To Dad
Abstract

The research presented in this thesis investigates the concept of sustainability in relation to mobile learning initiatives. Sustainability is seen as a key concept for mobile learning to gain acceptance. In linking sustainability to scalability, a term used to describe how well something can grow to suit an increasing complexity, a representation of this process is provided. In this thesis, this process is called “the quest for equilibrium.”

A study was conducted of an actual mobile learning initiative that involved introducing podcasts as a supplement to traditional lectures in higher education. In following this initiative, thorough data gathering was conducted, utilizing the process of iterative cycles that characterizes the action research approach. In accordance, a literature survey was conducted, whereby leading publications in mobile learning were classified and analyzed according to the following criteria: Reflections, Frameworks, Scalability, and Sustainability.

As the mobile learning system evolved from idea to an actual empirical study, trying to understand this process became important. The insights gained during this research were used to develop a conceptual model that is based on the notion that the two concepts of Scalability and Sustainability can be linked to each other.

This conceptual model is presented describing how a mobile learning system evolves, from Idea, to Experiment, to Project, to Release. Further, each of the stages in this evolution is described by using four areas of concern: Technology, Learning, Social, and Organization.

Using the experience from a specific mobile learning initiative to define a conceptual model that then is used to describe the same initiative, was a way to bring together practice, theory, and research, thus provide reliable evidence for the model itself.

The conceptual model can serve as a thinking tool for mobile learning practitioners, to help address the complexity involved when undertaking new efforts and initiatives in this field.

Keywords: action research, mobile learning, scalability, sustainability
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Thank you,

for the support in making this thesis a reality,
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Anna Wingkvist
Växjö, 9th December, 2008
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Chapter 1

Introduction

The interest in mobile learning has increased tremendously during the last decade. Taylor et al. (2006) acknowledge the rapid growth in research endeavors, aiming to develop and deploy mobile technologies to support learning. Mobile learning has grown from a minor research interest to a set of significant activities in schools, workplaces, museums, cities, and rural areas around the world (Kukulska-Hulme et al., 2009, Sharples et al., 2008). The term mobile learning is used according to Naismith et al. (2004), who define it as mobile technology that supports learning that happens across locations, or in reverse wording, that takes advantage of learning opportunities offered by portable technologies.

The information technologies finally have reached a level of maturity and ability where it is possible to support these learning activities. It all started with the seminal work of Alan Kay and colleagues at Xerox PARC, who had a vision about "Dynabook." The idea was to develop a small portable computer in the shape of a book (Kay and Goldberg, 1977) but it is only recently that both technology and educational needs have merged. These emergent technologies include multimedia-equipped mobile phones, personal digital assistants (PDAs), and pen tablet computers. In line with this progress, the phrase lifelong learning is prevalent. The emphasis on supporting the learner, in collaboration with peers and teachers, both within and outside the classroom, is evident. Naismith et al. (2004) state that the challenge will be to discover how to use mobile technologies to transform learning into everyday life seamlessly.

Few of the mobile learning initiatives ever are developed into actual learning aids that are in wide use (Keegan, 2005). While this is acceptable during start-up, the field is compelled to look for initiatives to develop into tools that are in wide use in order to prove its educational and scientific value. Traxler and Kukulska-Hulme (2005) reflect critically upon the quality of mobile learning initiatives and conclude that, to date, few studies have been grounded in sound theory. In order to do this, a more reflective stance is needed. Kjeldskov and Graham (2003) states that, in reference to Mobile Human Computing as another example of a young research field, often is a tendency to be highly opportunistic and technology driven, and to focus primarily on producing solutions while the reflecting part is less distinctive.

In line with that, a maturing research field examines how the research is
being conducted and reflects on the impact of its being addressed more and hence made clearer for others. This kind of knowledge being produced is necessary in order to be able to understand and influence the future direction of the field. No difference can be seen for the field of mobile learning, as it seems that every research field that has technology as a core goes through a similar rite of passage.

The problem of initiatives seldom leading to wider deployment or even further acceptance can be seen as a lack of sustainability, as mentioned by Zuga et al. (2006). The problems these initiatives face can be traced, for example, to bad assumptions regarding the complete situation; it can be a hostile or at least an unwilling environment. These factors make the system unsustainable, since the initiative did not understand well enough the setting that it is part of. Mobile learning has developed from just a tool, aimed to make learning more fun, to something meant to be a more integrated part of the setting it is brought into (Almstrum et al., 1996), even adding the claim to improve and enhance learning. Key stakeholders to a mobile learning implementation, as proposed by Barker et al. (2005), are: the learners, the lecturing staff, the system designers and the technical staff who implement them, and also device vendors, along with the university administration that oversees the whole initiative. The number of stakeholders and what follows in terms of factors to consider clearly is huge and not easy to grasp. Hence, in order to increase sustainability, the need to increase understanding follows.

To explain further, when looking at a typical mobile learning initiative, many of these often start as technology oriented activities, as discussed by Ting (2005). This is understandable, since technology often is a limiting factor in what is perceived as possible. However, when you move from a focus on the technology and introduce users, you open up a completely new world with many more factors to consider. This process will continue as you extend your focus to the entire situation. Laitinen et al. (2000) refer to this process as scaling the situation.

The term scalability has its origin in computer science. Bondi (2000) states that scalability is a desirable feature for a network, a system, or a process. The concept reflects the ability of a system to accommodate an increasing number of factors. A system that is not scalable cannot cope with an increase in the factors that must be handled. At the same time, the concept of scalability and the understanding of the factors that improve or diminish it are vague and even subjective. While many system designers have an intuitive feeling for it, the determining factors are not always obvious. This is transparent in reference to Davenport (2008), who conclude that an information system cannot be analyzed independent of the social and organizational arrangements that form its situation. Also, Hirschheim (1985) regards information systems as social rather than technical systems. Following in this line of thought, mobile learning systems should not be treated as technical systems with social consequences but rather as social systems with a high degree of reliance on mobile technology.
1.1 Definitions

This section defines four terms that are central to this thesis.

• A mobile learning initiative is defined as an approach intended to support a learning situation using mobile technology.

• A mobile learning system is the purpose of a mobile learning initiative and something that is developed continuously, including both technology and people.

• Scalability is the ability to adapt to the increasing complexity of the environment.

• Sustainability is the ability to function in an intended environment and maintain a steady state.

The meaning of these terms in relation to mobile learning will be investigated during the research presented in this thesis. In Chapter 5, a further discussion is presented in relation to these definitions.

1.2 Research Question

The issue of achieving sustainability is an important factor for the field of mobile learning to gain wide acceptance as a scientific field of research. In order for the mobile learning community to be able to develop and deploy sustainable mobile learning initiatives, there needs to be deeper understanding of what it means to scale a system of the same. When scaling a system, a new situation will arise and set, and this needs to be understood. In furthering this thought of evolution, sustainability and scalability are related. In this thesis, this process is called “the quest for equilibrium.”

Thus, the main research question to be explored can be formulated as follows:

*How can the concepts of scalability and sustainability be represented to contribute as a thinking tool to practitioners in the field of mobile learning?*

In order to answer the main research question, a separation is made into two specific questions, and these are:

• *How does a particular mobile learning system evolve during a mobile learning initiative?*

• *Which factors can be identified in connection to the evolution of a mobile learning system?*
1.3 Organization of the Thesis

This thesis is organized into nine chapters. This introduction, thus Chapter 1, is followed in Chapter 2 by a discussion of the methodological approach and a description of how the research was conducted. Chapter 3 presents related work, followed by a presentation of an overview of the research efforts in Chapter 4 and an analysis of these efforts in Chapter 5. The conclusion of the thesis is presented in Chapter 6, providing the main results together with future work. The last three chapters contain three publications, Paper I, Paper II, and Paper III, appended to provide a detailed description of previous research, which is summarized and extended in this thesis.
Chapter 2

Methodological Approach

The concepts of methodology and method can be confusing and easily misinterpreted, and thus discussed by Checkland (1999). In brief, the methodology is a set of principles for the method. So, methodology provides general thoughts on how to solve a problem. Further it states common ideas, concepts, techniques and how to use them. From this view, a particular method then is developed. Concepts and techniques are based on how the problem is perceived by the researcher, who needs deep insight into the problem situation. In line with this, all methods have weaknesses and strengths. This variation in method depends on the approach and researcher (i.e., weltanschauung, training, and skills), as acknowledged by Hirschheim (1985).

There is a distinct division between research in what is called traditional science (i.e., natural phenomena) and on the other hand for social science (i.e., social phenomena) (Myers, 1997). Understanding the discipline is important when deciding the way in which research should be carried out. The research question and the data that are to be extracted should be the guide. Järvinen (2004), however, explicitly mentions that the researcher always has a personal motivation to perform a scientific study; this, of course, greatly influences the research. Here, for example, the stance of qualitative and quantitative methods comes into play. Each functions within different assumptions about the nature of the world and they require different instruments and procedures. Quantitative research usually lays more on a positivistic paradigm and qualitative on a more interpretive paradigm, as mentioned by Baskerville (1999).

