved to a certain kind of information technology (IT)-supported technology.

<table>
<thead>
<tr>
<th>Online pedagogy and authors (p. 182)</th>
<th>Explanation (p. 188-189)</th>
<th>IT-supported activities, examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transmissive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magliaro et al., 2005</td>
<td>‘early stages of learning to provide orientation and prerequisite information’</td>
<td>N/A</td>
</tr>
<tr>
<td>Collins et al., 1991</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dialogic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vygotsky, 1978</td>
<td>‘providing students with the opportunity to more tightly define concept boundaries and negotiate meaning’</td>
<td>microblogging blogging</td>
</tr>
<tr>
<td>Laurillard, 2002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waite et al., 2003</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Constructive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Papert, 1986</td>
<td>‘enabling students to demonstrate their understanding in an integrated and contextualised fashion’</td>
<td>image creation podcasting</td>
</tr>
<tr>
<td>Willett, 2007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clements, 2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Co-constructive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neale et al., 2004</td>
<td>‘utilising socio-constructivist approaches to enable students learn while creating together’</td>
<td>wikis document sharing</td>
</tr>
<tr>
<td>Mayer, 2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willett, 2007</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The six learning types described by Laurillard (2012) – Acquisition, Collaboration, Discussion, Investigation, Practice and Production – were also considered for examining pedagogy in pedagogical patterns. Given that these types are associated with recurring and regular teaching-learning activities, they are not explicitly linked with a specific learning theory. Hence, the six learning types were not applicable for the examination of pedagogical patterns.

Therefore, by adapting the framework developed by Conole et al. (2004), it became possible to gain insights into the pedagogical approaches intended to support students’ learning as expressed in the pedagogical patterns.
3.1.2 The model of pedagogy

The model of pedagogy is a framework developed by Conole et al. (2004) to help teachers map the learning theories that underpin their planned learning activities. The model is described as a ‘toolkit’, but may in addition be used for ‘locating learning theories through the identification of key learning characteristics’ (Conole et al., 2004, p. 22), which is applicable to my analysis of pedagogical patterns.

The model was constructed first through identifying the learning theories Conole and colleagues considered relevant for technology use in teaching and that are possibly present in learning activities (Table 3). The selection revealed that these authors were keen for the model to represent a broad approach to learning. However, given that the framework was developed in the early 2000s, the authors had not yet been introduced to connectivism (Downes, 2005; Siemens, 2005), a learning theory that is explicitly linked to technology.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Representatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviourism</td>
<td>Skinner, Tennant</td>
</tr>
<tr>
<td>Cognitive</td>
<td>Anderson, Wenger, Hutchins, Piaget</td>
</tr>
<tr>
<td>Constructivism</td>
<td>Papert, Duffy &amp; Jonassen</td>
</tr>
<tr>
<td>Activity-based</td>
<td>Vygotsky, Wertsch, Engestrom</td>
</tr>
<tr>
<td>Socially situated learning</td>
<td>Mercer, Vygotsky, Laurillard, Lave,</td>
</tr>
<tr>
<td></td>
<td>Wenger</td>
</tr>
<tr>
<td>Experiential learning</td>
<td>Dewey, Kolb, Jarvis</td>
</tr>
<tr>
<td>Systems theory</td>
<td>Senge, Laurillard</td>
</tr>
</tbody>
</table>

*Note. Adapted from Conole et al., 2004, pp. 19–21*

The next step in the process was to identify common and key components of learning, which were grouped into three spectra (Table 4). They hence represent opposite positions but allow for continuity between the components.
Table 4
Key components of learning, arranged in three spectra

<table>
<thead>
<tr>
<th>Spectrum 1</th>
<th>Individual – Where the individual is the focus of learning. Social – Learning is explained through interaction with others (such as a tutor or fellow students), through discourse, collaboration and the wider social context within which the learning takes place.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum 2</td>
<td>Reflection – Where conscious reflection on experience is the basis by which experience is transformed into learning. Non-reflection – Where learning is explained with reference to processes such as conditioning, preconscious learning, skills learning and memorisation (Jarvis et al., 1998).</td>
</tr>
<tr>
<td>Spectrum 3</td>
<td>Information – Where an external body of information such as text, artefacts and bodies of knowledge form the basis of experience and the raw material for learning. Experience – Where learning arises through direct experience, activity and practical application.</td>
</tr>
</tbody>
</table>

Note. Adapted from Conole et al. (2004, pp. 22–23)

When the key components are arranged in an octahedron (Figure 8), Conole et al. (2004) are able to visualise not only the continua but also the space inhabited by the learning activity.

Figure 8
Representation of the model of pedagogies as an octahedron

Note. Adapted from Conole et al. (2004, p. 24).
How learning theories can be mapped in the model is exemplified by the authors:

Kolb (1984) use of Lewin’s experiential learning cycle can be mapped within the framework as the individual connecting abstract concepts (Information) with observation and reflection (Reflection) and concrete experience gained through the testing of concepts in situations (Experience). Behaviourist approaches can be mapped as being located between the Individual’s exposure to stimulus and response (Information) which produces a form of learning such as conditioning which is essentially pre-conscious (Non-reflective).

(Conole et al., 2004, p. 24)

Conole et al.’s (2004) model is of course limited by the fact that the six key components represent the developers’ perspective. Other components may be considered, such as creativity and productivity, both of which can be distinguished from the learning theories building the model and which today are considered important skills for students to develop. Even so, the model depicts selected aspects of learning that can provide important insights into the pedagogy of learning activities. In the context of this thesis, the model contributes to an understanding of how the six key components are related to learning activities found in pedagogical patterns.

3.2 Digital competence

Given that pedagogical patterns contain learning activities that make use of technology, they give students the opportunity to develop their digital competence and skills as requested by for instance Siddiq et al., (2016). To infer the kind of digital competence that students can develop, a suitable framework defining digital competence was sought. However, the term digital competence has been described as ‘a multi-faceted moving target’ (Ferrari, 2012, p. 11). Depending on the objective for a definition, the concept changes.

Before the mastering of technology came to be associated with competence or skills, a transfer of the literacy concept into the digital sphere was suggested: Literacy basically entails the situated decoding and encoding of written text, but when transferred to technology, multiple literacies were identified at first: digital literacy, computer literacy, visual literacy, media literacy, information literacy and ICT literacy (c.f. Belshaw, 2012; Buckingham, 2006; Martin, 2006). The most common term of these was digital literacy (Ilomäki et al., 2016), which besides encoding and decoding skills involved the ability to communicate through digital devices and applications (Ferrari, 2012).

In 2016, Ilomäki et al. (2016) expressed their dissatisfaction with the lack of a uniform concept, following a thorough review of articles on the matter (Figure 9).
As an illustration, they encountered 34 different terms, 17 of which were used only once. The data were sorted according to their connection to the four research domains encountered (Figure 9): media, technology, literacy and library. Information literacy was for instance first defined in 1998 by the American Association of School Librarians (AASL) and later developed into *The Standards for the 21st Century Learner* (Pérez-Escoda & Fernández-Villavicencio, 2016). Ilomäki et al. (2016) proposed the widespread application of the term *digital competence* – as presented at the centre of Figure 9 – while conceptualising it as a boundary object that would prove useful in any context.

Ferrari (2012) reached roughly the same conclusion by seeing digital competence as a term that brings together media, information, Internet and ICT skills. However, Ferrari additionally demonstrated that digital competence does not only entail the skills of the digital user. Indeed, given that technology is embedded in the social environment, certain attitudes are needed in order to develop competence. Hence, acquiring digital competence ‘entails a specific way to act and interact with technologies (and therefore it requires specific attitudes), of understanding them (and therefore holding specific knowledge), of being able to use them (and therefore having specific skills)’ (Ferrari, 2012, p. 19).
3.2.1 Digital competence in Swedish K-12 education
A large curriculum reform, initiated by the national government and prepared by the Swedish National Agency for Education, also involved a new curriculum for upper secondary education in 2011. It included few instructions on the use of technology, mainly prescribing an education in which students would be allowed to develop their ability to use digital technology (Swedish National Agency for Education, 2013).

In an attempt to strengthen the Swedish position as a leading country in terms of digitalisation, the Digitisation Commission was appointed by the government to investigate the matter carefully. In its comprehensive report, the Commission defined, among other things, digital competence as ‘the extent to which you are familiar with digital tools and services and have the ability to keep pace with digital development and its impact on your life’ (Digitaliseringskommissionen, 2015, p. 102). This definition was supplemented with four specific competencies (p. 103):

- knowledge to search for information, communicate, interact and produce digitally;
- skills to use digital tools and services;
- understanding of the transformation that digitalisation entails society with its opportunities and risks;
- motivation to participate in development.

Based on the Commission’s work, the Swedish government two years later presented a strategy aimed at digitalising the K-12 school system. It stated that children and adolescents must be given the conditions to develop adequate digital competence (Ministry of Education and Research, 2017). Following the formulation of the general strategy, the Swedish National Agency for Education was commissioned to promote digitalisation in schools. After revising all K-12 curricula, the curriculum for upper secondary education now states that all students ‘can use digital as well as other tools and media for knowledge seeking, information processing, problem solving, creation, communication and learning’ and ‘must also be given the opportunity to develop a critical and responsible approach to digital technology, to be able to see opportunities and understand risks and to be able to evaluate information’ (Swedish National Agency for Education, 2019a).

The Agency’s latest report at the time of writing this thesis, which focuses on digitalisation in schools, is based on data that were collected prior to the launching of the strategy. The report mirrors the current curriculum as it addresses the same elements of digital competence: 1) to assess and interpret media and information; 2) to retrieve information; and 3) to produce digital content (Swedish National Agency for Education, 2019b). The safe use of the Internet is not mentioned explicitly in the curriculum, but advancements concerning the issue were nevertheless reported.
Given that Swedish descriptions of digital competence are not based thoroughly on empirical research, I have sought a framework that is developed in the light of the broad knowledge that exists in the field. DigComp met the requirement and is presented below.

3.2.2 DigComp
The European Digital Competence Framework for Citizens (DigComp) has relevance for European countries (Vuorikari et al., 2016). The framework is political as it defines the desired competence of citizens, which should benefit the prosperity of the EU member states. However, the framework has its roots in education, as it develops further one of the eight ‘Key Components for Life Long Learning’ declared in 2006 by the European Commission (2007).

The DigComp project was launched by the Commission in 2011. The aim was to identify the key elements of digital competence and to suggest descriptors allowing for its validation.

The development of the final framework involved an investigation of hundreds of digital literacy frameworks and other kinds of initiatives, of which 15 were thoroughly analysed (Ferrari, 2012). Seven components were found describing knowledge, attitudes and skills related to digital competence:

1. Information management
2. Collaboration
3. Communication and sharing
4. Creation of content and knowledge
5. Ethics and responsibility
6. Evaluation and problem solving
7. Technical operations

Moreover, 95 experts in the field met online ‘to establish common ground of what really means to be digitally competent’ (Pérez-Escoda & Fernández-Villavicencio, 2016, p. 621). Eventually, the project was able to produce a definition of digital competence:

Digital Competence is the set of knowledge, skills, attitudes (thus including abilities, strategies, values and awareness) that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socialising, consuming, and empowerment.

(Ferrari, 2012, p. 43)
Furthermore, 21 competencies were identified, sorted into five competence areas (Table 5).

DigComp thus represents an effort to bring together various understandings of digital competence. However, as soon as 2018, the DigComp framework was elaborated by the United Nations Educational, Scientific and Cultural Organization (UNESCO), resulting in the Global Framework Reference on Digital Literacy Skills (Law et al., 2018). This framework consists of seven areas, including 26 competencies. The most important addition concerns the first area (‘Devices and software operations’) and the seventh and final area (‘Career-related competencies’).

