

Design and Use of Mobile Technology in Distance Language Education

To my family

Örebro Studies in Informatics 11



OLGA VIBERG

**Design and Use of Mobile Technology in Distance
Language Education:**

Matching Learning Practices with Technologies-in-Practice

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Abstract

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This thesis focuses on the adaptation of formal education to people's technology-use patterns, their *technology-in-practice*, where the ubiquitous use of mobile technologies is central. The research question is: *How can language learning practices occurring in informal learning environments be effectively integrated with formal education through the use of mobile technology?* The study investigates the technical, pedagogical, social and cultural challenges involved in a design science approach.

The thesis consists of four studies. The first study systematises MALL (mobile-assisted language learning) research. The second investigates Swedish and Chinese students' attitudes towards the use of mobile technology in education. The third examines students' use of technology in an online language course, with a specific focus on their learning practices in informal learning contexts and their understanding of how this use guides their learning. Based on the findings, a specifically designed MALL application was built and used in two courses. Study four analyses the app use in terms of students' perceived level of self-regulation and structuration.

The studies show that technology itself plays a very important role in reshaping peoples' attitudes and that new learning methods are co-constructed in a sociotechnical system. Technology's influence on student practices is equally strong across borders. Students' established *technologies-in-practice* guide the ways they approach learning. Hence, designing effective online distance education involves three interrelated elements: technology, information, and social arrangements. This thesis contributes to mobile learning research by offering empirically and theoretically grounded insights that shift the focus from technology design to design of information systems.

Keywords: online distance education, mobile learning, mobile-assisted language learning, information systems artefact, design science research, learning practices, structuration, self-regulation, technology-in-practice.

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List of papers

Paper 1

Viberg, O., & Grönlund, Å. (2013a). Systematising the Field of Mobile Assisted Language Learning. *International Journal of Mobile and Blended Learning*, 5(4), 72-90.

Paper 2

Viberg, O., & Grönlund, Å. (2013b). Cross-cultural analysis of users' attitudes toward the use of mobile devices in second and foreign language learning in higher education: A case from Sweden and China. *Computers and Education*, 69, 169-180.

Paper 3

Viberg, O., & Grönlund, Å. (2015). Understanding Students' Learning Practices: Challenges for Design and Integration of Mobile Technology into Distance Education. *Learning, Media and Technology*, DOI: 10.1080/17439884.2016.1088869

Paper 4

Viberg, O. (2015). Antecedents to Design of Software for Learning: Self-Regulation and Structuration. Manuscript submitted to *Educational Technology and Society* (under review).

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Abbreviations

AJAX	Asynchronous JavaScript and XML
App	application
CALL	Computer-Assisted Language Learning
CSS	Cascading Style Sheets
DBR	Design-Based Research
DESRIST	Design Science Research in Information Systems and Technology
DSR	Design Science Research
EU	European Union
EUROCALL	European Association for Computer-Assisted Language Learning
GPS	Global Positioning System
GUI	Graphic User Interface
HTML	HyperText Markup Language
ICT	Information and Communication Technology
IT	Information Technology
IS	Information Systems
JSON	JavaScript Object Notation
MALL	Mobile-Assisted Language Learning
NGL	Next Generation Learning
mLearn	Mobile learning
MOOC	Massive Open Online Course
OSLQ	Online Self-Regulated Learning Questionnaire
PC	Personal Computer
SLA	Second Language Acquisition
SMS	Short Message Service
SOLL	Seamless Online Language Learning
SRC	Swedish Research Council
SRL	Self-Regulated Learning
SST	Social Shaping of Technology
ST	Structuration Theory
TML	Technology-Mediated Learning
XML	Extensible Markup Language

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1. Introduction

Mobile technologies that are wirelessly networked are rapidly integrated into people's lives. Such technologies offer people opportunities to use their time in more effective ways for various purposes, not least for learning. The use of mobile technology makes it possible for learners to access information and assisting tools wherever they are. However, in order to manage such information and tools, learners must have a plan as well as the motivation, skills and strategies to make good use of them. Learners have to be able to direct and control their activities and to use the available resources effectively to achieve a goal. As access to information and tools increases, the need to be self-regulated increases accordingly.

To date, the use of mobile technology has barely been integrated into formal learning and teaching practices. Most often, mobile technology relates to learners' informal learning environments; such environments have not been designed for the purpose of formal education, and for personal learning practices. These practices can be guided by their own structured, self-directed learning methods and strategies. However, they can also be guided by incidental, and/or social learning, depending on the presence or absence of learning awareness and intentionality (Schugurensky, 2000). Formal learning practices are governed by the goals, regulations and procedures stated in documents of formal education. In the present research, formal learning and learning practices that occur in informal learning settings are considered to complement each other in supporting individuals' learning. Formal education can contribute through scientific knowledge and tested pedagogical methods. Learning in informal settings can contribute by allowing the individual to make use of personal learning styles and opportunities presented by the environment, including social, temporal and technical factors.

The vast majority of mobile learning materials created thus far has been developed to support informal ways of learning, individuals' learning styles and social processes. Only in a very few cases has such material been designed specifically to support institutionalised learning (Díaz-Vera, 2012). When designing formal education, a challenging task for educators is to mobilise and make best use of the benefits of new technologies, often labelled 'Web 2.0' and 'Mobile 2.0' in their teaching "without destroying what is most distinctive and interesting about Web 2.0 and Mobile 2.0, that is, the fact that it is driven by users" (Pettit & Kukulska-Hulme, 2011, p. 193). This task requires us to understand individuals' technology-mediated learning practices, which can be

considered as taking place in a socio-technical system made of individuals, technology, and the social contexts in which these practices occur.

The emphasis on ownership and agency is a dominant theme in current discussions about the ways in which educators can harness Mobile 2.0, which can be defined as “Web 2.0 on sleek mobile devices” (Pettit & Kukulska-Hulme, 2011, p. 192). According to Malpas (2012), within a global connectivity, where borders of time, place and communities become blurred through mobile technology-in-practice, it is important to be aware of the importance of the essential unit of connection, the *individual*, who makes such connection to a global world possible.

According to Castells, Fernández-Arvédol, Qiu and Sey (2009), individualism rather than mobility is seen to be the crucial social trend of the “mobile society”, where the distorting process of mobile communication centres on the individual. Traditional top-down communication is challenged by younger users of mobile technology, a technology that provides pervasive access to information. This use of technology changes the direction of the knowledge flow and questions previously established institutionalised educational practices and structures. Such communication supports the mixing of a variety of social practices in a variety of time/space contexts. (Castells et al., 2009)

The main theme of the present research is the adaptation of formal education to match today’s individualistic technology use patterns, individuals’ technology-in-use, where the employment of mobile technologies is central.

The integration of mobile technology into formal education could be directed to support student-centred learning environments and guide learners in their construction of meaning. The key assumptions of such student-centred learning environments include: i) the centrality of the learner in defining meaning, ii) the use of scaffolding by participation in authentic tasks and sociocultural practices, iii) the importance of prior and everyday experience in meaning construction, and iv) access to multiple perspectives, resources, and representations (Land, Hannafin, & Oliver, 2012).

Díaz-Vera (2012) claims that, “[a]lthough mobile technologies offer innovative ways for supporting learning, collaboration, and communication, the impact of these transformations on the ways students learn at schools and universities is so far definitely lower than initially expected” (p. xiv). This can be explained by the fact that the institutionally supported integration of mobile technologies into formal learning practices is not sufficiently developed, and the knowledge of how students use such technologies for their private (learning) purposes

is still limited. Students' learning practices, which are the focus of this present research, are understood to be as any structured or unstructured learning activities with or without technology-in-practice (see Theory, chapter 2, for further explanation), that are undertaken by individuals in order to learn.

This thesis aims to increase our understanding of how learners employ mobile technology in learning, specifically in foreign and second language learning. Furthermore, it seeks to examine and explain how such technology-in-practice, hitherto mainly used for various learning practices, can be integrated into online distance higher education in order to utilise student-centred learning environments and facilitate lifelong learning. More specifically, this research deepens our understanding of design challenges that stem from the integration of informal learning styles and environments into formal education. Such understanding would help software and courseware designers, and instructors of online distance education to develop and integrate mobile information technologies (IT) in ways that both support and further foster individuals' self-regulated learning behaviour. Furthermore, it would assist in their learning practices, both in formal and informal learning environments.

1.1 Learning and mobile technology

[B]y its nature, the learning enabled by mobile devices is often informal and contingent, and so needs careful structuring and guidance if it is to feed into formal learning and assessment systems. (Pegrum, 2014, p. 9)

This thesis is situated within the nascent field of mobile learning, which is seen as an interdisciplinary research area and attracts scholars from diverse fields, including education, informatics, and computing sciences, as well as language, cultural and media studies. According to Alavi and Leidner (2001):

[t]he increase in the quantity as well as quality of demand from both traditional students and working adults combined with the strong penetration rate of [mobile] information technologies present an extraordinary potential for the transformation of educational and learning practices. (p. 2)

The rapidly increasing penetration of mobile technologies into individuals' everyday activities nowadays creates learning opportunities

that go far beyond the previous technology-mediated learning and teaching practices. In particular, today's mobile devices-in-use extend individuals' learning opportunities in terms of both time and space.

The growing applicability and use of new technologies, among them mobile technologies, has an influence on social practices and enables new contexts of learning: indeed, "[t]he communicative potential of mobile devices can be seen as an important prerequisite for learning, enabling users to engage in interactions with themselves, with others and with their environments" (Vavoula, Pachler, & Kukulska-Hulme, 2009, p. 5). However, the integration of mobile technology into teaching and learning has been more gradual, as educators have sought to understand how mobile technology can be effectively used to support various kinds of learning (Kukulska-Hulme & Shield, 2008). Kukulska-Hulme (2012 a) suggests that in a constant process of development, higher education has to adapt to the widespread adoption of popular technologies such as social media, social networking services and mobile devices. In recent years, emerging personal mobile technologies have become a significant part of students' social learning landscapes. Thus, such adaptation is essential if learning is to be considered in relation to education.

The term *learning* is often used in various ways, reflecting the widespread acceptance of many different kinds of learning (Beckett & Hager, 2002). According to Winch (1998), the ambiguity of the term is increased by the fact that it is commonly used to refer to a task and to an achievement; in a task sense, learning is directed towards the process of learning, whilst in an achievement sense, learning focuses on the product and outcome of learning. Learning is a constantly changing process that takes place all the time and in all places and spheres of life. It reflects all human activities, regardless of whether they take place in a physical classroom, an online community, or outside the classroom in, for example, a museum. Learning is seen as a social process of interaction that is "built upon foundations which are part of our human endowment, our intelligence, our innate potentialities" (Barton, 2007, p. 49).

Learning here is thus understood as "any change in a [human cognitive] system that produces a more or less permanent change in its capacity for adapting to its environment" (Simon, 1996, p. 100). It occurs in a dynamic interaction between a learner and a context and between people in an environment, continuously and mutually affecting each other. Consequently, it constitutes a process of cognitive and social

development in which social interactions are mediated by cultural tools such as language and technology (Cook, Pachler, & Bradley, 2008).

As is the case of most existing IT artefacts, mobile technology is not primarily an educational phenomenon; rather, it is a sociotechnical phenomenon that occurs in different parts of the world and in different ways. Thus, mobile learning is not limited by institutionalised spatial and temporal frames of formal education, because the portability of mobile devices makes it possible to take learning outside the classroom. It is distributed and related to the everyday experiences of individuals that occur in both formal and informal environments, where the notions of outside and inside are blurred. Hence, mobile learning is seen as both a process and a product of sociotechnical construction, which involves and considers the individual's social environment.

Nowadays, when considering informal learning settings in which students spend much of their time, and the rapid development and use of technology, the notions of mobile technology and mobile communication become an inalienable part of our understanding of the processes that occur within these settings. One such process is learning. Learning in informal contexts comprises activities that tend to be individualised and contextualised in our everyday practices. Competences and skills that are gained through a process of learning in non-educational settings are of importance to the development of individuals' lifelong learning. Thus, learning is seen as a process and the result of both formal education-related learning practices and learning practices related to informal environments. Nevertheless, the challenge is "to discover how to use mobile technologies to transform learning into a seamless part of daily life" (Naismith, Lonsdale, Vavoula, & Sharples, 2006, p. 5). This challenge is faced by the educational instructors and institutions, and by the learners, themselves.

1.2 Problem statement and motivation

From a global perspective, there has been an explosion of the use of mobile Information and Communication Technology (ICT) devices in recent decades. For millions of people in Africa and Asia, using a mobile device is the only practical way to connect to the Internet. Even in countries where fixed broadband connection is commonplace, the use of mobiles has expanded for practical and lifestyle reasons. Businesses are connecting to users via mobile devices to a greater extent than ever, because this is now the most effective way to reach out to customers.

Mobile devices remain ever close to the users; indeed, their use extends around the clock. Furthermore, these devices are becoming increasingly “smarter”, allowing complex content to be presented through user friendly “apps”.

Universities see opportunities for reaching new students (and avoiding the risk of losing existing ones), and want to try new methods that involve the use of new technologies. Thus, in the higher education business, too, there are attempts to incorporate mobile devices. For example, Athabasca University (Canada), which is primarily a distance education institution, has implemented several mobile learning projects in their drive to optimise study content for mobile delivery. The Open University (UK), which is also a distance-oriented educational institution, started work on its own mobile learning development strategy in 2008 (Thomas, 2010). In 2010, the Open University went to offer and evaluate the Mobile Learning Guide (Kukulska-Hulme, 2012a). An evaluation of the guide by educators has shown an overall scepticism toward mobile learning integration into educational settings, which is mainly related to the ways of its integration and the potential consequences for established teaching and learning practises. In Asia, the Chinese University of Hong Kong introduced a Mobile Learning Project (2010) with the intention of promoting mobile learning among teachers and the university in general. The project’s evaluation indicated that, overall, teachers were not technically prepared enough to implement a mobile learning strategy. Here, continuous teacher support (i.e., teachers themselves need support) was identified as one of the key prerequisites for the future success of the strategy (Lam, Kwok, & Wong, 2011).

There are compelling business and social reasons for universities to try to integrate innovative learning methods enabled by new mobile technology-in-practice. Over the past two decades distance education has grown in volume and recent developments suggest a further, and considerable, increase. There is growing competition among universities for students, but there is also a potentially huge increase in demand for education at university level as millions of people in Africa, Asia, and Latin America seek education to increase their competences and competitiveness in the job market. Not all of these people can afford to go to a university in the industrialised world, or indeed a university at all. Open access distance education may be their only chance to get started in higher education.

However, these new methods and opportunities involve the use of new technologies that create design challenges for educational institutions. One recent response to these changing conditions and increasing demands for learning and teaching is the massive rise in online open courses known as MOOCs. The general idea of MOOCs is to be able to offer education on a mass scale using online material and automated tools as much as possible. This method cuts the costs of course delivery for universities and allows users to participate for free (other than communication costs). There are several as yet unsolved challenges related to the business case of MOOCs. These include the way in which students are examined and how formal crediting is arranged. However, it is to be expected that solutions to these challenges will appear over time, because the market potential is so vast.

The present thesis focuses on the educational side of such design challenges in higher education. As is the case for other forms of distance education, MOOCs draw on a number of changes in education as compared to campus education, including the need to provide good online content and technical tools for students and teachers, and the arrangement of effective peer cooperation. In general, these are known success factors for distance education. In particular, the online environment provides new opportunities in, for example, online peer cooperation using social media, multimedia content, user-generated content, and automated tools for course delivery, as well as the assessment and control of students' work. Nevertheless, the "challenge is to set guidelines for appropriate use and to provide tools and resources for personal learning that integrate with commercial applications" (Sharples, 2013, p. 13).

Thus, educational institutions are faced with considerable design challenges. Courses need to be adaptable to fit into various students' learning practices that occur in informal settings. They also need to be accessible across different technical platforms. In short, they need to be able to effectively integrate formal educational activities into informal learning environments and vice versa. This challenge includes technical and practical, as well as pedagogical, social and cultural aspects, all of which course designers and educational institutions need to learn more about.

The challenge that motivates this thesis is to understand the design issues involved in integrating informal learning styles and environments into formal education. These challenges pertain to issues of technology,

pedagogy, organisation of higher education, and in particular the integration of all these factors. The technical challenges involve the design of useful and usable technical tools to support students in personalising and optimising their learning environment and to support teachers in providing teaching material, instruction, and support. Pedagogical challenges involve the design of courses and modules in new ways to meet the needs of learners in diverse informal learning environments. The organisational challenges involve the rational production of more complex course material, the efficient use of available technical platforms, and more flexible course organisation, not only relating to recruitment and course delivery but also to assessment. Underlying these practical challenges is another, more fundamental, one: the cultural change on the part of students, teachers, and universities that is necessary to be able to rethink traditional classroom based education. Students, teachers and universities need to be prepared to re-consider traditional educational culture.

One solution is to bring the learning practices that occur in informal contexts into formal education. On the one hand, this may succeed in bringing the students closer; on the other hand, it may distance them even further. While students will no longer be present in the (physical) classroom, or at least not to the same extent, the contact between the teacher/university and the student can be extended into the students' private sphere. This is possible because education is no longer confined by time or place, because of the use of social media, e-mail, and Skype. Such changes in the way that technology is used in peoples' everyday lives, and in the ways that individuals communicate in their learning practices, may influence traditional institutionalised educational practices. Traditional educational practices and systems vary between countries and contexts, because of different cultural and historical backgrounds and settings. Nevertheless, there is still a lack of knowledge about how the emerging mobile technology use, in both informal and formal learning environments might impact established learning practices and systems.

Furthermore, the focus of this thesis is on a particular form of higher education, namely online distance education, where students spend most of their study time in informal learning settings, not in traditional campus-based education environments. The use of technology in online distance education in general is one of the main prerequisites for the effective implementation of such education. Thus, instructors have to

think about how various kinds of technology, both provided by the institution (so called educational technology e.g., certain software for running online synchronous group discussions or a learning management system chosen by the institution for course participants' asynchronous communication etc.) and not least students' private technologies-in-use are employed for learning purposes.

Nowadays, the use of mobile technology in informal learning settings plays a significant role in people's everyday lives. People use it extensively for many reasons, and in various social settings and processes. Thus, it becomes interesting to examine how they use such technology specifically for their learning, either spontaneously or deliberately. Such knowledge will contribute to a deeper understanding of how mobile technology-in-practice, which is presently largely used in informal contexts, can be integrated into more formal educational practices.

This research investigates in particular foreign and second language students' learning practices. Learning a foreign language is seen as a fundamental part of an individual's lifelong learning. Foreign language learning is an educational field that is well suited to distance education, because many people across the world wish to learn another language. Indeed, knowledge of more than one language is often a prerequisite for being able to access further education. Indeed, it is often a key requirement for being able to choose among various educational institutions worldwide. Knowledge of more than one language also offers graduates a wider variety of career options in an increasingly international job market. For some jobs, it is often specified among the main requirements, particularly in the European context. While some learners study foreign languages as their major subject, many more combine such studies with other educational programs or with full-time jobs. For those people, distance education is particularly attractive; sometimes, it is the only option available to them.

For such reasons, online and part-time study of foreign languages is likely to increase even further. Thus, the increasing flexibility and availability of mobile technology-in-use need to be considered in relation to educational practices.

1.3 Research aim and questions

This thesis investigates the technical/practical, pedagogical, social and cultural challenges involved in the integration of informal learning styles and environments into formal higher distance education. It seeks to investigate how students' informal learning environments can be integrated through the use of mobile technology into formal language learning practices in order to expand their learning landscapes and enhance learning as both a task (a learning process) and an achievement (a learning outcome).

The overall research question is:

How can language learning practices occurring in informal learning environments be effectively integrated with formal education through the use of mobile technology?

This question is investigated in four steps, each of which addresses a specific sub-question (see explanations below). All the steps are analytical in various ways. The last study is more directly design-oriented, than the others, because it involves the evaluation of a tool-in-use, the prototype of a mobile language learning application. It was designed in line with the investigations carried out in steps 1, 2 and 3, and was built to fit into a formal university education system, technically and formally. This tool-in-use was subsequently integrated into a selected university language course.

1. What is the current scientific knowledge about applying mobile technologies and techniques in second and foreign language learning within educational settings? This inquiry presents the overall problem in order to set the scene more specifically for further work. Reported in Paper 1.
2. What are the attitudes among students toward mobile technology use in and for second and foreign language learning? In this step, students' attitudes are investigated so as to understand if there are major differences, e.g., stemming from local cultural contexts, age, or gender. If so, how do they influence attitudes in terms of the implications for design and delivery of online courses. Reported in Paper 2.
3. How do students use technology in their language learning? Here, the focus is on students' use of technology in distance education, specifically in an informal setting (not crucial, but a style item for language learning). In this step, I attempt to answer not only the 'how'

- question, but also the ‘why’ question: Why do they use some technologies and leave out others in their learning? Reported in Paper 3.
4. What are the challenges of mobile application integration into online distance education with respect to learners’ characteristics? This analysis specifically investigates learners’ characteristics in terms of their self-regulation and structuration, and how these characteristics might influence the future design of (mobile) educational technology. Moreover, during this phase, I also aim to understand how students use the application integrated into their formal course with regard to these characteristics. Application use is analysed employing a number of technical tools built into the system, including technical measures (log data), as well as user interview data. Reported in Paper 4.

1.4 Mobile learning

The meaning of mobile learning has evolved during the last years, from the use of handheld devices in (physical) classrooms, through to the use of technology to support learning of various kinds “in context and on the move, towards a broader investigation of learning in a mobile society” (Sharples, 2013, p. 6). Such a shift has led to a more expansive framework for mobile learning and a set of innovative projects across a wide range of physical, institutional and social settings (Kukulska-Hulme, Sharples, Milrad, Arnedill-Sánchez, & Vavoula, 2011). Mobile learning has moved from smaller research and pilot initiatives towards large-scale projects and services, as for example in the English in Action Initiative (supported both by the Bangladesh government and the UK’s Department for International Development). This long-term project was launched in 2008 with the aim to improve the communicative English skills of people in Bangladesh.

Mobile learning is considered to be a relatively new research field, which is undergoing a rapid ongoing evolution. There is still much work to be done, not least in terms of achieving well-established definitions, concepts and theories specific to this research area. As yet, there is no definitive and widely accepted definition of mobile learning. This is because of the ambiguity of the term ‘mobile’, which can refer to the technology itself and/or to the mobility that this technology offers to the users (Kukulska-Hulme, 2009). Crompton (2013), in her historical summary of mobile learning, offers a concise overview of the genesis of

the term mobile learning, which, according to her has been accepted as a recognised term since 2005.

The first workshop on mobile learning was organised in 2002 (European Workshop on Mobile and Contextual Learning), indicating that the field had made its first attempts to distinguish itself from the more established and defined area of e-learning.

Mobile learning certainly shares many features and grounds with e-learning: one is technology itself. When a mobile device is a computer, currently in the form of a smartphone, tablet and so on, it presents a sophisticated level of technology that can offer a number of affordances to its users for the social processes in which they are engaged on a daily basis (e.g., communication, learning, and interactions using social media). Second, mobile learning research is often presented at e-learning conferences and within e-learning related publications, as a sub-area of e-learning. For example, research on mobile-assisted language learning (MALL) is often seen as a sub-division of computer-assisted language learning (CALL), a more established and widely recognised research field; hence, it is presented accordingly. This is not a surprising fact, because e-learning was the first acknowledged term to connect learning with digital technology.

During the early phases of e-learning the technology used lacked the sophisticated technical functionality that could offer possibilities for interaction with society and its contexts in a way that is possible with today's mobile technology. Peters (2009) claims that:

While mobile learning can be thought of as a subset of e-learning (which is web-based delivery of content and learning management), the emerging potential of mobile technologies tends to indicate that m-learning, which is mostly situated within the e-learning framework, also has links to the 'just enough, just in time, just for me' model of flexible learning. (p. 116)

A number of attempts have been made to define mobile learning. The focus of these definitions has shifted from the attention to the mobility of the device to the mobility of learners and learning itself, and finally to "the wider society and era in which the learning takes place" (Pegrum, 2014, p. 5). These shifts suggest that there are four important aspects of mobile learning as a concept that are central to its construction, understanding and further examination: technologies, people, learning and contexts.

One of the first attempts to introduce handheld devices in relation to educational settings took place in 1972, when Alan Kay introduced a personal computer for children of all ages, the Dynabook (Kay, 1972). In 1991, Wayne Grant (1993) went on to present the Wireless Coyote. During the 1980s, smaller projects in classrooms were based on Psions (especially Psions Series 5). The Handheld Learning Resources project started in 1997 and resulted in a number of early publications relating to mobile learning (Vavoula & Sharples, 2001; Chan & Sharples, 2002). In 2002, two major European projects, Mobilelearn and Mobile Learning, were launched. Mobilelearn was operational between 2002 and 2004, and included 24 partners from 10 countries, from both academia and industry. It focused on the development and support of learning outside classrooms (Sharples & Pea, 2014). Since then, a growing number of projects related to the use of mobile devices for different educational purposes have been carried out.

As mentioned above, earlier definitions tend to focus on the mobility of the devices involved: “It’s elearning through mobile computational devices: Palms, Windows CE machines, even your digital cell phone” (Quinn, 2000). Such early approaches to define mobile learning were criticised for their technocentrism. However this definition was aimed at a general public rather than at researchers.

Another definition of mobile learning, which highlights both learner mobility and learning with handheld technology, is that of O’Malley et al. (2003, p. 6): “any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies”.