Researchers working within the positivistic paradigm see reality as separate from themselves, and expect everybody to have the same perception of shared phenomena and thus common understanding. Researchers working within the interpretive paradigm see reality as a social construct and do not necessarily expect others to have the same perception or understanding of a shared phenomena (Robson, 2002). The interpretative paradigm supports the belief that reality is constructed by subjective perception and that predictions cannot be made. Interpretive researchers act on the assumption that social reality is being created and recreated constantly in a social situation (Checkland and Holwell, 1998).

Researchers who agree with this paradigm are interested in the study of social and cultural phenomena. In reference to Argyris et al. (1982), the
crucial elements in a research approach, which works within a special social situation, are:

- a collaborative process between a researcher and the people in the situation,
- a process of critical inquiry,
- a focus on social practice, and
- a deliberate process of reflective learning.

This is leading to the selection of an appropriate research approach, which should coincide with the research question (cf. Chapter 1), data to be gathered and the researcher’s abilities.

## 2.1 Action Research

Action research is one of a number of qualitative research approaches – others include, for example, case study and grounded theory – that are suited particularly to application in an actual and natural setting; that is, to study social and cultural phenomena (Myers, 1997). According to Darke et al. (1998), these approaches differ only slightly in the case study situation, in which the researcher is to be more of an observer than in action research. In grounded theory, the observation should be done without prior assumptions and the theory formulated only from these; in action research, a theory is intrinsic.

In action research, two words are central to this approach: involvement and improvement. Also, there are three major goals when using action research, according to Robson (2002): to improve a certain practice, to improve the situation in which the practice takes place, and to improve the understanding of the situation. This is in line with the ideas of Baskerville and Myers (2004), who argue that the goal of action research is to solve a problem in a real setting and also to make a knowledge contribution. Foremost, the research is a learning process. Action research often is depicted as a cyclic process and involves four linked phases (Kemmis and Wilkinson, 1998). These consist of planning, action, observation, and reflection. Figure 2.1 illustrates this cycle (Riding et al., 1995). The theoretical contribution emerges through iterations of action research cycles (Baskerville, 1999).

Some fundamental features of action research are stated by Järvinen (2005); for example, the researcher should contribute to the practical concerns of people in a situation, which means action taking and evaluating, both to be carried out between the researcher and the client. As the word action implies the researcher is engaged actively, which profits both the organization and the researcher, in combining practice and theory. A researcher needs to be able to balance this heavy involvement as well the strengths and weaknesses that follow with this approach. The argument to mention in particular is the involvement issue, which can be criticized as the
researcher is coupled so closely to the situation and may lose a critical stance (Checkland and Holwell, 1998). On the other hand, this unique position of in-house work allows the researcher to produce highly relevant results while informing theory simultaneously (Baskerville, 1999, Baskerville and Myers, 2004). Further, action research, as an approach, has been recognized in the information systems research community and entered into journals as well as conference proceedings, according to Avison and Myers (2002).

2.2 Research Approach

According to Holter and Schwartz-Barcott (1993), an action research approach is designed to bridge the gap of theory, research, and practice. One characteristic of action research, specified by Hult and Lennung (1980), is that the approach is applicable primarily to understand change processes in social systems. Clearly, this falls under an interpretive paradigm. Consequently, the action research approach was appropriate and used for the research conducted. The author of this thesis was new to the fieldwork connected to a mobile learning initiative, but entered the field with a theoretical, as well a research, background. None of the other approaches (i.e., case study, grounded theory) would have worked, since case study assumes that the researcher is a passive and an independent outsider, in contrast to the active stance the author of this thesis has had. Grounded theory could not be applied to the research since a theoretical perspective was present.

One major consequences of the choice of an action research approach is that the research is context-bound as opposed to context-free (Horsburgh, 2003). It is difficult to determine the cause of a particular effect, which could be due to environment (including its subjects), researcher, or methodology. Even though the results of action research are qualitative in nature and attached uniquely to the research, they do offer a degree of external validity,
according to Avison et al. (2008), since the theory developed can be interpreted and refined by others in other real-world situations. Furthermore, Avison et al. (1999) say that action research can address complex real-life problems and the immediate concerns of practitioners, although the findings as well as their presentation, need to be in accordance with the audience and often of a descriptive character, as recognized by Small (1995).

2.3 The Method Explained

The iterative cycle of planning, acting, observing, and reflecting (cf. Figure 2.1) supports an analysis of an application area and has been utilized for the research. The aim was to contribute to the practical concerns of people in a problem-riddled situation and to develop a set of tools that possibly could help increase the competence and self-help ability of practitioners in the field of mobile learning. In identifying findings and specifying the learning, a conceptual model was developed.

Part of the research conducted for this thesis took place in a mobile learning initiative at the Computer Science Department at Canterbury University, Christchurch, New Zealand, involving the use of podcasts with undergraduate students. The podcasts were produced to supplement the traditional lectures and offered the students a “heads-up” opportunity to continue their learning process outside of the specified curriculum. The author of this thesis was a visiting researcher and was presented the opportunity to participate and take an active stance.

In order to analyze the application area, the iterative cycle of the action research approach was utilized in three iterations. The first two iterations established the foundation for the continuing use of podcasts to supplement lectures. The first iteration studied the construction and results of surveys (cf. Paper I) and data logs, as well as observing the initial reactions from the student body; it was followed by discussions with the initiator of the initiative. After the first iteration, the initiative grew both in size (i.e., number of stakeholders, students, lecturers, and the university administration) and complexity (i.e., more factors to be made explicit). The lessons learned from the first iteration as well as the change in the initiative led to the formalization of themes and the need to understand the demographic characteristics better. The themes were: Technical/environmental issues, Podcast content, Pedagogical issues, and Overall impressions. The demographic characteristics were: Age, Discipline, Gender, and English language proficiency. This initiated the second iteration, where the issue of scalability became apparent (cf. Paper II).

After returning to the Center for Learning and Knowledge Technologies (CeLeKT), a research group at Växjö University, Växjö, Sweden, the author of this thesis studied other mobile learning initiatives and noticed that few results reach a wider audience, particularly in terms of deployment. The third iteration started with this discovery and introduced the concept
of sustainability, in an effort to systematize the perspectives of the field of mobile learning (cf. Paper III). This was followed by the construction of a literature survey based on four criteria (i.e., Reflections, Frameworks, Scalability, Sustainability) and, in parallel, connecting the concepts of scalability and sustainability as embryo for the conceptual model.

In following the approach of action research, reflecting on the process of the podcast initiative was part of the iterative cycle, and four distinct evolutionary stages could be identified. Within each of these stages, four areas of concern could be identified, as well. These were identified by analyzing and classifying the questions of the surveys, supporting the scientific contribution (cf. Appendix A) and validating the findings. The result of the third iteration cycle was the construction of a conceptual model. The experiences gained during this research and one particular initiative enabled the opportunity to contribute to the theoretical enhancement and define a conceptual model that attempts to illustrate the scaling process. The aim is for the conceptual model to be useful as a thinking aid for practitioners working in the mobile learning community.

2.4 Developing a Conceptual Model

In the process of seeking what can be of a practical orientation, the researcher is destined to provide new theoretical contributions based on the local knowledge gained from the action research conducted, stated by Elden and Lewin (1991). From the perspective of a systems approach, it must be understood that it is a way of thinking, as pointed out by Checkland (1988). In applying this thinking, the researcher tries to view the system holistically in a particular environment, always keeping in mind what the system as a whole is suppose to achieve. As the founding father of the system approach, Churchman (1971) considers the goal of a researcher to bridge philosophical reflection into the world of practice.

A conceptual model is created in an attempt to capture a certain degree of abstraction. It contains a unification or synthesis and also triggers the ability to understand the magnitude of issues involved. The conceptual model is there to correspond to the actual research. This is to understand better the different findings throughout the research and put them into context. The model may be suitable on a general level for mobile learning systems but the action research approach does not allow such generalization at this stage as the research is coupled so closely to the real-world situation it was derived from. This coincides with the point put forward by Susman and Evered (1978); hence, the conceptual model can work in accordance with all mobile learning systems but it is not a quality inherent to the research approach used.

In accordance with Robinson (2006), a conceptual model is the abstraction of a real or proposed system. Thus, in order to develop a conceptual model, some level of simplification of reality is needed. A conceptual model
can be seen as a set of concepts that stand in relation to each other to explain a phenomenon in the real world. In comparison to a framework, conceptual modeling is done from a more practical rather than a philosophical stance, as distinguished by Aidemark (2007). This entails a presentation of the conceptual model, often consisting of an explanation interlinking text, figures, and tables, which all are descriptive and informative in character, to match the intended audience (i.e., the client). The client for this conceptual model foremost is Tim Bell, professor in Computer Science, at Canterbury University, Christchurch, New Zealand, likewise initiator of the podcast initiative and academic host.