DigComp is, however, highly relevant in a Swedish context because of the country’s EU membership. Swedish educational policy is therefore expected to implement the framework in this country, especially given the follow-up publication concerning the framework on digital competence for teachers, the European Framework for the Digital Competence of Educators: DigCompEdu (Redecker, 2017). This explicitly addresses learners’ digital competence and explains that teachers should facilitate learners’ development of the digital competencies described in DigComp.

With its roots in broad research, DigComp is considered a suitable framework for the analysis of students’ digital competence training.

### Table 5

**DigComp 2.0 - the Conceptual Reference Model (Vuorikari et al., 2016)**

<table>
<thead>
<tr>
<th>Competence areas</th>
<th>Competencies</th>
</tr>
</thead>
</table>
| **1. Information and data literacy** | 1.1 Browsing, searching and filtering data, information and digital content  
To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies. |
| 1.2 Evaluating data, information and digital content  
To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content. To analyse, interpret and critically evaluate the data, information and digital content.  
1.3 Managing data, information and digital content  
To organise, store and retrieve data, information and content in digital environments. To organise and process them in a structured environment. |
| **2. Communication and collaboration** | 2.1 Interacting through digital technologies  
To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.  
2.2 Sharing through digital technologies  
To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices. |
2.3 Engaging in citizenship through digital technologies
To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies.

2.4 Collaborating through digital technologies
To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.

2.5 Netiquette
To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments.

2.6 Managing digital identity
To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services.

3. Digital content creation

3.1 Developing digital content
To create and edit digital content in different formats, to express oneself through digital means.

3.2 Integrating and re-elaborating digital content
To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.

3.3 Copyright and licences
To understand how copyright and licences apply to data, information and digital content.

3.4 Programming
To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.

4. Safety

4.1 Protecting devices
To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy.

4.2 Protecting personal data and privacy
To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a “Privacy policy” to inform how personal data is used.

4.3 Protecting health and well-being
To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies for social well-being and social inclusion.

4.4 Protecting the environment
To be aware of the environmental impact of digital technologies and their use.
5. Problem solving

5.1 Solving technical problems
To identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems).

5.2 Identifying needs and technological responses
To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility).

5.3 Creatively using digital technologies
To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.

5.4 Identifying digital competence gaps
To understand where one’s own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.

3.3 Teaching and design

Literature indicating that teachers and teaching are related to design is found in the two concepts *teachers as designers* and *teaching as design* (both abbreviated to TaD). It should be adequate to argue that upon indicating a relationship, the TaD literature implies a certain knowledge of how teachers design.

This section first presents an overview of how design is generally defined by traditional design researchers. Properties related to design are then presented alongside the TaD perspective regarding the same properties. Thus, any deviations and similarities can be distinguished. By identifying the abilities involved, it is also possible to describe what teachers need in order to be perceived as designers.

3.3.1 Defining design
To define the word *design*, there is a need to be wordy. One reason is that design is both a verb and a noun. When used as a verb, possible synonyms include, according to the Oxford English Dictionary, to produce, to conceive, to devise and to plan. The act of designing can be done with physical materials such as pens and laptops, or mentally, as the dictionary says, ‘[t]o form a plan or scheme; to conceive and arrange in the mind’ (n.d.b).

What is produced or formed when designing constitutes the noun and may be something either physical or immaterial, like a scheme, a system, or a programme. Related to education, we can think of teachers designing artefacts such as written lesson
plans, educational games and presentations, hence the outcome is physical. However, teachers may also design lesson plans or arrangements of physical learning environments in their heads.

The definitions of design that are offered by researchers in traditional design fields, such as industrial design and architecture, are consequently quite abstract. Daniel Edelson (2002), for example, states that design is ‘a sequence of decisions made to balance goals and constraints’ (p. 108), while Herbert Simon (1996) describes design as ‘the act of envisioning possibilities and elaborating them’ (p. 164). A third example is given by Lawson and Dorst (2009), who describe design as a ‘mix of rational, analytical thinking and creativity’ (p. 28).

Regarding a definition of design practice, Donald A. Schön (1983) adds a reasoning about professional practitioners, exemplified by engineers, teachers and lawyers, that is, any ‘specialist who encounters certain types of situations again and again’ (p. 60). What professional practitioners have in common concerning design is that they respond to recurrent situations that they encounter and their responses are based on their knowledge of the domain and their accumulated experiences. This know-how of professionals, Schön terms knowing-in-practice.

He develops a repertoire of expectations, images, and techniques. He learns what to look for and how to respond to what he finds. As long as his practice is stable, in the sense that it brings him the same types of cases, he becomes less and less subject to surprise. His knowing-in-practice tends to become increasingly tacit, spontaneous, and automatic, thereby conferring upon him and his clients the benefits of specialization.

(Schön, 1983, p. 49)

It is fair to expect that design is often used as a verb, because ‘design’ is commonly used for describing the ‘doing’ and ‘making’ of physical objects and immaterial ‘things’. However, it should not be sufficient to refer to TaD merely because teachers make something that supports learning. Any research article that aims at advancing knowledge of any kind needs to provide a theoretical foundation for the research and, similarly, in research about design and designers, the central concepts can be expected to be placed in the context of the design field. Considering that the ‘type of knowledge required for design and teaching is similar’ (Pareto & Willermark, 2019, p. 1194), such a request should be relevant.

3.3.2 Introducing perspectives on TaD
First, overarching opinions found in three scholarly essays introduce the perspectives that are reflected in the literature on TaD.

In the case of higher education, Goodyear (2015) claims that teachers must acquire design knowledge to accomplish learning designs and understanding of
teaching as design. The reasons, Goodyear explains, is that new student cohorts demand of teachers that they understand their needs and can deliver appropriate education. Moreover, the affordances of emerging technologies must be exploited. Thus, new pressures are imposed on teachers.

According to McKenney et al. (2015), teachers have design competence, acquired through experience, which should be further supported by research. Kirschner (2015), on the other hand, is hesitant about TaD and provides a kind of defence for teachers and their competence.

Teachers typically have little time, limited expertise, and rarely any formal endorsement for their design efforts. They are also one of the few, if not the only, professional group that in most countries does not have their own workspace or ‘down time’ during the day to maintain and increase the professionalism. Yet they must meet new demands placed upon them...

(Kirschner, 2015, p. 314)

Kirschner (2015) seems to be alone in providing a critical view regarding the contribution TaD can make to educational research, although criticism of models/tools is found in Bennett et al. (2018) as well. Indeed, these authors claim that ‘support tools and initiatives should align with the lifecycle of teacher design’ (p. 1021) and that the teacher perspective must be acknowledged. Teachers should furthermore have ‘agency in determining their own development goals and needs, rather than be limited by the pre-planned/pre-determined professional development that an institution assumes teachers need’ (p. 1022).

3.3.3 Central design topics

This section introduces various subjects that design researchers commonly address. The first topic is problem-solving, which can be considered one of the most central issues for research in design. The other three – design processes, design models and the characteristics of a designer and the choice of strategies – are areas that should also be relevant for research within TEL and in particular for research within LD. First, the traditional design research perspective is summarised. Second, what literature on TEL has found with respect to the same aspect is provided.

Problem-solving – traditional design perspective

A recurring discussion among researchers of design is centred on the question of the validity of problem identification and solution generation in design processes. For Simon (1996), design is about framing the problem in order to be able to work on the solution. Kruger and Cross (2006), on the other hand, claim that designers have individual ways of approaching the problem and working on the solution. Hence, designers may be either problem-oriented, meaning that designers start a design...
process by analysing the problem thoroughly, or solution-oriented, emphasising the generation of solutions. Both approaches render designs of quality and, accordingly, there is no preferred orientation to pursue (Kruger & Cross, 2006). It must however be emphasised that ‘design includes problem-solving, but it cannot be reduced to problem-solving’ (Dorst, 2006, p. 13). This is so because design concerns wicked problems (Cross, 2018; Rittel & Webber, 1973) that are utterly complex and need to be carefully framed and reframed in order to distinguish strategies for dealing with them (Beckman & Barry, 2012). Therefore, how problems are perceived has to be ‘through the eyes of the designer’ (Dorst, 2004, para. 29).

**Problem-solving – TEL perspective**

That problem-solving is a feature that teachers engage in when designing learning activities has been acknowledged, but not significantly examined (e.g. Bennett et al., 2018; Michos & Hernández-Leo, 2020; Michos et al., 2018; Svihla et al., 2015; Towndrow & Pereira, 2018).

By contrast, Jordan (2016) discusses problem-solving at length. In a design studio, teachers in training identified in collaboration ‘an authentic teaching-learning problem using a question form employed in design brainstorming: How might we . . .’ (p. 201). Furthermore, in Henriksen et al. (2018) the fundamental problem-solving aspect is enhanced as part of the Stanford Design Thinking Model, which consists of five phases. Following the first phase, ‘Empathising’ (with student perspectives), the second phase ‘Define’ involves individual teachers’ reflection regarding problems in their practice.

Pedagogical patterns accordingly emphasise the problem-solving aspect of teaching and learning matters, as thoroughly discussed in Goodyear (2005).

**Design processes – traditional design perspective**

What goes on during the doing or creation of a design is challenging to describe and has therefore long been explored and debated by researchers of design (Lawson & Dorst, 2009). The elusive characteristic of design may owe to the different conditions that characterise design processes, as has been suggested by Kimbell (2011). Design is either about giving form to objects or creating immaterial things. However, whatever the kind of artefact designed, the procedures vary within related design practices: ‘In some forms of design, the design procedure may be clearly articulated and followed, but many effective design processes are flexible and dynamic, meaning that the entire procedure cannot even be described until the design process is complete’ (Edelson, 2002, pp. 109–110) as illustrated in Figure 10.
According to Löwgren and Stolterman (2004), the design process is too complex to be described universally. Instead, the two authors understand the process as constituting three core levels of abstraction that the designer engages in throughout the process. A design situation produces the ‘vision’ level. This involves immediate yet unclear ideas that guide the design process further. An operative image is creatively developed in a dialectic process involving the vision and the design situation. The work done here at the second level is the most important part of the process as the image is gradually clarified. ‘Specification’ constitutes the third level, in which the designer has to account for every detail of the design and document so that it can continue to the fourth level, the ‘Construction’ phase. The design may need to be reconsidered and redesigned as a consequence of new ideas emerging during this phase.

**Design process – TEL perspective**

The fact that the methodology of the design studio pedagogy reported by Jordan (2016) was informed by traditional design research is made clear by the terms and concepts used. Students, for example, ‘sketch initial ideas, elaborating on and/or abandoning them over time, and, in later stages, create mockups for critique and further iteration’ (p. 202). Henriksen et al. (2018) also recognise the process as non-linear. Svihla et al. (2015) note that design studio pedagogy was used in a course for in-service teachers to develop design competence, indicating some kind of process thinking, but unfortunately, the method is described only briefly in the article. Nevertheless, in none of these studies do descriptions of the process appear as dynamic. Instead, the impression is that the processes are substantially linear, supposedly due to the application of a design process model.

A study reported of the design processes of pre-service teachers by inferring the teachers’ focus and influences during design work, consisting of outcomes, content, pedagogy, technology, context, student characteristics, and beliefs (Nguyen & Bower, 2018). The analysis made by Nguyen and Bower pays attention to group processes, but the creative design process is not the prime focus.
It appears as if the design process does not always require consideration of a series of related activities, although the TEL literature more or less considers design work an example of a process. What seem to be causing the confusion is that the word design mainly is used as a synonym to ‘doing’ and ‘making’ (e.g. Fowler-Amato & Warrington, 2017; Geiger et al., 2015; Pepin et al., 2017).