At the end of the Mobilelearn project (December 2004), researchers suggested that, “mobile learning should be re-conceived around *learner mobility* rather than technology - that learning interleaves with other everyday activities, complementing yet at times also conflicting with formal education” (Sharples & Pea, 2014, p. 502). In 2005, Traxler offered another definition of mobile learning, as “any educational provision where the sole or dominant technologies are handheld or palmtop devices” (p. 2). Later on, he argued that mobile devices and technologies transform the nature of knowledge and discourse, thus changing the nature of learning and its delivery (2009).

Moreover, mobile learning was later defined as “a process of coming to know through conversations across multiple contexts among people

and personal interactive technologies” (Sharples, Taylor, & Vavoula, 2007, p. 225), with a specific focus on the fluidity of contexts. This definition was applied in the first study that forms part of this thesis (Viberg & Grönlund, 2013a). It has remained one of the largely accepted definitions in the mobile learning research for several years. However, it was criticised by Crompton (2013), who emphasised that this definition was written for a study that highlighted conversational theory, and that the word ‘conversation’ may connote oral interactions, rather than interactions in general.

This critique led to a new formulation and conceptualisation of mobile learning by Crompton in Berge and Muilenburg (2013): “learning across multiple contexts, through social and content interactions, using personal electronic devices” (p. 4). Mobile learning can thus occur in various settings, educational as well as non-educational.

Two main motives drive interest in mobile learning. One is “a desire to equip each student with a powerful individual device, as this could provide a customised and personalized learning experience”. Another relates to an increasing recognition of the need for lifelong learning. (Sharples & Pea, 2014, p. 505)

In the present thesis, the context of learning is considered to be subjective and individual, as well as subject to change. Individuals’ patterns of learning will change along with changes in technologies, which become an integrated part of culture. On the one hand, mobile technologies-in-practice influence how we manage our everyday lives, including numerous social processes, of which learning being one. On the other hand, we simultaneously influence how these technologies are used through our personal characteristics, preferences, skills and learning styles. This understanding acknowledges the student or technology user at the centre, where the personal socio-cultural context is recognised as crucial for learning. In addition to the importance of context, user interface and interaction design have also been highlighted as two of the most important requirements for mobile learners’ practices (Kukulska-Hulme et al., 2011).

A point of departure in this thesis is that the function of technology is to guide and support the user or student in the process of creating a distributed system of meaning making (Viberg & Grönlund, 2012). Such a view of learning gives rise to the issue of “where the ownership of learning lies” (Sharples et al., 2007, p. 244). Accordingly, the agency is

seen to lie neither with a single individual, nor with the technology, but rather in the:

democratic synergy between the different parts of the system with the aim to advance knowing. Learning needs to be conceptualized in terms of interactions between individuals, humans or non-humans, which take place in order to achieve evolving states of knowing as they are shaped by mutually (and continuously) negotiated goals. (Sharples et al., 2007, p. 244)

In the present research, the use of mobile technology for learning is viewed from the social shaping of technology (SST) perspective (Williams & Edge, 1996). Here, mobile technology does not develop according to “an inner technological logic but is instead a social product patterned by the conditions of its creation and use” (p. 866). From the SST perspective, technology is perceived to be socially constructed. There is a mutual shaping of the relationship between technology and society. The integration of mobile technology in (distance) education, and its use for various learning purposes and in various learning environments, involves a number of choices. These choices are not merely technological, but also social. In particular, they influence which opinions are selected, thus shaping both the content of the technologies and their social implications for learning. These choices are an integral part of both the design and application of mobile technologies for learning and educational purposes. Such choices can be conscious and/or unconscious, related to the use of mobile devices in informal learning settings.

One of the recent definitions of mobile learning takes a technology perspective, seeing it as “the provision of educational content and services to people on the move, relevant to their location, across multiple devices including smartphones and tablet computers and even wall-size displays” (Sharples & Pea, 2014, p. 516). I have largely accepted this definition in my research. However, the use of laptop computers is not included in the meaning of ‘mobile technologies-in-use’ in the thesis.

Along with the lack of a well-established definition of mobile learning, there is currently a lack of solid theoretical pedagogical perspectives on mobile learning. This makes the process of mobile technology integration into formal education even more challenging.

1.4.1 Design guidelines for mobile learning

Mobile learning, as its own research area or as a sub-division of e-learning, is situated in the intersection between learning and technology. Mobile technologies support highly interactive learning environments, whether or not they are part of formal education. Nonetheless, there is relatively little knowledge about how individuals learn with these technologies, particularly in informal learning settings, where mobile devices' mediated learning practices predominantly occur. Knowledge about how learners employ mobiles in their learning practices is needed if educators are to understand how the use of these technologies can be improved and operationalised in formal educational settings.

A large number of studies have examined various mobile applications and their integration into miscellaneous educational contexts (e.g., Butgereit & Botha, 2009; Kondo et al., 2012; Li & Hegelheimer, 2013; Lumsden, Leung, D'Amours, & McDonald, 2010; Sandberg, Maris, & de Geus, 2011; Uther, Zipitria, Uther, & Singh, 2005; Veenhof, Sandberg, & Maris, 2012; Wong, Chin, Tan, & Liu, 2010). Nonetheless, there is still limited research that clarifies the underlying design principles and guidelines behind their development and integration. Thus, such guidelines need to address the technology employed, as well as the learning contexts in which a learning situation takes place and the individuals' characteristics, for example, in terms of their self-regulation. The critical focus should lie not on the potential affordances and specifics of each of these components standing alone, but rather on the nexus of all these components, which are considered to drive the integration of mobile learning technologies-in-use in informal contexts into formal education.

Based on early mobile learning projects, Vavoula, Lefrere, O'Malley, Sharples and Taylor (2004) presented 10 general design guidelines for mobile learning, including such dimensions as costs, systems usability, choice of technology, roles, equipment management, support for teachers, administration, collaboration, services or application and security issues. Herrington, Herrington and Mantei (2009) proposed general design principles for mobile learning in higher education that are based on the analysis of the conducted mobile learning projects. These design principles suggest: a) the use of mobile learning in authentic contexts; b) the use of mobile learning in contexts in which learners are mobile; c) the provision of time for the exploration of mobile technologies; d) the blending of mobile and non-mobile technologies; e)

the use of mobile learning spontaneously; f) the use of mobile learning in non-traditional learning spaces; g) individual and collaborative use; h) the exploitation of the affordances of mobile technologies; i) the use of the learners' own mobile devices; j) the use of mobile learning to mediate knowledge construction; and k) the use of mobile learning to produce and consume knowledge (Herrington et al., 2009, p. 134). Furthermore, Elias (2011) suggested universal instructional design principles of educational materials for mobile learning in distance education, including equitable and flexible use, simplicity and intuitivism, perceptible information, tolerance for error, low physical and technical effort, a community of learners and support, and an instructional climate. Palalas and Anderson (2013) presented a Mobile-Enabled Language Eco-System (MELLES) along with the corresponding MELLES design principles, which refer to both the technological aspects and pedagogical aspects of their intervention. Among the pedagogical characteristics of MELLES, which form the basis of design guidelines, the authors suggest that we “[i]ntegrate all four language skills but focus on listening activities” and “ensure balanced combination of individual and collaborative (group work) tasks, “include feedback mechanism (immediate and delayed)” (Palalas & Andersson, 2013, p. 985). With regard to the technological characteristics, they recommended that we “[enable exchange of information and artifacts as well as communication through the mobile-web portal”, “[i]ntegrate technology support and tutoring/instruction” and “[b]uild in cross-platform and multi-technology support”, among five other recommendations (p. 986).

Even though several attempts have been made to present design guidelines for mobile learning practice and research, it seems to be an extremely challenging task; indeed, it is sometimes regarded as an impossible one, because of the contexts in which mobile learning occur are in a constant process of change. Learners move all the time from one environment into another (i.e., from a physical one to a virtual one and from an informal setting into a formal setting). Moreover, technologies change at a rapid pace, which might have a direct effect on their potential affordances for learning. Finally, learners' skills and strategies might alter depending on the different social processes they are involved in. Underlying all these challenges the ethical aspects of mobile learning research may also become a significant issue.

1.5 Online distance education

There are many benefits for using mobile learning in education, but the most important ones include reaching people in remote locations and the disadvantaged, allowing learners to learn in context, and social interactions for learning. (Ally, 2012, p. 1)

The Sage Glossary of the Social and Behavioral Science defines distance education as a:

mode of education where learner(s) and teacher(s) are physically separated from each other and the instructional processes are fulfilled via information and communication technologies. Distance education alters the conventional patterns of education and provides opportunities of learning whenever and wherever you need. (Sullivan, 2009, p. 158)

The online character of distance education today suggests electronic methods of delivery for instruction. Thus, distance education is defined not purely in terms of geographical distance, but largely by the soft and hard technologies that are employed to overcome physical distance (Dron, 2014). The main challenge that remains for instructors and researchers is to answer the question: How can these technologies be effectively integrated in distance education?

The present research is conducted in the setting of online higher distance education, where students spend most of their learning time in informal learning settings (e.g., at home, on the bus and train), and where the use of mobile technologies is extensively integrated in their everyday activities. Thus, in this thesis I will assume that distance education scholars and practitioners might benefit more from the integration of mobile-technologies-in-use into distance educational teaching/learning practices than in campus-based educational practices. In the latter, learning environments are more observable, regulated, and are perhaps not as dependent on the functioning educational technology as in distance education. Here, educational technology is understood as “a diverse array of technological devices and technology-based activities and practices” (Selwyn, 2013, p. 5). However, the contrasts between campus-based and distance forms of education are becoming less obvious, with the mode of instruction often taking other accepted forms, such as blended learning.

Compared with previous forms of distance education, today’s teaching and learning environment differs in that students do not need to come to

campus to be able to take part in a formal educational course or programme.

Koszalka and Ntloedibe-Kuswani (2010) suggest two advantages of the use of mobile technologies for distance learners: i) mobile technologies can effectively bring community instructional resources and activities into the classroom from outside, and ii) mobile technologies can easily provide learners with resources and new kinds of instructional activities outside the classroom and in the community (pp. 139-140). The understanding of the word 'classroom' in my research refers to virtual classroom settings, supported by software for both synchronous and asynchronous interactions.

In 1989, Moore outlined three types of interaction in distance learning: student-student, student-teacher, and student-content. In 1994, a fourth type - student-interface - was added by Hillman et al. (Koole, McQuilkin, & Ally, 2010). The integration of mobile technology in distance education may support these kinds of interactions by bringing in additional flexibility and connectivity in terms of the time and space in which such interactions can take place; hence, it might broaden students' opportunities for learning.

Distance education today exists in diverse forms in different cultures and contains the use of various more or less advanced educational software for synchronous and asynchronous communication. Mobile devices-in-use also allow learners to create and choose their own communication and interaction learning patterns, which are closely connected to their everyday environments and related to their individual choices. This is something that educational institutions must consider when designing distance educational courses and software.

Online distance education is seen as one of the most changeable of education forms. Changes are driven both by rapid technical development and by alterations in the surrounding social environments (e.g., when more people combine jobs and education to meet a growing demand for upskilling). Changes in distance education refer to the changes in the accepted pedagogical approaches and technologies available. Dron (2014) identified three generations of distance pedagogies and suggests an emerging fourth generation:

1. the behaviourist/cognitivist model (Piaget, Skinner, Bruner & Cagne), with the focus on how individuals learn;

2. the social-constructivist model (Dewey & Vygotsky) with the emphasis on the notion that knowledge is socially constructed and the importance of others in developing understanding;
3. the connectivist model (Siemens & Downes), where the knowledge is in the network (human and non-human), and learning is a way of making sense of the network;
4. the holistic model (Dron & Anderson) that recognises that teaching and learning are “deformed by context and that no pedagogy has primacy.” (p. 239)

Dron further elaborated on the ambiguity of the term technology. Based on the Arthur’s (2009) definition, it is understood as the “orchestration of phenomena to some purpose” (p. 51). Here, the purpose is understood in terms of an individual’s learning, and the phenomena “may be natural or artificial, physical, mental, or abstract” (Dron, 2014, p. 240). Thus, learning is understood as a complex phenomenon that encompasses natural, artificial, physical, mental and abstract elements. Indeed the role of technologies in distance education practices is of much importance; without its effective employment in learning, the provision of the present forms of distance education would be an impossible task.

In this research, distance education is seen to take place in a student-centred learning environment, where the overall focus is to support the learner to actively construct meaning (Land et al., 2012) and provide opportunities for learning. Mobile technologies are used by learners on a regular daily basis. They are perceived as tools that might support their meaning construction and learning practices if designed and integrated carefully and effectively into distance education. Thus, in this thesis the focus is on learners’ characteristics in terms of their self-regulation. (For further discussion on self-regulated learning related to theory, see Chapter 2.)

Research attempts to examine the influence of mobile technologies-in-use in distance education have been made; however the results are ambiguous and require further investigation. Yousuf (2007) investigated students’ attitudes and perceptions in Pakistan towards the importance of mobile learning in distance education; the study showed that facilitating mobile learning can improve the entire distance education experience by enhancing communication between distance learners, tutors and supporting staff.

Koole et al. (2010) explored usability, learning, and social interaction related to mobile access to online course materials at a Canadian distance education university. Through the MobiGlam system, students were able to access Moodle course materials on a variety of mobile devices. The Framework for the Rational Analysis of Mobile Education (FRAME, Koole, 2006) was used to examine the complexities of the system, its perceived usefulness, and potential impact on distance education students. The study indicated that the controls and constraints of the device's usability, interaction learning, and social technology intersections were at such a level so as to impede the learners' choices and motivation. Usability, interaction, and social networking ratings were consistently higher for Moodle than for MobiGlam. However, learners showed their support of the potential of mobile devices. Koole's et al. (2010) research suggested a further examination of the balance between the controls and constraints of social technologies and the needs of distance learners. It is important to note that in the study's conclusion, the researchers indicated the limited potential of the generalisability of their results, which are specific to the context and technologies-in-use studied (Koole et al., 2010).

In 2010, a special issue (31(2)) of the Distance Education journal was dedicated to the theme of distance education and mobile learning, presenting studies conducted in different cultural contexts (Beckman, 2010; Taylor et al., 2010, etc.). This indicates that attempts are being made to integrate mobile learning practices in distance education, not only in the developed world, but also in the developing countries. In the latter, mobile technologies may be used differently but for the same purposes, to support the goals of formal education and provide students with the opportunities for lifelong learning.

1.6 Language learning and technology-in-use

Knowledge of how to use technology for personal purposes does not mean that they [learners] will know how to use it effectively for learning purposes, and this will obviously impact the pedagogical effectiveness of tasks and activities. (Stockwell, 2014, p. 211)

Historically computer-assisted language learning has been shaped not only by the trends in language pedagogy and SLA [second language acquisition] theories, but also by the state of computer technology. (Davies et al., 2014, p. 19)

While computer technology develops in a quite linear way, pedagogical and design approaches towards its integration into educational settings have been diverse, because they are determined by the contexts and cultures involved. An increasing amount of research on language learning in relation to technology has been conducted during recent decades and a separate academic field, computer-assisted language learning (CALL) has been chiselled out. CALL is considered as a rather recent area of instruction and research, and is often seen as too technocentric; in other words, “not pedagogically informed by classroom teachers”, and/or “not technically sophisticated enough by those from a computing background” (Thomas, Reinders, & Warschauer, 2014, p. 3). During CALL’s relatively short existence, it has moved from offering drill and practice exercises that focus on grammar and vocabulary towards more sophisticated language learning software for the teaching and learning of reading, listening, grammar and so on. Nevertheless what presently constitutes CALL in various contexts is a question for discussion.

A concise historical overview of CALL development was recently offered by Davies, Otto and Rüschoff (2014), who concluded that CALL “has reached the stage of normalization insofar as so-called Web 2.0 applications have become a common social phenomenon” (p. 35). Nevertheless, the question about what ‘normalization’ means in a particular educational context remains open for further discussion. The challenges in the present and future CALL research mainly refer to its methodological and theoretical frameworks, which have to be relevant to reflecting and understanding the current learning activities and processes in which individuals are involved.

A considerable number of papers devoted to the use of mobile technology in language learning can be found in the journals specifically dedicated to CALL (e.g., *International Journal of Computer Assisted Language Learning*, *the EUROCALL Review*, *ReCALL*, and *Language Learning and Technology*). In the EUROCALL research policy statement (2010), CALL is defined as:

an established but rapidly evolving academic field that explores the role of information and communication technologies in language learning and teaching. It includes highly interactive and communicative support for listening, speaking, reading and writing, involving extensive use of the Internet, and a wide range of activities and initiatives in materials development, pedagogical practice, and research.

Since the early days of CALL an increasing range of technologies has been available to CALL practitioners that are founded on various theories and pedagogies (Stockwell, 2012). Stockwell (2012) highlights the diversity that has arisen with regard to the relationship between technology and language learning. This diversity concerns the multiplicity in technology involved, the environments in which learning practices occur, and educational practices, users and research methods. This makes the field extremely interdisciplinary, as well as challenging for examination and moreover for potential generalisation.

Discussions of affordances in CALL contexts often point to the enabling or restricting capabilities of technology in language learning. Here “the term [CALL] is used to refer to how technology may help or hinder the learning process” (Stockwell, 2012, p. 7). Such understanding can be further extended to mobile-assisted language learning (MALL), because the author (Stockwell, 2012) assumes mobile technology use in language learning within the frames of CALL, using CALL as an all-encompassing term. At the same time, it does not mean that MALL and technology-enabled learning cannot coexist (Stockwell, 2012). MALL research is often presented, and coexists with and/or within the CALL research area.

Nevertheless, researchers investigating mobile technology use in language learning have started to distinguish themselves from the CALL research area by highlighting the term MALL. In contrast to CALL, they point out distinctive features of mobile devices used, such as portability, small size, interactivity, and ubiquity: “mobile-assisted language learning (MALL) can augment second language teaching and learning” (Palalas, 2011, p. 71). However, the difference between MALL and CALL is not that clear, because computers are also involved in MALL, especially on the server side.

In this thesis, MALL, which originates from a more overarching mobile learning research and practice area, is seen as a sub-division of CALL. Whilst it is still about language learning and technology, albeit in the new form of mobile technology, it may offer new affordances for learning, extending its practices to informal learning settings. However, in order to avoid confusion in relation to these acronyms, MALL is applied in the thesis when discussing the relation of mobile technology use to foreign and second language learning activities in higher education.

Mobile technology has unexplored pedagogical possibilities and potentials, not least when it comes to language learning, because learners constantly use language in its different forms; for example, when accessing social media, e-books, and online applications of various kinds. Through mobile devices, language learning can become an integral prevailing practice of learners' everyday lives.

Language is perceived to be a key tool for accessing other subjects and jobs. We constantly use language in its oral and written forms, even in body language when trying to adapt new information to different social processes, as for example in learning. Nowadays, the use of mobile technologies is seen as an integral part of such strategic educational goals as improving student achievement, supporting variation in learning needs, and reaching learners who would not otherwise have a chance to take part in education (Kukulska-Hulme, 2009).

MALL is defined by Chen (2013) as “the formal and informal learning of a foreign language with the assistance of mobile devices” (p. 21). It has been also explained and defined as the use of “mobile technologies in language learning, especially in situations where device portability offers specific advantages” (Kukulska-Hulme, 2013, p. 3701). Hsu (2013) claims that the development of mobile technology has changed the way we learn a foreign language, because of the advantages it offers in terms of flexibility, small size, low cost and user-friendliness.

Recent projects that have investigated how university students and other adults apply mobile technology to support their learning have traced the evolution of MALL. They have also examined ways in which language learners are using mobile devices (Kukulska-Hulme, 2012b) (for a detailed discussion of MALL research see Paper 1, Viberg & Grönlund, 2013a).

Bearing in mind that mobile learning is often associated with practice and research with regard to informal learning settings, very few theoretical models have sought to explain how the integration of mobile devices into (language) learning can be understood. A recent framework offered by Kukulska-Hulme (2012b) (Figure 1) is seen as an instructional approach, rather than a learning theory or a cognitive paradigm. In particular, it emphasises the set of choices that should be made when designing language learning activities ('designed learning') in non-traditional educational environments. The framework originates from learners' own practices, with a specific focus on the use of time and space.

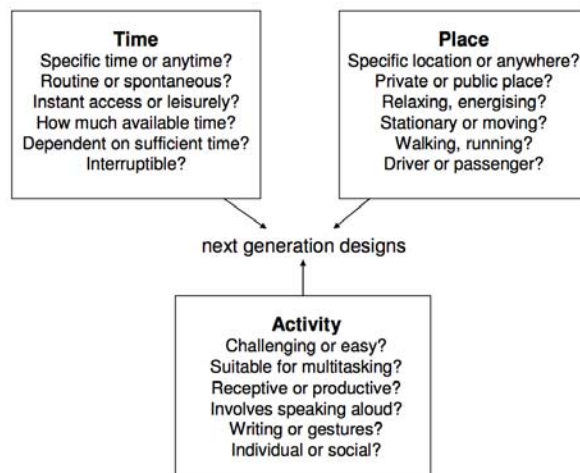


Figure 1. Conceptual framework for next generation designs for mobile-supported language learning in informal settings (Kukulska-Hulme, 2012b, p. 9)

The goal of this framework is to “move learning progressively closer to what learners require. The landscape in which learners operate is in itself changing (e.g., in terms of 3G coverage, wi-fi hotspots, public spaces designed for mobile devices), so a commitment to regular review of the situation is also necessary” (Kukulska-Hulme, 2012b, p. 10). Kukulska-Hulme (2012b) also highlighted the importance of the extent to which language learning may be defined in terms of time and place by discussing three possible approaches: i) sociolinguistic competence, ii) the vocabulary and phraseology of negotiating human encounters and movements are likely to become a more noticeable feature of language learning, iii) language learning can escape the traditional constraints of time and place that partly determine existing curricula. This framework has been taken into consideration, even though not that explicitly, when designing a prototype of a cross-platform language learning application, the use of which is analysed in the second part of this thesis (Paper 4, Viberg, *under review*).

Despite the fact that the research field of MALL is a rather young scientific area, a growing number of published papers are devoted to

foreign and second language mobile learning (Abdous, Facer, & Yen, 2012; Chang & Hsu, 2011; de Jong, Specht, & Koper, 2010; Kukulska-Hulme, 2009; Thornton & Houser, 2005). These studies refer to mobile technology use in different aspects of language learning and their results, though largely explorative, offer overall support of the hypothesis that mobile technology can enhance language acquisition for second language learners (Viberg & Grönlund, 2012). Burston (2013) offered an expansive MALL bibliography that extends from 1994 to 2012 in order to provide an adequate perspective of MALL implementations for academics and practitioners interested in MALL applications. His annotated bibliography briefly introduces readers to various MALL studies, rather than analyses them from a specific angle.

Despite the explosion of mobile technology and the growing number of research projects in the field, the investigation of how the use of mobile technology influences the practices of second language learners and language learning strategies is still in its embryonic phase. The idea that people can learn effectively with personal technologies has not been studied in detail, “perhaps [based] on the assumption that time and place of study outside an institutional setting are largely individual, perhaps idiosyncratic, choices” (Kukulska-Hulme, 2012b, p. 1). Often research on language learning is purely placed into the frames of formal learning environments with given instructions and within experimental settings. What is also needed to be taken into consideration are language learning practices that occur in informal environments and how these informal contexts contribute to and influence an individual’s language learning process, at both task and achievement levels. By examining “learner experiences in terms of time- and place-based opportunities and choices, the educators can build up a picture of emergent practices and formulate the implications for the design of language teaching and learning now and in the future” (Kukulska-Hulme, 2012b, p. 2).

In a recent literature review on mobile learning (including 164 papers covering the period from 2003 to 2011) Wu et al. (2012) has shown that studies of mobile learning for educational purposes have focused mostly on the professions and applied sciences (29%), followed by studies within the humanities (20%). Among the studies from humanities, 17% of the reviewed papers focused on languages and linguistic courses. Another literature review has focused specifically on second language learning in the period 2005 to 2012, where 86 research papers were identified and further analysed in terms of research approaches, theory

and methods, technology and gained linguistic knowledge and skills (Viberg & Grönlund, 2013a, Paper 1). This study shows that in terms of theoretical approaches there is a lack of conceptual and theoretical models specific to mobile learning. Even though a number of theories (originally derived from other research fields) are mentioned, they are used rather vaguely. Moreover this study shows a shift away from research into SMS-based language learning, which characterises the period from 2005 to 2008, towards the use of the more advanced multimedia and intelligent language learning systems that were prevalent from 2009 to 2012. So far, the MALL research has paid most attention to learners' vocabulary acquisition. All this shows that the research interest in the use of mobile technology for language learning in educational settings is growing. However, there remains much research work into many aspects of MALL (see the Results chapter and Paper 1, Viberg & Grönlund, 2013a).

Despite attempts to separate, conceptualise and approach MALL both in practice and theory, there is still much work to be done. This is especially the case for language learners' practices that occur in informal learning environments, because the understanding of how users actually employ mobile technology in their foreign and second language learning in non-institutionalised contexts is significant for instructors and educators involved in the design of formal language learning activities. The present research is one response to such a gap.