The conceptual model also can be useful to other mobile learning practitioners as a thinking tool, as it is bringing together practice, theory, and research in an attempt to trigger understanding of the complexity involved. This model hopefully can serve as an input, especially in the making of new efforts and initiatives in the field of mobile learning.
Chapter 3

Related Work

The related work to be presented in this chapter is the result of a literature survey in the field of mobile learning (first mentioned in Section 2.3). Based on lessons learned presented in Section 4.5 and the central concepts discussed in this thesis, four main criteria were selected. These four criteria, Reflections, Frameworks, Scalability, and Sustainability, guided the literature survey and provided the basis for the conceptual model presented in Chapter 5. The literature survey and the conceptual model were developed in parallel and influenced each other.

The relevant results found during the literature survey are classified and presented according to the criteria.

3.1 Reflections

After extensive review the available results (publications) from the mobile learning community show a lack of reflection. Many publications present experiments and projects and their results, but seldom reflect on the reasons for those results or whether they are positive or negative. Nonetheless, some attempts were made available and are provided in this section.

Sharples et al. (2008) made some interesting observations in regard to the “MyArtSpace” project. The aim of the project was to bridge the preparation phase as well as the follow-up work done in the classroom in connection with a museum visit. It encouraged students to produce their own interpretations of a museum visit through pictures, voice recordings, and notes they could share with each other and the teacher. The initiative was a success on both technical and educational levels, but still suffered problems regarding wider deployment. One issue was the maintenance of the technology, a task the museum staff was not able to undertake; another problem was who should be responsible for the costs of the mobile communication.

Smyth (2005) discusses his experiences with the “Skool” project, which consists of a portal developed and maintained by Intel Ireland. There are versions of the portal utilized for the United Kingdom and Sweden and their specific needs. The Ireland portal targets students (12–18 years of age), teachers, and parents, and complements the traditional curriculum by providing relevant resources. He finds that there was a need for an iterative approach during design and development of a mobile learning system. The
design and implementation should be followed by feedback and evaluation. This cycle should be repeated until the system stabilizes.

Frohberg (2006) notices that a large part of the mobile learning projects work in areas in which the context of the learner does not have to be considered. Context in this case is his suggestion on a sufficient meta criterion. He specifies five contexts (i.e., free, formalized, digital, physical, and informal) and concludes that most mobile learning initiatives occupy themselves in a free context. The mobile learning initiatives are to be considered to have low educational complexity, be technology driven and lead to fast results. Projects in the category of formalized context, he claims, reinvent the wheel, since much data already has been collected and the time for consolidating the available knowledge has come, leaving the research phase and building commercial products. He finds the other context types to be at least as interesting, and these should be further investigated.

Traxler and Kukulska-Hulme (2005) present a review of the current practice of evaluation of mobile learning projects. They find that many projects seem to rest on a “common sense” view of learning. This affects the evaluation since there may be a lack of theoretical justification. This, in turn, can risk the credibility of such evaluations. The authors hold evaluation as the key to sustainability of mobile learning, as it informs the outside world about the effectiveness of pilots and trials. Secondly, it informs the funders of the utility and cost-effectiveness of the projects they support. In some cases, evaluation will determine whether pilot projects become embedded as ongoing provisions in institutions and hence is of utmost importance.

Syvänen et al. (2004) discuss the problem of fragmentation during the learning process, i.e., when the amount of information and communication sources are increasing, thereby making the learning situation more distracting for the learner. For example, if the user interface of a mobile device is “counter intuitive,” it may affect the learning. They offer suggestions on how to prevent this fragmentation, e.g., the user needs to be familiarized with the devices used or have experiences with similar interfaces. Also, that when learners are constructing knowledge, the time required for this process is of essence.

Taylor (2004) points to the lack of guidance for evaluation in the mobile learning field, and cites the novelty of the field as a possible reason. The novelty itself is dangerous, since the “fun factor” may skew the evaluation data – something that must be avoided carefully. An example is when users find playing with a device interesting and fun and report this but when reflecting on their experience they do not see the impact and react in the opposite way, disengaging from the activity. Evaluation is more than to verifying the technical solution that she calls a bottom-up perspective; it also needs to include a top-down approach considering pedagogical validity and socio-pedagogical usability. She also argues the importance of always keeping in mind that the system developed needs to be embedded in the environment for which it is intended.
3.2 Frameworks

Keegan (2005) offers opinions and a discussion on why mobile learning has not entered the mainstream yet. His main focus is on the revenue stream; he believes that the reason mobile learning projects do not move from project to mainstream is that telecom companies still do not see the economic potential. He also addresses a possible solution in applying criteria to know when the credibility for mobile learning reaches wide deployment, e.g., enrollment for students into accredited courses that utilize these portable technologies.

Traxler (2004) does not focus on the revenue of telecom companies, but discusses means to evaluate the effectiveness in relation to the cost of mobile learning. He attempts to identify the important elements from a theoretical basis, which can lead to commercial acceptance and achieving mainstream viability for mobile learning.

Cobcroft (2006) gives a comprehensive overview of the field of mobile learning and comments on the future areas to be addressed by mobile learning research. She concludes that the acceptance of mobile learning will be measured by how well it blends with everyday life, with total success being achieved when it no longer is noticed as mobile learning. Further, she states that educators and learners are required to adopt new tools and techniques of communication, pedagogy and practice.

The reflections provided in publications are important assets when trying to understand and learn from other mobile learning initiatives. These attempts to share experiences within the mobile learning community are valuable, but these kinds of reflections still are sparse. More such endeavors are needed to give a feedback loop value to others specifically as consideration when new efforts and initiatives should take form within the field of mobile learning.

3.2 Frameworks

Several frameworks, models, roadmaps, and development strategies have been published for the field of mobile learning. After a careful review, it was clear that many of them focus on one or a few aspects of mobile learning, even though claiming “full” disclosure for a mobile learning system. However, in this section, only frameworks that attempt to capture the entire mobile learning system will be presented.

For example, Attewell (2005) identifies five broad categories of technology that should be considered, i.e., transport, platform, delivery and media technologies, and development languages. Sharples (2000) considers conversation theory from Pask (1976) as an important element of a mobile learning system.

Vavoula et al. (2004) offer a set of guidelines, i.e., a theory-informed and pedagogically sound set of do’s and don’ts, to direct different audiences, e.g., institutions, system designers, teachers, of mobile learning. These also can be used as important considerations when developing a system. So far, there are ten guidelines originating in their work of reviewing the actual practice
from mobile learning projects identified in the literature. The themes include costs, usability, choice of technology, roles, equipment management, support for teachers, administration, collaboration, services, and security vs. privacy. A justification for each guideline is provided in an elaborate discussion, followed by a clear reference to the literature source.

Barker et al. (2005) proposed a theoretical model, specifically in regard to mobile learning adaptation for developing countries, for how mobile devices can be used to support academic learners with online assessments. This model incorporates all the areas of concern that the conceptual model in this thesis explores. They consider the essential elements of a mobile learning environment, i.e., communication, infrastructure, mobile devices, learners, and teachers, as well as point out the issue of necessary policies and standards to be in place.

Brasher and Taylor (2005) use an adaptation of technology roadmapping from Phaal et al. (2004), to plan for the use of ambient technology. The use of ambient technology, which is a means to collect data without the users being aware of it. The technology roadmapping approach can be used to find, evaluate, and pick strategies to achieve a desired technological goal (Kostoff and Schaller, 2001). Kostoff and Schaller (2001) aggregate two fundamental roadmapping approaches: expert and computer based. Thus, the option is using experts to identify and develop attributes for the nodes and links or let the computer do it. A combination of the two also is a possibility.

Taylor (2004) presents an abstract evaluation framework for the “MOBIlearn” project. The overall aim of the “MOBIlearn” project was to evaluate the pedagogical effectiveness of mobile learning and thus ensure that it is sound. While the framework is intended for evaluation, the evaluation process is similar to the view in this thesis on the evolution of a mobile learning system and the order in which different areas are in focus. She is starting from a technical standpoint, entering into usability aspects, and continuing with pedagogic issues and socio-pedagogical perspectives while also acknowledging the counter-flow of data influencing each other.