In contrast, essayists Bennett et al. describe design as an iterative process that ‘shapes the teacher as designer, building their stock of design experience and, potentially, their teaching repertoires’ (2018, p. 1020). That teachers are currently involved in design processes should therefore be recognised.

**Design process models – traditional design perspective**

Models are simplifications of theory (Seel et al., 2017) and theory may be adapted to the specific character of the design context. Hence, academia, industry and business may develop different models that suit their respective needs (Bobbe et al., 2016). It can roughly be said that early models supported a linear view of the design process, whereas current models emphasise iterative notations. However, business and industry usually follow a straightforward process that does not provide many flexible or iterative options (Bobbe et al., 2016, p. 1206).

In the realm of design thinking, Löwgren and Stolterman (2004) explain why linear models should be avoided:

> A good designer is not the one who best follows the prescriptive steps of a method or technique or the one who knows “the solution” in advance. Rather, a good designer can approach, appreciate, and assess a complex and unique design situation. Based on a creative idea, she can compose a design that fulfills and possibly surpasses the functional, structural, aesthetical, and ethical demands of the situation.

(Löwgren & Stolterman, 2004, pp. 43–44)

To ensure the utility of design-supporting models, Badke-Schaub and Voute (2018) demand empirical evidence and thus systematic research. In addition, the two authors claim that in the case that ‘design methodology is aiming to support the designer it is obvious that there is a primary need to understand the designers’ thinking and acting behaviour before further support can be derived’ (p. 29).

Despite different perspectives on the usefulness of models, there is general agreement that tools and techniques may support a creative design process. The techniques involve sketching, brainstorming, storyboarding, prototyping and more (Cross, 2018).

**Design processes models – TEL perspective**

In educational research, design process models may be understood as constituting almost the same as a learning design. However, both models and tools require work on
different stages. A difference is that design support tools allow the designer to in detail describe design items that are considered vital for a complete design for learning. Thus, the design support tools may generally be said to involve the specification of the design (see Löwgren & Stolterman, 2004).

Henriksen et al. (2018) argue that the applied Stanford Design Thinking Model ensures that novice designers can become acquainted with different design phases even though their future practice will not allow a linear design process. Therefore, design thinking empowers teachers, the researchers explain. Jordan expresses a similar view of the benefits that can be obtained from participating in a design pedagogy studio:

Cultivating adaptive practitioners through the professional preparation of teachers requires moving beyond helping novices efficiently take up other people’s designs to helping them engage in the kinds of thinking needed to generate innovative uses of their own knowledge.

(Jordan, 2016, p. 204)

By contrast, Bennett et al. (2017) believe that compulsory models do not function as support for teachers because the teachers’ design work is independent and cannot be adapted to their varied routines. Nor do teachers make systematic representations of their ideas themselves, although notes can be made.

**Designer characteristics and strategies – traditional design perspective**

As an effect of research in the design thinking field, our interest turns to the thinking of individual designers and the strategies they commonly use.

Professional designers can make decisions under difficult conditions involving wicked problems. They are inclined to reflect on experiences and thus build a knowledge repository that makes them capable of designing a response to the situations that emerge (Schön, 1983). This ability is shared with any other professional working under similar conditions, hence including for example software developers, architects, doctors, lawyers, urban planners and teachers. Herbert Simon similarly (1969) proclaims that ‘[e]veryone designs who style action aimed at changing existing situations into the preferred one’ (p. 55).

Designers apply personal principles that are constructed on the basis of a profound knowledge of the practice and that support the completion of a design. It is important to recognise that designers are considerably ‘free to design according to his taste, style and abilities’ (Dorst, 2004, para. 9) and hence the strategies used, the course of the whole design process and the outcomes attained will all differ.

A strategy is the above-mentioned problem-framing, which includes consideration of the specific design situation. It is a key activity that is often characterised by the designer’s personal motivation (Cross, 2018; Dorst, 2011). Another strategy concerns the use of individually constructed design principles that support the completion of a design (Cross, 2018). The principles are associated with a profound
knowledge of the domain as well as familiarity with the tools and resources available. The idea of design principles furthermore aligns with Schön’s (1983) notion of knowing-in-practice.

Divergent and convergent thinking is also an effective approach for exploring ideas and thoughts. Commonly, diverging is considered an essential design activity in which the designer generates different possible solutions. Beckman and Barry (2012) claim that it is essential to be able to remain in a divergent state when designing for wicked or multifaceted problems. The reason is that divergent thinking involves ‘identifying multiple alternative frames for the problem to be solved as well as multiple different solutions. It also entails leaving open the choice of a frame for the problem until enough has been learned about the implications of the alternatives to choose among them’ (Beckman & Barry, 2012, p. 370).

Differences among designers can be seen and it is common to attribute different competencies to novices and experts (Cross, 2018; Löwgren & Stolterman, 2004). Dorst (2004) distinguishes five levels of competencies, or abilities: novice, beginner, competent, proficient and expert. These differences lead to varied design processes because experts tend to be less focused on analysing the design problem, which is given greater attention by novice designers (Cross, 2018). Instead, expert designers explore the solutions thoroughly because they recognise the problem and therefore know where to look for solutions (Lawson, 1990).

In addition, Cross (2018) describes the innovative designer as a designer who is highly motivated by an ‘urgent necessity of designing’ (p. 74), that is, they are able to keep parallel perspectives on the problem simultaneously.

**Designer characteristics and strategies – TEL perspective**

A finding that relates to traditional design research concerns expert and novice designers, specifically that pre-service teachers are considered novice designers (e.g. Jordan, 2016; Nguyen & Bower, 2018). However, not only pre-service teachers are considered novice designers. Teachers in general may also be characterised as novice designers in the sense that they do not master all the parts of the design process (Adams et al., 2019; Henriksen et al., 2018). However, how novice and expert designers respond to training may be unsuspected, as developers of ILDE confirm:

On the one hand, participants with less formal training in education frameworks got the most out of the intervention. These “less knowledgeable” educators understood both the design process and how each design task fitted in it. They started with an educational challenge and iteratively defined a learning activity to address this challenge. On the other hand, participants with more knowledge of pedagogical approaches had a stronger focus on ICT tools, biased by their earlier experiences and knowledge, and they benefitted less from of the HCD approach and techniques. (Garreta-Domingo et al., 2018, p. 1125)
A common starting point for TaD research is that teachers need to adopt a new mindset, to transform from teacher-centred to student-centred learning and innovative pedagogy, or introduce 21st-century skills and thereby change their beliefs about teaching and learning (e.g. Garreta-Domingo et al., 2018; Kim, 2019; Lee & Kim, 2017). Changing teachers’ beliefs about teaching and learning is considered vital in the quest to improve teachers’ practice and thus enhance learning (e.g. Chai & Koh, 2017; Michos et al., 2018). It is further explained that studies show that teachers often take a pragmatic approach toward design: prioritizing the practical use of designs and privileging feasibility, in ways that are congruent with their own beliefs and convictions. (McKenney et al., 2015, p. 189)

Professional designers consult their design principles as a strategy in the problem-solving process. Furthermore, it has been found that design principles are indeed considered a key support resource for supporting teachers’ design activities, but these principles have not been created on teachers’ own initiative. Instead, design principles form a part of the project launched at schools. Geiger et al. (2016) brought design principles with them to support teachers of subjects other than Mathematics so that they could implement numeracy in their teaching, while Cremers et al. (2017) have claimed that the design principles they brought from their research context into their project allowed teachers to ‘adapt or “translate” these results to their own needs and context’ (p. 206).

Lastly, divergent thinking is recognised by Jordan (2016) which sees a similarity of teaching and divergent thinking because teaching involves ‘integrating multiple perspectives, managing competing trade-offs, and making judgments about unknowns’ (p. 198).
4 Methodology

The research carried out and summarised in this dissertation can be described as explorative, which is applicable when researchers ‘have little or no scientific knowledge about the group, process, activity, or situation they want to examine but nevertheless have reason to believe it contains elements worth discovering’ (Stebbins, 2001, p. 5). Indeed, no previous research has reported complete pedagogical patterns or learning designs, or provided guidance on appropriate methods. Those that were eventually applied in the dissertation have their origins in educational research, interaction design research and design research.

Each article submitted as part of this thesis is motivated by a distinct aim. For the compilation, the following aim was chosen: ‘to understand how teachers work as designers by analysing details pertaining to the use of pedagogical patterns, that is, content and use’ (p. 6). A workshop series and a single workshop provided the data for qualitative analyses of collected artefacts and audio-recorded discussions during design work. Alternative methods could have been interviews about design work, the use of technology and pedagogical approaches. However, given that such methods have already been applied and reported in publications, a different approach to data collection was taken.

A multi-method research design was employed to achieve the aim, thus applying different qualitative methods (Table 6). Although content analysis was the prevailing method, two distinct kinds were applied: directed and summative (Hsieh & Shannon, 2005). In both cases, manifest and latent analyses of data were used (Terry et al., 2017). The manifest approach is applicable when meaning can be derived from explicit utterances or writing, whereas the latent approach is useful for interpretations of less explicit meanings. Directed content analysis is suitable for deduction and is used for thematic analysis (Clarke & Braun, 2006) and protocol analysis (Stempfle & Badke-Schaub, 2002). Both analyses extend the application of existing frameworks. Summative content analysis is also performed and involves manifest analysis for the quantification of words and latent analysis for understanding the use of the pedagogical patterns.
### Table 6
Overview of collected data, used data and applied methods

<table>
<thead>
<tr>
<th>Data collection context</th>
<th>Part 1: The character of pedagogical patterns</th>
<th>Part 2: The use of pedagogical patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>A workshop series for upper secondary teachers from ten schools that aimed to create design patterns, two hours each.</td>
<td>A two-hour workshop for upper secondary teachers in a school that aimed to use the pedagogical patterns created in part 1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants, teachers’ subjects and/or other</th>
<th>Mathematics</th>
<th>Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swedish and English</td>
<td>Swedish and Learning Technologist</td>
<td></td>
</tr>
<tr>
<td>Swedish and Spanish</td>
<td>Arts and Spanish</td>
<td></td>
</tr>
<tr>
<td>Swedish and Learning Technologist</td>
<td>Swedish and Learning Technologist</td>
<td></td>
</tr>
<tr>
<td>Music and Learning Technologist</td>
<td>Swedish and Swedish as a Second Language</td>
<td></td>
</tr>
<tr>
<td>Swedish, Social Sciences and Swedish as a Second Language</td>
<td>Swedish as a Second Language</td>
<td></td>
</tr>
<tr>
<td>Swedish as a Second Language</td>
<td>Special education teacher</td>
<td></td>
</tr>
<tr>
<td>Swedish as a Second Language</td>
<td>English, Italian and Learning Technologist</td>
<td></td>
</tr>
<tr>
<td>Special education teacher</td>
<td>Librarian</td>
<td></td>
</tr>
<tr>
<td>Team 1: Social Sciences and English</td>
<td>Team 2: Mathematics</td>
<td></td>
</tr>
<tr>
<td>Team 2: Mathematics</td>
<td>Team 3: History and Social Sciences</td>
<td></td>
</tr>
<tr>
<td>Team 3: History and Social Sciences</td>
<td>Team 4: Swedish</td>
<td></td>
</tr>
<tr>
<td>Team 4: Swedish</td>
<td>Team 5: Mathematics</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data collection method</th>
<th>Documents: Design patterns were created by teachers without interference from facilitators</th>
<th>Natural discourse: Teacher teams discussing their design</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Documents: The final design for teaching was documented in a structured format, a teaching activity plan (TAP)</td>
<td>Documents: The final design for teaching was documented in a structured format, a teaching activity plan (TAP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kinds of data</th>
<th>Textual data: Design patterns</th>
<th>Oral data: Audio recordings of design talk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Textual data: Design patterns</td>
<td>Textual data: TAP</td>
</tr>
<tr>
<td></td>
<td>Textual data: Design patterns</td>
<td>Previously created pedagogical patterns</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data for analysis</th>
<th>Pedagogical patterns extracted from design patterns</th>
<th>Transcribed design talk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pedagogical patterns extracted from design patterns</td>
<td>Pedagogical patterns TAP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method for analysis</th>
<th>Summative content analysis</th>
<th>Summative content analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Directed content analysis: Thematic analysis</td>
<td>Directed content analyses: Thematic analysis Protocol analysis</td>
</tr>
</tbody>
</table>
Other data resources were also collected, such as video recordings, photographs, participants’ sketches and observations. The data obtained from these were however mainly used as material for presenting and understanding the research context in a non-analytical sense.