1.7 Technology-mediated learning and Information Systems research

In order to understand the pros, cons and influencing factors related to technology-mediated learning, many studies have been carried out across several research areas (Webster & Hackley, 1997; Alavi & Leidner, 2001; Piccoli, Ahmad, & Ives, 2001; Wan, Fang, & Derrick, 2007; Hu & Hui, 2012; Laurillard, 2012). However, there still “remains considerable ambiguity about what we know, and what directions future research should take” (Wan et al., 2007, p. 184). According to Webster & Hackley (1997):

[t]echnology-mediated distance learning is becoming an important option within education because it facilitates the sharing of costs, information, and expertise among multiple sites while providing additional educational opportunities for distant and disadvantaged

locations. Another advantage of using information technologies in education is that students are introduced to and take advantage of the very technologies that businesses are using to gain competitive advantage. (pp. 1282-1283)

Sølvberg and Rismark (2012) noted that the use of technology in higher education is grounded on the mutual interrelationships between three areas: technology, theories of learning, and issues of educational practice, where any change in one area directly influences the others.

In order to understand the mobile learning phenomenon and to approach and build field-specific theoretical frameworks, contributions of research in different academic disciplines are needed. One important contribution is from the Informatics field, where the research, as mentioned by, for example, Orlikowski and Iacono (2001), has highlighted the centrality of information technology in socio-economic life.

Mobile learning, as discussed above, is seen as a sociotechnical phenomenon rather than a purely educational one; learning occurs everywhere and at any time, both inside and outside formal educational settings mediated by mobile technologies. Thus, traditional educational theories and practices are challenged by the context in which the learning occurs and by the technologies involved. Presently, the evolving mobile learning research field is considered as a multidisciplinary and multiparadigmatic area, which attracts scholars from various research disciplines: Education, Computer Science, Engineering, Informatics, and more. The Information Systems (IS) discipline is also in itself multiparadigmatic, giving rise to research questions, methods, theories and grounding philosophies from various scientific areas that are unified by a common goal – to understand “the way in which human-computer systems [such as the use of mobile technologies by second language learners] are developed, produce and process information, and influence the organizations [higher educational institutions] in which they are embedded” (Vaishnavi & Kuechler, 2008, p. 2).

While educational researchers often focus on learning practices and processes, the role of IT artefacts can often be underestimated or taken for granted. The IS research area is “premised on the centrality of information technology in everyday socio-economic life” (Orlikowski & Iacono, 2001, p. 121). The present research is based upon what Orlikowski and Iacono (2001) term *the ensemble view* of technology, which can be seen as a specialisation of the social shaping perspective of

technology (Williams & Edge, 1996), in IS research field. The present research applies this view of technology to mobile technology use in second and foreign language learning in higher education. More specifically, mobile technology-in-use is seen as an evolving system that is embedded in a complex and dynamic social context of online distance education. Thus, the use of mobile technology in the present research context is believed to contribute to a change in individuals' foreign and second-language learning practices, rather than just deliver course content to students in another form (i.e., online instead of in books). Compared with the *tool view*, which sees technology as “the engineered artifact, expected to do what its designers intend it to do” (Orlikowski & Iacono, 2001, p. 126), and which thus fails to take into account the transformational nature of technology, the *ensemble view* does not consider mobile technology to be either a dependent or an independent variable. Rather, it is seen to be interwoven into use situations (i.e., various formal and informal language learning practices), and thus is called the “embedded system” (Orlikowski & Iacono, 2001, p. 126).

The reciprocal influence of learning contexts and involved mobile technology-in-use is important to this thesis; so too are the learners who act using this technology. Mobile technology use in online distance education is seen to be embedded in a complex system of interrelationships between learner-centred formal and informal learning environments where not only the learner/individual but also the surrounding contexts (formal and informal learning settings) influence how mobile devices are employed. All in all, both learning contexts and technologies-in-use influence each other and consequently change each other.

The importance of technology-mediated learning to the IS community was highlighted by Alavi and Leidner (2001). According to them, technology-mediated learning (TML) refers to a learning “environment in which the learner’s interactions with learning materials [...], peers, and/or instructors are mediated through advanced information technologies” (Alavi & Leidner, 2001, p. 2). They suggest that the IS discipline is uniquely positioned to contribute to the intellectual development of TML. Their arguments are:

- The IS field has a history and tradition of research and development that involves the application of information

technologies to cognitive processes (e.g., decision making and problem solving);

- The IS field is based on a long tradition of research in the appropriate structures and processes to enhance IS success;
- Given that technology can be both an enabler of, and a hindrance to, innovation in education, IS scholars can deploy their knowledge of information technologies to help determine appropriate instructional applications. (p. 3)

Another contribution from the IS research field, which is beneficial to the TML research in general and the present thesis in particular, derives from the recent extension of our understanding of the information technology (IT) artefact. The established concept of the IT artefact, which plays an important role in IS research, has been suggested to be extended to the more encompassing concept of the *Information Systems (IS) artefact* (further discussed in the final chapter of the thesis). The *IS artefact* includes the ‘information artefact’, ‘technology artefact’ and ‘social artefact’ (Lee, Thomas, & Baskerville, 2015). An investigation of these artefacts in terms of their interaction as an entire system will help researchers to gain a deeper understanding of the studied phenomenon, especially in design science research settings.

Hence, it is important to bring IS knowledge to the field of technology-mediated learning, in particular to further our understanding and explaining of the MALL phenomenon in the chosen online distance higher education settings.

Santhanam, Sasidharan, and Webster (2008) discussed the importance of self-directed learning and self-regulated learning strategies in order to assimilate the training content in an e-learning environment, because TML methods do not automatically lead to superior learning outcomes. According to the authors, attention must be given to instructional design and the specifics of the TML context. In response to this, the present research, which is positioned in the setting of the student-centered online distance learning environment, focuses on the learners’ characteristics in terms of their self-regulation and structuration. In particular, it examines human and design aspects with a particular focus on the interrelation between learners’ characteristics and the design and use of mobile

technology in higher educational online language learning settings (see Paper 4, Viberg (*under review*)).

1.8 Structure of the thesis

Chapter 2 presents the theoretical approaches applied in this thesis. The chapter starts with an introduction to, and argumentation for, the social constructivist perspective, which constitutes the underlying epistemology of the present research. This is followed by a discussion of Design Science Research (DSR), which is the overall theoretical and methodological approach applied. Furthermore, theories and frameworks applied to answer the research questions are presented in the same chapter. They encompass the theoretical underpinnings of the sociocultural perspective to learning, self-regulated learning, cultural perspective, as well as the groundings of the *technology-in-practice* definition and understanding that applied throughout the thesis.

Research design, methods, case study settings and ethical considerations are presented in chapter 3. This includes the overall methodology used in the thesis, Design Science Research, and also the methods used for each of the four studies.

Chapter 4 presents the prototype of a mobile language learning application that has been used in the educational courses on which part of the empirical work is based.

The results of the individual studies with research limitations are presented in chapter 5.

Chapter 6 offers a reflection on the research through a summary discussion, conclusions, and a critical reflection from the DSR perspective together with future research directions.

2. Theoretical Foundations

Rather than using the lens of a single theory to examine students' learning practices related to their use of mobile technology in formal and informal learning settings, I looked at mobile assisted language learning (MALL) from within in order to make sense of it as a body of knowledge in its own right. By understanding what students think, believe and do when they participate in MALL activities, and by understanding the design process of MALL materials and software development and use, this thesis provides important insights into MALL practices. These are linked to the goals of formal distance education, and relate to the miscellaneous theoretical approaches, that are originally derived from various research disciplines.

According to Gregor (2006), “to understand IS [Information Systems], theory is required that links the natural world, the social world, and the artificial world of human constructions” (p. 613). Theory, as one form of knowledge, is “an abstract entity, an intermeshed set of statements about relationships among constructs that aims to describe, explain, enhance understanding of, and, in some cases, predict the future” (Gregor & Hevner, 2013, p. 339).

To understand a complex MALL phenomenon in distance education, a number of theoretical frameworks and perspectives were employed at various stages of the research, for various levels of analysis, and for different purposes (Figure 2).

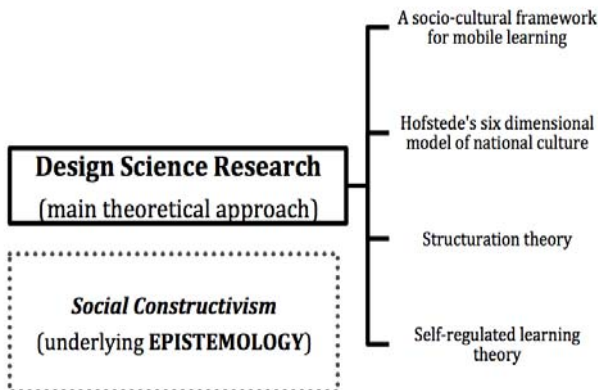


Figure 2. Overview of theories used in the research

Social constructivism, with its particular focus on the roles of agency and society in the knowledge construction process, was applied as the underlying holistic epistemology for the research carried out (see section 2.1 for further elaboration). The overarching theoretical research approach that provides the overall foundation of this thesis is Design Science Research (see section 2.2).

For the purpose of explaining and understanding the studied phenomena, the four theories employed were mainly aimed at answering questions related to what, how, and why (Table 1). The word ‘theory’ here encompasses theoretical frameworks, models, theories (as a body of knowledge in a broader sense) and theoretical concepts used. Design Science Research and explanatory theories can be seen to be strongly correlated, because “knowledge of people and information technology capabilities informs the design and development of new information systems art[e]facts” (Gregor, 2006, p. 629).

A pedagogical framework to mobile learning from a socio-cultural perspective (Kearney, Schuck, Burden, & Aubusson, 2012) was applied in order to understand and explain students’ views on mobile technology integration into second language higher education (Viberg & Grönlund, 2013b, Paper 2). Furthermore, in the same study (Paper 2), Hofstede’s six-dimensional model of culture (Hofstede, Hofstede, & Minkov, 2010) was employed as a proxy for ‘culture’, to explain if and how students’ cultural characteristics might affect the above-mentioned attitudes. These two theoretical models and the relevance of their application in the present thesis are further developed in sections 2.3 and 2.6.

The last two studies (papers 3 and 4) used structurational theory (Giddens 1979, 1981, 1984), and in particular the adaptations for the IS field suggested by Halperin and Backhouse (2007) as a research framework for structurational modalities. Orlikowski’s structurational model of technology (2000) was also used to understand the students’ relations to (mobile) technology-in-practice, and specifically to the designed language application-in-practice (Paper 4). Structuration theory is further explained in section 2.4.

Self-regulated learning (SRL) underpinnings (section 2.5) were used in this thesis. In particular, the Online Self-Regulated Learning Questionnaire (Barnard, Paton, & Paton 2008; Barnard-Brak, Lan, & Paton, 2010), which originates from the philosophical assumptions of the social cognitive view of SRL, was used as an analytical instrument to measure students’ level of self-regulation in online distance education

settings. The questionnaire was used in order to understand if, and how, students' individual characteristics are associated with their (mobile) technology use. Also explored was the way in which this may influence the future design of mobile learning software and its use for educational purposes.

Table 1. Theories used in the research

Studies	Theories Used	Research Questions
Study 2	A pedagogical framework for mobile learning from a socio-cultural perspective	<i>What</i> are the attitudes among students toward mobile technology use in and for language learning?
	Hofstede's six dimensional model of national culture	Do cultural characteristics affect students' attitudes toward mobile technology use in and for language learning, and if so, <i>how</i> ?
Study 3	Structuration theory	<i>How</i> do students use technology in their language learning?
		<i>Why</i> do they use certain technologies and leave out others in their learning?
		<i>How</i> do learners use the mobile application for learning in distance education?
Study 4		<i>What</i> are the challenges for mobile learning?
		<i>What</i> are the characteristics of users/learners in terms of structuration?
	Self-regulated learning theory	<i>What</i> are the characteristics of users/learners in terms of their level of self-regulation?

2.1 Social constructivism

Social constructivism is the underlying epistemology of this thesis. The ontological assumptions of social constructivism are built on the

understanding that human reality is socio-technically constructed. Technology use in this reality is socially embedded.

Social constructivism is one of the forms of the larger concept of constructivism, which in general is seen as a theoretical school for building knowledge about self, school, everyday experience, and society through reflection and meaning making (Shor, 1992). Among the items for which constructivist claims have been made, Kukla (2000) mentioned: “people, objects, states and conditions, events, practices, actions, experiences, relations, substances, concepts and an assortment of what Hackling [1999] calls ‘elevator words’ (because they raise the level of discourse, both rhetorically and semantically): reality, truth, facts, knowledge” (p. 1).

The social orientation of this branch of constructivism emphasises the cultural and social context that guides knowledge construction and learning processes. In contrast with pure constructivism, which highlights cognition as an individual activity, social constructivism claims that knowledge - the human understanding of reality - is socially constructed (Hung, 2010). In his discussion of constructivism and social constructivism, Hung (2010) summarised these two schools of thought on the three aspects: i) learning is an active process of constructing rather than acquiring knowledge; ii) knowledge can be socially constructed where the social interacting may include just oneself; iii) the interpretation of knowledge is dependent on (a) prior knowledge and beliefs held in one’s own mind and (b) the cultural and social context through which knowledge was constructed.

Social constructivism is the sociological theory of knowledge and also a learning theory. With regard to sociology, it stems from Berger and Luckmann’s work “*The Social Construction of Reality*”, according to which the sociology of knowledge understands human reality as socially constructed (1966, 1991). In particular, the authors explained this reality by explaining the reality of everyday life, where the individuals’ attention to the present world is seen to be influenced by what they are “doing, have done and plan to do in it” (1991, p. 36). The everyday reality of life is moreover understood as an intersubjective world, which humans share with each other, and in which they interact with each other using different tools and in different ways. In my understanding, such interaction and sharing are today directly related to the use of various technologies, not least mobile technologies that have pervasively penetrated individuals’ lives. Berger and Luckmann prioritised social

interaction that occurs in face-to-face situations above others (1966). Over time, their idea of social construction has been developed. The specifics of this construction have been argued by, for example Giddens (1984). The role of technology has also been added and discussed (e.g., Halperin & Backhouse, 2007; Latour, 1996). Clearly today's technical environment, which features online social interactions of many kinds, has changed the means and venues of human communication in many ways. In addition, it poses challenges for researchers who are looking to better understand the new social landscape. The idea of social construction remains valid. However, both the preconditions for it and its effects have changed so profoundly that the theories of social construction - and indeed socio-technical construction - also need to be reconsidered so as to capture the reality of social situations today. More specifically, the role of IT needs to be further clarified. This thesis contributes to this discussion by applying the concept of the IS artefact (Lee et al., 2015), which originated in the IS field, to describe and analyse the role of technology in social situations (further discussed in the final chapter).

As a learning theory, social constructivism is predominantly associated with the work of Lev Vygotsky (1978, 1987), who was one of the first academics to emphasise the role of language and social interaction in development and learning. Vygotsky emphasised the social essence of knowledge construction by explaining how meanings and understandings develop from social practice. Learners' construction of knowledge is seen as the product of social interaction, interpretation and understanding (Vygotsky, 1962). Culture, which encompassed language, history and social context, plays a significant role in the cognitive development and learning processes of a person. Moreover, Vygotsky stressed the role of language (1978) arguing that learning through discussion is important and differs from learning only through individual practice: the act of articulating an idea is itself a contribution to what it means to know that idea (Laurillard, 2012).

Social constructivism and MALL

Despite the pervasive integration of (mobile) technology in people's lives, we should not assume that students can plan and conduct technology-mediated learning activities (related to formal education) by themselves simply because of the accessibility and availability of information and tools. As Laurillard (2012, p. 4) states, the instructor "is more deeply involved in scaffolding the way students think and how they develop the

new kinds of skills they will need for the digital literacies”. The role of the educator is thus to serve as a facilitator, working to provide students with opportunities and incentives to construct knowledge and understanding by designing effective learning environments. In these environments, for example, learners use the individual mobile technology in informal learning settings for practical reasons, namely, to communicate *in* and *with* the target language.

Social constructivism does not eliminate the need for an instructor. Rather it re-orientes teacher activity towards the provision of an effective learning environment in which the construction of student knowledge and social mediation are of high value (Adams, 2006). Pragmatic social constructivism, which is relevant to the current research, encourages educators to think of the “entire context, the environmental ethos of schools and community within which the student as a creative individual must function in organic interconnection” (Garrison, 1998, p. 60). Educators have to create possibilities for students’ learning, whether it occurs in a formal or an informal learning environment. In trying to do so, the role of today’s mobile technology-in-practice in individuals’ lives should not be underestimated.

To understand the “entire context” of foreign language students’ MALL practices related to the goals of online distance education and their lifelong learning is a challenging task. In particular, a multi-theoretical approach is needed in order to understand the relationship between the context’s various elements. Even though attempts have been made to create a specific theory for mobile learning research (Sharples et al., 2007), there is still a gap of knowledge on how to apply this theory in certain empirical research contexts. Thus, to understand the MALL phenomenon in the setting of online distance foreign language education, the more established theories, which originally derive from academic disciplines such as sociology, psychology, and information systems, are applied in this thesis. In the next section, I will briefly explain how the theories chosen for this research relate to the social constructivist’s epistemology.

Social constructivism in this thesis

In the present research, the mobile learning phenomenon is seen as a social phenomenon rather than an educational one. It is considered to be a process and a result of sociotechnical construction, where human action and social context reciprocally influence each other. Such influence does not need to be equally distributed: indeed, the roles and importance of social context and human action or agency will vary within the different settings in which mobile learning might occur. Such variations will depend on learners' skills, capabilities, and characteristics, as well as on the specificity of a particular context involved, and the tools or technology employed. From a social constructivist perspective, the role of mobile technology is to allow a learner to be a generator of his or her own knowledge, in cooperation with other people, resources, and contexts.

The adoption of new technology, with a focus on mobile technology use for foreign language learning in particular, is considered to be one such social process that forms and regulates new social behaviours and norms. These norms and behaviours may consciously or unconsciously determine other social processes involved in humans' knowledge construction. From the constructivist's view, education is also a social process (Dewey, 1897), which, like many other social processes nowadays, implies the use of this technology in the individuals' "world of everyday life" (in the words of Berger and Luckmann (1991, p. 33)), for learning purposes. However, our knowledge of how students use mobile technologies for such purposes is still incomplete, which may limit educators' opportunities to create prerequisites for effective learning environments.

Taking into account the idea that knowledge is socially constructed will help researchers to understand how formal educational practices can be effectively integrated with other social processes, such as mobile learning, which mostly takes place in informal learning environments.

The more specific focus of this thesis relates to our understanding of the second and foreign language learners' (mobile) technology-mediated learning practices, which take place in informal setting of online distance education. Such an understanding can help to improve the formal higher educational practices of language learners in the chosen context in order to develop their foreign and/or second language competence. From a social constructivist view, the role and impact of (mobile) technology-in-practice can only be understood through an understanding of the social

constructions that individuals create and draw upon when participating in learning practices.

As mentioned above, the research focus of this thesis is on students' (mobile) technology-mediated learning activities, (i.e., their language learning practices), rather than on technological innovations as "technology alone, even good technology alone, is not sufficient to create social or economic value" (Kling, 1999, §10). In the words of Orlikowski (2000),

Using rich case studies of technological invention and development, social constructivist research examines how interpretations, social interests, and disciplinary conflicts shape the production of a technology through shaping its cultural meanings and the social interactions among relevant social groups. (p. 405)

As a social process, mobile learning is a phenomenon of sociotechnical construction; it happens everywhere, independently of whether a learner is in, for example, an online or virtual classroom or is outside.

The philosophical underpinnings of social constructivism influenced the choice of the theoretical approaches, frameworks and models used in this thesis. Through them, I wished to better understand the nature of the MALL phenomenon and its different aspects in regard to the overall research aim. All these theories are seen to be grounded in the social-constructivist view of knowledge construction in one way or another.

Firstly, Design Science Research was used as the overall approach to the study (further presented in section 2.2). Such an approach acknowledges multiple, contextually situated alternative world-states. It also acknowledges the socio-technological enabled reality (Vaishnavi & Kuechler, 2008), where the introduction of a new artefact such as mobile technology can lead to the changes in the surrounding existing contexts and social processes involved (e.g., education).

Secondly, I took a sociocultural perspective by using a pedagogical framework for mobile learning (Kearney et al., 2012), to investigate and understand students' attitudes toward mobile technology integration into higher foreign and second language education (Paper 2). Such an approach springs from sociocultural learning theory. This theory has its origins in the social-constructivist paradigm, in which learning is viewed as a social process. Learning in the sociocultural view is influenced and altered by the tools used; at the same time, such learning tools are modified by the ways they are used for learning.

Thirdly, this thesis pays special attention to the cultural aspects of knowledge construction, which may affect the examined MALL elements and practices. Webster's definition of culture includes:

- the beliefs, customs, arts, etc., of a particular society, group, place, or time;
- a particular society that has its own beliefs, ways of life, art, and so on;
- a way of thinking, behaving, or working that exists in a place or organisation (2015).

In terms of online distance education setting studied in this thesis, the term 'culture' can be understood in different ways. As such, it is difficult to examine it in any one particular way that is acceptable within the Information Systems research field. For example, currently it is common practice that students from various cultural backgrounds participate in the same language course with the same purpose to learn a language. This is one understanding of culture. Moreover, such an institutionalised language course takes place in the setting of a particular online distance educational culture, which is different from a traditional campus-based education. This is another understanding of culture. Furthermore, these online distance educational practices relate to a particular educational institution, which in turn presents its own educational culture with its own established teaching traditions and norms. Students, who participate in online educational environments, often form their own group cultures; for example, when they participate in a synchronous online seminar. In this way, they bring their own individual learning cultures. Hence, from the social constructivist view, all these different 'cultures' influence how students learn and use tools or technologies to reach their goals. At the same time, students' actions are largely mediated by technology-in-practice in chosen educational settings. These actions affect these cultures in these settings, because they belong to certain social contexts and processes. Thus, culture is seen as a variable that is changeable over time, because it is directly influenced by the social, individual and technological factors involved. This variable is considered to have the potential to change students' existing learning practices, and is related both to the goals of formal education and informal learning practices.

In the present research, Hofstede's cultural dimensions (Hofstede et al., 2010) were used to investigate students' attitudes to the integration

of mobile technology into their institutionalised foreign language learning practices (Paper 2, Viberg & Grönlund, 2013b). The relevance of Hofstede's cultural dimensions stems from the fact that its measurement instrument (a survey) includes categories that contain elements such as "power distance" and "individualism vs. collectivism" that also in other contexts and models have been proposed playing a role in people's behaviour and attitudes towards education.

Fourthly, I used Giddens's structuration theory (Giddens, 1979, 1984) together with its adaptations to the IS research field, which include the Halperin & Backhouse (2007) framework for structurational modalities and Orlikowski's structurational model of technology (1992, 2000). These are all solidly grounded in the social constructivist ontology. Structuration theory acknowledges the mutual duality of agency (human action capacity) and structures. Knowledge construction occurs in a process of social interaction, where, according to Orlikowski's model, technology is embedded in practice. Thus, technology can be understood as a facility, where the structures of technology "are not embodied and appropriated but, on the contrary, emergent and enacted" (Halperin & Backhouse, 2007, p. 6). Consequently, technology can be seen both as a structure and a tool for agency. In the current research, agency is understood in terms of students' (mobile) technology-mediated language learning practices, which take place in formal educational and informal learning settings. Thus, structuration theory was employed in the third and fourth of my studies to understand these practices. The foundations and the use of structuration theory in this thesis are further explained in the section 2.4.

In the final research study (Paper 4), I used the Online Self-Regulated Learning Questionnaire (OSLQ; Barnard et al., 2008; Barnard-Brak et al., 2010) to understand the human dimension of students' characteristics and actions in such social processes as online distance education and related MALL practices. This instrument was developed on the basis of the social cognitive view of self-regulated learning, SRL (Zimmerman, 1989), which is similarly grounded in social constructivist epistemology. According to the social cognitive theory, SRL "is never an absolute state of functioning but rather varies in degree, depending on the social and physical context" (Zimmerman, 1989, p. 332). In line with this theory, personal, behavioural and environmental influences are interdependent; thus, in their attempts to understand students' SRL, researchers must be attentive to the impact of the contexts and personal experiences involved.

The applied measurement instrument, OSLQ, includes statements with a particular focus on the social settings of online distance education (e.g., ‘I know where I can study most effectively for online courses’; ‘I allocate extra studying time for my online courses because I know it is time demanding’). OSLQ also includes sub-scales and elements (e.g., help-seeking, environmental structuring, goal setting etc.) that are thought to play a role in students’ self-regulated learning behaviour in other contexts.

2.2 Design Science Research

This section discusses Design Science Research (DSR), the overarching theoretical foundation of this thesis. In particular, it examines the relevance of using DSR to address the studied settings and phenomena. Furthermore, DSR, which is usually employed in the Information Systems (IS) research field, will be explained in relation to Design Based Research (DBR). Design Based Research is recurrently applied by educational researchers in order to deepen readers’ understanding of the interdisciplinary nature of the field of mobile learning and in particular, the studied MALL practices in distance language higher education.

2.2.1 Design Science Research and Information Systems

Questions frequently arise that have a sparse or nonexistent theoretical background, and exploring these is where design science research – exploring by building – excels. (Vaishnavi & Kuechler, 2008, p. 2)

The world we live in today is much more a man-made [man as an androgynous noun and encompassing such androgynous pronouns as ‘him’, ‘he’ ‘his’ includes women and men equally] or artificial, world than it is a natural world. Almost every element in our environment shows evidence of human artifice. (Simon, 1996, p. 2)

In everyday institutionalised educational settings, a teacher or instructor who interacts with students has an opportunity to find out what methods work more or less effectively in a particular learning environment. It is a complex and challenging task, as it involves several significant mutually dependent factors: individuals, technologies used, educational practices or processes, and contexts in which learning might occur. This aligns well with the four analytical dimensions that constitute the Information Systems (IS) research field: people, processes, technologies and contexts

(Hevner, March, Jinsoo, & Ram, 2004). From the educators' point of view, the provision of relevant methods of instructions and the creation of successful learning environments, in terms of the times and places where such learning might take place, becomes even more challenging with the ubiquitous intervention and integration of mobile technology into individuals' lives. Indeed, our knowledge of how these technologies are used for learning especially in informal learning settings, is limited. These informal learning settings are closely related to the online distance educational environments being studied, where students' learning practices predominantly occur in informal learning contexts.