Laouris and Eteokleous (2005) make an attempt to create a framework to define mobile learning, which is systematically complete. They propose the following abstract formulation for the definition:

\[
MLearn = \{t, s, LE, c, IT, MM, m\}
\]

Where, \( t \) = time, \( s \) = space, \( LE \) = learning environment, \( c \) = content, \( IT \) = technology, \( MM \) = mental, and \( m \) = method. This framework, which is spanning over technical, methodological, educational, social, and philosophical dimensions, is expressed using a “mathematical notation.” The concepts then are described as relations and dependencies, using functions. For example, the information technology (IT) resources available are described as functionally dependent on the learning space, \( IT = f\{s\} \). The attempt is done to address the complexity of mobile learning and is a way to visualize in greater detail the interrelation between certain elements.
3.3 Scalability

As a remark and comparing the research findings in this thesis to the frameworks, models, roadmaps, and development strategies presented in this section, the framework by Laouris and Eteokleous is the one that is most similar, at least in terms of intentions. The conceptual model created (cf. Chapter 5) considers the evolution of a mobile learning system as well as what happens within each stage of that evolution. Further, it addresses a repertoire of domains, considering all the essential factors. Some efforts presented in this section attempt to do either of these, not both. Other efforts include parts of both, but do not present a complete picture.

3.3 Scalability

Scalability is the ability of a system to change to accommodate an increasing number of factors, for example a higher demand in terms of more users (Bondi, 2000). The term scalability has its origin from computer science, and is considered a quality of, for example, a network or a system. If a system is not scalable, it cannot handle an increase of factors. The understanding of scalability often is vague or subjective, but a number of research efforts to define this notion have been carried out. Laitinen et al. (2000), in addition to Weinstock and Goodenough (2006), give a good overview of the underlying concepts and problems of scalability in relation to system development.

Stone (2004) investigates the notion of scalability in relation to mobile learning, with reference to content delivery, i.e., how can a teaching material be adapted automatically to fit a number of possible platforms, both e-learning wise and mobile? For example, can a video stream be reduced to pictures, and will the learning remain when this scaling happens? In fact, he wants digital content to be able to be reused across different technologies and network solutions, still ensuring the pedagogic “value” of the material. He also wants to highlight the issue of scaling up relatively small pilot projects, using the results gained as input to new projects in order to reach wider deployment.

3.4 Sustainability

The term sustainability is defined by Eckersley (1998) as the ability to continue an activity or maintain a certain condition indefinitely. Black (2004), in connotation to communities and societies, says that sustainability increasingly is seen as involving three interrelated dimensions: the economic, the social, and the ecological. These dimensions all need to be considered when thinking about sustainability in this context. When applied to systems in a general sense it relies on Beer (1984), who states that a viable system needs to be organized in a way to meet the demands of an ever-changing environment in order to survive. The Darwinian saying “survival of the fittest,” from his theory of natural selection, comes to mind, and a
system needs to be able to maintain a separate existence over time. Therefore, the end product needs to be stand alone to its creators and sustain a steady state by itself.

To date, the only publications in the field of mobile learning found that, which address both the concepts of scalability and sustainability, in a similar way to how they are defined in this thesis, are Traxler and Leach (2006), and McFarlane et al. (2008).

Traxler and Leach (2006) use the notions of scalability and sustainability in a study of two mobile learning initiatives in Africa. These are called the “DEEP” project, which takes place in Egypt and Eastern Cape Province of South Africa, and the “SEMA” project in Kenya. Both projects are investigating the impact of portable technologies on teachers’ pedagogy and practice. The two projects used different approaches in establishing the communication platform. The “DEEP” project invested more resources on the technical solution with PDAs and laptops while the “SEMA” project utilized available technology (mobile phones) and standard for communication, i.e., GSM. The projects differed considerably in the number of users, with the “DEEP” project involving 50 teachers while the “SEMA” project addressed almost 100,000 teachers. They find that both scalability and sustainability prove to be two key challenges, due to infrastructure, technology, equality, and policy.

McFarlane et al. (2008) bring the concepts of scalability and sustainability to be addressed in relation to main policy issues. They give the following points to be of relevance: support and founding, devices (specification, supply, services, commercial interests), local authorities and school, technical issues, and professional development of teachers. They recommend a thorough look on these issues as all are necessary when scaling up the use of mobile technology in education. As a suggestion they think main founding agencies should adopt a new model, stressing these issues and promote using successful results from pilot projects, and teacher knowledge exchange, as an input for new projects and potentially reach wider deployment, and hence sustainability.
Chapter 4

Overview of the Research

This chapter presents three papers (Bell et al., 2007, Wingkvist and Alexander, 2007, Wingkvist and Kurti, 2008) that summarize the research conducted, and together form the growing grounds of the conceptual model that will be presented in Chapter 5.

The first and second papers are part of a collaborative research effort at the Computer Science Department at Canterbury University, Christchurch, New Zealand. The aim of this research was to introduce podcasting to the student body as a complement to traditional lectures. The research focused on this particular mobile learning system initiative.

To complement the initial research, a holistic perspective was initiated in the third paper in order to understand mobile learning system initiatives on a general level. This research effort was carried out at the Center for Learning and Knowledge Technologies (CeLeKT) research group, Växjö University, Växjö, Sweden.

4.1 Papers


URL http://www.iris31.se/proceedings.html
4.2 Paper I

Podcasting is an asynchronous mode of distributing media files across the Internet. These generally are referred to as podcasts (usually audio-only as in this paper) and often are pushed automatically to devices (such as portable digital audio players) using syndication techniques and/or aggregators such as iTunes. The combination of digital audio files and distribution allows for a highly mobile learning tool, one that some universities were fast to adopt. Since, a large number of these universities use the technology to distribute recorded lectures, which can be seen as a rather limited view on how to exploit the potentials of this technology.

It does not make good use of the audio-only format and the possibility to listen on things “on the go.” By taking advantage of the obvious mobility of portable devices, the students can be offered a way to extend the number of hours they study, without imposing on the time they need for other activities, such as household chores or exercise. However, by combining learning with such activities, it is necessary to be aware of distractions, the inability to take notes or look up references, etc. Therefore, a suggestion was made to provide material to supplement the lectures, rather than just to repeat them.

In order to test the idea, the first step was to decide the viability, i.e., to chart the students’ access to and interest in podcasts. In a questionnaire, the students were asked if they had access to audio players, how much they used them, and so on. It turned out that most of the students had access to portable digital audio players and used them for several hours per week. Few of the students listened to podcasts regularly, but a majority would be willing to try as a learning aid. As part of the experiment, supplementary podcasts were introduced in two first-year Computer Science courses.

Both courses offered weekly podcasts. One of the courses used 20-minute long podcasts with one presenter, while the podcasts for the other course varied in length (20–60 min) and used two presenters. Both used a similar format; the past week’s material was reviewed, there were discussions and commentary, future topics were discussed and the students were reminded about upcoming events and deadlines. While experimenting with the content of the podcasts over the length of the courses, a few complete lectures also were provided as podcasts, just to see how many students would download those.

After five weeks of weekly podcasts, another questionnaire was administered to gain insights into the use of and opinions about the podcasts. Of the students who completed the questionnaire, a majority had not listened to any podcasts. Most of these either had forgotten, intended to, or suffered technical difficulties. Of the students who actually downloaded the podcasts, a majority listened to all the material with one exception, i.e., a podcast that contained a long sequence reading aloud from a textbook. This one had a higher “switch off” rate.

During informal discussions with the group, we learned that the longer
4.3 Paper II

Surveys of several mobile learning initiatives in higher education that involve podcasts report a lack of feedback and low response rate on surveys. The lack of feedback is understandable, since the users listen to the podcasts “on the go” and often lack the means (such as e-mail) to give feedback. When the students get back to their computers, they have forgotten what they wanted to comment or give feedback on. As the podcast initiative at the University of Canterbury grew to include more courses, more lecturers and more students, the importance of feedback and evaluations also grew. While feedback is important in order to make the podcasts as good as possible, it also is vital in order to gain support and funding from the university.

During the initial run of the podcast initiative, minor evaluations were performed. These evaluations suffered, like so many others in the field, from a low response rate and a lack of feedback on open questions. The continued run of the initiative had increased its scope to include courses in Economics, Japanese, Music, Education, and Computer Science, and had received funding. In a continued effort to use both lecture podcasts and supplementary podcasts, the differentiations between these in the evaluation became apparent. These facts meant that an evaluation needed to cover a larger range of issues.

In order to plan the evaluation, an established six-step model was used. There are benefits to doing an in-house evaluation; however, such evaluation also risks criticism for being biased or simply of low priority. Using the model, minimized the risk of such issues, while still gaining the benefits of in-house evaluation. In order to deal with some of the previous problems, it was decided to use an electronic survey. Electronic surveys usually have a low response rate, but they have the added benefit of being able to send out reminders automatically. Similarly, it was decided to move away from open questions, and formulated multiple-choice questions carefully. Issues of extending the evaluation to use semi-structured interviews and voluntary focus groups to supplement the questionnaire also were addressed.