The research summarised in this compilation thesis thus seeks to explore matters related to teachers’ design experiences when applying designing with pedagogical patterns. The specific methods employed for collecting and analysing data are further presented for each of the two research parts.

4.1 Part 1
This part included a workshop series for the generation of design patterns, characterisation of patterns related to a pedagogical content by applying summative analysis and examination of content of patterns related to pedagogy and digital competence via directed content analysis.

4.1.1 Context for teachers’ writing of design patterns
According to Scandinavian participatory design (Halskov & Hansen, 2015), people affected by changes should also be involved in change processes. Through participation, people are empowered. In the same spirit, Bennett et al. (2018) point out that teachers’ perspectives must not be neglected and that any intervention must accordingly build on what they need, not on what researchers believe they need. In the I Use IT project, the expectation was that teachers would take the opportunity to disseminate their knowledge to less technology-experienced teachers and thereby lead the process towards enhanced technology use in teaching.

To support bottom-up strategies for the dissemination of upper secondary teachers’ experiences related to technology in education, the educational administration of Stockholm city consulted Stockholm University for the arrangement of a workshop series. Specific teachers were invited to participate. These teachers had distinguished themselves as keen to spread their knowledge of the use of technology in teaching, that is, they had been appointed ‘development teachers’ in upper secondary education in Stockholm. Thirteen teachers and a librarian from ten different schools attended the first workshop. In addition to teaching, some teachers were appointed learning technologists. The details of the participating teachers can be summarised as:

Mathematics
Biology
Swedish and English
Swedish and Learning Technologist
Swedish and Spanish
The workshop series was held from February to October 2016 and included five workshops. These were prepared and implemented by my two supervisors; I attended the workshops as an observer. Given that the workshops were based on the Scandinavian participatory design perspective (Halskov & Hansen, 2015), the first three seminars applied well-known participatory design methods (c.f. Löwgren & Stolterman, 2004) for bringing the teachers together and fostering creativity. The methods applied allowed the participants to examine common problems related to technology use in teaching, envision a hassle-free teaching environment and articulate actions to achieve the desired condition (see Rolf et al., 2019 for details). The participatory design approach was maintained by the introduction of design patterns at the third workshop, whereas the other two workshops focused on creating design patterns to be shared, resulting in 17 design patterns in total.

The attendance decreased during the workshop series, from 14 participants at the first workshop to two at the last. In addition, every participant was absent at least once. Given that the teachers participated voluntarily, they were free to drop out of the workshop series at any time without giving reasons why. Possible explanations may include personal reasons, lack of precious working time and lack of interest in the project. The latter two would suggest that the workshop series was not considered valuable, which of course would be disappointing. The phenomenon of teachers showing only mild interest in participating in interventions has previously been reported by Garreta-Domingo et al. (2018). Moreover, Bennett et al. (2017) claim that teachers mainly share ideas with colleagues directly and therefore do not need design support, as they hinder them from approaching design according to their own routines. Furthermore, participants in Pareto and Willermark’s (2018) study initially shared the same reluctance towards TPACK by claiming that it was too time-consuming. However, those teachers who remained in the I Use IT project were those who were most committed to the idea of disseminating ideas regarding the use of technology to colleagues.

Given that the librarian left the series early, the writing of design patterns was made only by teachers.
As this dissertation is about the pedagogical patterns extracted from design patterns and written by upper secondary teachers, an evaluation of the workshop series was not essential to my research. Rather, gathering authentic data was the prime concern.

4.1.2 The design pattern template

In the literature, different design pattern layouts have been developed for specific projects, based on their particular purpose. All layouts have a title, a problem and a solution in common; moreover, most examples feature a context section, although any other section appearing in the original Alexandrian layout may be omitted or added. The term *forces* does not constitute a section of its own in the original template, but covers the requirements many adapters choose to include in their layout. Forces describe certain constraints or conflicts that are part of the context and, by identifying them, the problem and the solution may be better developed (Alexander, 1977).

The choice of design pattern layout for the workshop series was guided by a version previously used at a similar workshop series at a compulsory school in Stockholm. The teachers and researchers using it deemed it suitable for their expansion of technology use, hence it was also considered suitable for the I Use IT project. The template is reproduced along with an example of a pedagogical pattern (Table 7): number 13 of the total 17 design patterns (available in Appendix A).

<table>
<thead>
<tr>
<th>Design pattern section</th>
<th>Explanation</th>
<th>Design pattern 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pattern name</td>
<td>Title of the pedagogical pattern</td>
<td>Learners – collaborative work by brainstorming</td>
</tr>
<tr>
<td>Problem</td>
<td>A recurring problem encountered</td>
<td>Learners are not familiar with technology for sharing and editing.</td>
</tr>
<tr>
<td>Context</td>
<td>The typical context of the problem</td>
<td>Work with new digital tools that the teacher assumes the student can understand because contemporary students are ‘digital’.</td>
</tr>
<tr>
<td>Solution</td>
<td>The suggested solution to the problem</td>
<td>Learners work in a classroom with the teacher the first time using Padlet.</td>
</tr>
<tr>
<td>Maturity</td>
<td>The maturity of the pattern, in terms of how established the solution is</td>
<td>-</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Any other comment</td>
<td>-</td>
</tr>
<tr>
<td>The pattern creator’s name and date</td>
<td>The pattern creator’s name and date</td>
<td>-</td>
</tr>
</tbody>
</table>
Pattern status Whether the pattern is currently in use  
References to other patterns References to other patterns that are necessary to accomplish the solution in the current pattern, or that inform other patterns  
Recipient Description of the recipient of the pattern (e.g. teacher, learner, principal)  

4.1.3 Summative content analysis: Characterising pedagogical patterns
It was first necessary to establish whether the 17 design patterns were describing problems related to teaching or to technology issues concerning devices and software. The general character of the pedagogical patterns in terms of structure and comprehensibility was additionally examined.

Design patterns should describe a problem and provide a solution, but teachers articulating learning activities often include more than one activity, or solution. Harris et al. (2009) solved their matter by distinguishing ‘units’, while Conole et al. (2004) considered theirs ‘mini-learning activities’. Conole et al.’s suggestion was applied in the first and the second published articles, but during the research process, the term sub-solution came to be deemed suitable because it clearly expresses a close connection with solutions, as is part of the design pattern model. Both solutions and sub-solutions were identified in the pedagogical patterns.

Only design patterns that could be identified as pedagogical and thus suitable for teaching or in another way related to students and their learning could be deemed pedagogical patterns. Design pattern numbers 3, 15 and 17 (see Appendix A) were deemed to clearly address technological problems unrelated to students’ learning, while design patterns 2 and 16 were deemed to be teachers’ responsibilities in certain contexts. Figure 11 shows a design pattern that is concerned with technological issues and another that describes pedagogical content. The second, to the right, can be deemed a pedagogical pattern.
4.1.4 Themes for directed content analysis of pedagogy

Conole et al.’s (2004) framework is based on a sample of learning theories, involving for example those developed by B. F. Skinner, David Kolb, Etienne Wenger, Jean Piaget, John Dewey and Lev Vygotsky. The authors of the framework derived essential aspects from these theories, naming them key components. In the context of the analysis, the framework was adapted to function as a framework for analysing the pedagogy expressed in pedagogical patterns. The original idea of perceiving a continuum between the key components of learning was not kept. Indeed, the level of precision was deemed too difficult to obtain, so an intermediate position was considered sufficient for the analysis given the characteristics of the pedagogical patterns. Therefore, the framework adapted involved three spectra consisting of three modes of pedagogy.

Theme spectrum 1: Individual / Individual – Social / Social
Theme spectrum 2: Reflection / Reflection – Non-reflection / Non-reflection
Theme spectrum 3: Information / Information – Experience / Experience

A theme from each spectrum was iteratively derived from the learning activities that were identified in the solutions and the sub-solutions of the pedagogical patterns. To reach a coherent and reliable interpretation (Braun & Clarke, 2006, 2013), the analysis was reviewed in collaboration with a senior researcher.

4.1.5 Themes for directed content analysis of digital competence

The DigComp framework identifies five areas of digital competence, involving 21 competencies in total (Vuorikari et al., 2016). To infer the development of students’ digital competence expressed in the pedagogical patterns, the competence areas were considered themes, sufficient to portray the learning opportunities provided by the teachers in Rolf et al. (2019). In this thesis, the 21 competencies as defined in DigComp (see 3.2.2) are considered the themes for the analysis in addition. Hence, to distinguish
the character of the digital competence training of students, references to specific competencies have been made.

1. Information and data literacy: 1.1 Browsing, searching and filtering data, information and digital content; 1.2 Evaluating data, information and digital content; 1.3 Managing data, information and digital content.

2. Communication and collaboration: 2.1 Interacting through digital technologies; 2.2 Sharing through digital technologies; 2.3 Engaging in citizenship through digital technologies; 2.4 Collaborating through digital technologies; 2.5 Netiquette; 2.6 Managing digital identity.

3. Digital content creation: 3.1 Developing digital content; 3.2 Integrating and re-elaborating digital content; 3.3 Copyright and licences; 3.4 Programming.

4. Safety: 4.1 Protecting devices; 4.2 Protecting personal data and privacy; 4.3 Protecting health and well-being; 4.4 Protecting the environment.

5. Problem solving: 5.1 Solving technical problems; 5.2 Identifying needs and technological responses; 5.3 Creative use of digital technologies; 5.4 Identifying digital competence gaps.

4.2 Part 2

The second part included a workshop in which teachers in teams used pedagogical patterns for the articulation of designs for teaching. Document and protocol analyses of the use and design work of teachers were conducted.

4.2.1 Context for the use of pedagogical patterns

To explore how the upper secondary teachers use the pedagogical patterns in their natural setting, a workshop was facilitated by me and one of my supervisors. A small municipal upper secondary school agreed to participate in the workshop. Ten teachers representing different subjects were able to participate and thereby give the school’s other teachers a professional development opportunity.

To facilitate the teachers’ participation, the workshop was held at the teachers’ school in two large classrooms following the end of the school day. The workshop lasted two hours and included an introduction by me that involved a presentation of the structure of twelve pedagogical patterns (Figure 12). The teachers’ task of creating a design for teaching was presented as follows: ‘The task is to create learning activities suitable for your future teaching based on one or more pedagogical patterns’.
The ten teachers paired themselves into five teams, reflecting a shared subject or related subjects.