Mobile technology-in-practice has the potential to take learning practices outside formal educational contexts. Hence, the knowledge of how such technology is employed by students, particularly in their informal learning environments, becomes crucial for educational institutions, and for software and course designers.

In the words of Mor and Winters (2007), "[d]esign is critical to the successful development of any interactive learning environment" (p. 61). Design "is concerned with how things ought to be, with devising art[e]facts to attain goals" (Simon, 1996, p. 114). The term design originates "from the Latin *désigné* [to designate], which means to point the way" (Purao, 2002, p. 4).

In this thesis, the design *for* learning is indirect in a sense that "learning cannot be designed directly, but only designed for by providing good conditions in which learning can take place" (Kukulska-Hulme & Jones, 2011, p. 59). The provision of these "good conditions" can only occur through a thorough understanding of the context and the relationships between different elements of that context. Design strives "to create things that serve human purposes", which involves "devising art[e]facts to attain goals" (Simon, 1996, p. 55).

Information Systems as a research discipline focuses on the employment of "information technology-related artefacts in human-machine systems" (Gregor & Hevner, 2013 p. 339). According to Benbasat and Zmud (2003), the IS discipline focus "should be on how to best design IT art[e]facts and information systems to increase their usefulness" (pp. 191-192). DSR is seen to be distinct from routine design, because it involves the production of new knowledge for some community (Vaishnavi & Kuechler, 2004). DSR is an important paradigm in IS research, and its general acceptance is recognised by the

annual International Conference on Design Science Research in Information Systems and Technology (DESRIST), held since 2006.

DSR is essentially a ‘problem solving’ paradigm (Hevner et al., 2004). March and Smith (1995) have claimed that applying DSR in the IS discipline increases the relevance of IS research to the real environment by suggesting solutions to the existing problems. Thus, an understanding of the problem is not the ultimate goal of DSR. Rather, DSR researchers offer solutions that are situated in a particular sociocultural context, where the role of the novel artefact is stressed. However the functionality and meaning of this artefact may be changed over time due to other significant factors (i.e., people, processes, and contexts). In the present thesis, this ‘real’ environment refers to the foreign and second language students’ technology-mediated formal and informal learning environments, and is related to the goals of online distance education.

Furthermore, DSR is related to the systematic creation of knowledge about organisational or institutional problems and potential solution(s) through building and evaluating novel artefacts (Hevner & Chatterjee, 2010). In this process, the evaluation of the design artefact becomes crucial. The first, analytical part of my research focuses on our understanding of the prerequisites for design, such as students’ attitudes toward the integration of mobile technology into online distance language education, and our understanding of *if* and *how* cultural factors may influence such attitudes. The second part, which is based on the analytical investigations of the first part of my research, focuses on the design and evaluation of an online tool that aims to bring together formal and informal learning environments through mobile technology use. The processes of understanding, building and evaluating constitute fundamentally the DSR process, where “[i]n the building process, a sequence of activities aims to produce ‘something new’, then in the evaluation process, the created IT artefact undergoes evaluation to produce feedback and generate new knowledge about the problem” (Beck, Weber, & Gregory, 2013, p. 639).

Within the DSR community in information systems, researchers differentiate between Design Research and Design Science. According to Winter (2008), “[w]hile design research is aimed at creating solutions to specific classes of relevant problems by using a rigorous construction and evaluation process, design science reflects the design research process and aims at creating standards of its rigour” (p. 471). In Design Science, researchers attempt to construct frameworks and methods for conducting

DSR in an effective and scientific manner; they emphasise the DSR internal process (Alturki, Bandara, & Gable, 2012). The distinguishing feature of DSR is the fact that it is “research *using design as a research method* or technique,” not to be confused with Design Research, which is “research *into* or *about* design” (Vaishnavi & Kuechler, 2004, p. 6).

Vaishnavi and Kuechler (2008) discussed the philosophical assumptions of DSR:

1. *Ontology*: DSR recognises multiple, contextually situated alternative world-states, and the socio-technologically enabled reality.
2. *Epistemology*: knowing through making; objectively constrained construction within a context; iterative circumscription reveals meaning.
3. *Methodology*: developmental; measures impacts of the artefact on the composite system.
4. *Axiology (what is value)*: control, creation, progress (i.e., improvement), and understanding.

Noticeably, in DSR research “neither the ontology, the epistemology, nor the axiology of the paradigm is derivable from any other” [...] [where] “ontological and epistemological viewpoints shift” as the project runs through various in nature project phases (Vaishnavi & Kuechler, 2008, p. 18).

Alternative world-states are recognised by DSR researchers as the introduction of novel artefacts, which often leads to changes in the existing environments. Thus, the integration of mobile technology-in-practice into students’ everyday lives may lead to changes in their existing environments, not least educational ones.

The theoretical groundings of DSR and the definition of “artificial” or “man-made” go back to the work of Herbert Simon, *The Sciences of the Artificial* (1969, 1996), where the IS field is seen as one example of such sciences. Simon defines the “artificial” as “[p]roduced by art rather than by nature; not genuine or natural; affected; not pertaining to the essence of the matter”, and associates it with such synonyms as “affected, factitious, manufactured, pretended, sham, simulated, spurious, trumped up, unnatural” (1996, p. 4).

Simon furthermore gives rise to the four differentiating features that distinguish the artificial from the natural. Artificial things:

1. are synthesised (though not always or usually with full forethought) by human beings;
2. may imitate appearances in natural things while lacking, on one or many respects, the reality of the latter;
3. can be characterised in terms of functions, goals and adaptation;
4. are often discussed, particularly when they are being designed, in terms of imperatives as well as descriptives (p. 5).

According to Simon (1996), to achieve or adapt to a goal - to design the tool to fit into a formal university education system, technically and formally in the current research – involves a relationship between three elements: the goal, the artefact's character, and the environment in which the artefact performs. The relationship between these elements is the focus of the present research, where the goal is to provide foreign language students with effective conditions for learning. The character of the artefact-in-practice is emphasised in terms of its pervasiveness, ubiquity, accessibility and so on. The studied contexts are online distance educational settings, which mainly include students' informal learning environments, where they spend most of their time.

In Simon's work (1996, p. 53), humans as behaving systems are seen in the sciences of the artificial as "quite simple". The potential complexity of their behaviors largely depends on the complexity of the environment in which they act. The examined settings of online distance education are considered to be complex in regard to many factors, including time, space, norms, and not least the technologies or artefacts-in-practice used for learning purposes. This makes the behaviours of human beings/students a complex phenomenon to comprehend.

As a research paradigm, DSR is open to theories: the combination of the constructed artefact, individuals, contexts and processes has an influence on the choice of relevant theory or theories that may come from different disciplines. With regard to MALL research, such theories may derive from sociology, psychology, education, informatics, language studies and more. Theories in DSR are applied "to predict or explain

phenomena that occur with respect to the artefact's use (intention to use), perceived usefulness, and impact on individuals and organisations (net benefits) depending on system, service, and information quality" (Hevner et al., 2004, p. 77). In my research, the chosen theories are applied with the main purpose of understanding and explaining the MALL phenomenon, rather than to make predictions, which is made more difficult due by the changeable nature of its elements (i.e., technologies, contexts and people).

Considering the ultimate aim of this research, and the multi-faceted nature of my study, DSR is a relevant overall approach to producing meaningful practically valid results for educators, language learners and other communities.

2.2.2 Mobile learning in relation to DSR and DBR

In recent years, DSR has also attracted the attention of educational researchers, who often refer to as design-based research (DBR) or design research or design experiences (Anderson, 2005; Anderson & Shattuck, 2012; Brown, 1992; Mor & Winters, 2007; Palalas, 2012). Design Based Research in technology-enhanced learning and DSR in IS research are both strongly influenced by the seminal work of Herbert Simon (1969, 1996), who was the first to refer to design as a science: "Schools of engineering, as well as schools of architecture, business, education, law, and medicine, are all centrally concerned with the process of design" (Simon, 1996, p. 111). The science of design is placed at the core of the study of the artificial. Compared with natural sciences, which are concerned with *what is*, design science seeks to address the question of how it *ought to be* (p. 114).

What DSR and DBR have in common is that both are representations that aim to symbolise the designer's mind and behaviour, and the *real* world. The DBR research tradition is grounded in the pragmatic meta-paradigm. Most DSR researchers are likewise considered to be pragmatists; however, they can also be seen as instrumentalists, because they are dependent on a predictably functioning artefact (Vaishnavi & Kuechler, 2008). This does not imply that DSR focuses on the development of technology; rather, it is about the application of technology, technology-in-practice in, for example, educational settings.

The DSR has the potential to contribute to our understanding of mobile learning practices and frameworks that are currently lacking a solid theoretical basis. A seminal literature review of MALL has asked

whether and how mobile devices support collaborative practices in speaking and listening (Kukulska-Hulme & Shield, 2008). The authors suggest that MALL studies are carried out in two ways, using either a content-related approach or a design-related approach. Further investigations have shown that, more recently, the research focus has turned towards design-related studies (Viberg & Grönlund, 2013a; Wong & Looi, 2011). From the perspective of mobile learning as a product of sociotechnical construction, the link between previous and current research on mobile learning becomes non linear, because learners, who are using the personal mobile technologies, are unpredictable and embedded in ‘real-world’ complex and various socio-cultural environments:

If we look to the natural sciences there is a direct link between current and previous research, leading to well-founded cumulative knowledge. In the social sciences such linearity is difficult to achieve because, by their very nature, the social sciences are embedded with real-world complexities and contradictions and, worse still, they involve those unpredictable human beings-people-who act back on the system. (Mor & Winters, 2007, p. 72)

In the sciences of the artificial, learning can be defined as “any change in a [human cognitive] system that produces a more or less permanent change in its capacity for adapting to its environment” (Simon, 1996, p. 100).

Design-based research as a research methodology in education emerged in order to link theory and practice within educational research. At that time, attempts to create such links through traditional research methods had failed (Alghamdi & Li, 2013). The philosophical underpinnings of DBR are grounded in the pragmatic paradigm. The introduction of DBR as a methodology in education research is associated with a report by Collins (1990) and a study about theoretical and methodological challenges in creating complex interventions in classroom settings by Brown (1992). However, none of these authors referred to the work of Simon (1969), which is the foundation of DSR.

According to Laurillard (2012), the idea that education can be considered as design science was raised in the 1990s in order to bring educational research “out of the laboratory into practice” at a time when computers were introduced in educational settings. In her work *Teaching as a Design Science* (2012), she was among the first scholars in education

to refer to Simon (1969) and DSR, primarily developed and used in the IS field. In her work she offers her own interpretation [in brackets] of DSR:

Design science research [teaching by a reflective practitioner] is grounded on existing ideas drawn from the domain knowledge base [theories of teaching and learning]. Inspiration for creative design activity [new lessons design] can be drawn from many different sources to include rich opportunities/problems from the application environment [the classroom, seminar, lab, etc], existing artifacts [other teachers' lesson designs and resources], analogies/metaphors [for good pedagogy], and theories [of teaching and learning]. Additions to the knowledge base [new teaching methods, pedagogic ideas] as results of design research [reflective teaching] will include any additions or extensions to the original theories and methods made during research, the new artifacts (design products and processes [lesson designs and teaching resources]), and all experiences gained from performing the iterative design cycles [design and re-design of lesson plans] and field testing the artifact [the implementation of the lesson plan and resulting student assignment] in the application environment [the classroom etc.]. (Hevner 2009; 127). (Laurillard, 2012, pp. 6-7)

This interpretation, like many other interpretations of DBR in education research does not stress the importance of the novel artefact to the same extent as DSR applications in the IS field. When DBR researchers bring up the notion of an artefact, which is frequently the case, they mean the design of a particular learning or teaching situation, often associated with the classroom context.

The distinguishing characteristics of DBR as a research methodology in education are summarised by Wang & Hannafin (2005) (see Table 2).

Table 2. Design-Based Research characteristics (adapted from Wang & Hannafin, 2005, p. 8)

Characteristics	Explanations
Pragmatic	DBR refines both theory and practice. The theory value is appraised by the extent in which principles inform and improve practice.
Grounded	Design is theory-driven and grounded in relevant research, theory and practice. Design is conducted in real-world setting and the design process is embedded in, and studies through, DBR.
Interactive, iterative, and flexible	Designers are involved in the design processes and work together with participants. Processes include iterative cycles of analysis, implementations, and redesign. Initial plan is usually insufficiently detailed so that designers can make deliberate changes when necessary.
Integrative	Mixed research methods are used to maximise the credibility of ongoing research. Methods vary during different phases as new needs and issues emerge and the research focus evolves. Rigour is purposefully maintained and discipline applied appropriate to the developmental phase.
Contextual	The research process, findings, and changes from the initial plan are documented. Research results are connected with the design process and the setting. The content and depth of generated design principles varies. Guidance for applying generated principles is needed.

From an educational point of view, DBR is a “methodology designed by and for educators that seeks to increase impact, transfer, and translation of education research into improved practice [...], it stresses the need for theory building and the development of design principles that guide, inform and improve both practice and research in educational contexts” (Anderson & Shattuck, 2012, p. 16). This approach

illuminates the importance of such “improved” pedagogical activities in educational contexts (organisations in a form of educational institutions) with a learner at the centre of their practice and research.

In terms of the individualisation concept, which is considered to be one of the crucial characteristics of the current mobile society, DBR’s firm focus on learners in educational environments can make a valuable contribution to our understanding of mobile learning practices. On the other hand, as one of the DBR’s developers in education has stated: “an effective intervention should be able to migrate from our experimental classroom to average classrooms operated by and for average students and teachers, supported by realistic technological and personal support” (Brown, 1992, p. 143). This is seen as a significant limitation of the DBR in mobile learning research. With regard to mobile learning practices, such a goal is hard, or even impossible, to achieve: the definition of “average” in mobile learning settings simply does not exist, because of the variety of formal and informal learning contexts students are involved in, and the variety of (mobile) devices they use, especially in the context of the studied distance online education. Another critique of DBR focuses on the problematic and challenging role of the researcher, who is often involved in the conceptualisation, design, development, implementation, and re-searching of a pedagogical approach. Barab and Squire argue that, “ensuring that researchers can [then] make credible and trustworthy assertions is a challenge” (2004, p. 10). Moreover the challenge of constraining the DBR project’s temporal extent is compounded by the requirement for multiple iterations, which anticipates large-scaled multilayers and multifaceted research agendas that are financially supported. In terms of funding, this has been a problematic issue in education research (Anderson & Shattuck, 2012).

Influential DSR frameworks in information systems (Hevner et al., 2004; March & Smith, 1995) have stressed the IT artefact per se. Vaishnavi and Kuechler (2008) suggested that DSR in the IS field is significantly different from DBR in other fields, because “the need for and manner of validation of research results is more emphasized in IS, human-computer interaction (HCI) [...] due to the groundings of those fields in management science, psychology...” (p. 2). Though the focus on the IT artefact per se is considered to be a limitation, in the context of mobile learning research it can be seen to make a valuable contribution to our understanding of mobile learning practices. In particular, the features of mobile technologies, which stand out in terms of their

pervasiveness, portability and ubiquity, have the potential to influence learning practices in new ways. Such devices, used by learners, can offer access to a global information world, thus supporting another main trend of our mobile society – globalisation. Nevertheless, other influential IS researchers have argued that the boundaries of DSR in IS should be extended to include both organisational and social aspects of IS (Baskerville, Pries-Heje, & Venable, 2007). Thus, there is a need to investigate the entire IS artefact, a system that includes the three interrelated artefacts: the technology artefact, the social artefact and the information artefact (Lee et al., 2015).

2.3 Socio-cultural pedagogical framework for mobile learning

Despite the fact the mobile learning is becoming popular in the field of educational technology, there is a lack of theorisation about the nature, process, and outcome of mobile learning (Sharples, Taylor, & Vavoula, 2005; Sha, Looi, Chen, & Zhang, 2012). A number of existing studies have “grounded and conceptualized the application of mobile technologies to learning in the framework of activity theory” (Sha et al. 2012, p. 367). From this perspective, learning is oriented by goals. One existing mobile learning theoretical approaches has taken the approach developed in the context of distance education (Park, 2011) by drawing on Transactional Distance Theory (TDT) (Moore 1972, 1973, 2007), where distance is considered both as a geographic separation and a pedagogical concept. This makes it possible to include classroom education, where the presence of technology, especially mobile devices, is often encountered, and an online distance type of education, which is communicated through technology use.

In the second study of the present research, Kearney’s et al. (2012) sociocultural pedagogical framework for mobile learning (Figure 3) was employed (Viberg & Grönlund, 2013b, Paper 2) to understand foreign and second language university students’ attitudes and perceptions toward the integration of mobile technology in their institutionalised language learning. In this study (Paper 2), the framework served as a basis for the quantitative part of the online survey.

The choice of this particular framework, with its basis in the socio-cultural perspective, was made because, from the thesis' socio-constructivist point of departure, mobile learning (a phenomenon of sociotechnical construction) is seen as a process and product of social interaction, interpretation and understanding. In this sense, the interdependency of agency's or students' actions, IT-artefact-in-use and sociocultural and historical contexts are emphasised. The roots of the theoretical underpinnings of socio-cultural theory are likewise grounded in the socio-constructivist paradigm.

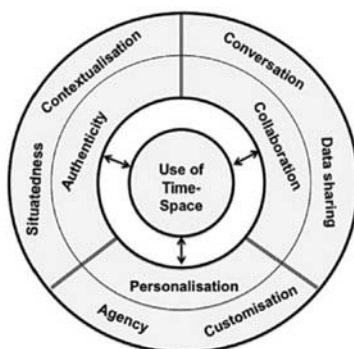


Figure 3. Framework comprising three distinctive characteristics of mobile learning experiences with sub-scales (Kearney et al., 2012, p. 8)

A socio-cultural perspective suggests that learning is affected and modified by the tools used for learning. At the same time, these learning tools are transformed by the way they are used for learning (Kearney et al., 2012). Learning is a situated, social endeavour that is facilitated and developed through social exchanges between people and mediated through tool use (Vygotsky, 1978; Wertsch, 1991). The Kearney et al. framework (2012) was essentially used to criticise the pedagogy in a selection of mobile learning cases, which often lacked appropriately developed pedagogical models. The main focus of the framework is not technology, but rather pedagogy. Technology is “under investigation only for what may be distinctive about the learning afforded by that technology” (Kearney et al., 2012, p. 2). The framework focuses on the three distinctive features of mobile learning, authenticity, collaboration and personalisation, each of which has a number of sub-scales (Figure 3). It was designed to incorporate the unique features of mobile learning

environments, distinguishing them from traditional ones. Such unique features include the opportunity to enable learning in a multiplicity of more informal settings (both physical and virtual) and under various temporal conditions.

The rationale behind the design of the sub-scales is provided through the use of subordinate themes under each of the three main features. This focuses on the distinctive mobile learning features from a pedagogical perspective (Kearney, Burden, & Rai, 2015). For instance, the personalisation feature, which consists of the two sub-themes of agency and customisation, “has strong implications for ownership, agency and autonomous learning” (Kearney et al., 2015, p. 49). The authenticity feature emphasises the opportunities for situated, participatory and contextualised learning practices through mobile technology-in-practice. The collaboration characteristic, which includes conversation and data-sharing subthemes, contains and explains conversational and connected mobile learning traits.

The framework has been tested in two mobile learning projects within the education area (Schuck, Aubusson, Kearney, & Burden, 2013). It has also been employed to address mobile learning research in school education (Burden, Hopkins, Male, Martin, & Trala, 2012), teacher education (Kearney & Maher, 2013; Kearney et al., 2015), and other fields of higher education (Kinash, Brand, & Mathew, 2012). A recent study (Kearney et al., 2015) investigated how teachers use distinctive features of mobile learning (collaboration, authenticity and personalisation). This study indicated that teachers’ perceptions of authenticity were high, but that aspects of networking, online collaboration, and student agency were rated unexpectedly lower than anticipated.

2.4 Structuration theory

Structuration theory (ST) is used in this thesis to explain and deepen our understanding of the students’ use of (mobile) technology in both formal and informal learning settings, related to formal educational goals, with a particular focus on the learning practices that occur in informal learning environments. In the present thesis, the aim is to understand and explain students’ language learning practices, their beliefs and assumptions in relation to these practices, and their technology-in-practice, all for the purpose of soliciting requirements for the design of MALL technologies and practices.

Structuration theory originates from a social-constructivist stance and essentially takes an interpretive point of departure (Giddens, 1984). It initially derives from sociology and was later adopted and adapted by various research disciplines, not least by IS researchers (e.g., Walsham & Han, 1991; Orlikowski, 2000; Rose, 1998). Even though Giddens never explicitly focused on technology itself in his theory, Halperin and Backhouse (2007) claim that he did not reject the possible contribution of ‘technology-sophisticated, hard-edged’ research.

Structuration theory has been similarly used for research in education (Enriquez, 2008; Huang & Liu, 2009; Walker & Creanor, 2005). Enriquez (2008) applied Social Network Analysis along with ST to analyse relations among students on a university language course in online discussions, in terms of both density and centrality. Here, ST was applied to understand networked learning in terms of structure. ST has also been used for evaluation purposes: for example, in e-learning design (Walker & Creanor, 2005). In addition, ST has been adapted for the analysis of learning practices in the context of developing countries (Andersson, 2010). There is, however, limited cumulative use of ST, particularly in educational settings.

The use of ST in this thesis is associated with the above-mentioned aim. ST was primarily applied in the last two design-oriented studies of this thesis (see Table 1). In the third paper (Viberg & Grönlund, 2015), ST was used to answer two questions: *how* students use both institutionalised and their own private (mobile) technologies for language learning, and *why* they use certain technologies in learning, when leave out others. Moreover in the last study (Paper 4, Viberg, *under review*) ST was employed to complement the quantitative analysis’ findings by asking *how* the students used the SOLL application, and *what* their characteristics were in terms of their structuration, their ‘ways of thinking’ with regard to their (mobile) technologies-in-practice. From a methodological point of view, ST is open to a multi-method approach, which is of importance to the thesis.

Moreover an ultimate purpose of the ST application in this research is to understand the students’ use of mobile technologies in their (language) learning. By using ST, the present thesis intends to contribute to the creation of effective technologies-in-use through development and integration of relevant language learning software, and the identification of usage patterns, which merge with students’ individual characteristics and their private technologies-in-use. One effective way to find a solid

and stable basis for the design of such technologies is through the application of ST, which will help us to understand how students think through their use of available technologies. The answers to this are grounded in the research into and about technology-in-use, rather than in 'fast' answers to questionnaires. Thus such answers or results are seen to be more abiding over time.

According to Jones, Orlikowski and Munir (2004), ST is not methodologically prescriptive; however, its epistemological and ontological stance does carry some important implications for the conduct of research. The main ontological assumption of ST is the interwoven nature of structure, and human action or agency. This assumption is strongly supported by the socioconstructivist epistemology, which focuses on the importance of the socio-cultural context and interaction in learning practices. ST sees structure and agency as a duality; thus, social phenomena such as the mobile learning phenomenon are the products of both structure and agency.

Human action is placed at the centre of the structurational analysis. In relation to my research, human action includes the foreign and second language learners' practices when employing mobile technology in their formal and informal learning situations. Agency is, according to Giddens (1984, p. 14), "the capacity to make a difference", a human ability to act in a certain context and under certain circumstances. ST acknowledges humans to be highly autonomous in their actions. However, a review of ST and IS research showed that there sparse attention has been paid to the "continuous operation of agency, the mutuality of constitution, or its pervasiveness" and thus, researchers need to be sensitive to the role of individuals in "sustaining and modifying settings, perhaps especially in those that are considered to be unchanging (and, perhaps, unchangeable)" (Jones & Karsten, 2008, p. 151).

Structure is understood as "[r]ules and resources, recursively implicated in the reproduction of social systems. Structure exists only as memory traces, the organic basis of human knowledgeability, and is instantiated in action" (Giddens, 1984, p. 377). Structures are seen to emerge through practice, as opposed to the idea that they are exceptionally embedded in technologies (Halperin & Backhouse 2007; Orlikowski, 2000). Such structures are assumed to be in the heads of individuals. Thus, in some way, they direct - as is the case in my study - the above-mentioned learning practices and make them possible, through available technologies-in-use.

Structures include norms and beliefs that exist in the students' minds. These norms and beliefs are underpinned by the available facilities (technologies) upon which the students draw:

[H]uman agents build into technology certain interpretive schemes (rules reflecting knowledge of the work being automated), certain facilities (resources to accomplish that work), and certain norms (rules that define the organizationally sanctioned way of executing that work). (Orlikowski, 1992, p. 410)

In the present research, the facilities are presented by the (mobile) technology-in-use. Specifically, the focus of the last study in this thesis is the use of the newly designed online mobile language learning application for the distance online language course, *Russian for Beginners I*.