Comparing this evaluation to the previous evaluations and surveys, it now focused a lot more on the learners and not so much on technology and its adoption. For example, the interesting spectra spanned into age, gender, background, and proficiency in the English language, as well as a thematic schema that differentiated the Technical/environment issues,
Overview of the Research

Podcast content, Pedagogical issues, and Overall impressions. The plan to evaluate both the experience of the students and the participating lecturers was a first.

Evaluations like the ones run previously suffered from low response rates and few participants. It also is common that students with extreme opinions (i.e., either love or hate it) are the ones who feel most obliged to respond. Another issue involving podcasts in particular is that they are better suited toward particular demographics (such as non-native speakers) and learning styles (such as auditory learners). This is expected to show through in the results, but in an effort to overcome this, the survey is constructed to be as quick and easy as possible to complete in order to encourage as many students as possible to give feedback.

4.4 Paper III

Mobile learning is exposed to an inherently complex situation, which does affect the sustainability of these initiatives. In order to understand better the situation and the issues that may impact sustainability, there is profound need to see the complete picture. When advocating that mobile learning must be studied within the environment it is deployed in, the view of context becomes crucial (and the ability to decipher the same). A popular way to deal with the environment in which a mobile system is deployed, e.g., the social, the personal, and the material world, is to employ “context thinking.”

As all real-world situations, these exist within complex organizational settings. A context has many definitions, but can be seen as a time and place with information and content to support a specific activity, such as learning. A context can be modeled in many ways, for example mathematically using a coordinate system with three axes. Each context representation will signify a specific point in time.

While contexts provide a useful way to represent a mobile learning system, it is just a model, and not an “answer” to sustainability. A model can be used to communicate or represent something, while the ability to better understand things to improve the situation with regard to sustainability is needed. A sustainable system would indicate that the mental paradigm reflects the real world, while an unsustainable system would signify the opposite.

A problem with the use of contexts (and not the concept) is that many situations can be hard to model accurately. There are many attributes to consider, and many of them have complex relations. Nonetheless, in order to be able to understand the system, the ability to capture and abstract these attributes and connections, and to see the complete picture, is needed. In essence, this means to set an inner and outer boundary for the context and its attributes. Keeping in mind that a system is more than the sum of all the included elements.

Generally, system modeling approaches can be divided into hard and soft
4.5 Lessons Learned

The research presented in the three papers appended to this thesis can be divided into two themes: the first two papers studied the growth and evaluation of an actual mobile learning initiative in which the author participated and the third paper presents a reflection of the state of mobile learning. These two themes form the basis for two important lessons learned, which can be described as the scalability and sustainability of mobile learning initiatives and the mobile learning system to follow.

The mobile learning initiative studied grew carefully and adapted amenably. The growth happened in stages, each of which ended with reflection and adaptation of the concept to suit the needs and requests of the target group. For each growth stage, the initiative grew larger and more complex. The first sign of this that the author of the thesis noticed was the problem of conducting evaluations at the end of stages. The first questionnaire addressed one Computer Science course and 150 students. This can be seen as part of the culmination of the first stage (cf. Paper I). At the end of the second stage (cf. Paper I), a questionnaire was presented to the students of two Computer Science courses, which together had roughly 400 students.

The questionnaire that was to be given at the end of the following stage (cf. Paper II) would be offered to the students of four additional disciplines as well as all the involved lecturers. One of the issues concerned how to distribute and analyze the questionnaire, which in turn affected the types of questions that should be asked and how they were asked. For example, analyzing open questions can be time-consuming when dealing with a large number of responses. Another issue was that the target group of the first two questionnaires had been rather homogeneous (a group of Computer Science students). The third questionnaire (i.e., divided into two separate sets) addressed a heterogeneous target group, consisting of both students from other disciplines and lecturers.

When the initiative grew from a voluntary basis to a funded project, another issue arose. The funding party, i.e., the university, had an interest in how it spent its money and wanted feedback. This feedback might require that other factors other than those interesting for the continued projected are measured, just to offer the information the university asked for. The first issue, i.e., the increased number of participants, was a scalability issue. The open questions and paper questionnaires simply did not grow to meet approaches, in which the hard are bottom-up while the soft are top-down. By using hard approaches, one can gain a good understanding about something in particular, and by using soft modeling, one can gain a holistic understanding. In order to extend the view of context, the notion of modeling mobile learning as a system is introduced. Suggesting the use of a combination of hard and soft approaches, in order to reflect on both the details and the complete picture, thus will maximize understanding.
the practical needs. In a similar manner, the increased complexity at each
growth stage also could be seen as a scalability issue. For every stage, the
understanding of the initiative had to be expanded – it had to scale. The
impact and importance of scalability was a valuable lesson learned from
Papers I and II.

After moving on from the podcast initiative, the research focus changed
to other initiatives. There is a documented lack of initiatives that become
actual learning aids and reach wide deployment within the mobile learning
community (cf. Chapter 1) and it is important to understand why this is.
A comparison between the podcast initiative and others revealed a signif-
icant difference in many cases. While the podcast initiative started with
an elementary idea and always stayed close to and adjusted its goals based
on the reactions of the growing target group, many other initiatives started
with an elaborated idea that was pushed onto the target group at a later
stage of development, e.g. the complete project already had been defined.
Both courses of action have their advantages and disadvantages. Experience
shows that it is important to understand the target group and setting, and
to make sure the idea can survive on its own merits. The term sustainabil-
ity refers to an initiative that can survive on its own merits in a realistic
setting.

The term context often is used to refer to the setting and target group of
a mobile learning initiative. In order to achieve sustainability it is impor-
tant to understand the context. The scalability aspect discussed previously
makes this context more and more complex for each development stage. To
address sustainability, there must be a way to describe contexts and to be
able to reason about them. The importance of sustainability and ways to
model context is an important lesson of Paper III.

Derived from the research described in this section, four main criteria were
selected to guide the literature survey found and addressed in Chapter 3. In
Chapter 5, an attempt to describe the context of a mobile learning initiative
is presented.
Chapter 5

Analysis of the Research Findings

This chapter presents an analysis of the findings of the research summarized in Chapter 4. The research closely studied what happened when a mobile learning initiative grew from an idea to an actual empirical study.

In order to understand the findings and make them useful, a conceptual model has been defined that depicts the evolution of a mobile learning system, in terms of the entire process as well as what happens in each stage.

The chapter begins with a short description of how the mobile learning initiative involving podcasts grew. The growth process then is analyzed and used as a basis for a conceptual model. Once this model is understood, the terms scalability and sustainability can be discussed. The chapter concludes with an analysis of the conceptual model.

5.1 The Evolution of the Mobile Learning Initiative Involving Podcasts

In this section, the development of the podcast initiative is described. This evolution is described in more detail in Papers I and II.

The podcast project started with an idea. The initiator, Tim Bell (professor in Computer Science at Canterbury University, Christchurch, New Zealand), listened to podcasts while doing other activities, such as riding a bike to and from the university. He imagined that students had similar activities in their lives and that they would benefit from and appreciate the ability to refresh course work while doing these often mundane activities (such as household chores).

A number of concerns grew from the idea that potentially could affect how well the students accepted the podcasts as a learning aid. For example, was the technology required, both to download and listen to podcasts, (such as digital audio players) in use by the student body? Another concern was whether the students were willing to, or already did, download and listen to (other) podcasts. A final concern was the content of the podcasts, for example if complete lectures should be recorded, or if material should be tailored for the podcast format, and if so, what kind of material was suitable.

The technology needed for the podcasts was very simple. It basically
was a digital audio file that can be played on a number of devices, such as
portable digital audio players, mobile phones and computers. And, the idea
was not so much to investigate the technical issues, but rather to determine
if the technology already was being used in the target group. In order to
investigate this, the students were asked to answer a few questions regarding
their use of podcasts and digital audio. They also were asked if they would
listen to educational podcasts and, if so, which format they would prefer
(i.e., complete lectures, supplementary material, or additional material).

The questionnaire was analyzed and used as a means to gain understand-
ing of the situation. This understanding provided enough information to
support a larger study. The initiative was extended to cover two computer
science courses and a few hundred students. The podcasts were produced as
a supplement to the traditional teaching, so it would not affect the students
who for some reason did not want to or could not adopt the technology.

The primary goal was to investigate how the different types of podcasts
would work in practice and what the students would prefer. Another impor-
tant goal was to improve the technical solutions and make the production
efficient. In order to test what the students preferred in terms of material,
several different types of podcasts were prepared, ranging from supplemen-
tary interviews and Q&A (questions-and-answers) sessions, to complete lec-
tures and even reading from a textbook. These activities all fit with the
educational goal.

In order to continue to explore the state and the potential, a second
questionnaire was used to evaluate what the students experienced. This
questionnaire repeated a few questions from the first questionnaire, such
as if the students actually would use the podcasts or not. In measuring
what format (lecture vs. supplement) the students preferred and how the
technical solutions worked out, the questionnaire was used in conjunction
with other collected data, such as download records and observation of the
student body. Several interesting refinements can be noted on the technical
side, caused by the progress from an idea to an experiment.