Team 1: Social Sciences and English  
Team 2: Mathematics  
Team 3: History and Social Sciences  
Team 4: Swedish  
Team 5: Mathematics

**Figure 12**  
Example pedagogical pattern provided in a workshop

**Pedagogical pattern 6**  

<table>
<thead>
<tr>
<th>Problem</th>
<th>Some learners do not want to speak up in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>In classroom situations.</td>
</tr>
<tr>
<td>Solution</td>
<td>Use digital and anonymous response apps such as Padlet, Kahoot, Socrative</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Requires a device to submit their responses to.</td>
</tr>
</tbody>
</table>

Once paired, the teachers had an hour to complete their work. The time was considered reasonable and in line with the high work pace to which teachers are accustomed. The design work was thus able to mimic the time pressure that generally characterises teachers’ practice.

Like the workshop series, this workshop was not thoroughly evaluated in terms of successful outcomes; instead, the main concern was gathering textual and oral, natural data.

**4.2.2 Themes for directed content analysis: Teaching activity plan**  
To articulate their designs for teaching, the teachers were provided with a teaching activity plan (TAP), which was constructed on the basis of didactic questions that were assumed to be familiar to all Swedish teachers. The purpose of the questions was to reflect on different parts of lesson planning, such as ‘What?’ ‘Why?’ and ‘How?’ (Lindström & Pennlert, 2019; Wickman et al., 2018).

**Purpose:** The aim of the design for teaching.  
**Objective:** The goal(s) students would achieve.
Tools and resources: The materials to be used, including technology.
Sketches or storyboarding of activities: Visualisation of the details of steps of activities.
Steps of activities in writing: The details of the learning activities of the design for teaching.
Teacher’s preparation activities: The activities required by the teacher to enact the design for teaching.
Teacher’s subsequent activities: The activities required by the teacher following the enactment of the design for teaching.
Miscellaneous: Any additional comment.

Each design team was given a large workspace with room for the TAP, which was enlarged considerably to be clearly distinguishable from their typical working materials and hopefully inspire creativity (Figure 13). (Given that the teachers were not familiar with DigComp, they failed to fill in the areas applicable to their designs for teaching. Consequently, this part has not been analysed.)

During the teams’ design work, the researchers worked as facilitators, which involved explaining the task or the TAP when requested and encouraging the teams’ design work through listening to their thoughts and ideas.

**Figure 13**
Design of teaching activity plan

<table>
<thead>
<tr>
<th>Design pattern, number and letter (if applicable):</th>
<th>Writers’ code name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aim</td>
<td>Objective</td>
</tr>
<tr>
<td>Key components of pedagogies</td>
<td>Tools and resources</td>
</tr>
<tr>
<td>Key components of digital competence</td>
<td>Subsequent activities of the teacher</td>
</tr>
</tbody>
</table>
4.2.3 Summative content analysis: Use of pedagogical patterns
The teams’ use of pedagogical patterns was demonstrated in two ways: a) in writing as expressed on the TAP; and/or b) during teams’ discussions. Elements in the form of direct and indirect references to the pedagogical patterns were sought, here exemplified by references to pedagogical pattern 6 (Figure 13) (corresponding to design pattern 8 in Appendix A) and the statements of teachers in team 2.

‘I want them [the students] to dare to talk. Ask questions, give answers’.
‘Pedagogical pattern is 6. Purpose: To make students more comfortable’.

The first quotation demonstrates a need for a latent analysis (Hsieh & Shannon, 2005). The context and the reference to ‘dare to talk’ can be interpreted as the pedagogical pattern titled A way to let everybody use their voice. The second statement needs no interpretation because the speaker refers to a distinct pattern number.

4.2.4 Directed content analysis: Protocol analysis of the design work
In order to gain insights into the design processes of upper secondary teachers, applied methods were sought in the field of traditional design research. A common method is to encourage individual designers to articulate what they are thinking, to think aloud, which creates verbal reports or verbal protocols to be further analysed (Cross, 2018; Gero & Mc Neill, 1998). Stempfle and Badke-Schaub (2002) adapted the method by analysing a protocol that reproduces discussions between team members. They then carried out a two-sided analysis, partly of content of what is said and discussed about matters related to the design, partly of the group processes involving matters related to how they organised their work.

To capture the design process, Stempfle & Badke-Schaub (2002) developed a coding scheme consisting of six codes described as common to design processes in the fields of systems engineering, problem solving theory and design methodology. For the analysis carried out and reported in this thesis, these codes were adapted to align with teachers’ planning of learning activities (Table 8). The codes were renamed ‘topics’ to distinguished them from the original scheme. Moreover, the analysis carried out and reported in this thesis involves only the content. Hence, the group processes of the teams were not analysed.

For comparison, Gero & Mc Neill’s (1998) coding scheme uses macro and micro coding, involving up to eight micro codes for each macro code. However, the level of detail obtained by adapting Stempfle and Badke-Schaub (2002) scheme was considered suitable for my analysis.
Table 8
Original codes in Stempfle and Badke-Schaub’s (2002) coding scheme and the topics applied in the analysis of teacher teams’ design work

<table>
<thead>
<tr>
<th>Original code</th>
<th>Topic applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal clarification</td>
<td>Aim and goal clarification</td>
</tr>
<tr>
<td>–</td>
<td>Problem definition</td>
</tr>
<tr>
<td>Solution generation</td>
<td>Generation of learning activities</td>
</tr>
<tr>
<td>Analysis</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>Previous experiences</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Evaluation</td>
</tr>
<tr>
<td>Decision</td>
<td>Decision</td>
</tr>
<tr>
<td>Control</td>
<td>Obstacle identification</td>
</tr>
</tbody>
</table>

It is common to consider the process within a specific time frame and thereby keep track of the time the designer or design team spends on a code. Given that design talk related to anything other than the content was omitted from the analysis, the time frame became irrelevant. By instead counting the total number of words in the transcribed data, the proportion of topics inferred could be calculated.

4.3 Ethical considerations

The guidelines applicable to my research were Stockholm University’s research integrity and ethics policy and the European Code of Conduct for Research Integrity (All European Academies, 2017), commonly referred to as the ALLEA code.

My research followed those guidelines regarding the involvement of participants, both in the I Use IT workshop series and the workshop arranged to allow teachers to use pedagogical patterns.

Teachers’ participation was voluntary and they were allowed to stop at any stage of the research process. In order to participate, written consent was required (Appendices B and C).

The letter of consent explained that the results of the research would be published and that the participants’ identities would be anonymised. The material collected would include:

- Written evaluations (these were, however, not requested).
- Interview data (interviews were, however, not conducted).
- The researcher’s notes from observations and discussions during design workshops.
- Audio recordings, videos and still images from the design workshops attended.
- Participants’ texts and sketches produced in connection with the design workshops.
4.4 Credibility

My research is qualitative and relies partly on the quality of data and partly on my ability to conduct the thematic analysis and the protocol analysis.

The set of pedagogical patterns used for the thematic analysis was a result of the participants’ own creation. The teachers independently created designs they thought would be useful for their colleagues and were thus rooted in their accumulated experience of using technology (Cross, 2018; Schön, 1983). The analyses of the original pedagogical patterns were conducted in Swedish, which is my native language. Some of the wording may have been lost when translating the patterns into English.

Besides two summative content analyses, three content analyses were carried out in order to infer pedagogy and digital competence and examine teachers’ design processes. In all three cases (themes, competence areas and topics), the codes were predefined. The analyses were thus conducted deductively. Of these, i) competence areas were adopted from DigComp (Vuorikari et al., 2016, pp. 8–9), whereas ii) the themes derived from key components of learning were adapted by replacing a continuum regarding the components of the spectra with an intermediate theme, and iii) the topics were adapted from a protocol analysis template (Stempfle & Badke-Schaub, 2002). All frameworks were chosen carefully to suit the research aims and questions. This means that the frameworks were chosen after the aims and the questions had been articulated.

To manage the challenge of keeping credibility at a high level, certain conditions and measures were set to minimise the risk. First, thematic analysis strives to identify ‘underlying ideas, assumptions, and conceptualizations’ (Braun & Clarke, 2006, p. 84) which can be recognised by a technology-experienced upper secondary teacher such as myself. My ability to visualise the intentions expressed in the pedagogical patterns should be regarded as honest and thus lead to a sound understanding of the data. Second, how the data were interpreted has been explained in the methodology chapter of this dissertation and in additional detail in my articles. My analyses have been discussed thoroughly with my head supervisor, who tested my interpretations carefully (Terry et al., 2017). In addition, all analyses were performed several times to ensure that the data were consistently understood in the same way. Third, the frameworks were chosen from completed and reviewed research and are thus part of the available knowledge. The analyses may not be replicable, that is, the same results may not be found in every aspect. However, my research presents a suitable method that can be successfully replicated.
5 Summary of Findings

This section presents the results of four analyses concerning the pedagogy in pedagogical patterns, students’ digital competence training, the use of pedagogical patterns and teachers’ design processes. To answer this dissertation’s RQs, the section synthesises the findings from the submitted articles. The RQs are:

1. What characterises the pedagogical patterns created by upper secondary teachers and, more specifically, their inclusion of:
   a. the pedagogical approaches expressed in the patterns?
   b. the digital competence training for students made available in the patterns?

2. How do teachers as designers use pedagogical patterns, specifically in terms of:
   a. the provided ideas and solutions?
   b. the design processes of upper secondary teachers?

5.1 Characteristics and content of pedagogical patterns

The 17 design patterns in total (see Appendix A) were generally created by deeply attentive and engaged teachers. Nevertheless, the patterns were seldom elaborated. Instead, certain sections available in the layout were often left unused and the wordings were limited in the sections used. The median length of all the patterns was 48 words and the shortest pattern used 16 words. The patterns generally became more elaborate throughout the course of the workshop series, with the longest pattern including 220 words. The mean design pattern comprised 69 words. A tendency observed was that the longer the design pattern, the more solutions found within it.

When the teachers used a small number of sections and words when writing design patterns, there was a risk that their design patterns would carry too little information to be intelligible. When one-line statements were used, the risk increased. One of the shortest patterns, number 8, serves as an example:
Pattern name: A way to let everybody use their voice.
Problem: Some learners do not want to speak up in class.
Context: In classroom situations.
Solution: Use digital and anonymous response apps such as Padlet, Kahoot and Socrative.
Miscellaneous: Requires a device to which to submit their responses.

In addition, the solution section of some of the design patterns revealed patterns that included more than one proposed solution to the defined problem. Only half of the design patterns contained just one solution, while the other half contained three or more solutions. In addition, solutions to a problem were found in the miscellaneous section of a pattern. Although the purpose of a design pattern is to propose a solution to a problem, multiple solutions were thus identified. A total of 40 solutions were identified in 17 design patterns.

The level of incompleteness may enhance the risk of abstraction, as the following summary show: the full design pattern format was not utilised by the teachers; the word count was low on average; many design patterns contained more than one solution; one-line statements were frequently used.

This part of my research is accounted for in three publications.

5.1.1 Pedagogical approaches expressed in pedagogical patterns


Learning designs other than pedagogical patterns have been examined by the research community in terms of pedagogy, albeit mainly in the case of TPACK (Boschman et al., 2015; Koh & Chai, 2016; Nguyen & Bower, 2018). Considering that pedagogy should be of prime interest for those seeking learning designs that are intended to be disseminated (Masterman & Manton, 2011), these articles contribute to existing scholarship by identifying the pedagogy embedded in pedagogical patterns. A practical reason for inquiring about pedagogy is that if users can access the pedagogy suggested in pedagogical patterns, then the designs may be adapted smoothly. The question of
whether even fragmented and incomplete patterns can communicate pedagogical approaches is additionally relevant.