The present research adopts in particular the framework for structurational modalities suggested by Halperin and Backhouse (2007) in its investigations of the relations between students' formal and informal learning practices and social structures (papers 3 and 4). The framework, which was developed, validated and further tested in higher education settings to evaluate the students' use of the WebCT learning management system, offers operationalisation guidelines for the key modalities that facilitate the inter-linkage between agency and structure. The modalities are *facility* (technology), *norms* (formal and informal), and *interpretive schemes*. These modalities or dimensions were initially suggested by Giddens (1979, 1984). Facilities include technologies and their properties, which are employed by students for various learning purposes. The research categories for the analysis of facilities include modules, tools and procedures for accomplishing tasks, data available through use, as well the technical set up for features in-use. Norms include accepted behaviour with regard to technology use. The researcher focuses on both the formal and informal character of these norms, the various types of norms (e.g., participation, and contribution), and the degree of sanction (i.e., weak vs. strong). Interpretive schemes include actors' or students' underlying beliefs about practice, their practical assumptions about effectiveness in that practice, and their perceived role of technology in its accomplishment. Paper 3 gives an analysis of all these modalities as a whole, thus helping to deliver a deeper understanding of students' (mobile) technology-mediated learning practices that occur in both the chosen formal settings of online distance education and in

students' informal learning environments, where private mobile technologies are regularly used for learning purposes (Viberg & Grönlund, 2015). Moreover a specific focus on the modality of facility or technology in the developed mobile application-in-use in Paper 4 contributed to a more rigorous evaluation and a deeper understanding of how this tool, developed with regard to the goals of formal education, was used by the students.

Technology-in-practice

The notions of *technology-in-use* and/or *technology-in-practice* are used synonymously throughout this entire thesis. The term *technology-in-practice* was originally introduced by Orlikowski, who was the first to propose a structurational model of technology (1992, 2000) (Figure 4). She suggests that technologies-in-practice are a sort of structures: “the particular structures of technology use that users enact when engaging recurrently with a technology” (Orlikowski, 2000, p. 411). In her propositions, she claims:

[w]hile a technology can be seen to embody particular symbol and material properties, it does not embody structures because they are only instantiated in practice. When humans interact regularly with a technology, they engage with (some or all of) the material and symbol properties of the technology. Through such repeated interaction, certain of the technology's properties become implication in an ongoing process of structuration. The resulting recurrent social practice produces and reproduces a particular structure of technology use. Thus, structures of technology use are constituted recursively as humans regularly interact with certain properties of a technology and thus shape the set of rules and resources that serve to shape their interaction. Seen through a practice lens, technology structures are emergent, not embodied. (Orlikowski, 2000, pp. 406-407)

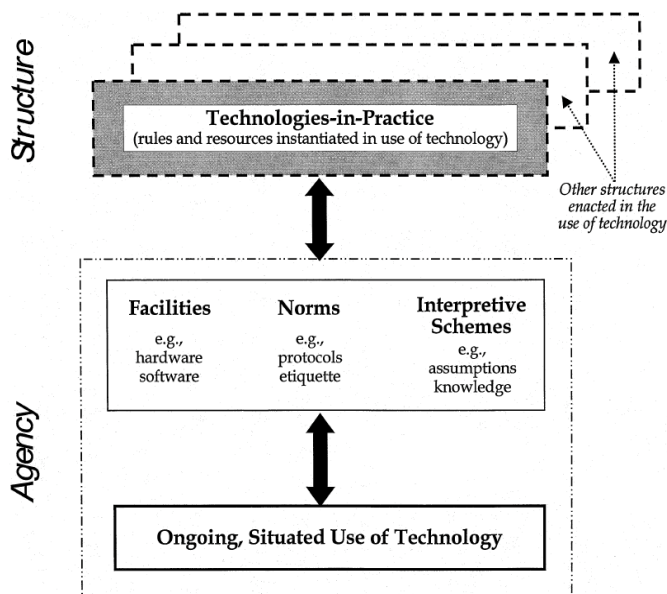


Figure 4. Structural model of technology. Enactment of technologies-in-practice (Orlikowski, 2000, p. 410)

According to Orlikowski's theoretical assumptions and her proposed model, technology is offered with a set of properties that were originally set up by designers, and hardware and software developers. How these properties will be used on certain occasions depends predominantly on what an individual does with them. Hence, technology use is seen as a "situated and recursive process of constitution, which-while it may often invoke intended activities or replicate familiar uses-may also and at any time ignore such conventional uses or invent new ones" (Orlikowski, 2000, p. 408).

Consequently, in my research the focus of structural analysis is on the recurrent technology-mediated language learning practices that are related to online distance education goals, and in particular to the

students' mobile technology-in-use to achieve these goals. Students' use of technologies is further assumed to be directly and firmly affected by their understanding of the properties available and the system's functionality. In their learning (social) practices, students draw upon a particular sociocultural context, their previous actions, the facilities available to them (including technology), and the norms that inform their current language learning practices. My focus on the students' mobile technology-in-practice does not imply that other structures they recurrently enact are less important for their learning than others. However, according to the Gidden's recommendation (1979) for the implementation of structurational analysis, one must prioritise some structures over others. Technologies-in-practices are seen to be changeable over time, because students' knowledge, experiences, contexts, and technology may undergo changes through human action. Such potential changes lead to changes in the modalities of norms and interpretive schemes employed in technology use.

Given the pervasive integration of mobile technology into humans' everyday lives and learning practices, and the technology dependency of the educational setting studied, the application of ST is highly motivated with regard to the nature of such practices, technology-in-practice, human actors, and the surrounding context. What attracted me to ST, based on my earlier observations and teaching experience, is the fact that students use various technologies for their e-learning in the chosen settings, while some of the assigned technologies were sometimes neglected in favour of their own mobile technologies. According to Halperin (2005, p. 77): "Which [technological] properties are ignored and which are adopted for use in certain ways is an empirical question that calls for exploration. Normative and interpretive conditions may, likewise, undergo changes during the situated use of the technology." An additional motive for using ST is the success of earlier practices. When students are describing their practices, their explanations are usually formulated in terms of norms for conduct, attitudes, and general notions of how things should be done (see e.g., Andersson, Hedström, & Grönlund, 2009). The ST concepts have been useful in capturing these underlying motives.

2.5 Self-regulated learning

Distance education is considered a student-centred learning environment where the overall focus is to support the learner to actively construct meaning (Land et al., 2012). In such a highly student-centred environment, learner autonomy and self-regulated learning (SRL) are seen as the most influential success factors (Zhao, Chen & Panda, 2014). Learning in multi-representational and open-ended environments, as distance educational practices suggest, encompasses the “use of various self-regulatory processes such as planning, reflection, metacognitive monitoring and regulation” (Azevedo, Behnagh, Duffy, Harley, & Trevors, 2012, p. 171).

Self-regulated learning (SRL) theories make three basic assumptions. Self-regulated learners are able to i) personally improve their ability to learn through the selective use of meta-cognitive and motivational strategies, ii) proactively select, organise, and even create advantageous learning contexts, iii) play an important role in choosing the form and amount of instruction they need (Zimmerman & Shunk, 2001). All this emphasises the notion of learner agency, where learners are seen as highly autonomous in their actions.

Despite the fact that self-regulated learning is a well-established and well-researched area of study, there is a knowledge gap regarding its application to online distance education, and especially to the second language subject.

In the present thesis, it is important to gain an understanding and knowledge of learners’ characteristics in terms of their level of self-regulation, because the overall pragmatic intention is to support learners in their technology-mediated (language) learning practices and their language competence development by providing them with relevant and effective learning conditions and resources. This involves the design and development of educational software. In order to offer such conditions and resources, instructors and software developers need to know more about how students as independent individuals act when learning, and how they employ technologies in different learning settings for such purposes.

The effectiveness of employing mobile technology in learning practices generally depends on human (students and instructors), design (content, technologies), and institutional (policies and strategies) aspects (Vogel, Kennedy & Kwok, 2009). Paper 4 of this thesis seeks to respond to calls for research that can help clarify the roles of learner characteristics in

mobile learning (Sha et al., 2012). In particular, it examines human aspects with regard to students' self-regulative characteristics with the ultimate aim to improve the design components for MALL practices. The investigation was conducted by means of an online survey, the Online Self-Regulated Learning Questionnaire (OSLQ) (Barnard et al., 2008), the use and theoretical underpinnings of which are explained in the next section.

Self-regulation is one of the developments of contemporary educational psychology that has attracted researchers from various disciplines. Information Systems' researchers (Santhanam et al., 2008; Wan et al., 2012) have often discussed it in relation to e-learning in organisational settings. Scholars in the field of second and foreign language learning have also been interested in self-regulative learning and its strategies (e.g., Kondo et al., 2012; Lai & Gu, 2011; Lai, 2013, 2015; Oxford, 2011).

Self-regulated learning and performance are seen as "the processes whereby students activate and sustain cognitions, affects, and behaviors that are systematically oriented toward the attainment of personal goals" (Schunk & Zimmerman, 2011, p. 1). Definitions of SRL typically include three key features: i) learners' use of self-regulated learning strategies, ii) their responsiveness to self-oriented feedback about learning effectiveness, and iii) their interconnected motivational processes (Zimmerman, 1990).

The concept of SRL, which originates in social cognitive theory (Bandura, 1986; Zimmerman, 1989), claims that personal cognition (i.e., cognition, affect, and academic achievement) is reciprocally determined by behavioural and environmental (i.e., instructional design) factors (Sha, Looi, Chen, & Zhang, 2012). From a social cognitive viewpoint, the ability to self-regulate one's learning progresses in a cyclical manner in a form of interaction of personal, behavioural and environmental aspects (Zimmerman & Schunk, 2001). SRL theories in general try "to model how cognitive, metacognitive, and emotional processes as and contextual factors influence the learning process", where self-regulated learners are acknowledged to be active and efficient agents in their learning through monitoring and strategy use (Azevedo et al., 2012, p. 173).

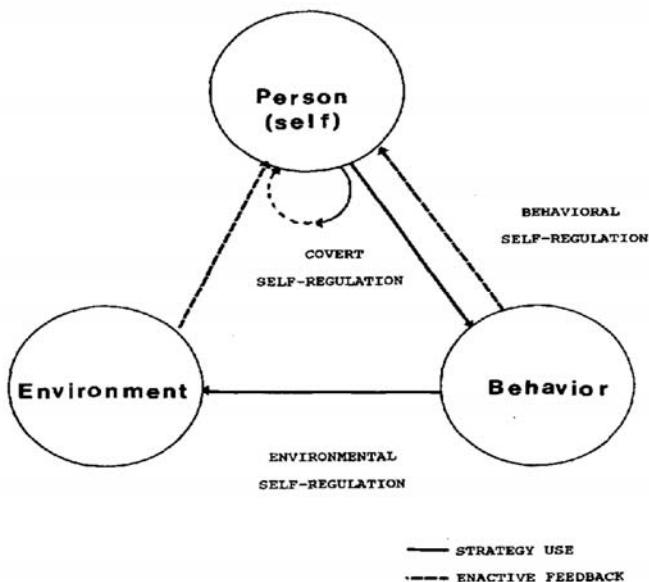
The effectiveness of any learning environment for learners' engagement is determined by learner characteristics, i.e., prior knowledge, goals, learning practices and styles, and self-perception of the task. Both IS researchers and educational researchers have pointed out

the importance of including learners' personal factors and behavioural patterns along with the pedagogical and technological issues when designing (mobile) technology mediated learning environments (Sha et al., 2012; Wan, Compeau, & Haggerty, 2012). Self-regulated learning includes strategies by which learners actively engage in learning activities and apply intentional efforts to manage and direct their learning activities (Santhanam et al., 2008).

The Online Self-Regulated Learning Questionnaire

Self-regulated learning refers to “those active and volitional behaviours on the part of individuals to achieve in their learning” (Barnard-Brak et al., 2010, p. 2). Such behaviours include goal setting, time management, task strategies, environmental structuring, and help seeking. They are seen as “a function of an individuals' desire to achieve in their learning” (Barnard-Brak et al., 2010, p. 1). To access foreign and second language students' self-regulated characteristics in online distance education, the Online Self-Regulated Learning Questionnaire, OSLQ, was used. This uses a 24-item scale with a 5-point Likert type response format (Barnard et al., 2008). The six subscales constructs, which are equal to the individuals' behaviour segments mentioned above (e.g., goal setting, and time management etc.), are detailed in the 24 items that appear in the questionnaire. The OSLQ is a shortened form of an 86-item instrument that was developed to reflect a multi-dimensional conception of SRL, which originated from Zimmerman's research (1989).

The OSLQ has its theoretical foundations in social learning theory (Bandura, 1986), and more specifically in the social cognitive view of self-regulated learning, further developed by Zimmerman (1989). Self-regulated learning, according to Zimmerman (1989), “occurs to the degree that a student can use personal (i.e., self-) processes to strategically regulate behavior and the immediate learning environment” (p. 330). For the purpose of increasing the regulatory influence of individual (self-) processes, Zimmerman proposed three classes of strategies designed to i) control behaviour, ii) control the environment, and/or iii) control covert processes (p. 330). All these types of self-regulation and the relationships between them are presented below (Figure 5).



*Figure 5. A triadic analysis of self-regulated functioning
(Zimmerman, 1989, p. 330)*

The reciprocal influence of the three domains, environment, behaviour, and person (self), is interdependent; however, “the relative strength and the temporal patterning of mutual causation” among them can vary, and “be altered through (a) personal efforts to self-regulated, (b) outcomes of behavioural performances, and (c) changes in the environmental context” (Zimmerman, 1989, p. 330). In other words, the relationship between these domains will vary to a certain degree depending on the changes in one of them. This assumption consequently applies to the present research, which aims to explain the MALL phenomenon, rather than predict its absolute role and value.

The OSQ was initially developed in order to model student self-regulatory learning behaviours. It was suggested as a mediator in the relationship between student perceptions of course communication, collaboration and achievement in online education (Barnard et al., 2008).

The application of this particular instrument to the present research can be explained firstly by its explicit focus on the settings of online learning environments, settings that are less well researched than others

in terms of self-regulation. Secondly, it can be explained by the fact that the subscales presented in the questionnaire in general replicate the nature of other SRL research instruments, models and concepts, which are perhaps assumed to be more accepted and validated. As Barnard, Paton and Lan (2008) state: “While self-regulatory behaviours in online learning environments would appear to develop similarly as in other domains, self-regulatory behaviours have been indicated as being ‘highly context dependent’ (Zimmerman & Schunk, 2001, p. 125) requiring the examination of self-regulatory behaviours within the context of the online [and distance] learning environment”, which is seen as a unique context requiring investigation (p. 2).

SRL is at the centre of agents or students, who, through their actions, influence the surrounding environment by means of the choices made and the structures engaged in on a particular occasion and in a specific context. SRL is considered to be a function of the individual’s skill and will (Barnard-Brak et al., 2010). In the current research, such skills are considered to be transformative rather than stable, because their development is influenced by the surrounding learning environments, which are constantly changing. Students shift between home, work, commuting spaces such as trains and buses, and online learning environments provided through communication software such as Adobe Connect or Skype. This is seen to be significant to the educational goals the individuals are working to achieve.

2.6 Cultural perspectives

[C]ultural differences may influence the extent and effectiveness of people’s interactions with IS [information systems]. (Tams, 2013, p. 383)

This thesis addresses cultural issues among others (technical/practical, pedagogical and social) in order to lend an insight into the relationships between mobile technology use and culture in the higher education settings of foreign and second language learning. In general, culture is a challenging variable for researchers, because of numerous and diverse definitions of the concept and its measures. The major part of cultural IS research remains immature; the major problems are considered to derive from inadequate definitions of culture and the lack of diversity of the epistemological approach used (Tams, 2013).

In the present research, the epistemological approach to culture is interpretative in that it acknowledges that culture, as one form of reality, is socially constructed. Appropriately, culture encompasses values, history, language, and social structure, “all of which indicate that it is deeply embedded in a social context” (Tams, 2013, p. 388). Previously discussed theoretical foundations of the thesis (i.e., social constructivism, structuration theory, a sociocultural perspective on mobile learning, etc.) are seen to be wholly consistent with this understanding of culture. In his review of definitions of the culture construct, Tams (2013) suggests that, since culture can be assumed to be a rich construct and meanings can be best conveyed by the individuals themselves, the interpretivist lens may be effective for cultural IS research. He further outlines three main potential advantages of using the interpretivist approach in IS research:

1. It can effectively address circular relationships, as culture and technology use have a bidirectional relationship influencing each other;
2. It can effectively account for the fact that culture is temporal and emergent;
3. It can examine the interplay between culture and technology use at multiple levels of analysis to build multilevel theory. (p. 388)

“Information technology is often implicated in failings of culture”, (Leidner & Kayworth, 2006, p. 358), and IT researchers have studied the impact of national and organisational culture on various IT issues. Nevertheless, cultural aspects are still under-researched (Sánchez-Franco, Martínez-López, & Martín-Velicia, 2009), particularly with respect to the application of mobile technology in learning.

Among the key factors that determine students’ use of technology for learning, cultural values are identified to be of importance (Sánchez-Franco et al., 2009). Cultural factors are extremely interesting to study, because many learning contexts today include a mix of students from various cultural backgrounds (Arenas-Gaitán, Ramírez-Correa, & Rondán-Cataluna, 2011), not only in distance tuition but also on campus. With regard to second language learners, the cultural diversity of the students taking online distance courses is highly relevant. Often, the online form

of distance tuition offers a smooth access to formal education for students who are not geographically bound to one particular physical place or country. They can take courses from everywhere. The only prerequisite for participation in such modes of education is a good Internet connection.

Cultural differences are, though, notoriously difficult to investigate, because different kinds of culture can merge in complex ways. The first significant challenge to approaching culture is its definition, and understanding what culture is (Leidner & Kayworth, 2006). Some scholars have suggested that culture comprises more explicit, observable cultural artefacts in the form of norms and practices (DeLong & Fahey, 2000; Hofstede, 1988). Pettigrew (1979) has considered culture to be manifested through artefacts and creations, where these artefacts might include art, technology, behavior patterns, language, ideology, and rituals. Others (Sackman, 1992) have approached culture in terms of ideologies, basic assumptions and sets of beliefs. Schein (1985) offered a three-dimensional model of culture. At the first level, basic assumptions are at the core of culture and represent the belief system that individuals have toward relationships, human behaviour, truth and reality. These assumptions stand for cognitive structures that individuals use to make sense of situations. At the second level, values represent a demonstration of culture that signifies adopted beliefs. These determine what is important to a particular cultural group (i.e., people behave the way they do). At the last level, the culture is displayed through artefacts and creations, which are the most visible manifestations of culture. These artefacts include technology, among others.

The second research challenge in IS cultural research is “the assumption that all individuals within a given cultural unit will respond in a consistent fashion based on the group’s cultural values” (Leidner & Kayworth, 2006, p. 381). This assumption does not take into account the possible variation between individuals within the same cultural entity, which may lead to different behaviour patterns and outcomes in relation to technology use.

A third major challenge relates to methodological issues that arise when there are three types of bias present (Karahanna, Evaristo, & Srite, 2002): i) construct bias (the same concept can be understood differently in different cultures), ii) method bias (subjects across cultures do not respond similarly, because of, for instance, demographics or language),

iii) item bias (respondents interpret questions differently because they are poorly translated).

A number of “characteristics of culture have been the subject of extensive research, but a commonly held view is that the cultural environment influences and shapes the values of society” (Johns, Smith, & Strand, 2003, p. 87). To reflect on the cultural perspective of mobile technologies use in language education, Hofstede’s model of national culture (Hofstede et al., 2010), which presents culture through a number of dimensions (e.g., power distance, and individualism-collectivism) is applied in this thesis (Viberg & Grönlund, 2013b, Paper 2). While these categories are contested as measures of specifically national cultures, they do contain elements that may also play a role in people’s behaviour and attitudes towards education in other cultures, including “power distance” and “individualism vs. collectivism”. This means that even though they may not indicate the culture of entire nations, they may predict attitudes towards learning and technology (Viberg & Grönlund, 2013b).

The present thesis considers culture to be a critical variable in explaining how students employ mobile technology in their second language learning in higher education. To this end, a value-based approach to culture is employed. Such a theoretical approach, being predominant in IS cultural research during the recent decades (Leidner & Kayworth, 2006), facilitates the investigation and identification of possible contradictions that may occur at a national level, as well as possible similarities in mobile technology use in higher education.

In the present research, culture is considered as a variable that is influenced by various social, technological and individual factors when there is a considerable degree of stability; hence, culture is liable to change over time (Csonka & Schweitzer, 2013).

Technology can be seen as a cultural phenomenon, itself. As such it may influence other existing cultures and social processes. It has already changed our views and practices regarding work hours (“always available through the mobile phone”), what we consider private information (Facebook), and how we consider personal meetings in the service sector (e.g., Internet banking, and travel agents). While changes like these first relate to practices, they are also deeply ingrained in values: “A handshake and looking each other in the eyes is necessary for doing business” may still be true in many cases, but trust in electronic transactions has increased enormously due to the fact that an increasing

number of people use them. Indeed, they serve as examples to other people who start trusting them as a result of social influence. Eventually, such changes in practice turn into changes in attitude and, over time, into what can be considered as changes in more fundamental values.

Students' attitudes towards mobile technology integration into formal second language learning in higher education in Sweden and China were investigated in the current research. These two countries were chosen because, traditionally, according to Hofstede's investigations and other accounts of cultural differences between regions, Sweden and China are seen as two polar countries in many cultural aspects: for example, one is being very individualist, while the other is very collectivist. However, nowadays, both these countries are extensive users of (the same) mobile technology (see paper 2, Viberg & Grönlund, 2013b), which makes the study of potential cultural influences on students' MALL practices extremely interesting.

Attitudes in general are not a culture in its core, but they largely derive from cultures. In this sense, they can be considered as expressions of one's beliefs, feelings, and past experiences in relation to an object or a concept. Furthermore, they are echoed through cognition and affection, and have an influence on one's behaviour (Aizen, 2005). Consequently, it can be assumed that attitudes predict students' behaviours in different aspects.

In turn, culture is a more established and deep-set phenomenon than attitudes; thus, it is more difficult to transform culture and its values than it is to transform attitudes. Attitudes also stem from individuals' previous practices, as mentioned above; for example, more experienced technology users are more positive to new technology than non-experienced ones. The usability of technology, or the lack thereof, may also have an influence on actual technology use. For example, experienced users may have negative attitudes towards a certain type of technology for various reasons, such as integrity. Negative attitudes to a certain kind of technology can also be generated by other factors, including poor quality of the available technology, and when less effective pedagogy is applied in educational institutionalised settings. Such 'practical' factors in comparison to a national culture are still challenging; however, they are changeable in a less multifaceted way. Educational instructors have an opportunity to approach such challenges and offer practical solutions by designing new learning environments in which mobile technology is integrated into learners' everyday practices.

In recent years, numerous studies have discussed the benefits of web-based learning, where researchers have emphasised the need for well-designed learning support (Hwang & Chang, 2011). With regard to the rapid development of mobile technology and its perpetual integration into individuals' lives, little has been done as yet to show how second language students and educators can benefit from the use of such technology in higher education settings.

3. Research Design

This chapter presents the overall design of my research, with a main focus on the research process, methods and analysis. Design Science Research as an overall approach to this thesis was discussed in chapter 2, Theoretical Foundations. This chapter starts with an introduction to my research in accordance with Design Science Research (DSR). Furthermore, arguments are given for my choice of methods within DSR. Finally, ethical considerations for this research are discussed.

3.1 My research in accordance with DSR

Research can be generally considered as an *activity* that contributes to the understanding of a *phenomenon* (Vaishnavi & Kuechler, 2004). In my case, the phenomenon is mobile learning, specifically in the setting of online distance language education. The present research unit of analysis comprises second and foreign language students' learning behaviours and practices. The activities undertaken to understand the phenomenon encompass a set of methods and techniques, which, when applied, produce new and valid for community knowledge. Information Systems (IS) is a multiparadigmatic research community that is open to the use of multidisciplinary research methods (Vaishnavi & Kuechler, 2004).

Along with the numerous approaches to conducting DSR (e.g., Hevner et al., 2004; March & Smith, 1995; Purao, 2002), the present research is carried out based on the general methodology of Design Science Research (Figure 6), as put forward by Vaishnavi and Kuechler (2004, 2008). This methodology highlights “the knowledge generation inherent in the method” (Vaishnavi & Kuechler, 2008, p. 19). My DSR effort proceeds with five iterative steps, which are presented as follows.

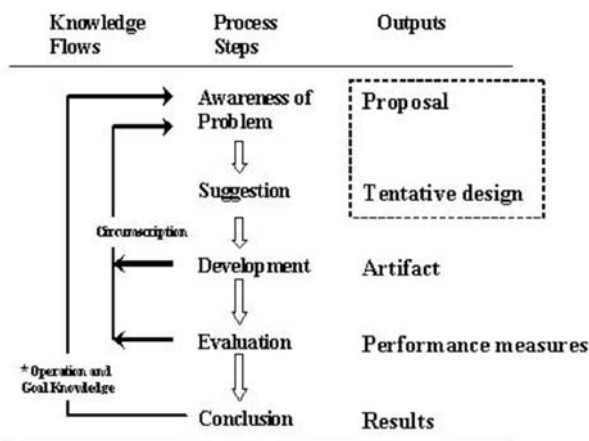


Figure 6. The general methodology of design science research
(Vaishnavi & Kuechler, 2008, p. 20)

3.1.1 Awareness of problem

Awareness of a problem can derive from various sources, including developments in society, (e.g., technology development), and/or in a reference discipline. The output of this step is a proposal (formal or informal) for a new research inquiry (Vaishnavi & Kuechler, 2008). In the present research, the initial awareness of the problem, which is how students' informal learning contexts can be incorporated into formal educational practices, derives partially from several years of experience of teaching beginner second and foreign language students at university level, using an online distance mode of teaching and learning. My interest also has its origins in the fact that more and more educational institutions worldwide are now offering online distance education in some form or other.