For example, there was a server crash, which made the podcasts inac-
cessible for some time. This might have had an effect on the number of
students who tried the podcasts, since those who did so during the server
problem might have been reluctant to adopt the technology. Similarly, it
was discovered that there was a need for a subscription model, since many
students forgot to download and listen to podcasts when they had to do it
manually.

Based on the results of the analysis of the second questionnaire, five weeks
later, it was decided to extend the study again, this time to include more
disciplines and in turn more courses, lecturers, and students. The results
also were used to gain funding from the university for this part of the study.
Until now, the study had been conducted on a voluntary basis.

A new and important goal was to investigate the implications of how
different people in different roles are willing to use and accept the technology.
Interesting questions to research were how students learn, i.e., if they prefer
audio or if they need visual aids, the effect of things like environment (e.g.,
distraction, disturbance), and the willingness and ability of other lecturers
to produce podcasts. Another change was that the university now had a
stake in the study.

For example, by receiving funding there was now an obligation to re-
port findings, which might affect already defined structures concerning the
setup and the educational goal. In a similar manner, there was a need
for a larger infrastructure to help lecturers produce podcasts, for example
training, access to a studio, equipment, etc. There also was a need for a
better infrastructure so students could access the podcasts. Furthermore,
there are Internet traffic fees in New Zealand at the university, connected
to the student login accounts, and these fees might affect the willingness of
students to download podcasts.

A questionnaire was created to evaluate the potential and to see if the
podcast initiative could be applied to the whole university. As a conse-
quence of being a visiting researcher, the author of this thesis left before
this evaluation was done. So, no further comment can be made on the
development of the podcast initiative.

5.2 Analysis of the Podcast Initiative

This section presents an analysis of the Podcast initiative (cf. Section 5.1
and Papers I and II). This forms the basis of the research carried out by
the author of this thesis. The aim of the Podcast initiative was to pro-
vide supplementary material to the courses held at Canterbury University,
Christchurch, New Zealand, that students could use while doing other ac-
tivities.

Four main stages can be discovered by analyzing the evolution of the
initiative. First, there was an idea. After testing whether the idea would
work or not, it was extended to an experiment. During the experiment,
the findings of the idea were verified using actual courses and students in
a controlled environment. For the third stage of the study, a project was
started, and funding was introduced, i.e., formalization of the environment
(e.g., disciplines, lecturers, students, technical solutions). The goal was
that the third stage would be the final test of the study, and the underlying
ambition was that podcasts would be released as an educational aid across
the whole university as a result. This would be the fourth stage.

The stages introduced above can be considered steps in the evolution of
the podcast initiative. The idea evolves into an experiment with a more
realistic setting but with complete control. The experiment then evolves
into a project with an even more realistic formalized setting. The project
then would evolve into deployment.

Each of the identified stages is distinct and separated from each other by
some kind of reflection, often in the form of an analysis of a questionnaire.
For example, the idea stage ends with the analysis of a questionnaire that
5 Analysis of the Research Findings

### Questions

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<tr>
<td>Do the students have access to portable digital audio players?</td>
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<td>Do the students have any previous experience with podcasts?</td>
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<tr>
<td>How much time does a student spend listening to digital audio?</td>
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<tr>
<td>Which types of material would the students find interesting? (recorded lectures, summaries and extra information, topical issues)</td>
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<tr>
<td>Do the students intend to listen to the first podcast?</td>
</tr>
<tr>
<td>In what situations do the students listen to digital audio? (walking, bus/car, exercising, on the bike)</td>
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**Table 5.1**: Example of Questions Asked when Reflecting over the Idea

was posed in order to test the viability of the Podcast initiative in the intended environment. Table 5.1 gives an example of the questions asked. Appendix A shows the questions used for the later stages as well.

All of the stages are separated into areas of concern. For example, the first stage was concerned primarily with the acceptance of the technology and the learning activity. An analysis of the three questionnaires used during the evolution reveals four major areas of concern. These can be classified as issues regarding: the technology, the learning activity, the social interplay, and the organizational setting. The analysis reveals further that certain areas of concern are dominant during certain stages, and that they are linked. Table 5.2 shows the questions in Table 5.1, classified by area of concern. Appendix A shows the questions used in the later stages, classified by area of concern as well.

For example, in order to interview people, there is a need for social interaction. It turns out that this social interaction is a lot easier if the end result can be edited before it is transmitted – people prefer not to do “live” interviews. This influence from an educational standpoint to a social setting and vice versa was followed by a technical implication of both hardware and software, as recording and editing of the digital audio files now must be supported.

### 5.3 Formulating a Conceptual Model of a Mobile Learning System

In this section, the model of the evolution of a mobile learning system is described (cf. Figure 5.1). This evolution happens in four stages: **Idea**, **Experiment**, **Project**, and **Release**. Depending on the outcome and scope, the evolution can be limited to fewer stages, but from this particular point of
5.3 Formulating a Conceptual Model of a Mobile Learning System

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<td>Do the students have access to portable digital audio players?</td>
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<tr>
<td>(walking, bus/car, exercising, on the bike)</td>
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Table 5.2: Example of Questions Asked when Reflecting over The Idea Classified by Area of Concern (T = Technology, L = Learning, S = Social, and O = Organization)

...view, the aim of a system should be a release in a “production” environment. The model of evolution says nothing about how long each stage should take or how to move from one stage to the other. As by default, any mobile learning system must evolve through the stages described. If one or more are skipped, the changes it goes through will be too large to handle.

Every system starts with an idea. The Idea (cf. Section 5.2) generally is a vague notion of what, who, and how, i.e., how should some kind of learning be transformed to a mobile device and who is the intended audience.

The next step is to try out the idea in an experimental setting. In order to evolve from the Idea to an Experiment (cf. Section 5.2), a deeper understanding of the problem area is needed. In order to gain this understanding, the Idea stage needs to be studied closely, and these findings then is combined with an understanding of the intended target of the experiment.

For example, if there is an idea to teach math using games on mobile phones, the Idea stage would mean understanding how to use mobile phones to implement games and how to translate the mathematical content to games. In order to move on to the Experiment stage, the focus needs to be changed to which type of games actually would work, for instance by looking closer at the learners, and then to implement these.

The major role of the Experiment stage is to determine if the idea works or not in a controlled setting. Hence, the Experiment stage is carried out with a small group and with much focus on figuring out what works and what does not. Once this point is reached, where there is a convincing idea and it works in practice, the next step is to move on to the Project stage (cf. Section 5.2). This is done by taking what was learned, study how the environment will change in the project, and combine them.
The Project stage basically is a more formalized and realistic extension of the Experiment stage. A project is defined formally with stated prerequisites and a goal. There still is an interest in understanding if the idea works or not, but now the move has been made to a setting that is much closer to the intended setting. It also is important to scale the number of participants and focus closer on how they interact within the project. If continuing with the math education example, a project would implement the game on mobile phones and distribute it to a sample of the intended population. It will remain at the Project stage until it achieves stability and all the needed learning has taken place. Further, this learning is combined with an understanding of the actual environment in which the system is intended to be released.

The Release stage (cf. Section 5.2) occurs when the project ends and the mobile learning system is released as an actual product.

The important evolution that happens throughout the process happens within the stages. From the experience gathered with the mobile learning initiative, a mobile learning system can be defined by four areas of concern: Technology, Learning, Social and Organization. These areas, as depicted in Figure 5.2, are interconnected and of equal importance – keeping in mind what the mobile learning system as a whole is supposed to achieve. Each area will be the focus of concern during at least one of the stages.

The Technology area involves all the actual technology needed to realize the system. This includes hardware and software, for example mobile phones, servers, blogs, etc. The technology often is what is perceived as the focus, and the limiting force, of any mobile learning system. It is therefore important to acknowledge the technology and its relation to the entire situation.

The second area of concern is the Learning. It is separated from technology since the technology is there only to facilitate the learning, not to be the center of it. In a similar manner, its focus is only on the actual
5.3 Formulating a Conceptual Model of a Mobile Learning System

The translation of the learning activity to the mobile device in this area and not on the actual producers and consumers of learning. Since learning is the goal of any mobile learning system, it is important enough to constitute its own area: How will people learn, what are the important characteristics of the learning, how can a learning concept be transformed into something suitable for the system, etc.?

The third area of concern is the Social. This includes the people involved in the process, and the parts they play. All learning will happen in a social context, and even if it happens via mobile devices, there will be social interplay. In order to create a working mobile learning system, it is very important to understand how the people involved “work” and what they want.