The two articles noted above aimed to understand the pedagogy inherent to pedagogical patterns; the findings are elaborated in greater detail in the second article. Given that understanding of the concept of pedagogy also increased during the research process, the second article offers the following definition: pedagogy reflect learning theories (Conole et al., 2004; Phillips & Soltis, 2019). As learning activities describe intended methods and strategies, learning theories in the format of components of learning (Conole et al., 2004) could be discerned in each of the solutions identified in the pedagogical patterns.

The pedagogical themes to be discerned in the pedagogical patterns were grouped into three spectra. In order to position learning activities that could not clearly express either of the components in a group, intermediate positions were added to each, thereby enabling the emergence of a spectrum involving themes.

Individual – Individual-Social – Social
Non-reflection – Non-reflection-Reflection – Reflection
Information – Information-Experience – Experience

Examining the pedagogical theme of each solution revealed that individual activities predominated (Figure 14). Eleven out of 23 solutions were deemed activities to be carried out by an individual. Hence, only a minor proportion of the pedagogical patterns pertained to the Social theme, involving collaborative activities. The patterns expressed a concern for the Reflection theme, as also found in 11 of the solutions. Finally, the activities were considered to provide students with information to only a limited extent, experiential learning proving more important.

A pedagogical pattern that exemplifies a problem identified by the pattern designers is the following: ‘The learners need a basic knowledge of concepts, but their knowledge is at different levels’ (design pattern 11 in Appendix A). Its solution involves a flip, that is, teachers are advised to make all teaching materials available online and to encourage students to submit questions to them. The recipients are individual students who can log in to the online resource; moreover, it is assumed that working with the material will require students to reflect. The findings accordingly revealed that few of the pedagogical patterns provided solutions aimed at individual students without needing them to reflect, indicating that the individual activities mainly required some form of consideration by the students.

Approximately one third of the solutions allowed students to be engaged in direct experience. This was mainly a consequence of the emphasis on the use of technology, as this can provide opportunities to work in an environment outside the school but can also involve practical experiences such as recording a video (design pattern 1).
However, given that all the themes were represented and none were completely dismissed, this result points to a variation in components of learning. Such a result was confirmed by an examination of how the themes were combined. Specifically, out of 27 possible combinations, 14 were present in the pedagogical patterns, thus depicting a variety of pedagogical approaches expressed in the learning activities. The most prominent clusters were deemed opposites. The combinations Social–Reflection–Experience and Individual–Non-reflection–Information both occurred in three patterns. The former cluster is associated with a behaviouristic approach and the second with social situated learning. This finding is, however, not startling, because the variation in pedagogy found mirrors a common practice in which teachers vary their pedagogy in order to adapt to the content and context as well as meet the needs of their students (Lindström & Pennlert, 2019; Peterson et al., 2018; Säljö, 2015). A variation in pedagogical approaches furthermore points at a student-centred perspective because it ensures that the needs of different students are considered. The fact that collaborative approaches were found less often indicates that ‘emerging pedagogies’ (Gros, 2016; Gurung, 2013) were not a primary concern for the designers.

When extracting the essence of learning theories and defining key components, it is possible to understand the association to different teaching methods and strategies (Conole et al., 2004). Hence, pedagogy is discernible in learning activities, even when pedagogical patterns were characterised as fragmented. Consequently, pedagogy should also be discernible in other learning designs.

A limitation of the analysis is the pedagogy retrieved on the basis of the selection of key components made by Conole et al. (2004). Other contemporary learning theories may form different components. However, the components provide a broad enough picture of the approach discerned in the pedagogical patterns.
5.1.2 Digital competence training of students made available in the pedagogical patterns


To ensure the successful use of technology in teaching, teachers and students must know how to use it. In this article, the concern of teachers to introduce and use digital technology for pedagogical ends was examined. This is of interest because the suggested technologies can help increase students’ digital competence, a research area not yet investigated thoroughly (Beetham et al. 2013; Fraillon et al., 2014; Littlejohn et al., 2012). Moreover, little is known about the content of pedagogical patterns, a framework introduced for teachers’ planning of learning activities. Through an analysis of pedagogical patterns written by upper secondary teachers, this article describes the digital competence training students may receive. The framework applied for the analysis was the European DigComp 2.0 (Vuorikari et al., 2016).

The kind of technology mentioned in the pedagogical patterns was examined. Besides a learning management system (LMS), Microsoft Office 365, Wikipedia and a website that describes current hoaxes (‘The viral eye’), four freeware apps were suggested for use. Through these applications, most learning activities (46.2%) were found to be related to communication and collaboration, hence constituting nearly half of the activities (Table 9). An explanation is that many learning activities are associated with referencing, which applies to communication. Collaboration with peers was found to constitute only a limited proportion of the activities. Information and data literacy were found to represent 30.8%, in which the assessment of data was the most prominent. Digital content creation was found in four learning activities (15.4%), of which two were related to a single pattern. Safety issues were not found, while only two learning activities trained problem solving. A limited number of DigComp competencies were thus identified in the patterns, specifically eight of the declared 21.

In the context of creating pedagogical patterns, these results are not startling. The patterns were created by upper secondary teachers mainly concerned with providing colleagues with good ideas of technology use and preparing students for future academic studies. Competencies involving the safety of individuals and problem identification are therefore less significant for examinations. However, one should expect more activities training students’ collaboration skills.

Moreover, these results can be related to the results of the thematic analysis of pedagogy, in which individual and reflective learning activities were found to be frequent. Using digital technology requires the attention of individuals, especially if the technology is completely new.
Table 9
Digital competencies discerned in pedagogical patterns

<table>
<thead>
<tr>
<th>DigComp 2.0 competence areas</th>
<th>DigComp 2.0 digital competencies</th>
<th>Number of mini-learning activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Information and data literacy</td>
<td>1.1 Browsing, searching and filtering data, information and digital content</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1.2 Evaluating data, information and digital content</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1.3 Managing data, information and digital content</td>
<td>2</td>
</tr>
<tr>
<td>2. Communication and collaboration</td>
<td>2.1 Interacting through digital technologies</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2.2 Sharing through digital technologies</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>2.3 Engaging in citizenship through digital technologies</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2.4 Collaborating through digital technologies</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2.5 Netiquette</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2.6 Managing digital identity</td>
<td>-</td>
</tr>
<tr>
<td>3. Digital content creation</td>
<td>3.1 Developing digital content</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3.2 Integrating and re-elaborating digital content</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>3.3 Copyright and licences</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>3.4 Programming</td>
<td>-</td>
</tr>
<tr>
<td>4. Safety</td>
<td>4.1 Protecting devices</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>4.2 Protecting personal data and privacy</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>4.3 Protecting health and well-being</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>4.4 Protecting the environment</td>
<td>-</td>
</tr>
<tr>
<td>5. Problem solving</td>
<td>5.1 Solving technical problems</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>5.2 Identifying needs and technological responses</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>5.3 Creatively using digital technologies</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5.4 Identifying digital competence gaps</td>
<td>1</td>
</tr>
</tbody>
</table>
It can be concluded that it is possible to access upper secondary teachers’ perceptions of matters concerning students’ ability to use technology for learning. Moreover, by using the DigComp 2.0 framework, teachers can reflect on their own digital competence when planning learning activities within lessons.

5.2 Use of pedagogical patterns


The second part of my research aimed to explore upper secondary teachers’ use of their peers’ pedagogical patterns. Such use was explored from two perspectives: 1) the use of elements in pedagogical patterns in designs for teaching; and 2) the design processes while creating designs for teaching. The reason for choosing the second analysis was that LD claims to be associated with design, but continues to show limited interest in the processes in which teachers engage. While my research thus may inform the construction of design support tools (Bennett et al., 2018), the contribution is equally important.

5.2.1 Teachers’ use of ideas and solutions in pedagogical patterns

It was clear that no two teams worked in the same way. Thus, variations can be deemed the main finding. Given that the teams chose to use different elements in their patterns, it was not possible to discern any specific trend. Explanations may involve the situated nature of teaching (Goodyear, 2005; Laurillard, 2012) and of design in general (Cross, 2018; Löwgren & Stolterman, 2004). Therefore, the prevailing context must guide the creation of designs for teaching.

In detail, the differences involve a different number of patterns chosen (Table 10) including two teams that picked two related patterns. Four of the five teams recognised the problem or problems expressed in the pattern, although the solutions were used to varying degrees. How these findings covaried with the teams’ design work can be seen in the next table, Table 11.
Table 10
The teams’ use of pedagogical patterns

<table>
<thead>
<tr>
<th></th>
<th>Team 1</th>
<th>Team 2</th>
<th>Team 3</th>
<th>Team 4</th>
<th>Team 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pedagogical patterns used</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Problem description used</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Solutions or sub-solutions used out of the total provided by the chosen pedagogical pattern(s)</td>
<td>2/3</td>
<td>0/1</td>
<td>0/7</td>
<td>2/3</td>
<td>1/5</td>
</tr>
</tbody>
</table>

The outcomes can be summarised as follows:

Team 1: The solutions to the chosen pedagogical pattern were more or less duplicated.

Teams 2 and 5: The suggestions described for the chosen pedagogical patterns were abandoned. Hence, the teams’ designs show no resemblance with the original ideas.

Team 3: The team was preoccupied by the problem stated in the pedagogical patterns and did not use the solutions available. This team did not complete a design for teaching.

Team 4: The suggested solutions to the pedagogical patterns were developed further in their design for teaching.

Thus, three types of uses tended to be observed. If the plans showed a resemblance to pedagogical patterns, they inspired the teachers’ design work (teams 1 and 4). If the teachers were initially inspired by pedagogical patterns, but then completely lost their connection to them, the patterns were deemed springboards to a design for teaching (team 2 and 5). If the teachers did not complete a design for teaching, the patterns worked neither as inspiration nor as springboards (team 3).

In addition, the findings derived from the summative analysis can inform the findings of the directed content analysis performed (see Table 10).

5.2.2. Teachers’ design processes
The RQ for this part of the article was as follows: What characterises teachers’ design processes when they use pedagogical patterns? The different topics that teachers addressed during design work (adapted from Stempfle & Badke-Schaub, 2002) were examined, involving the following: Aim and goal clarification, Problem definition, Previous experiences, Generation of learning activities, Evaluation, Decision and Obstacle identification.
The design process is generally considered a problem-solving activity (Cross, 2018; Dorst, 2004) and most of the teacher teams started their processes by addressing the aim and goal or the problem (Figure 15). However, one team (team 1) did not follow the same procedure, as they never recognised a problem, only opportunities. All the teams did, however, alternate between topics after starting, although some expressed an inclination to keep the purpose in mind by returning to the aim and goal and/or the problem throughout the entire process. One team (team 3) distinguished themselves from the others by repeatedly discussing the problem throughout their design work and were thus not able to present a clear design for teaching. As a whole, Figure 15 makes it clear that the teams’ design processes differed in their levels of detail. What seemed to be common was that the teachers effectively focused on the creation of learning activities once the aim and goal were satisfactorily determined.

**Figure 15**
The design process of five teams, illustrated by the distribution of topics

![Diagram of design process for five teams](image)

*Note. The illustration appears in Rolf et al. (2021).*

It could be seen that the teams’ design processes bore similarities to the characteristics of any other design process. Indeed, they were different, situated, explorative, provided learning, unpredictable and dynamic. For instance, the situated character of design work was apparent, because the teachers did not copy and paste pedagogical patterns and so how the patterns would be used could not be predicted. Given that teachers explore ideas and adapt patterns to various degrees to suit the context of the learning environment, they learn new perspectives on teaching. When teachers design, their work is dynamic and always differs from others’ because an individual designer’s personal motivation affects their work.
The varied nature of the teachers’ design approaches could be emphasised further on putting different findings together (Table 11). A correlation of details pertaining to the use of pedagogical patterns could not be discerned, except for one team. Indeed, team 3 spent much of their design work on problem identification while paying negligible attention to working on learning activities. As a result, they completed no design for teaching. The other relationships identified were disparate, showing that all designers work differently to achieve results in the form of designs for teaching.