Moreover, the pervasive integration of mobile technologies in individuals' lives (both privately and at work) over the last decade raises the question of what new learning platforms are becoming available for users. Formal education courses need to be adjustable to students' lifestyles, socio-cultural contexts and technology development.

In my research, this is considered to be an analytical step that encompasses several studies. These studies reflect different aspects of the problem, based both on the examination of previous MALL research conducted within various research disciplines (e.g., education, language

studies, and human-computer interaction), and on empirical studies, which are relevant for online distance education contexts.

This analytical step is initially reflected in the first two studies; after these, I decided to begin software development. However the third study is also an analytical one, even though it was conducted at the same time as the initial phase of the software design and developmental work.

First, a systematic review of MALL literature published between the years 2005 and 2012 was conducted within the area of second language acquisition (SLA) in terms of approaches, theories, methodologies, technology and results related to linguistic knowledge and skills (Paper 1).

Second, an investigation of Swedish and Chinese students' attitudes towards the integration of mobile technology in their institutionalised language learning was carried out (Paper 2). Students' attitudes were examined so as to identify any major differences stemming from, for example, local cultural contexts, age, or gender, and, if so, how these differences might have implications for the design and delivery of online courses.

Third, a study of, students' use of technology, with a specific focus on their learning practices in informal learning settings and their perceived understanding of how this technology-in-practice guides their language learning was carried out (Paper 3). This study focuses on our understanding of students' learning practices in terms of their structuration, which is mediated by their technologies-in-use in mainly informal settings of distance education.

The results of these studies helped me to understand the problem and to narrow down my research focus to the specific context of online distance language education.

3.1.2 Suggestion

The suggestion phase follows directly after the proposal phase, and is inherently connected with it (Figure 6). It is a fundamentally creative step that deals with the tentative design of a new artefact, or the configuration of an already existing one (Vaishnavi & Kuechler, 2008). A tentative design and even the performance of a prototype built to that design "would be the integral part of the Proposal" (Vaishnavi & Kuechler, 2008, p. 20). Accordingly, a prototype of an online tool, namely a web-based mobile application for beginner language students was built based on my understanding of the problem. The prototype was

built to fit into a formal university educational system, both technically (i.e., by offering cross-platform access to the language application) and formally (i.e., by adapting the content to particular course goals and structure). This step is mainly practical, and involves a requirement specification, the material development of the artefact, early programming work, and early usability testing. At this stage, the prototype was mainly tested for its usability from a technical point of view in terms of access, usability and functionality on various mobile and desktop computer platforms. The results of the suggestion phase are represented in the artefact, which is a product in itself. In addition, they are reflected in a short paper and a poster, presented at *the 12th and 13th International Conferences on Mobile and Contextual Learning, mLearn 2013/2014*, and more extensively in the next chapter (The SOLL Prototype for Language Learning).

During this phase, the design process helped me to delve deeper into the present research problem from a practical perspective, in terms of the technical and material development challenges that occur when designing an educational tool to support students' mobile learning language practices. However, to be able to understand the problem from the students' or users' point of view, namely the integration of the application into the online distance language education setting, the tool needed to be tested and further evaluated in a DSR cycle.

3.1.3 Development

At this stage, the tentative design of an artefact is further developed and implemented. "Elaboration of this design into a complete design requires a creative effort", where the implementation techniques can vary depending on the features of the artefact and it does not "need to involve any novelty beyond the state-of-practice for the given art[e]fact; [where] the novelty is [seen] primarily in the design, not the construction of the art[e]fact" (Vaishnavi & Kuechler, 2008, p. 21).

The prototype of suggested language learning application has been, on an experimental basis, integrated into an online language course on two occasions; the first was in Autumn 2013 and the second was in Spring 2014. This would allow me to validate the study's results, and enlarge the studied sample. The integration was conducted in collaboration with course teachers and instructors, as well as the IT support and Information departments at the university. The key activities implemented at this step are: the final designing of a cross-platform

language learning application for beginner language learners; usability testing with several learners and instructors (four learners and two language instructors working at the same university); testing with the university server (data processing, log in process); handling errors, and testing of the application's dissemination. This phase also includes the detailed planning and implementation of the experiment, and the actual integration of the application into a formal language course.

3.1.4 Evaluation

The evaluation step includes an evaluation of the developed artefact in accordance with chosen criteria, and an analytic phase in which hypotheses are formulated about the behaviour of the developed artefact. Rarely in DSR are the initial hypotheses about behaviour borne out; instead, at this stage the additional information gained derives from the process of construction and integration of the artefact. This information often gives rise to further considerations, which reveal new aspects of the problem awareness, and thus lead to another round as part of the next step. This implies a new design (Vaishnavi & Kuechler, 2008), thus opening up a new DSR cycle.

The evaluation of the prototype of the web-based mobile language learning application in this thesis was carried out according to the initial product/prototype requirement specification. This was originally developed directly after the second study (Paper 2). In this research, the limited time resources meant that only one round of DSR cycle was possible (for further elaboration, see the section on limitations).

The evaluation of the constructed artefact's use was implemented both at the end of the Autumn 2013 term and also at the end of Spring 2014, on completion of the official formal courses into which the application was integrated. Its use was analysed using a number of technical tools built into the system, including technical measures (log data available from the server). It was evaluated on the basis of students' interview data, which was collected at the same time.

The results of the use of the prototype are presented in Paper 4. The evaluation criteria were two-pronged. On the one hand, based on log data I examined students' use in terms of time in its different aspects (e.g., total usage time, time per one use, and daily and weekly time) spent on the application-in-practice. On the other hand, semi-structured interviews were carried out to qualitatively investigate students' perceptions of the usefulness and effectiveness of the application for their

language learning, with a focus on opportunities to merge formal and informal learning settings.

Moreover, at this evaluation phase the results of the analysis of the students tool use were related to the research investigations with regard to the learners' perceived levels of self-regulation and structuration. These findings thus brought up an additional dimension for consideration in a future DSR cycle.

The evaluation step is reflected in Paper 4.

3.1.5 Conclusion

At this final stage of DSR, the findings were presented to the relevant audience. Final conclusions may derive from each of the steps of the conducted research, not just from the final findings from the evaluation phase. The conclusion phase presents results that show the degree to which the implemented 'solution' satisfies the needs of the target users and the situation that is targeted for improvement. Any deviation from the predicted behaviour of the artefact is analysed. Consequently, any knowledge that is gained during the research steps is categorised as either being based on " 'firm' facts that have been learned and can be repeatedly applied or behaviour that can be repeatedly evoked, or as 'loose ends', anomalous behaviour that defies explanation and may well serve as the subject for further research" (Vaishnavi & Kuechler, 2008, p. 22).

At this stage of my study, the findings of my research in the form of scientific papers were presented at international field-specific conferences, workshops, and higher seminars (both nationally and internationally). They were also published in conference proceedings and international journals relevant to the MALL and IS research communities. The prototype SOLL application that was developed during the project is still a prototype and work-in-progress. This should be further developed and tested in similar online distance language education settings. For example, one of the evaluation results implies that students would benefit more if there was also an offline/native version of the tool, because they cannot always be online when they want to study.

The overall design of my research is presented in the Figure 7. In this figure, the content of each step is presented based on the research questions answered during the entire research process. While most of the research questions are numbered in the figure (e.g., RQ1, and RQ2), some of them, which are not explicitly presented in the published papers,

but which are included in this thesis remain unnumbered here (e.g., RQ: How could online tools for integrating formal and informal learning be designed?). However answers to these unnumbered questions can be found in in chapters 4, 5 and 6 of this thesis.

RQ: How can language learning practices occurring in informal learning environments be effectively integrated with formal education through the use of mobile technology?

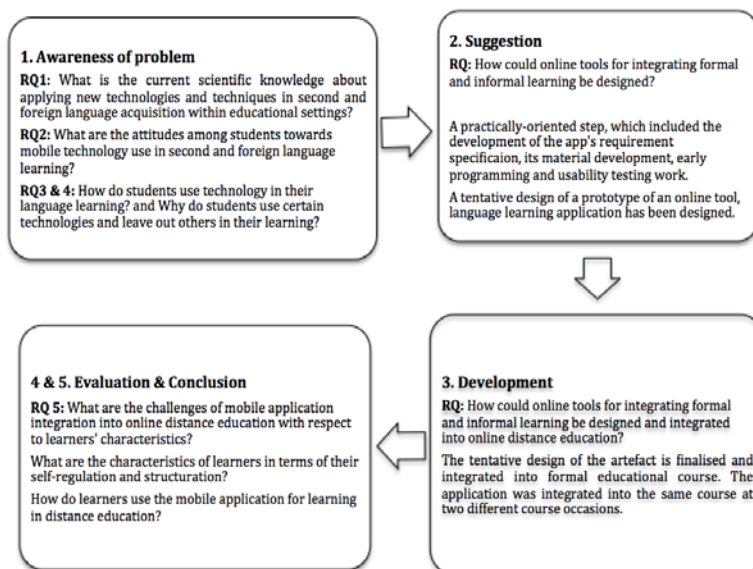


Figure 7. The overall design of my research process

My research follows the guidelines for Design Science in IS research suggested by Hevner et al. (2004) (Table 3).

Table 3. My research in accordance with the guidelines of DSR (guidelines and their descriptions are adopted from Hevner et al., 2004)

Guidelines	Description	My research
1. Design as an artefact	DSR must produce a viable artefact in the form of a construct, a model, a method, or an organisation.	A prototype of a cross-platform mobile language learning application (Seamless online language learning (SOLL)) is developed at the Suggestion and Developmental steps of the research.
2. Problem relevance	The objective of DSR is to develop technology-based solutions to important and relevant problems.	The construction of the SOLL application is a technology-based 'solution' that is relevant to addressing the identified problems in relation to mobile technology development and formal learning settings in higher distance education.
3. Design evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated through evaluation methods.	The development of evaluation criteria has been carried out throughout the entire research, where such criteria constructed based mainly on the context specific data, including both the analysis of quantitative and qualitative data, supported by the findings from the overall review of the MALL research field.

<p><i>4. Research contributions</i></p>	<p>Effective DSR must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.</p>	<p>The main contributions are:</p> <ul style="list-style-type: none"> i) a systematic review of MALL research in relation to methods, approaches, theories applied and results in the forms of linguistic knowledge gained and skills (Paper 1). ii) an increased understanding of language learners' attitudes towards the integration of mobile devices in the institutionalised language learning (Paper 2). iii) Paper 2 moreover contributes to the research literature of MALL by relating use of mobile devices in education to cultural factors. The findings that the attitudes related to technology culture are more important for students' attitudes and behaviour than their attitudes related to (national, traditional) culture is an important contribution. iv) an increased understanding of how online tools for integrating formal and informal learning environments can be designed, and what the main challenges are when developing such a tool (Presented in chapter 4). v) an increased understanding of how learners' characteristics in terms of their self-regulation and structuration may influence the use of (mobile) technologies for language learning (Paper 4). vi) an increased understanding of how students use the designed software in distance education (Paper 4).
<p><i>5. Research rigour</i></p>	<p>DSR relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.</p>	<p>Rigorous methods have been applied in the analytical and design-oriented parts of the research, including the artefact's construction. While the evaluation of the design artefact has been implemented in a rigorous way, it is still subject to further test in similar education environments, and on the other technological platforms, for its more effective usability and potential effectiveness for learning. For example, by changing the application's content in terms of language studied (to e.g., Arabic for Beginners or German for Beginners),</p>

		the app can be re-integrated into similar distance language courses, where its use should be further evaluated for better generalisability.
6. <i>Design as a search process</i>	The search of an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.	The search for an effective artefact was organised and implemented by identifying the insufficiency of existing formal learning environments in higher education (in regard to second and foreign language learning), technological viability, and learners' attitudes towards the adoption of mobile technology, and finally followed by the construction of a cross-platform prototype of an application that was further tested on an experimental basis and further evaluated.
7. <i>Communication of research</i>	DSR must be presented effectively both to technology-oriented as well as management-oriented audiences.	The research findings have been communicated to both technology-oriented as well as management oriented audiences; at international conferences on mobile learning and next generation learning; at higher seminars for both practitioners and research scholars, and in international journals related to MALL and IS research community.

3.2 Research methods

The choice of method for a research task is decisive for the value and character of the results.

(Swedish Research Council, 2011, p. 41)

The choice of methods in this thesis was supported on the one hand by the philosophical assumptions of DSR, which presuppose openness in the choice of methods used to measure artificial impacts on the composite system. On the other hand, the choice of methods was influenced by a particular examined phenomenon of MALL in a specific context of online distance education.

In order to answer the overall research question (*How can language learning practices occurring in informal learning environments be effectively integrated with formal education through the use of mobile technology?*) a mixed methods approach was adopted. The key assumption of such an approach is that, “the combination of both qualitative and quantitative approaches provides a more complete

understanding of a research problem than either approach alone” (Creswell, 2014, p. 4). This is not just the overall approach to my thesis as a whole, but also to two of the individual studies (Papers 1 & 4), which both use quantitative and qualitative methods.

Both qualitative and quantitative methods, and techniques of analysis are applied in this research. Qualitative research in IS involves the use of qualitative data, such as interviews, documents and participant observation in order to understand and explain social phenomena (Myers, 1997). Mobile learning is understood as a complex sociotechnical phenomenon; thus, qualitative research methods are relevant with regard to some required investigations.

My philosophical assumptions are grounded in the pragmatic social-constructivist paradigm (see section 2.1 on Social Constructivism). I believe that to understand the nature of mobile learning and its practices in relation to second language learning in both formal and informal distance learning environments, the pragmatic standpoint is of particular value:

Pragmatism is concerned with action and change and the interplay between knowledge and action. This makes it appropriate as a basis of research approaches intervening into the world and not merely observing the world. This would be the case if the intervention is organizational change (as in AR) or the building of the artefacts (as in DR). (Goldkuhl, 2012, p. 136)

From the pragmatic viewpoint, action is the way to change a state of being, and so as to perform changes in desired ways action must be guided by purpose and knowledge. As mentioned in the theoretical part of this thesis (chapter 2), learning is also understood and defined as a change: “any change in a [human cognitive] system that produces a more or less permanent change in its capacity for adapting to its environment” (Simon, 1996, p. 100).

To be able to understand how to design and integrate educational software (i.e., action) into formal educational practices qualitative methods (i.e., semi-structured interviews, and documents’ analysis) and quantitative methods were applied.

DSR is an iterative research process that is in a constant process of understanding and development. Understanding evolves through iterations of developments, trials, and analyses. It is open to various

theoretical approaches and methods, both qualitative and quantitative, and to combinations of methods:

Combining [qualitative and quantitative] methods introduces both testability and context into the research. Collecting different kinds of data by different methods from different sources provides a wider range of coverage that may result in a fuller picture of the unit under study than would have been achieved otherwise [...] using multiple methods increases the robustness of results because finding can be strengthened through triangulation – the cross validation achieved when different kinds and sources of data converge and are found congruent (Benbasat et al., 1987, Bonoma, 1985, Jick, 1983, Yin, 1984), or when an explanation is developed to account for all the data when they diverge. (Kaplan & Duchon, 1988, p. 575)

In order to answer the overall research question of this thesis various methods and techniques were required. These were applied to enrich the research overall findings and conclusions.

The Problem Awareness phase (Paper 1), for example, offers a review of the MALL research by using both qualitative and quantitative methods and techniques to give a fuller illustration of the current state of art in MALL. In Paper 2, when investigating language learners' attitudes towards the integration of mobile technology in their learning, I carried out a survey applying a number of statistical methods. Survey research, according to Creswell (2014), "provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population" (p. 13). The survey in my second study requires statistical methods of analysis, because of the number of respondents involved (345 students). In Paper 4, statistical methods of analysis were further applied when investigating students' characteristics in terms of their self-regulation and structuration. There were fewer respondents in this study ($n=69$), compared with the study reported in Paper 2 ($n=345$). Nonetheless, it was essential to use statistical methods to answer the research question and to be able to validate these findings by comparing them with those findings from the qualitative interview data analysis (Paper 4). Other information related to the tool's use is available from the server, where the application is located, and where the information about users' actions is stored (e.g., time used, and results of tests). This information has been analysed using both quantitative and qualitative techniques and methods.

To be able to understand how students employ technologies for their language learning, it is necessary to uncover their ‘structures’ in terms of the effectiveness and usefulness of the (mobile) technologies employed and the ways students interacted with them. Thus, I applied such qualitative methods as individual semi-structured interviews and document analysis, with a focus on the analysis of formal documents related to the settings of the studied context (Paper 3). At the evaluation stage, all data collected was taken into consideration in order to offer richer answers to the formulated research questions.

Data collection was carried out using mainly primary sources. Data for the literature review was mainly collected from online sources, including such databases as Summon, Google Scholar, and Eric. Primary data was gathered predominantly online, through, for example, information available from the server, and documents available from the university’s learning management system, online surveys, as well as the individual semi-structured interviews that were largely carried out online using Adobe Connect and Skype conference software. A focus-group interview was held with the IT department’s representatives and a face-to-face focus-group interview was carried out with two course instructors (Paper 3). A large part of data for the second study (Paper 2) was collected manually. The survey was distributed to and collected manually from the Chinese respondents, because of the governmental restrictions that limited Internet access to certain web pages. Given the chosen research settings, it was difficult to carry out participant observations, which are a kind of qualitative research method regularly applied in IS research and useful for understanding situations. This was mainly due to ethical issues, which will be discussed in the next section, and the potential travel costs involved.

3.2.1 Case study settings

Pedagogical practices and educational settings are considered to be two of the most decisive factors when educators strive to merge the mobile learning approach into their traditional teaching practices (Motiwalla, 2007). Following this recommendation, the description of the study’s specific teaching and learning contexts is of importance, not only for the overall results and conclusions of the present research, but also for the potential to generalise these results.

The study took place in a *higher education* setting and focuses on second and foreign language students' learning practices in *online distance education* in Sweden.

The forms and practices of distance education in Sweden differ among various higher educational institutions. In some cases such educational forms still presuppose prearranged face-to-face group meetings on a regular basis (thus mirroring campus-based educational practices). Other courses predominantly use online forms of communication and interactions, which are supported both by the use of asynchronous educational software (e.g., learning management systems such as Fronter, Blackboard and Moodle) and the software used for synchronous online group meetings (e.g., Adobe Connect and First Class). The latter form (online only) requires effective continuous technological support from educational institutions, both for educators and students.

Even though such distance educational courses and programs may be highly teacher-structured and planned, they still require more self-regulated activities on the part of students to be able to achieve formal educational goals and individuals' personal learning goals. As Selwyn (2013) puts it:

Now there is widespread acceptance that digital technologies must play an integral role in the provisions of all aspects of lifelong learning – from the integration of computers in school, college or university classrooms, to the virtual delivery of online courses and training. Digital technologies and media are also recognised as implicit elements of 'formal' modes of learning that are stimulated by general interests, pursuits and hobbies outside the formal curriculum. In short, digital technology is now an utterly integral but wholly unremarkable component of educational conditions and arrangements around the world. (p. 5)

Moreover, it is important to mention that distance education in Sweden, along with other forms of higher education, is available for free, not only for Swedes, but also for many EU citizens. This puts an additional pressure on the Swedish educational institutions to retain their existing students and attract new ones.

The settings of the present research are unique in several aspects. Firstly, it is based on a higher education institution that provides online distance educational form for most of its programs and courses. Indeed, the online or distant mode of teaching and learning often prevails over campus-based courses in terms of the number of students registered on

the programs and courses. Secondly, for the majority of languages, foreign and second language education is offered only in the distance form, which suggests online-only communication, and both synchronous and asynchronous modes of interaction. However, time for scheduled instructor-led synchronous group meetings is often limited to one to two hours a week, which implies that students spend most of their time in non-educational informal settings. Thirdly, the chosen online educational form requires functioning technology with high Internet connection speed. Certain skills and strategies are also needed on the part of the institution as well as the learners, if they are to employ this technology for teaching and learning purposes related to the goals of formal education.

Course settings

An increased interest in this particular distance form of education in recent years has been indicated among second and foreign language students. These students often register on one or two language courses, rather than on a whole program, which suggests that they often combine their studies with other activities.

One of the online distance second language courses, Russian for Beginners (part1) was selected for this study. The focus on the beginner level was because there are more students at this level than on higher level courses. In addition, at this level, students usually decide to continue their study of the chosen language or not. Thus, research into these students' learning practices is especially important for the educational institution. Firstly, it is important from an economic point of view; in volume, these students may represent more than 50% of all the students who choose to study languages. Secondly, it is also valuable from the students' view of their own learning, because such institutions are faced with the challenge of maintaining their interest and motivation to continue to study a chosen language. Additionally, the beginner level was chosen, because dropout rates at this stage are high (approximately 60%). Through my research, I attempted to identify ways of keeping students motivated enough to continue to study the chosen language. To do so, I have examined if, and how a better IT support could be a possible solution.

This study includes adult language students from different parts of the world, though the majority are Swedish-speaking (80-90%). Many learn a new language not primarily for the purpose of obtaining a university

degree, but rather for the purpose of being able to apply their target language.

The choice of these particular course settings for the research was based on the course instructors' willingness to cooperate in this project, as well as the institutional support in terms of resources provided for the design and construction of the studied artefact-in-use (the prototype of the SOLL application). My own earlier second language teaching experience at the beginner level was also a factor. The institutional support for this particular project was part of a larger five-year-long *Next Generation Learning* (NGL) program, which ran between 2010 and 2014. This program aimed to develop and support pedagogical innovations and developments through the use of existing technologies and the design of new technologies for teaching and learning practices. The program supported both practice-oriented and research-oriented activities through, for example, the organisation of international conferences on NGL, higher education seminars, as well as financial support for related research projects.

In the chosen course environment, students met regularly in electronic settings (both synchronous and asynchronous), though for a limited period of time each week (i.e., one and a half hours a week for the synchronous teacher-led seminars). Participation in the seminars was mandatory. It was difficult to measure the number of asynchronous interactions with the learning management system (Fronter), which is mainly accessed through a desktop computer, and other course participants, because of the absence of proper support from the IT department in terms of tracking and documenting students' use of the educational software. All the course materials were available primarily through the use of Fronter, which provides rather limited access for mobile technologies-in-practice, even though a mobile learning application is available.

Taking into account the limited interaction time with the course instructors and the other course participants, these distance students need various tools to support their learning practices in order to keep their motivation, support their learning progress, and smoothly blend their formal and informal learning environments.

3.3 Ethical considerations

Research ethics is not static. New ethical issues surface when new scientific questions are asked, when new methods are used and when new material is analysed. (Swedish Research Council, 2011, p. 11)

The mobile learning research field is a new research area that contains a number of new, previously unanswered questions in terms of individuals' learning practices, occurring not only in formal but also in informal learning environments. Such practices have been largely unexplored in regard to education. The use of new mobile technologies in education may bring about a change in students' learning practices. In turn, it implies new ethical concerns and challenges. These challenges relate not only to various contexts in which such technology-mediated learning might take place, but also to learners' personal mobile technologies, which are typically connected to the Internet and thus raise potentially problematic privacy issues. Mobile technologies-in-use may provide various kinds of personal information about learners, though their GPS location and communication patterns in social media and so on.

The mobile learning research community has made certain attempts to reflect on the ethics of mobile learning research (e.g., Aubusson, Schuck, & Burden, 2009; Dyson, Andrews, Smyth, & Wallace, 2013; Wishart, 2009). Nonetheless, the ethics of a particular research project should be considered in relation to its cultural and social context (Swedish Research Council, 2011).

In this thesis, I followed the ethical research guidelines and recommendations offered by the Swedish Research Council, or SRC (2011), because my study took place in the Swedish system of higher distance education. Consequently, my project's research ethics are placed in the chosen cultural and social context.

When planning to conduct research, both the existing laws and morals should be considered (SRC, 2011). Morals, as distinct from laws, have no explicit system of sanction, but are of importance when conducting research in a particular social setting. According to the *Act concerning the Ethical Review of Research Involving Humans* (the law, was accepted in January 2004 and modified in 2008), this project is not ethically sensitive, because it does not involve any treatment of individuals, no sensitive information about individuals is collected and no such information is produced by the research. This was endorsed by the Regional Ethics Review Board's advisory statement upon inquiry in

2011, and “corresponds to an approval based on review according to the law” (SRC, 2011, p. 50).

Compared with *the law*, the implications of morals are less clear and precise, however general guidelines have been developed. In all my studies in which ethics issues are involved, I have followed the principles of anonymity and confidentiality, as outlined by the SRC.

Anonymity is about eliminating the link between samples or questionnaire answers and a certain individual, so that neither unauthorised individuals nor the research group can re-establish it (SRC). In my project, I have conducted two large online surveys to investigate i) students’ attitudes towards mobile technology-in-use integration into higher education, and ii) their learning characteristics in terms of their perceived level of self-regulation and structuration. Participation in the surveys was voluntary, and all the answers were anonymous. The data collected in China (Paper 2) was collected manually, also on an anonymous basis, which makes it impossible to connect it to certain individuals. The qualitative data collected for the Papers 3 and 4, which mainly contains information about students’ technology-mediated language learning practices, was collected by means of interviews. It was then anonymised by means of coding which removes the trail to the interviewee. All results were presented anonymously in the published articles.