The fourth and final area of concern is the Organization. Any situation is controlled by rules and regulations – this is the main function of the organization – as well as to provide support and infrastructure. Any mobile learning system will exist within one or more organizational settings, each complete with agendas, policies, politics, etc. In order to work within these organizations it is vital to understand the setting well enough to be able, at least, to coexist with it.

Let’s consider a simple example, in which a pupil in a classroom reads a textbook. If translating this example to the conceptual model, the book is the technology. Consider the actual reading of the book the learning and the pupil reading the book the social part. The classroom itself is the organization. This example should not be taken literally, but rather as an intuitive depiction of what the four areas of concern represent.

From the example, it can be seen that the four areas together form the complete picture of the mobile learning system. However, the focus can and most likely will be on one area at a time and advance in that. For example, during the Idea stage, there will be some vague ideas about “how,” “what,” and “who.” The most likely turn of events will be to begin with a focus on Technology and solve that area before moving on to Learning. The other areas still are present and important, but the focus is on technological problems and the counterpart of solutions. Think in terms of this as a
camera lens that zooms in on different parts of a picture (cf. Figure 5.3). The part that is zoomed in on is sharp and detailed, but the other parts are still there, even if blurry.

Even if focusing on one particular area, changes to and developments of that area may influence the other areas. For example, if extending the example with the pupil reading a book to include a teacher, the focus would be on and extend to the social area of concern by introducing a new role. This in turn would affect the learning, since reading no longer is the only way to learn. Thus, lecture and explanation are added as other possible ways to learn. In order to support these new ways of learning, the need to extend the technology to include, for example, a blackboard and chalks would be an option. A teacher is not the head of a school, but rather governed by the rules and regulations of the school. To address this, this would add the classroom to the school, and in turn to the school board, and to the organizational area of concern.

As can be seen in the example presented in this section, there is a lot of interaction going on between the different areas, and even a subtle change to one area can affect all the others in various ways. An interesting question is how can these changes be understood and when is it enough: how do you know when it is time to stop, and in turn when to move on? This process is called “the quest for equilibrium.”

5.4 Equilibrium

In order to know when to stop, the notion of equilibrium is introduced. Changes to one of the elements will affect the others as well, in the sense that they need to react and adjust in order to reach equilibrium. This is in line with the arguments put forward by Ashby, in Umpleby (2001), where he states that a system in general goes to equilibrium. And in going from one state to another there is a selection process going on whereby the system rejects or accepts changes.

This is similar to Newton’s laws of motion, three laws formulated to explain the relationships between forces acting upon a body and the motion of the body. In layman’s terms, if a force is acting upon a body and there is no counter-force, the body will move and the forces are not in equilibrium. If there are no forces or all the forces in play are perfectly balanced by counter-forces, the body will not move and all forces are in equilibrium.

Pareto, addressed in Hirschheim (1985), applied the notion of equilibrium from the physical science to a social science model addressing the economic allocation in any system, being real or in theory. If the allocation is not
efficient, there is a theoretical potential for improvement and the system will react and compensate for the change of circumstances, which can be introduced.

In respect to Leavitt (1965), the notion of equilibrium can be seen as he views organizations as complex systems in which at least four interacting variables, i.e., Task, Structure, Technology, and People, can be noticed. These are highly interdependent, as indicated by the arrowheads between them, depicted in Figure 5.4. This means that change in any one usually results in compensatory, or retaliatory, change in others.

By introducing the idea of equilibrium to the four areas of concern, the changes can be considered as the forces. If one area of concern changes, several others may need to adjust and change before the system once again is in balance. If it is the case that equilibrium cannot be reached, the change that caused the system to not be in balance needs to be reverted; if that is not possible, the system will fail.

5.5 Evolution, Areas of Concern and Equilibrium

In this section, the mobile learning system is described, along with how it will evolve, how each stage of its evolution will work, and the concept of equilibrium.

Within each stage, equilibrium signifies a stable system. Reaching that state means that the system is working as planned. A system working as planned is as important during the evolution as it is during the release stage. If the system is not in equilibrium, it is hard to measure and extract any meaningful data, which are needed in order to be able to evolve to the next stage.

For example, assume that a system is in the Experiment stage, in which
the system is not in equilibrium due to a poor software solution. The poor software will reflect badly on the system and it will be hard to separate the poor response that was due to the software from eventual poor response to the entire system.

In a similar manner, evolution is controlled by equilibrium. A system never can evolve if not in equilibrium. If attempting to move forward, without making a proper analysis of the findings of the stage at which the system is currently, the possibility to adjust and use this input for the next stage is lost, ultimately not giving the system a possibility to evolve into the next stage.

In Section 5.3, the concept of focus and how the focus is on one area of concern at a time are discussed. The same holds true for evolution. In each stage of evolution, one or a few areas dominate the focus. This is due to the increasing complexity of the mobile learning system. A simple way to describe the areas of concern is that each area adds an additional layer of complexity, i.e., factors to consider. The more complex the system gets, the more of these there are to worry about.

In the first two stages, the focus is on getting the technology to work and dealing with the learning task or activity. Once these two are on acceptable levels, the later stages focus on introducing producers and consumers of the learning activity, as well as the organizations that for example, pay for everything. These generally are far more complex and need to be in focus once the first two areas of concern are stable. Figure 5.5 depicts this change in focus during the evolution of mobile learning systems.

In order to illustrate the evolution and equilibrium, consider the following example, focusing on the technical aspects, in continuing in which students want to learn mathematics by playing a game on their mobile phones. During the Idea stage, a mockup was created, a pen and paper model of the game, to refine the idea. When moving to the Experiment stage, a working
prototype of the game is needed, but there are few requirements on the software and hardware other than that it should illustrate the concepts. It could, for example, be run on a laptop rather than on a mobile phone. Once entering the Project stage, people outside of the formal members of the project team will be exposed to the game, so it now must run on some realistic device that still can be controlled by the project, for example a particular mobile phone.

Moreover, the software now must be robust enough for the users to be able to use it without problems. Another issue that may come up in this stage is the need to customize the game, i.e., to add new content or new math “problems.” In terms of software projects, the game has evolved into a project with far more formal requirements, both on functionality and quality, compared to the prototype from the experiment. If it evolves to the last stage, the software must run on the devices of the intended audience, i.e., any mobile phone that fulfills certain requirements. In a similar manner, it no longer is possible even to interact with all the users, which for example means that resources must be found to deploy the software on the mobile phones, etc. The quality of the software must be even higher, and the math-game now has evolved from an Idea, to an Experiment, to a Project, and a Release with requirements similar to that of a commercial product.

The example in this section is meant to illustrate how each area of concern will grow more and more complicated as the system evolves. Once reaching the later stages, it well may require domain experts to make sense of an area, although failure to make sense of an area will result in a system that will not reach equilibrium, and a system that does not have balance will slow down, eventually come to a complete stop, and die. There must be equilibrium between the four areas of concern, i.e., Technology, Learning, Social, and Organization.

5.6 Scalability and Sustainability

In this section, the terms scalability and sustainability are developed further and the conceptual model is used to define them.

Scalability can be considered as the system’s ability to grow. This growth, in respect to all the four areas of concern defined in section 5.3, should be able to handle different types and groups of users and organizations with everything that is entailed for the areas of concern. There will always be a point at which scalability stops making sense, i.e., a largest rational organization it can scale to or a “market” that can be “controlled.”

Using this description, scalability can be defined as the ability to reach equilibrium at an evolutionary stage. The more stages at which it reaches equilibrium, the more scalable the system is. In this respect, saying that a mobile learning system is scaled to Project stage simply means that the system reached equilibrium at Idea, Experiment, and Project stages. The components were in unison with each other at each stage.
5 Analysis of the Research Findings

The term sustainability is described as something that is able to be maintained at a certain rate or level. If considering ecological sustainability, it is defined as conserving an ecological balance. If transferring this kind of striving to the conceptual model, a sustainable mobile learning system would be one that reaches equilibrium at the last stage, i.e., the Release stage.

By combining the definitions of scalability and sustainability, sustainability is the same as “maximum” scalability.

5.7 Analysis of the Conceptual Model

In this chapter, a conceptual model has been described and defined, with interlinking text, figures, and tables in a descriptive manner to suit the intended audience. This model is based on the experiences with a mobile learning system whereby traditional university education was extended and made mobile with the use of podcasts. This model then is used to describe the evolution of the mobile learning system.

The conceptual model illustrates the evolution of a mobile learning system, which includes the stages from Idea, Experiment, Project, and Release. Each stage includes the four areas of concern: Technology, Learning, Social, and Organization. These are related to each other and this relationship can be seen as a matrix, which is explicitly shown in Figure 5.6.

In using the experience from an actual mobile learning initiative to define a conceptual model that then is used to describe the same initiative is a way of bridging the practical, with the empirical, with the theoretical, providing reliable evidence for the model itself. The model seems to be general enough to be used as a thinking aid for any mobile learning initiative. It can be, and has been, used to gather new information about the mobile learning system that it was created from. This in turn can be seen, as the model
can be applied and useful.