**Table 11**
Overview of selected findings related to the use of pedagogical patterns

<table>
<thead>
<tr>
<th></th>
<th>Team 1</th>
<th>Team 2</th>
<th>Team 3</th>
<th>Team 4</th>
<th>Team 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pedagogical</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>patterns used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem description used</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Proportion of process</td>
<td>0</td>
<td>1</td>
<td>24</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>spent on definition (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solutions or sub-solutions used out of the total provided by the chosen pedagogical pattern(s)</td>
<td>2/3</td>
<td>0/1</td>
<td>0/7</td>
<td>2/3</td>
<td>1/5</td>
</tr>
<tr>
<td>Proportion of process</td>
<td>30</td>
<td>73</td>
<td>5</td>
<td>66</td>
<td>48</td>
</tr>
<tr>
<td>spent on generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of learning activities (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character of use</td>
<td>Inspiration</td>
<td>Spring-board</td>
<td>N/A</td>
<td>Inspiration</td>
<td>Spring-board</td>
</tr>
</tbody>
</table>

Lastly, it would have been interesting to connect the findings from part 1 to ascertain whether the designers favoured a specific pedagogy or digital competence training. However, given that not all of the teams used solutions from pedagogical patterns, the findings of part 1 cannot shed light on these issues. Future research is thus needed to carry out analyses of designs for teaching.
6 Discussion

Recent research has claimed that the use of learning designs, including pedagogical patterns, is beneficial for education in schools and universities (e.g., Dalziel et al., 2016; Goodyear, 2015; Mor et al., 2014a; Persico & Pozzi, 2015). However, the promises attributed to learning designs are based in particular on teachers producing learning designs during interventions, rather than on analyses of them or their use, that is, when planning learning activities. This thesis is among the first to add knowledge regarding these matters. Indeed, as stated in the introduction, my research has aimed to understand how teachers work as designers by analysing details related to the use of pedagogical patterns, including their characteristics and content.

The following discussion relates back to the research questions formulated for this dissertation.

6.1 Characteristics and content of pedagogical patterns

The collection of pedagogical patterns created in the workshop series made further exploration possible and, by examining these, an understanding of the content was achieved. Both pedagogy and students' digital competence training proved to be discernible despite the fragmented character of the pedagogical patterns. This indicates that even limited learning designs portray valuable information upon which to reflect.

A varied approach to pedagogy was discerned, both in terms of single pedagogical themes and cluster-wise. For instance, the analysis of themes from each spectrum revealed that two completely different clusters were most prominent. One of the clusters can be associated with a behaviouristic approach and the other with social situated learning (Conole et al., 2004). This finding corresponds to teachers’ practice, as teachers generally neither reflect on learning theories nor confine themselves to a single pedagogical approach (Lindström & Pennlert, 2019; Peterson et al., 2018; Säljö, 2015). Rather, they vary their methods to meet their students’ needs. Therefore, it is important that themes with a connection to learning theories are made discernible in learning designs. Doing so gives researchers opportunities to retrieve what they believe is omitted and thus inaccessible (Bennett et al., 2018; Nguyen & Bower, 2018).

The pedagogical patterns were created by experienced teachers who wanted to support their less technology-experienced colleagues with ideas on how to use
technology in teaching. Hence, the experienced designers’ suggestions regarding the use of technology in pedagogical patterns may have been adjusted to match what they deemed suitable learning designs for their colleagues. What they considered suitable activities to start a sustainable use of technology was therefore reflected in their patterns. Through the strategies they adopted, the experienced designers came to promote students’ individual and reflective learning. Of course, using technology for collaboration is equally necessary, but apparently the designers of the pedagogical patterns here did not prioritise such usage.

In relation to the DigComp framework, the pedagogical patterns were found to provide delimited digital competence training for students. All competencies in the first competence area, involving information and data literacy, were covered. This indicates either that such technological competence was deemed suitable for upper secondary education or that these competencies were regarded by the designers as essential and basic. In addition, it is possible that upper secondary education is unable to provide training for all competencies. Safety issues may be better introduced at lower levels, with problem-solving ability emerging when the need arises. Furthermore, the assumed strategy used by the experienced designers in this study may have reflected a conscious choice that favoured the limited digital competence training of students.

6.2 Use of pedagogical patterns

Pedagogical patterns, like any other learning design, are intended to be shared and adapted by users. How their use is manifested was analysed.

Only two of the five teams created designs for teaching that showed a resemblance to the original ideas given in the pedagogical patterns, whereas the designs for teaching of two of the other teams bore few traces of a relationship. In addition, the problem description in the pedagogical pattern was so engaging for one team that it took up all the design work. The nature of the use of pedagogical patterns can therefore be summarised as follows: pedagogical patterns either inspire users’ design for teaching, function as springboards to different ideas expressed in these, or do not work at all for designers, as has been anticipated by Scott et al. (2007). Furthermore, how a learning design will be used cannot be predicted, owing to the characteristics of the design processes (Beckman & Barry, 2012; Cross, 2018; Edelson, 2002; Lawson & Dorst, 2009; Löwgren & Stolterman, 2004) involved in teachers’ design work.

Although this dissertation has only been able to account for the limited knowledge gathered by design researchers, it should be clear that designers design differently. Indeed, they perceive problems differently and examine solutions differently, because their contexts and their personalities differ. How designers reach their goal, i.e. a design, also differs as a result. What this analysis of teachers’ design work has shown is that teachers are designers.
6.3 Teachers as designers

Teachers as designers have emerged as a concept related to interventions in which researchers bring tools and resources to the teaching practice (e.g. Michos & Hernández-Leo, 2020; Laurillard et al., 2018; Kali et al., 2018; Pepin et al., 2017). However, Kirschner (2015) argues that teachers were designers even prior to interventions which may include design support tools, other learning designs, models and design principles that participants are required to use. By working with these resources, teachers may demonstrate that they are also designers, but they may equally be defined as designers in their own right, without specific artefacts brought to their practice.

Moreover, Schön (1983) considers every professional, including a teacher, a designer and teaching has been described as a form of design (e.g. Garreta-Domingo et al., 2018; Jordan, 2016; Nguyen & Bower, 2018). However, hence, perceiving teachers as designers rests on two perspectives.

First, the idea of teachers as designers is applied by the research community as an umbrella term for supportive initiatives in which teachers design something, such as learning activities and learning materials. For this type of research, I have proposed the incorporation of additional design phases to create an overall picture of the design processes that teachers perform.

Second, teachers can be considered designers in a professional and traditional sense. As has been shown here, teachers’ design work is worth examining from this perspective.

By using available knowledge in studies of teachers as designers, both these perspectives may add constructive approaches. A broad understanding of the designers of learning designs can, for instance, be enriched by analysis of the character of the design work made also when creating a design for teaching. Expert and novice designers (Adams et al., 2019; Cross, 2018; Henriksen et al., 2018; Lawson, 1990) may thus be identified based on their performance as suggested by Dorst (2004) who identified five levels of design abilities: novice, beginner, competent, proficient and expert.

6.4 Contributions

This explorative research into pedagogical patterns has advanced our understanding of teachers as designers by incorporating a second phase of teachers’ design process. In detail, this thesis contributes to existing research in the following ways:

1. Until my research, an understanding of the characteristics and content of the pedagogical patterns or other learning designs created was lacking in existing scholarship. My research is therefore an attempt to add knowledge to educational
research in TEL and LD by showing that an understanding can be obtained through thematic analyses.

2. Thousands of different types of learning designs are available online and in print. They are intended to be shared and used by teachers. However, prior to my thesis, how teachers use them had not been carefully examined. It has been shown that teachers use pedagogical patterns in different ways indicating that use is unpredictable.

3. Until now, teachers’ design work had not been significantly studied in accordance with the vast knowledge gathered by traditional design research and had therefore not been incorporated into TEL or LD research. My research shows that a design research method such as protocol analysis is able to present the similarities and the wide variations in teachers’ design processes.

6.5 Future research
I consider it valuable to continue advancing the knowledge reported in this dissertation. There are, in fact, many research angles to approach.

First, the pedagogical patterns format may be promising for trainee teachers. During their training, these teachers will probably find that their use of technology occasionally fails. Creating pedagogical patterns may aid reflection and the articulation of problems and, by sharing such problems with peers, teachers may be able to receive solutions that can be tested in future classroom environments. Consequently, trainee teachers may be given the opportunity to halt for a moment and reflect on teaching and learning matters. Equally, the creation of pedagogical patterns can be made part of a teacher’s professional development (TDP) programme. To verify these outcomes, research examining the use of patterns in teacher education and in TDP programmes is needed.

The methods used to identify the content of pedagogical patterns and other learning designs should also be used by other researchers wanting to characterise teachers’ ideas in terms of pedagogy and students’ digital competence development. However, there may of course be other aspects to look for than just pedagogy and digital competence.

The characterisation of teachers’ learning designs can in addition be used in a school context where a certain pedagogy is required by the school authorities or as a result of an agreement among the teachers. By asking teachers to write a couple of patterns, an analysis of these can distinguish the extent to which these professionals are complying with the requirement. Such analyses would yield interesting results that may be equally rewarding for the teachers and promote reflection.
Moreover, Dawes and Ostwald (2017) argue that the design pattern format can be of great use in contexts where values and visions need to be communicated, as patterns may be able to package complex phenomena in a manageable format. The values embedded in pedagogical patterns have already been considered (Eckstein et al., n.d.; Law et al., 2017) and may be interesting to examine further.

Central to my research are matters related to design as a problem-solving activity, a cornerstone of creative design. Given that specifically pedagogical patterns rely on problem-solving pertaining to wicked problems (Cross, 2018; Rittel & Webber, 1973), this aspect may be further explored and utilised to support teachers’ identification as designers. Hence, understanding teachers’ planning as similar to design processes in general (e.g. Kirschner, 2015; Schön, 1983) can be examined to a significant extent. Greater knowledge regarding teachers as designers should help advance teachers’ design abilities. In addition, acknowledging teachers as designers in a wide sense may provide an incentive for reflection that can strengthen teachers’ professionalism.

The gap between research and practice can be bridged if researchers devote time to teachers’ practice, specifically by studying teachers’ regular design processes and how their teaching follows their designs’ intentions. By understanding the conditions that surround teachers’ everyday work, research can assist practice in a way that teachers perceive as useful and supportive.

Perceiving of teachers as designers is complicated, as it may involve two associations. First, teachers may be considered designers in a professional sense. Second, the idea of teachers as designers has also been applied by the research community as an umbrella term for supportive interventions in which teachers design something, for instance, learning activities or learning materials. However, each phase may shed light on the teachers as designers. If both these perspectives are further investigated, not only may TEL and LD research benefit from future findings. Teachers’ practice may indeed benefit from research.
7 Conclusion

To further our understanding of teachers as designers, this compilation thesis has presented findings regarding the content of pedagogical patterns, their use by other teachers and the design work performed in the process.

The pedagogical patterns were written by upper secondary teachers and analysed in terms of pedagogy and digital competence training for students. Both of these important aspects of learning designs were discernible, which should benefit future research within TEL and LD regarding different learning designs.