Paper 4 makes use of log data in regard to the app-in-practice. Logs are user-related, and log data can thus be linked to a particular user or student. The log in function was deliberately built into the tool by the designers, so as to be able to provide a deeper understanding of the research questions and thus to contribute to new knowledge relating to the Information Systems and MALL communities. However, such log data, which is stored on the university server, does not contain any sensitive information about users (in accordance to the above mentioned law). Rather, the software tools for log file analysis provide the researcher only with technology-in-practice related information with regard to the technical devices used, tasks practiced and time spent on the interactions with the tool employed. This was thoroughly discussed during the tool’s requirement specification and programming procedures with the project participants, especially with the software developer at the early stages of the project.

Because of these arrangements, it is impossible to connect the qualitative interview data to the quantitative log file data.

Confidentiality means protection from unauthorised individuals gaining access to the information. However, the researchers can use code keys to associate information or samples with specific individuals in order to be able to, for example, scrutinise the implemented research (SRC). This principle is most important in terms of the project's data documentation procedures. The collected data is primarily stored on the university's server and the files containing recordings from interviews and users' log data are protected with the code keys, which are available to the researcher and the university's IT department. Even though the data formally belongs to the educational institution, the access to it is restricted.

The above-mentioned principles and considerations primarily concern the handling of data collected for the project and the participants' involvement in the project. Another important issue is the role of the researcher. In this work, I have tried to remain objective and merely report what could be supported by the data. Nevertheless, it does not matter how objective you wish to be, your own experiences, ideas and values will influence how you interpret your data. One of the ways of making sure that you have not misunderstood the data, which is a risk in particular for qualitative data gathered during interviews, is to ask respondents to validate your interpretations. This method was implemented during the project.

4. The SOLL Prototype For Language Learning

The prototype of a Seamless Online Language Learning Application (SOLL), a web-based mobile application (app), was developed as a learning resource for students' use in undergraduate second language education. The web-based form of mobile application development allows learners to employ their own mobile and desktop technologies, thus offering opportunities for everyone to access the information. The web-based application development form was additionally selected to be able to infer changes and improvements in the app's content and functionality (during its experimental testing). Such work with native iOS and/or Android based applications (which can be used in an offline mode) requires extra financial and time resources, which might be an important factor for many educational institutions in their choices and opportunities to continue with such work or not.

4.1 Technical characteristics

The system design of the SOLL prototype is presented below (Figure 8).

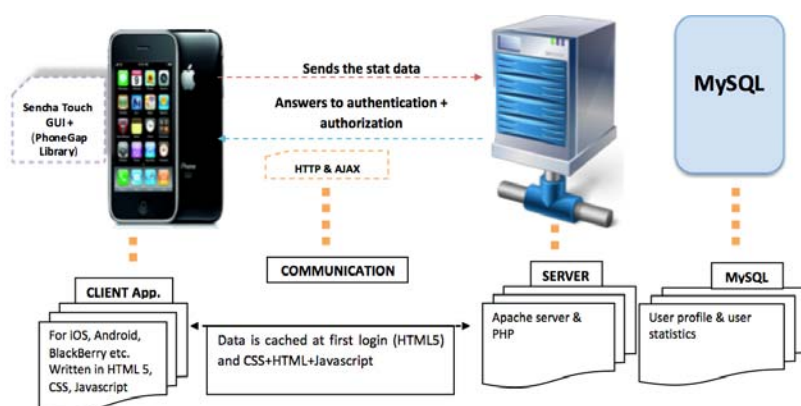


Figure 8. System design. Prototype of the SOLL application

The system consists of two parts: a server side and a client side applications.

Client Application

The client application is written using HTML 5, CSS 3 and JavaScript as a programming language. For the GUI implementation it uses Sencha Touch, a high-performance HTML5 mobile application framework. PhoneGap library, in turn, provides application access to destination platform native functions like Media, Network, and Contacts. These cross-platform technologies allow the application to seamlessly work on iOS, Android, BlackBerry, and Kindle Fire, as well as the PC platform. Communication between client and server is performed via AJAX and JSON as a data serialisation format.

Server Application

The server-side software is written in PHP. The server stores XML descriptions for each particular test in the application and the binary data content (pictures and sounds). It also provides such functions as client authentication and authorisation, and the gathering of application usage statistics per client. On the first launch of the application on a user device a request is made to the server that retrieves all the XMLs with scenario descriptions as well as all the corresponding data. All such data is then stored on the mobile device's local storage. Locally stored data will be used as a cache if the device goes offline. From time to time, when online, the application checks cache validity and re-fetches data from the server. The application loads these scenario definitions and creates on the fly UI Wizards for given test, using predefined GUI templates (written in CSS+HTML+Javascript).

4.2 Application development

The SOLL prototype was specifically developed to support beginner students' individual learning practices related to the studied course goals and informal learning environments. As such, the application is seen as a learning support resource that complements other tools which exist for students.

The prototype content design was developed on participatory grounds, based on regular weekly meetings with the person responsible for the course, and instructors, students, and the IT and Information

departments at the chosen university. The SOLL application prototype was developed over a period of eight months. The first project meetings with the course instructors, the developer, and the university's IT and Information departments' representatives took place in January 2012.

Following the agile software development method, the app programming work was a continuous regular collaborative effort between the materials' developers, the designer and the programmer. The university's IT department was also involved, especially at the project's very beginning, because the prototype is stored on the university's server. The agile development paradigm suggests that each development step and/or process (e.g., design requirements, design, and programming) be continuously revisited. Thus, a project's development may change and alter direction several times during its work. This was the case with this project, where the developmental directions changed on several occasions.

Furthermore two students who had previously been registered on the same course, and two other second language teachers, who did not have any knowledge of the Russian language, were involved in testing the various app's scenarios during the developmental process. They did so on a regular weekly basis so as to be able to offer prompt feedback on the prototype's structure, content and navigation features.

Supplementary work was devoted to the recording of the audio files and to the selection of and work with images, which were included in the content. To be able to provide an authentic native pronunciation of the studied language, three mother tongue speakers with a language teacher background were engaged in the recording process. The recording was conducted in a professional sound recording studio. This work produced sound files of a worthy quality, which could then be included in the prototype.

The project team also completed a review of educational apps available on the market, Apple Store and Google Play. This review showed that the available applications were not suitable for integration into a formal educational course for many reasons. Firstly, many of them were devoted to one particular aspect of language learning (e.g., vocabulary or grammar), and not the combination of different language skills, which is the focus of the chosen course. Secondly, the quality of the sound files included in the many apps was rather low, and in many cases such files were not accurate phonetically. Thirdly, users of such apps have to pay for them after a trial period that is often free of charge. All in all, there are several barriers to integrating apps already available on the market into formal educational contexts.

The link to the SOLL prototype was provided to course participants at two occasions, in September 2013 and in January 2014. They were offered the prototype in order to infer necessary changes and ongoing improvements during its experimental use.

To be able to access the app's content, students needed to log in with their university user account. This allowed me, as researcher, to later study their individual use of the application in terms of, for instance, time spent on its use, devices used to access the app (i.e., whether they used their desktop computers or mobile devices), and tasks/scenarios practiced.

4.3 Application content

While most of the apps available on the market are focused on some specific language aspect, such as vocabulary learning or reading, SOLL encompasses vocabulary, listening, reading, writing and grammar tasks/scenarios. Thus, it reflects the examined course content and the formal educational goals.

The application content was adapted to the formal course material and echoed the official syllabus. SOLL encompasses eight thematic modules related to the course content (Figure 9). It provides easy navigation and enables a simple connection to be made to the structure of the course material. Each module consists of three central parts: vocabulary, structure/grammar, and applied use of the target language in the form of dialogical learning scenarios. Listening and reading tasks are integrated into most of the scenarios. For example, when introducing and practicing new vocabulary or new grammar, listening is an obligatory part of these scenarios (e.g., Figure 10). Users may choose what part of the application they prefer to work with (e.g., practice of a new grammar case or participate in a vocabulary quiz) by selecting a relevant scenario through the navigation feature (Figure 11).

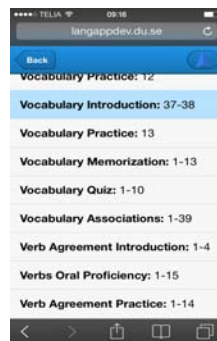
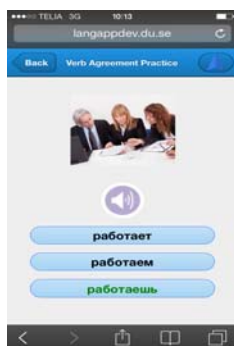


Figure 9. Prototype structure Figure 10. Verb agreement practice Figure 11. Prototype navigation

Interface

The ultimate objective of any application interface is user-friendly navigation. Such factors as variable screen size, processing speed, and interactivity are critical to the learners' experience of that application (Cheon, Lee, Crooks, & Song, 2012). The developers aimed to make the app available on various types of mobile devices (Android, iOS based), as well as on laptops. This gave rise to several technical challenges during the development process. For example, the amount and size of images and audio files must be adapted to the different platforms and the app should have the same "look-and-feel" on all platforms.

Another issue is associated with the fact that the prototype includes more than 50 scenarios, which was a challenging task in terms of navigation solutions. The programmer, the interface designer and the prototype content designer worked continuously on solving these problems, in order to offer navigation opportunities that were as simple and effective as possible. The SOLL application includes swiping and touch screen features.

The majority of the scenarios are related to vocabulary learning (e.g., vocabulary introduction, practice, memorisation, association and quiz) and grammar (e.g., introduction to new grammatical rules, practice and quiz). Moreover, a couple of scenarios relate to the applied use of the language, where the students are introduced to dialogical practice.

The practice and quiz scenarios offer automatic instant feedback to users, which is seen as a necessary component of the successful mobile application integration in learning settings (Wu et al., 2012).

Despite the fact that the chosen course is not grammar-focused, there is still a great need for grammar instruction to achieve the course goals. Consequently, a number of grammar scenarios and tasks, many of them with immediate feedback have been developed and integrated into the application. The grammar-focused scenarios often start with an introduction to a specific grammar aspect, which is relevant to course content, and are followed by some practice and quiz scenarios (Figures 12, 13, 14, 15, 16).

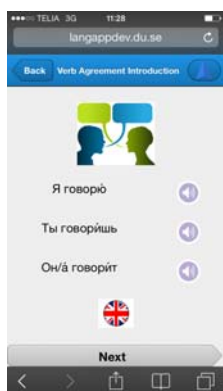


Figure 12. Verb agreement intro

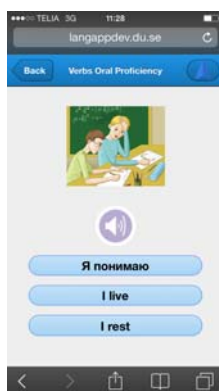


Figure 13. Verb oral proficiency

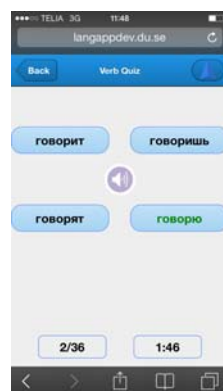


Figure 14. Verb quiz

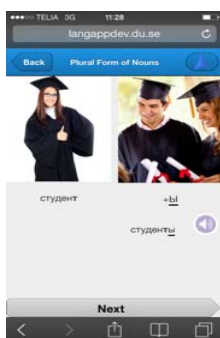


Figure 15. Plural form of nouns

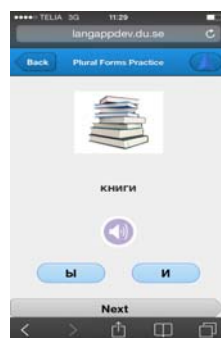


Figure 16. Plural form. Practice

5. Summary of the Research

In this chapter I present the findings of the studies conducted in this thesis. For each paper, I first present the aim and research questions, followed by a short description of the methods used, the results found and the main conclusions drawn.

5.1 Paper 1 – Systematising the Field of MALL

This study is part of the Problem Awareness stage in my Design Science Research cycle. A number of positive reports and papers have been written about the potential effectiveness of the mobile technologies' use in second language education. However, at that time, there was no systematised evidence, published in English, which illustrated the state of the field with regard to MALL (mobile assisted language learning) research, and which could shed light on what this effectiveness would mean in empirical educational settings. It was also unclear how MALL research was different from the more established area of CALL research. The aim of the first paper is thus to provide such a literature review of the field.

The study provides a systematic review of MALL research within the specific area of second language acquisition (SLA) during the period of 2005 to 2012. The review covers mainly empirical research published in English on the use and effectiveness of MALL in second and foreign language education. In particular, it focuses on practices and trends relating to methods, theories, focus and outcomes in terms of linguistic knowledge. The key research question is: *What is the current scientific knowledge about applying mobile technologies and techniques in second and foreign language acquisition within educational settings?* The review follows the Webster and Watson (2002) method of combining keyword searches and the examination of leading journals. In all, 86 papers were identified as relevant and were further investigated.

The findings show a shift from studies of the prevailing SMS-based language learning in the early years (2005-2008) towards the use of more advanced multimedia and intelligent language learning systems in the later years (2009-2012). In these studies, many of which were experimental, the use of such systems is frequently compared with a 'traditional' way of teaching and learning a language in educational settings. As such, they have focused on the results of the developed

software's use in, for instance, vocabulary acquisition or listening and speaking skills. A substantial number of these studies present explorative and comparative knowledge.

Many highly cited studies have focused on the design of mobile language learning systems and the experimental evaluation of their effectiveness. Studies often draw on mature pedagogic models and methods. However, with regard to research approaches and methods, descriptive and small-scale experimental studies have dominated these studies.

In terms of theoretical approaches and frameworks, there is a lack of specific mobile learning conceptual and theoretical models, which makes it difficult to distinguish specific mobile learning theories from other learning theories. Only one such field-specific theory, the Theory of Mobile Learning (Sharples et al., 2007), was found. While a large number of theories deriving from other research areas (e.g., psychology, education, philosophy, and informatics) was found, there is an issue as to how these theories were used. In general, theories have been vaguely used. Another issue is the scattered theory use. Numerous theories have been mentioned in the papers but most of them appear only in one or a few papers.

So far, research has paid most attention to learners' vocabulary acquisition. Studies that focus on grammar learning (Ally, Schafer, Cheung, McGreal, & Tin, 2007) and writing skills (Hwang, Chen, Shadiev, Huang, & Chen, 2012) are underrepresented in the reviewed literature. However, there are papers that analyse mobile technology applications on language acquisition in general terms (Abdous et al., 2012; Cheng, Hwang, Wu, Shadiev, & Xie, 2010; Fallahkhair, Pemberton, & Griffiths, 2007; Hsu, 2013; Oberg & Daniels, 2012). These papers often indicate positive attitudes towards mobile technology use and suggest better results in terms of language proficiency.

This study showed that MALL is a field of study that is mainly united by the focus on mobile technologies. It is a theoretically immature field, with little cumulative research and so far only one field-specific tentative theory. The borders with other fields, such as CALL, or even e-learning, are unclear conceptually and theoretically, because similar concepts are used and definitions are vague.

The dominating research focus within MALL is learners' attitudes towards technologies, their intention to use them, and the various actual uses of mobile technology integrated in their second and foreign language

learning. The impact of mobile technology on language learning is often measured in terms of individuals' stated perceptions, i.e., not by any objective measure. This exemplifies what Orlikowski and Iacono (2001) call the *proxy view* of technology. Technology itself is not studied directly but filtered through users' opinions. What is largely missing in the reviewed papers is reflection upon the fact that technology itself plays a role in reshaping people's preferences, perceptions, and attitudes, and that the new teaching and learning methods that evolve are co-constructed in a sociotechnical system rather than engineered. Technologies change and so do we. This is referred to as the *ensemble view* of technology (Orlikowski & Iacono, 2001). The idea of a sociotechnical construction of reality (as opposed to a purely social construction) is something that is often lacking in MALL studies.

An early, partial, version of the paper was published as a full paper in the conference proceedings of the *11th International Conference on Mobile and Contextual Learning*, mLearn 2012 (Viberg & Grönlund, 2012). The complete version of this paper, which is included in this thesis, was published in the *International Journal of Mobile and Blended Learning* (Viberg & Grönlund, 2013a).

5.2 Paper 2 – Survey of Users' Attitudes toward Mobile Technology Use in Second and Foreign Language Education

This paper was a response to my continuing curiosity about students' perceptions of mobile technology use in educational settings, because the use of such technologies is rarely associated with educational settings and formal educational goals. Moreover, I was seeking an increased understanding of potential factors that might affect learners' perceptions towards mobile technology adoption in higher education. In general, despite the rapid development of the mobile learning industry, there is still a lack of understanding of the factors that drive mobile learning adoption by learners in higher education (Cheon et al., 2012; Liu, Hongxiu, & Carlsson, 2010; Sung & Myer, 2012).

This study examines students' attitudes towards mobile technology use in and for second and foreign language learning in higher education. Moreover, the study investigates whether age, gender or cultural factors affect these attitudes. In all, 345 students from two in many aspects very different countries, China and Sweden participated in this study. To access learners' perceptions towards mobile technology use, I used

Kearney's pedagogical framework to examine mobile learning from a socio-cultural perspective (Kearney et al., 2012). Hofstede's cultural dimensions were used to investigate students' cultural views, because these dimensions represent some values (i.e., aspects of culture) that may affect attitudes to technology and learning, individually as well as in combination.

The study investigated two hypotheses:

H1: Cultural differences impact the perceptions of, and attitudes toward, mobile technology for language learning among students.

H2: Cultural background does not significantly impact these perceptions and attitudes. To the contrary, technology use is more important for shaping these attitudes, and thus culture.

Data was collected by means of a questionnaire, which contained three sections: one with personal data such as age and gender, one with questions specifying Hofstede's cultural categories, and one with questions operationalising Kearney's mobile learning theory (Kearney et al., 2012).

All statistical analyses were conducted using SPSS version 21. Descriptive analyses were used to examine the learners' backgrounds and attitudes towards the integration of mobile technologies in their language learning. To determine statistical significance, Spearman's Rho correlation tests and their associated p-values were used ($p < 0.05$ was considered statistically significant). Mann-Whitney U tests were used to identify the correlations between learners' gender and attitudes towards mobile learning and Hofstede's factors. Missing responses/data was taken into account when weighting the data.

The study found that respondents' attitudes towards mobile learning are very positive, with personalisation (focusing on learner choice, self-regulation and customisation) being most positive (83%) followed by collaboration (students' attitudes toward the importance of students being able to communicate multi-modally with instructors and exchange information through the mobile technologies' use in language learning) (74%), and authenticity (students' attitudes toward the opportunity of mobile technologies-in-use to provide real world relevance and personal meaning in their language learning) (73%). This suggests that educators do not need to worry about the idea of trying to integrate mobile technology into education. The statistical analysis showed that Hofstede's factors cannot explain the differences in attitudes towards

mobile-assisted language learning attitudes in the chosen sample. This finding is interesting because it shows that, overall there are very positive attitudes towards mobile learning; these differences do not come from cultural factors, as defined by Hofstede. This is an important finding as it means that traditional pedagogical cultures often found in Asian countries will be challenged by the more constructivist pedagogy on which typically e- and mobile learning is based.

Students' positive attitudes were found in both countries, which means that there are no substantial national differences when it comes to views on technology. The cultural differences do not influence the attitudes towards technology (-in-use). On the contrary, the results show that technology is a global culture in its own right. Students in these two so culturally different countries are equally positive. This implies that technology-in-use directs culture rather than the other way around. This is a small study and the sample (university students) may not represent the entire population in this respect, so it is of course not possible to make far-reaching generalisations from this study alone. Nonetheless, it is interesting to note the strong influence of technology; indeed, it is so strong that it overrides cultural differences.

Among the personal factors, gender was the only predictor to explain the differences in students' attitudes towards MALL. This means gender is a stronger predictor than Hofstede's cultural factors. Some caution should be added: this investigation does not show if this influence is permanent or temporary, as it has shown to be in other aspects of Internet use. For example, in the early days of the Internet several studies concluded that the Internet was mainly for men because the majority of early users were men. The Internet's development since then has proved this to be wrong. However, one factor supporting our findings is that girls generally perform better than boys in school and are more ambitious in their studies (Stoet & Geary, 2015). One might hypothesise that these generally higher academic ambitions also make women more interested in a technology that they feel is likely to make studying work more effective or efficient.

Overall, this study shows that technology itself seems to be the most important culture-shaping factor; more important than culture inherited from the physical environment, and more important than age. It implies that there are other factors that influence students' positive attitudes towards technology-in-use. Students either strongly believe in the

affordances provided by their technology-in-use or they might like their life styles.

The paper was published in *Computers & Education* (Viberg & Grönlund, 2013b). All these findings helped to raise my awareness of the problem and prompted me to go further in the DSR process, by, for example, deciding to start with the design of educational language learning software for students' mobile devices' use.

5.3 Paper 3 – Understanding Students' Language Learning Practices: Implications for Design and Integration of Mobile Technology into Distance Education

In order to gain a deeper understanding of how educational technology for mobile devices can be effectively designed and integrated into online distance education to improve second language students' learning practices and contexts in higher educational settings), I needed to make an additional research inquiry. This would seek to explain how students employ technologies for their language learning, with a specific focus on mobile technologies-in-use in informal learning settings.

This study focuses on design *for* learning, rather than design *of*, learning. In particular, it investigates design requirements for mobile applications for second language learning in online distance higher education settings. I examined how students use technology and how they perceive that these technologies-in-practice facilitate their language learning. Structuration theory (Giddens 1979, 1984), particularly the adaptation of it suggested by Halperin and Backhouse (2007), and Orlikowski's (2000) structurational model of technology were applied to analyse the three structurational modalities of facility (technology), norms (formal and informal), and interpretive schemes. These modalities facilitate the inter-linkage between agency and structure (Halperin & Backhouse 2007). The use of structuration theory, which takes an interpretative point of departure, helped me to delve further into the problem of understanding students' learning practices through qualitative research techniques and methods.

The research questions answered in this study are: *How do students use technology in their language learning?*, *Why do students use certain technologies and leave out others in their learning?*

The implication of the findings of this structurational analysis is that designers of online learning environments for beginner learners need to

re-think the nature of students' use of technology. They also need to reconsider their individual preferences and strategies with regard to language learning. The following aspects were found important.

- Students' self-initiated learning tasks, which are predominantly governed by their informal norms and the perceived effectiveness of technology, are an essential part of their learning practices which they apply to achieve the goals of the formal distance education;
- Students use their private mobile technology frequently, along with desktop/laptop computers when conducting self-initiated learning tasks;
- Students try to avoid reducing other activities and so try to use "spare moments" for their studies. Therefore their mobile technologies-in-practice are important, and course designers should design materials and tools for such use practices;
- Tasks included in such software development should provide constant goal setting and prompt feedback to learners, so as to reinforce their motivation;
- Students prefer to work on their own because of the limited time they want to devote to their studies.

Consequently, with regard to the pervasive nature of mobile technology integration in society and learners' habitual use of mobiles, students need to access various software tools on such devices to support individual training.

All in all, the structurational analysis showed that students' processes of reconstituting their previous learning practices in this study's settings are both *deliberate* and *inadvertent*. *Deliberate* reconstitution is often related to already established learning strategies, experiences from studying other languages and interaction with technology for learning purposes. *Inadvertent* reconstitution is related to formal education's planned teaching and learning processes, especially in situations where students interact with their own mobile technology to perform their self-initiated learning tasks or those prompted by the surrounding environment. Students constitute the course-learning model when they work according to it, and they re-constitute practices when they work in their own way with their own technology. Both types of reconstitution are strongly guided by students' technology-in-practice. Beginner

students' learning practices are often focused on *reinforcement*, as students attempt to apply structures that have worked for them previously in order to use their available time for learning most effectively. In this way, mobile technology-in-practice often becomes the only available modality for facilitating their learning process. *Transformation* occurs for example when students find new software that can help them in ways they did not think of before, or did think of before but were not able to do, because they did not have the technology.

Through the use of structuration theory this study has shown that students' established ways of using technology strongly guide the way they approach their language studies. The technology is always at hand because it is ingrained in their daily lives; they use it regularly and frequently, and their use includes finding new applications that may prove useful for their learning. Structuration theory has contributed by providing tools to distinguish the underlying structures and norms that guide people's use of technology, which is important to understand how to design learning materials and applications.

Even though the findings helped me to narrow down the design guidelines for the studied higher distance educational context in this study, the effectiveness of an artefact can only be evaluated through the analysis of its use. The design implications and requirements cannot be too specific from the beginning, because of the reciprocal relationship between learning processes and technology; the processes evolve over time under the influence of the technology used.

The paper was published in the *Learning, Media & Technology* journal (Viberg & Grönlund, 2015).

5.4 Paper 4 – Antecedents to Design of Software for Learning: Self-Regulation and Structuration

In this study, students' use of a prototype of a mobile language learning application was examined in relation to students' characteristics. The prototype was integrated into a formal language course for beginners organised by a university. Human factors are seen as one of the fundamental elements (along with design and institutional factors) that influence the effectiveness of using mobile technology in learning (Vogel et al., 2009); hence, this study pays special attention to learners' individual characteristics in terms of their perceived level of self-regulation and structuration in relation to their use of technology.

The main research question of this study is: *What are the challenges of mobile application integration into online distance education with respect to learners' characteristics?* Both quantitative and also qualitative methods of analysis were applied. In the qualitative interview analysis, structuration theory was used to validate the study's quantitative findings, and to increase our understanding of these findings by providing us with explanations and clarifications in relation to the prototype's use.

The results show that, overall, the studied sample was rather weakly self-regulated (with 70% rating themselves below the middle of the 5 point Likert scale), bearing in mind the strong need for such self-regulation in independent distance learning. Less self-regulated students implies a need for institutional support in regulating their learning activities so as to be able to achieve their learning goals. Online distance education settings predominantly take place in informal learning environments; thus, such support must to a large extent be technology-mediated and fit in with students' own mobile technologies-in-practice. In the study, those students who perceive themselves to be self-regulated also consider themselves to have high self-regulated learning (SRL) skills related to time management and help seeking.

Qualitative and quantitative analyses consistently show that students' SRL characteristics are strongly correlated with their structures, their 'way of thinking' with regard to their technologies-in-practice, and their practical assumptions about effectiveness in learning. For example, students' practical assumptions about effectiveness of their interactions with peers, teachers and resources (their structures) and time management (one of the categories used to investigate students' levels of self-regulation) were identified to be strongly correlated with each other. This particularly concerns mobile technology, as this is what they routinely use in their daily life. Thus, it is important, however challenging for educational (software) designers to consider learners' SRL characteristics and technologies-in-practice in their developmental process.

There were no correlations found with regard to the students' age. However, gender was strongly correlated with such learners' characteristics as self-evaluation, task strategies and goal setting, with females being more self-regulated. Nevertheless, earlier research is ambiguous regarding gender differences in self-regulation (Yukselturk &

Top, 2013; Zhao et al., 2014); thus, these results require further research.

How do learners use the software?

Log data analysis shows that students used various computer devices to access the application. In all, 53% used their desktop computers or laptops (laptops were not considered as mobile devices), 24% used their mobile devices, and 23% used both their desktop/laptop computers and mobile devices. As students use all kinds of hardware and want course technology to be usable from all platforms, educational designers and software developers need to build such educational software not only for use on mobile devices, but also for traditional personal computers.

In terms of students' time management, user sessions that were longer than 15 min involved the use of desktop/laptop computers. They also occurred predominantly during the evening time. Shorter user sessions (<15 min) mainly involved the use of mobile units in the mornings and during lunch. However, there were also examples of 'heavy' mobile users, students who spent more than five hours working with the app primarily using their mobile devices. Although there is a pattern showing mainly short use sessions, some users exhibit totally different patterns. To a large extent, it is likely that the patterns reflect students' different work situations, which may obviously differ considerably.

All these findings imply that students prefer to have learning materials readily available so they can decide to study for a short period of time when the opportunity occurs, such as during lunch or in the morning before going to work.

Firstly, the findings helped me to revisit my awareness of the problem, the first phase of the Design Science Research cycle by suggesting new aspects of the human factor that should be taken into consideration in the design process. Secondly, they introduced new design elements and challenges with regard to the design of educational language learning software and its integration into online distance education, thus suggesting a new DSR effort and cycle.

This paper was submitted to the *Educational Technology and Society Journal* and is currently under review.

5.5 Limitations

This thesis is a multi-disciplinary study of the interdisciplinary phenomenon of mobile learning that, in my case, encompasses people/learners, process/learning, technology/mobile and contexts/formal, and informal language learning settings. All these components are reflected in the papers included in this thesis in one way or another. This suggests that the study has several limitations.

The general limitations are associated with the complexity of mobile learning, both from theoretical and practical perspectives: “mobile learning is essentially personal, contextual, and situated; this means it is ‘noisy’, which is problematic both for definition and for evaluation” (Traxler, 2009, p. 10). This is also a rather new research area. By employing one particular definition of mobile learning in this thesis and focusing on one specific context of distance online second and foreign language education, some other important aspects (in other educational contexts) may be ignored. Therefore, the generalisability of the study’s results should be considered, with particular emphasis on the research aims and context studied.

In addition, the ambiguity of what is currently labelled as mobile learning theory makes it difficult to apply it in practice; thus, several other more established theoretical approaches and frameworks (i.e., sociocultural theory, social constructivism, and self-regulated learning theory) related to learning theories are applied in this thesis.

Another limitation can be related to the relatively small number of participants involved in the design-oriented part of the research. It would be interesting to integrate the same or similar artefact in another, analogous context of distance second language education in order that a broader international audience can validate the results. This would add to the generalisability of my conclusions.

Furthermore, in order to offer more extended answers to the research question and potential solutions to the problem, it would be beneficial to examine the participants’ interactions with the developed tool in their ‘natural’ informal environments (i.e., at home, and work), by means of observations (recommended in structurational analysis by Halperin and Backhouse (2007)). However, observations were seen as a challenging and problematic method in this study, because participants are dispersed in terms of time and space.

Moreover, the construction of the developed artefact was based on existing knowledge, which can be assumed to be rather limited in many aspects, e.g., pedagogical, technical as well as individual.

To better understand the effectiveness of the artefact/prototype-in-use, it would be valuable to carry out a longitudinal study that involves several DSR cycles, something that is lacking in my case. Indeed, the research project's limited time frames would make this difficult. The generalisability of the study's findings should be seen in its specific and similar contexts, rather than in a perfect universal generalisability sense. However, according to the DSR perspective and method, the knowledge being gathered from my thesis is not the end of the research process; rather, it is a direction for further examination and investigation of the studied phenomenon. With respect to this, the above-mentioned limitations should be considered as potential problems to be overcome in future research.

6. Discussion and Conclusions

The research question of this thesis is: *How can language learning practices occurring in informal learning environments be effectively integrated with formal education through the use of mobile technology?* In this chapter, I will discuss the answers offered in the four studies that make up this thesis, and the implications they suggest.

This will be discussed from the point of view that technology itself plays a role in reshaping individuals' preferences, perceptions, and attitudes, and that new teaching and learning methods that evolve are co-constructed in a sociotechnical system rather than engineered.

6.1 IS perspective on learning with technology

Information systems are about people, technology and organisations; in other words, how people harness technology and organise their efforts so as to achieve what they strive for. The foundation of this discussion is the concept of the Information Systems (IS) artefact (introduced in sections 1.7 and 2.1), which is conceived as a system that consists of a technology artefact, a social artefact and an information artefact (Lee et al., 2015). To understand mobile assisted language learning (MALL) it is important to understand how technology, information and social context interact both productively and destructively. Designing technology and formal education means making use of this knowledge. Designing technology for use in MALL contexts means understanding the three artefacts and making technology fit in productively. Designing formal education in a MALL context means arranging courses so they make best use of technology. Both technology design and education design are undertaken for a purpose: to enable students to learn. This may include making changes to the social artefact. In order to learn, students may have to rearrange their social situation and the way they do things, i.e., rearrange the social artefact. Consequently, on the one hand students have to adapt their personal learning styles, their preferences and the involved learning contexts involved to match the changing nature of the social artefact, the nature of diverse relationships related to, for instance, formal education. In this, the flexible and effective everyday use of private mobile technology in educational settings may support their learning. On the other hand, educators have to support such adaptation and use by

providing students with an effective combination of both technology and education design, thus offering better conditions *for* learning. This provision is especially important in the online distance education settings today, where students spend most of their learning time in non-educational settings, and where the functioning technology is one of the key tools that connects students' learning practices with the goals of formal education.

There is no hen and egg in this process; the various artefacts affect each other. Yet of course, at some point in time one artefact may play a more guiding role than the others.

Following the conceptualisation of the IS artefact offered by Lee et al. (2015), my study shows that when attempting to integrate students' mobile technology mediated learning practices into formal education, course and software designers have to consider not just the technology but the entire *information systems (IS) artefact*. Thus, designing a conducive MALL environment involves designing three interrelated and interacting artefacts, one technical, one informational, and one social. The present research is an example of how the MALL phenomenon can be understood as an IS artefact based on an investigation of the relationships between the three.

In this case, the technology artefact includes, among other things, the prototype of a web-based mobile language learning application (see chapter 4). The social artefact comprises students' language learning practices related to their technology-in-use, both in formal and informal learning settings (analysed in papers 3 and 4), and the language learning scenarios built into the prototype. The information artefact contains various documents, data and procedures designed to express and communicate the goals and content of formal education. The design challenge is concerned with matching the three in the most effective ways. For example, one specific design challenge was to design the scenarios in the prototype so as to match the educational technology used (mainly, but not always, mobile devices), students' technology-in-use (e.g., studying on the bus with the mobile and at home with the laptop) and the formal educational goals of the course as defined by the university generally and the teachers specifically.

In my research, technologies-in-practice/use are understood as the interrelations between all the three artefacts. While the software prototype and the students' personal mobile and non-mobile technological devices are considered to be the technological artefacts, the

design process through which the prototype was developed, its further integration into the language course, and the students' actual use of it relate to the social and information artefacts. The social artefact in the overall design process of formal education in MALL contexts pertains to the various relationships between, for instance, the course instructors, the students involved, the established educational culture of the university, and the informal learning contexts (e.g., home and work related environments), in which these students are involved. In the process of integrating the application into the formal language course, the information artefact for the students has been represented by the various documents. One part of these documents concerns the information about the course in general (e.g., the formal syllables, the grading criteria, the course materials 'posted' through the employed learning managements system, Fronter, and the students' instructions about Adobe Connect, which was used for the online synchronous group meetings). Another part of such documents relates to the students' instructions about the use of the developed application. The effectiveness of the information artefact directly affects how students used the prototype of the SOLL application. The students were not in a direct contact with the software developer, nor were they in contact with the project coordinator; thus, the clarity of such information and easy continuous access to it were important elements in the integration process. The clarity of the user instructions was provided through the fruitful relationships between the software developer and the project coordinator, who was responsible for the accuracy of the information given to the students about the prototype's use.

By combining the information artefact and the social artefact, the mobile language learning application (the technology artefact) is able to function more or less effectively in the teaching/learning settings of online distance higher education. The information artefact is directly interrelated with the technology artefact, the SOLL app. Changes in one affects the other. Changing information about the formal educational goals, course syllabus, and course content entail changes in the technology artefact as a product. Changing information in the technical requirements for the application, and changing content of the scenarios similarly evoke alterations in the artefact. Consequently, it will affect the character of the social artefacts, e.g., students' technology-assisted language learning practices. Thus, it is likely that the initial design intentions will be questioned, along with the effectiveness of the

integration of students' informal language learning practices into formal education through mobile technology.

The information artefact interacts closely with the students' use of the application, i.e., their technology/application-mediated language learning practices. Such interaction brings together several components that are important for the effective integration of the mobile technology-in-use into formal education. In general, the effective integration of the technology artefact, the information artefact and the social artefact is a goal of technology development, because with such an alignment, between technology-in-use will be easier for the students. The fourth paper (Viberg, *under review*), for example, shows how students used the prototype on a bus, or on a train, where they could previously only use this commuting time for interaction with course books, which many said they did not do anyway. Such usage means that times and places that were once not useful for studies have become more easily accessible through the use of mobile technology; indeed, even short passages of time could be used effectively.

Technology-in-use also has an individual component. Distance education is generally considered highly learner-centred, where learner autonomy and self-regulated learning (SRL) are seen as the most influential success factors (Zhao et al., 2014). This research has investigated the interrelation between language learners' self-regulated characteristics and their use of mobile technology in language learning practices. It has shown that, in the learning contexts of online distance education, individual's characteristics such as self-regulation and structuration are of importance for the effective integration of their personal learning practices into formal educational settings. The results of the analysis of these personal characteristics in relation to the students' (mobile) technologies-in-use are presented in papers 3 and 4. For example, Paper 4 shows that the majority of students perceive themselves as being relatively poorly self-regulated. This suggests that these students need further guidance in their learning process. In distance education, this means that, to a large extent, the technology, information, and social artefacts involved must all be adapted.

The findings in this thesis demonstrate that existing learning and teaching practices (the social artefacts) are challenged by the emerging integration of mobile technology in individuals' lives, because changes in any of the factors involved (i.e., technology, educational practices and learning theories) influence the others. Students are very positive towards

the integration of mobile technology into their formal language learning practices (Paper 2), which is not surprising as they have already developed technologies-in-practice involving these technologies in their informal (learning) settings. This raises the question of just how such mobile technology should be effectively integrated into educational practices. The students' attitudes here can be understood as an important aspect of the *social artefact*, because these attitudes are created in the reciprocal relationships that exist between the students' individual choices of technologies, their experiences of and preferences for using personal mobile technology for learning, and consequently the information that becomes available through such technology-in-practice. Thus this information becomes a part of the technological artefact that is involved in the design process of the entire IS artefact. In this research, for example, such information is integrated into the language learning materials that are made accessible to students through the use of the offered prototype.

The design implications offered in the third paper are grounded in our understanding of students' (mobile) technologies-in-practice, which encompass the functioning technology (technology artefact) in combination with effective teaching/learning practices (social artefact) relating to such technology use. Teachers and course designers will have to become more oriented towards the facilitation of individuals' learning. As part of this facilitation, teachers or instructors who design formal learning practices should take into consideration informal learning settings that become available through the use of mobile technology. The employment of students' own technological devices, which they use on a daily basis out of preference, is seen to be an important factor that might influence the effectiveness of the overall adoption of mobile technology in educational settings. The design implications that should be considered by researchers and practitioners largely relate to the online distance education settings. However, attention has to be paid to the particularities of the specific contexts and the constituting artefacts.

Another important conclusion of this thesis concerns a significant *social artefact*, namely educational culture. My research has suggested that education design based on the features of mobile technologies is likely to be positively received in countries of different cultures. This shows that existing local cultures are not insurmountable. Technology itself seems to be the most important culture-shaping factor (Paper 2), thus supporting the belief that learning is a process of sociotechnical

construction. Technology (-in-use) can be considered as a cultural phenomenon in its own right: it influences not only students' informal learning practices, but also the learning practices associated with the goals of formal distance language education. This suggests that traditional pedagogical cultures will be challenged by the more constructive pedagogy on which e-learning and mobile learning are grounded.

Moreover, this thesis concludes that when designing a technology artefact (i.e., various software for foreign and second language learning), designers and software developers need to consider cross-platform educational software that will allow as many students as possible to be reached. Students should also be offered an opportunity to employ their own mobile and non mobile computer technologies. This especially concerns online distance education, where individuals' skills and strategies of working with technologies and their personal experiences of using them, are seen in many cases to be decisive factors for their potential learning success. However, from the technical perspective, such design might be challenging in regard to the rapid technology development.

Online distance educational environments predominantly involve students' informal learning environments, in which they employ mobile devices for various purposes. Thus, institutional support must to a large extent be technology-mediated and fit with students' own pre-established mobile technologies-in-practice.

To sum up this discussion, I argue that it is not a technology artefact *per se*, but rather the combination of the technology artefact with both social and information artefacts in the online distance educational settings that has the most potential to create a solid ground for the integration of students' language learning practices in informal learning contexts into formal education.

With regard to the development of the MALL research field and the understanding of MALL education design, one contribution of this thesis is the application of Information Systems research concepts, such as the above-discussed notions of the *IS artefact* and *technology-in-practice*, and approaches, especially the DSR approach. Through the application of the IS artefact perspective, the examined design constructs (e.g., students' perceptions and attitudes, their learning practices, their personal characteristics (self-regulation and structuration), and technology-in-use) could be approached in ways that together contribute

to a more in-depth understanding of how students' learning practices taking place in informal contexts could be integrated into formal education with mobile technology use.

6.2 Design science research and MALL research

This study is an example of how Design Science Research (DSR), an inclusive framework that employs different, mutually constituting methods and techniques to address a research problem, can be used in the field of MALL. Within the Information Systems research area, where the original focus is the design of an information system, DSR is often seen to mainly address problems within business. However, in the present research, the DSR guidelines and principles were used to address practical educational problems within the settings of online distance higher education. The majority of existing research within the DSR paradigm has so far been limited to the information technology (IT) artefact (Lee et al., 2015). However, the meaning of an IT artefact has been defined differently, not just limiting it to the discussion of technology *per se*. For instance, Hevner et al. (2004) considered IT artefacts as “*models* (abstractions and representations), *methods* (algorithms and practices), and *instantiations* (implemented and prototype systems)” (p. 77). Though this definition of the IT artefact encompasses several aspects, Hevner, as many others, did not discuss it in terms of the overall *IS artefact*. Earlier, Mumford (2006) presented the history of socio-technical design, in which she emphasised the set of values such design embraces, the people adopting its theory and the organisations that are involved in this design. In her discussion, the focus is on technology and human factors (Mumford, 2006); however, the information artefact suggested by Lee et al. (2015) is missing. Silver and Marcus (2013) introduced the concept of a sociotechnical artefact, in contrast to just an IT artefact. They suggested that design science “needs a more sociotechnical focus and to be fully integrated with consequences research” (p. 86). However, they also omitted to discuss the role of the information artefact in the design of information systems.

In the DSR process, the artefact needs to be acknowledged and analysed as an entire IS artefact. This is especially the case in educational research settings, where the focus on the design of the pure technology artefact is re-directed towards the more holistic design of the technology artefact, the information one and the social one.

On the whole, DSR is concerned with the issues that contribute to an increased understanding of the question ‘how’ in a broader sense. DSR is a relatively more complex process than the design itself, because it develops and further applies knowledge about the context of an artefact that is embedded internally and externally and the different social relationships (the social artefact) involved in this context. In particular, it concerns the study of the technology artefact, social artefact and information artefact, which support each other in the overall design of an IS artefact.

In my study, the application of the DSR approach in the processes of understanding students’ (mobile) technology mediated language learning practices and the design of an artefact contributed with its methodological and theoretical openness. In particular, I used various theoretical perspectives, such as structuration theory, Hofstede’s model of culture, and a pedagogical framework in which to study mobile learning from a sociocultural perspective (Kearney et al., 2012). Thus, certain important aspects (e.g., attitudes, learners’ characteristics, and facilities/technologies-in-use) of the MALL integration into formal education could be approached in ways that contributed to my investigation of the overall research question: *How can language learning practices that occur in informal learning environments be effectively integrated with formal education through the use of mobile technology?*, and to my deeper understanding of the particular elements (artefacts) that constitute the MALL phenomenon.

DSR is an applicable approach, because it focuses on the development of technological support. Thus, the analysis of a situation in which a certain technology is applied will be more perceptive, because technology has to be designed *for* support, not just for the interpretation of a particular situation.

Nevertheless, DSR foundations do not offer a solid ground for practical matters, namely, for how a situation should be investigated.

Based on the procedures and results of my research, design science researchers who plan to delve further into the investigations of how mobile technologies-in-use can be integrated into distance (language) education are recommended to consider the following aspects:

- Thorough studies of the problem domain that related to a specific educational context studied are required.

- It is important to understand factors that may be influential in the adoption of a particular technology, in order to be able to improve and utilise students' learning experiences.
- In the process of understanding, such elements as technology artefacts, social artefacts and information artefacts should be reflected. The role and place of these artefacts may vary in a particular case, depending on the unit of analysis and the contexts involved.
- In the settings of online distance education, a special focus should be paid to the examination of the informal learning contexts, and their place in students' (language) learning practices.
- A 'bottom-up' approach, encompassing participatory design, is important.
- Institutional support is necessary so that educational technologies can be integrated most efficiently into existing educational practices and embedded within existing institutionally provided technologies (e.g., used learning managements systems, and synchronous conference software).
- If an artefact-in-use does not meet all the initial objectives, the data collected during the DSR cycle should be used to guide future research in modifying the artefact to meet specific practical needs.

With regard to the actual development of an IS artefact, which in my case was a design of a prototype of a mobile learning application for beginner second and foreign language students, the following issues need to be addressed:

- When introducing a similar artefact into educational settings, information about the technical requirement that would enhance its use should be explicitly provided to students.
- During the integration process, dissemination of information relating to ongoing changes in the technology/software's functionality and the content of the material included should be provided on a regular basis.
- The efficiency and effectiveness of the app-in-use should be evaluated on multiple occasions to further improve the process.

- Cross-platform development may be seen as efficient, though challenging in terms of the rapid technological development of mobile devices.

This research does not deny the importance of the information technology artefact (e.g., the prototype of the mobile language learning application); however, it problematises and highlights the importance of the other two social and information artefacts, which seem to pose more of a challenge to the design process. Thus, they must be addressed when trying to integrate mobile technology-in-use into formal education.

6.3 Contributions to practice

From a pedagogical viewpoint, the contributions made by this thesis are valuable in several ways.

With regard to the improvement of online distance language learning education, this research offers an increased understanding of how online tools for integration formal and informal learning environments can be designed. In particular, it offers design implications for educators and instructors (Paper 3) in the specific context of online distance language education.

Students' language learning practices are investigated through the study of their actual use of the designed software and their structures in relation to the use of these and other technologies for learning. Thus, this research offers an increased understanding of how students act when interacting with online tools (e.g., the designed application), and how these behaviours in terms of their self-regulation and structuration can be made more effective to improve their learning practices (Paper 4).

By examining the students' level of self-regulation and structuration (Paper 4) in relation to their technologies-in-use, this thesis offers important insight into the design of the social artefact, and the relationship between teachers and students with regard to the educational and non-educational technologies-in-use. Self-regulation is associated with the students' potential success in an online learning environment (Viberg, 2015 *under review*). Thus, the findings of this thesis are important in the design of effective learning settings, where adequately developed and integrated educational software may facilitate

such self-regulated learning practices and directly influence the individual's learning process.

The findings of the second study (Viberg & Grönlund, 2013b) contribute to practice by prompting discussion of the role of the cultural factor, here focusing on the educational culture, where technology-in-use influences not only students' informal practices but also their practices related to the formal educational goals. The results of this study imply that that education design that is grounded on the characteristics of mobile technologies-in-use is likely to be positively accepted in various countries. Thus, the process and the results of mobile devices-in-use integration in one educational environment may be applicable, to some extent, in other similar educational contexts.

This thesis offers valuable insights into possible solutions for the development of cross-platform educational software by presenting a prototype of a cross-platform web-based (mobile) language learning application. Learning content provided through such kind of software-in-use can be seen as a link between educational and non-educational learning environments. It suggests that students have an opportunity to use their available time and technology for learning practices more flexibly, compared with long-established educational practices. Students can access learning materials whenever they want and in different forms (both as a desktop application and a mobile application); thus, they can be easily adapted to suit their individual preferences and learning styles. This is especially relevant to online distance education, where individuals' skills and strategies for working with technologies and their personal experience of using them are seen to be decisive factors for learning success. Thus, this research illustrates the design challenges from the technical perspective.

6.4 Contributions to MALL research

The present thesis makes a theoretical contribution to mobile assisted language learning (MALL) research. In particular, it brings Orlikowski's definitions of *technology-in-practice/use* and *the ensemble view* of technology into the MALL research and practice fields in order to deepen a theoretical understanding of the phenomenon. Similarly, it introduces the concept of the *information systems (IS) artefact* (Lee et al., 2015). By approaching the MALL phenomenon through the lens of the IS artefact concept, MALL scholars, practitioners and the MALL research community can benefit by addressing a technology artefact, a social

artefact and an information artefact as an entire system, when designing and studying mobile technology mediated learning practices in their relation to formal and informal learning contexts.

The application of structuration theory, particularly Halperin and Backhouse's framework for the investigation of structuration modalities (2007), has contributed by providing tools to distinguish the underlying structures and norms that guide students' technology use. This is important if we are to understand how to design learning materials and applications.

The findings of the systematic literature review on the empirical mobile assisted language learning research (Paper 1, Viberg & Grönlund, 2013a) are important for practitioners and researchers in the target community. These findings offer further research directions by focusing on theoretical development in the field, the technologies involved and studied, and the aspects of language learning (e.g., listening, vocabulary learning, grammar, and writing) under examination.

The second study (Viberg & Grönlund, 2013b) contributes to the research literature by investigating cultural factors, which are traditionally considered to be influential in education design, in relation to the use of mobile technologies in higher education. This research has shown that the technology is more important in terms of shaping students' attitudes and behaviour than issues related to national, traditional, or local culture. This is an important contribution, because it shows that existing local cultures are not insurmountable and that education design based on the features of mobile technologies is likely to be positively received in countries with different cultures.

6.5 Future research

Bearing in mind the limitations mentioned in section 5.5 and the overall results and contributions of this thesis, future research should focus on:

- the development of new theories that are specific to the mobile learning research field, to distinguish it from other kinds of technology-assisted learning, such as CALL;
- studies of how mobile technologies-in-use can enhance individual language learning results with regard to the goals of distance education;

- an evaluation of MALL practices, which should not only be based on the analysis of learners' perceptions, but also involve other available measures;
- the further study of learners' characteristics in terms of their self-regulation;
- investigations of how mobile technology-in-use can assist and improve various aspects of language learning (e.g., reading comprehension, grammar acquisition, and the learners' writing process);
- the involvement of larger test groups and longer empirical studies, which would pave the way for future research;
- an examination of personal factors, such as gender, in relation to MALL practices (where existing research and my current research has shown a certain ambiguity);
- the further investigation of factors that may influence the adoption of mobile technology in distance higher education in various cultural contexts;
- the development of evaluation concepts and frameworks that are specific to the field, which would encompass the distinctive features of mobile learning.

6.6 Concluding remarks

In summary, this thesis provided knowledge from analytical studies by reflecting on four dimensions (people, processes, technologies and contexts) and constructive design efforts, which involved both the construction of the novel artefact and the study of its use in online distance language higher education. It should be seen as a first step towards the effective development and integration of educational technology for mobile devices' use within online distance language educational settings.

This thesis contributes to knowledge about technology use in learning by building on previous research in Information Systems. The term 'technology-in-practice' is used to focus on the role of technology from the point of view that reality is socially constructed. In this, technology-in-practice is considered to be key to understanding students' learning practices and thus is an important factor in the design of both (formal)

courses and the technological support of them. The rapid development of mobile technology is not as problematic as other, social and information artefacts, which remain a challenge. By focusing on mobile assisted learning practices in higher education and research within a higher education setting, this thesis switches the focus from the design of an information technology artefact to the design of an entire IS artefact.

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