The use of the pedagogical patterns was also studied. Given that these spurred design work for almost all the teachers, they can be characterised as inspirations for or springboards to designs for teaching in the classroom. The approach taken regarding teachers’ design processes mirrored the differences in teachers’ use of the pedagogical patterns, indicating that individual teachers worked in different ways. The methodology applied may also be valuable for further TEL and LD research. Accordingly, an integration of educational and design research is recommended.

Given that pedagogical patterns can help teachers reflect on pedagogical problems, I suggested that the concept be made available for trainee teachers and those in teacher professional development programmes. It would, in addition, be interesting for teachers to learn about the characteristics of design processes and preferably for them to receive support so that they can analyse and reflect on their own processes. Educational practice would certainly welcome future research on these suggestions.
References


All European Academies (2017). *The European code of conduct for research integrity.* ALLEA - All European Academies.


Swedish National Agency for Education. (2012). IT-användning och IT-kompetens i skolan. [IT use and IT competence in school]. Report no 386


Links to websites
E-LEN website: http://www2.tisip.no/E-LEN/
The Integrated Learning Design Environment (ILDE): https://ilde.upf.edu
The Learning Design Support Environment (LDSE): https://sites.google.com/a/lkl.ac.uk/ldse/
The Learning Designer: https://www.ucl.ac.uk/learning-designer/
The Learning Activity Management System (LAMS): https://lamscommunity.org/
Pedagogical patterns, examples from Bergin et al. (2012): http://csis.pace.edu/~bergin/PedPat1.2.html#earlybird
Pedagogical Patterns Project: http://www.pedagogicalpatterns.org
Open Pattern Repository: https://www.learningenvironmentslab.org/openpatternrepository/Main Page
Appendices

A. Design patterns created by upper secondary teachers
B. Letter of consent 2016–2017. Medgivande om att delta i projektet I Use IT
C. Letter of consent 2018. Medgivande om att delta i projektet I Use IT
### Appendix A

*Design patterns created by upper secondary teachers*

<table>
<thead>
<tr>
<th>Pattern name</th>
<th>Problem</th>
<th>Solutions and sub-solutions</th>
<th>Other sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Share (good) examples</td>
<td>1. Lack of time, will, fear of sharing examples of ICT usage</td>
<td>1. Learners and teachers prepare examples of technology use</td>
<td>N/A</td>
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<tr>
<td></td>
<td></td>
<td>2. Learners and teachers record a video of examples of technology use</td>
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<td></td>
<td></td>
<td>3. Other learners and teachers at the school watch the video</td>
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<tr>
<td>2. Enhance basic IT skills using video tutorials</td>
<td>2. Learners lack basic digital skills. Teachers lack time to give repeated support.</td>
<td>4. Tutorials arranged in a searchable database</td>
<td>Context: Students do not know how to use their email, Fronter, change passwords, Powerpoint, etc.</td>
</tr>
<tr>
<td>3. Ignorance of copyright at school</td>
<td>3. At school, there is uncertainty about what one may or may not do with other people’s material on the Internet.</td>
<td>5. Clear, easily accessible collective information on the school’s web forum that has the same value as PUL and crisis plan, 6. A separate point at the start and the end of the semester. 7. Workshops during the academic year linked to other ICT activities. 8. Introductory workshop day leads to the information material at school.</td>
<td>Context: At school, there is uncertainty about what one may or may not do with other people’s material on the Internet. Misc: Workshop proposal. 1/1 day. Am, lecturer, authors (STIM) + lawyer + inspiration from open CC sources (.SE). Pm. workshops: To gather good info, rules and good sources. Reassembly and termination. Follow up during the academic year.</td>
</tr>
<tr>
<td>4. The laptop is used only as a typewriter</td>
<td>4. N/A</td>
<td>9. Encourage optional presentation alternatives 10. Use the tool to support a culture of sharing 11. Use the tool to support creativity</td>
<td>N/A</td>
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<tr>
<td>6. Plagiarism, cheating</td>
<td>6. Learners hand in copy-pasted work. They are ignorant of the differences between writing a text in their own words, citing and plagiarising.</td>
<td>16. Make the learners show their work in progress</td>
<td>17. Demonstrate how to search and find the same material</td>
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<tr>
<td>7. Invent pre-knowledge</td>
<td>7. The teacher is ignorant of the pre-knowledge or misconceptions of learners</td>
<td>19. Use a response app</td>
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<tr>
<td>8. A way to let everybody use their voice</td>
<td>8. Some learners do not want to speak up in class</td>
<td>20. Use digital and anonymous response apps such as Padlet, Kahoot, Socrative</td>
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<tr>
<td>9. Evaluating the lesson</td>
<td>9. The teacher does not know how much the learner has absorbed from a lesson</td>
<td>21. Use exit tickets at the end of the lesson, i.e., Padlet</td>
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<tr>
<td>10. Follow-up of previous lessons</td>
<td>10. Saved material in digital response apps can be used for future lessons.</td>
<td>22. Students’ previous answers can be their new questions for later lessons. Ex. previous answers may recur as a question.</td>
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<tr>
<td>11. Learners work with concepts by flip</td>
<td>11. The learners need a basic knowledge of concepts, but their knowledge is at different levels</td>
<td>23. Give learners online access to all material (concepts, task, videos, links) and work at a preferred pace</td>
<td>24. The learners submit further questions via a form at the end of the lesson.</td>
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<tr>
<td>12. Collaborative work by brainstorming</td>
<td>12. A group should be able to collect, think and brainstorm collaboratively in the cloud; all members should be able to edit; and nothing is linked to a user or screen.</td>
<td>26. Work in the cloud so that many learners can edit work, for example via Lucidchart or Padlet</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pattern</td>
<td>Description</td>
<td>Context</td>
<td>Reference to other patterns</td>
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</tr>
<tr>
<td>13.</td>
<td>Learners’ collaborative work by brainstorming</td>
<td>Learners are not familiar with technology for sharing and editing</td>
<td>Work with new digital tools that the teacher assumes the student can understand because contemporary students are 'digital'.</td>
</tr>
<tr>
<td>14.</td>
<td>Working anonymously on a group task</td>
<td>Social patterns in the classroom generate preconceptions about learners and what they can add to project work. Learners may therefore avoid working with classmates. This causes a problem, as the democratic values of the school support the development of confident learners who are able to cooperate with anyone in the classroom.</td>
<td>Group work is a central part of teaching and removing preconceived notions about students' capacity removes a major concern when the groups are divided.</td>
</tr>
<tr>
<td>15.</td>
<td>Lost laptops</td>
<td>Many students lose their laptops</td>
<td>Requires a lot of preparation by the teacher who will create a Padlet for all groups, create documents/presentation. Distribute Alias. As well as educating students in how to use the programs. Also urge students not to reveal their alias.</td>
</tr>
<tr>
<td>16.</td>
<td>Learners lose digital documents</td>
<td>Learners forget to save documents or lack structure in digital environments</td>
<td>Sorry, there is currently no support for Office365.</td>
</tr>
<tr>
<td>17.</td>
<td>Teachers do not know where to turn with IT-related issues</td>
<td>Teachers have nowhere to get help with IT issues</td>
<td></td>
</tr>
</tbody>
</table>

- All learners do not need to be in the same place at the same time.

- Learners work in a classroom with the teacher the first time using Padlet.

- Learners brainstorm together anonymously online in Padlet.

- Learners work anonymously in an online document to create a presentation.

- Teach the learners how to use the applications.

- Put a name tag on the laptop. These are easy to remove with special cleaning sprays.

- Migrate to Office365.

- Make a step-by-step guide to frequently asked questions.

- Ex. linked PPT or a TWINE.
Appendix B

Medgivande om att delta i projektet I Use IT


Projektet fokuserar:

1. Tillsammans hitta (nya) fungerande sätt att använda IKT i skolan
2. Medverka till att dessa kommer till användning i skolan
3. Studera och förstå processer, aktiviteter och förändring av er praktik

Vi kommer att samlas in följande data:
- Skriftliga enkätvar
- Forskaranteckningar från observationer och diskussioner under designworkshops
- Dina texter och skisser producerade i samband med designworkshops.
- Ljudinspelning, video och stillbilder från designworkshops som du deltar i.

Vi följer de forskningsetiska regler som fastställts av Vetenskapsrådet (se http://www.codex.vr.se/forskningsetik.shtml), vilket bl.a. betyder att individens integritet ska skyddas och respekteras.


Om du har några frågor så tveka inte att kontakta Ola Knutsson eller Robert Ramberg på knutsson@dsv.su.se eller telefon 08-16 16 84, robban@dsv.su.se eller telefon 0705 680 441.

Om du går med på att delta behöver vi ditt skriftliga medgivande. Detta gör du genom att skriva under på nästa sida. Du kommer att få en kopia på ditt medgivandedokument.

Medgivande
Jag har läst informationen om projektet I Use IT och jag ställer upp som deltagare. Härmed ger jag forskarna som arbetar med projektet I Use IT rätten att använda de uppgifter som inhämtas under studiens genomförande för forskning, undervisning, publicering och presentation (på konferenser, workshops etc.). Jag godkänner också att detta material helt eller delvis publiceras i pappersform eller i elektronisk form.
Detta medgivandeformulär skrivs i två likalydande dokument. Ett dokument ges till vardera part.

________________________
Underskrift, deltagare

________________________
Textat namn, deltagare

________________________
Underskrift, ansvarig forskare

________________________
E-post, deltagare

________________________
Ort och datum
Appendix C

Medgivande om att delta i projektet I Use IT

Medgivande om att delta i projektet I Use IT

Studien som du ger ditt medgivande till deltagande i är en del av projektet I Use IT. Projektet är ett samarbete mellan Stockholms stad och Institutionen för data- och systemvetenskap vid Stockholms universitet under 2018.

Projektet fokuserar:
- Tillsammans hitta (nya) fungerande sätt att använda IT i skolan.
- Medverka till att dessa kommer till användning i skolan.
- Studera och förstå processer, aktiviteter och förändringar av praktik.
- Bidra med verktyg som stödjer förändringsarbete i den egna skolan.

Vi kommer att samla in följande data:
- Skriftliga utvärderingar.
- Intervju data.
- Forskaranteckningar från observationer och diskussioner under designworkshops.
- Ljudinspelning, video och stillbilder från designworkshops som du deltar i.
- Dina texter och skisser producerade i samband med designworkshops.

Vi följer de forskningsetiska regler som faststälts av Vetenskapsrådet (se http://www.codex.vr.se/forskningsetik.shtml), vilket bl.a. betyder att individens integritet ska skyddas och respekteras.


Ditt deltagande är helt och hållet frivilligt. Du kan när som helst avbryta ditt deltagande i studien.

Om du har några frågor så tveka inte att kontakta ansvariga forskare Ola Knutsson via knutsson@dsv.su.se, telefon 08-16 16 84, eller Lisa Rolf via elisabeth@dsv.su.se, telefon 076-60 95 209.

Om du går med på att delta behöver vi ditt skriftliga medgivande. Detta gör du genom att skriva under på nästa sida. Du kommer att få en kopia på ditt medgivandedokument.
Medgivande om att delta i projektet I Use IT

Medgivande
Jag har läst informationen om projektet I Use IT och jag ställer upp som deltagare. Härmed ger jag forskarna som arbetar med projektet I Use IT rätten att använda de uppgifter som inhämtas under studiens genomförande för forskning, undervisning, publicering och presentation (i tidskrifter, på konferenser, workshops etc.). Jag godkänner också att detta material helt eller delvis publiceras i pappersform eller i elektronisk form.

Detta medgivande skrivs i två likalydande dokument. Ett dokument ges till vardera part.

Ort och datum

Underskrift, deltagare

E-post, deltagare

Textat namn, deltagare

Ort och datum

Underskrift, ansvarig forskare