Further, the model is used to define the concepts of scalability and sustainability. Even if the conceptual model proves to not be general enough to capture all possible mobile learning systems, the definition of these two concepts shows their importance and provides an intuitive notion of what they mean, especially in regard to practitioners in the mobile learning community.
Chapter 6

Conclusion

The goal of the research presented in this thesis was to establish the concepts of scalability and sustainability in the field of mobile learning and mobile learning system development. Putting focus on these concepts and defining them in a way that is accessible by practitioners in the field might result in consideration and reflection during the development of new efforts in mobile learning.

In order to be able to define the concepts of scalability and sustainability, in this context, it was important to understand the process of developing a mobile learning system. Based on experience with a mobile learning initiative involving podcasts, the factors that influenced the development, as well as the stages that happened during the development process, were studied and categorized. This resulted in a conceptual model that then was used to illustrate scalability and sustainability.

The next two sections first look backward to summarize the main results and then forwards to outline future challenges to be addressed.

6.1 Main Contribution

The implications of being a visiting researcher resulted in extensive insight of how the mobile learning system evolved, but not always why. To gain this knowledge and investigate the why, factors that could be identified were sought. As the conceptual model started to take form during the work with the mobile learning system involving podcasts presented in Chapter 4, and as the research continued, the answer to both how and why were found.

Finding the relevant results was an outcome from utilizing the process of iterative cycles of the action research approach, explained in Chapter 2. These results then were put together in the shape of a conceptual model, interlinking text, figures, and tables, to correspond to the intended client, is described in Chapter 5.

The conceptual model then was used to study how and why evolution happened or not. The notion of scalability was defined to reflect how well a mobile learning system can scale up or down to suit the situation, both in terms of the actual system as well as the understanding. In regards to the conceptual model, scalability is defined as the ability to transition from one stage to the next.
In practical terms, this scalability means the ability to extend the results from the previous stage and combine them with knowledge of the areas of concern of the next stage, and to reach equilibrium. As the system evolves, each area of concern grows more and more complex. Furthermore, the concept of sustainability is defined as the ability to reach the Release stage of evolution and establish equilibrium there.

When seeking related work (cf. Chapter 3), several other published mobile learning initiatives, as well as ways to model such initiatives, were studied and classified according to these criteria: Reflections, Frameworks, Scalability, and Sustainability. The literature survey was done in parallel with the conceptual modeling to strengthen the results. The results suggest that the conceptual model developed in this thesis is at least expressive enough to classify other initiatives and find related mobile learning systems.

During the study, no models, frameworks, or reflections similar to the conceptual model presented in this thesis were found. Even if the model defined in this thesis has yet to be proven general enough to be applied to other mobile learning initiatives, the model can prove helpful to practitioners in the field of mobile learning.

The main contribution of this research is the conceptual model, which shows the evolution of a mobile learning system in terms of how it went from Idea to Experiment to Project, as well as what happened during each of these stages. In other words, the conceptual model describes evolution in four stages: Idea, Experiment, Project, and Release, and divides each stage into four areas of concern: Technology, Learning, Social, and Organization. The key to the conceptual model is the notion of equilibrium – to achieve a steady state – in each stage. This is linked to the acceptance of a mobile learning system and thus the “quest for equilibrium.”

6.2 Future Work

An important future challenge is to test the conceptual model developed in this thesis to determine whether it can be used to map other mobile learning systems. This test is done to see if it is possible to capture other mobile learning initiatives using the model. It can be done, for example, by studying how an idea grew strong enough to move on from this stage. Also interesting is which focus was applied and if it changed.

A related but different study would be a literature survey of the major conference series of the mobile learning field and an analysis of the papers (publications) to the conceptual model. In this thesis, a partial study like this was conducted; based on it, a larger study likely would be of interest to the mobile learning community.

The complexity of mobile learning and aspects in the area of evaluation, which can include a magnitude of factors to follow, is an intriguing arena to enter, and the conceptual model developed could be an aid in identifying both the time (literally) and the issues concerned. These are the two
dimensions specified in the model.

The conceptual model also should be given to practitioners so they can use it on their own. This would test how intuitive and useful the model would be from the perspective of a real practitioner working in the field of mobile learning.
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Podcasts as a Supplement in Tertiary Education: An Experiment With Two Computer Science Courses

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Abstract

The current generation of undergraduate students are enthusiastic adopters of mobile technologies, and some of these technologies offers significant opportunities for broadening the times, places and manner that students study and learn. One of these is podcasting, which greatly eases distribution of content to portable devices, giving the students opportunity for anytime, anywhere learning. However, most educational podcasts do not take advantage of the potential of podcasting. In this paper we discuss the issues surrounding the use of podcasting for higher education. We report our experiences using podcasts to supplement two undergraduate Computer Science courses, and we provide tips for others considering the use of podcasts in education.

7.1 Introduction

Podcasting is an asynchronous mode of distributing multimedia files – “podcasts” – over the Internet using syndication feeds, for playback on portable devices and personal computers at the user’s convenience. It has much potential as a highly mobile learning tool, and yet almost all applications of podcasting in university education fail to exploit the potential as they simply broadcast lectures (which are visual and even kinesthetic experiences) as a podcast (which is primarily an audio experience). Some educational podcasts compensate for this by including images, video, and/or web links. However, we believe that there is value in creating audio-only podcasts that supplement the lectures, so that mobile learning can occur in a “hands-free, head-up” mobile situation to enable students to learn also during activities such as commuting.

Despite the audio-only limitation of podcasting, it is attractive for education because it potentially enables students to increase the number of hours of studying without necessarily having to remove something from their schedule such as doing household chores, or exercising. And although we advocate a supplement to lectures, the time required to prepare the extra material in such a podcast need not be too demanding on the lecturer. There are some restrictions on what is possible with mobile podcast listening: the student is not likely to be able to take notes or look up references. A related issue is that it can be difficult to elicit a response because the user may not be in a position to use email or even send a SMS message at the time they are listening, and are likely to forget to do it when they have the opportunity later.

In this paper we review the ways that audio podcasting might be used in an educational setting, particularly in a tertiary environment. We also report the results of experimenting with podcasting as a supplement to two first-year Computer Science courses with approximately 150 and 250 students respectively.
7.2 Podcasting

The normal process for podcasting is that a content provider (podcaster) will make the files available on the Internet via an RSS (Really Simple Syndication) feed, to which the audience subscribes using aggregation software (a podcatcher). When a new podcast is published, it can be automatically uploaded to their portable device and hence they can listen to it at their convenience. Normally subscriptions are free, and there are no direct costs for listening to podcasts. Podcasts are typically provided in a heavily compressed MP3 format and can be played on a wide variety of devices, many of which are available inexpensively. Students are likely to already own something suitable. In addition, any desktop computer with Internet access is bound to be able to play a podcast, which means that owning a portable player is not essential.

Podcasting is a relatively recent phenomenon; the first RSS audio feeds appeared in July 2003 (Doyle, 2005) and by mid-2005 there were approximately 10,000 different podcasts available on a wide range of topics. In June 2005 Apple added podcasting to their free “iTunes” program, and this provided a surge of interest – within two days Apple announced that a million podcast subscriptions had been made. In December 2005 the editors of the New Oxford American Dictionary announced “podcasting” to be the word of the year and it appeared in the dictionary in 2006. Many podcasts have irregular and/or very limited followings, but some have hundreds of thousands of downloads of each episode. Their content and frequency is diverse, from hourly 3-minute newscasts, through daily 20 minute commentaries, to weekly one-hour in-depth discussions. Free software is also available for podcast creation, and there is also a lot of material on the Internet (including in podcasts) explaining how to make your own podcast. For users with an Internet connection, a desktop computer with a soundcard, and a relatively inexpensive microphone, the main additional cost to produce a podcast will be a relatively small fee required to have the files hosted on a server with a plan designed for the large number of downloads that podcasts can get, such as “Liberated Syndication” (http://libsyn.com).

7.3 Using Podcasts in Education

A key benefit of podcasting is that it enables students to listen to course related material while they are engaged in other activities. In the past a highly motivated student might have used such time for revision of their lecture notes, or reading literature references, but the use of digital media players provides a level of portability and ease of file transfer that has not previously been feasible. Also, the use of a feed such as RSS coupled with an aggregator such as iTunes means that the material can be pushed onto the student’s portable device. By having files pushed like this, users are more likely to listen to them because they need not remember to carry out an explicit download.
7.4 Podcasts at Other Institutions

The medium does have disadvantages, such as the lack of visual content, the difficulty of taking notes, and the divided attention of the listener between environmental distractions and the material on the podcast. Also, the material will be of most benefit to auditory learners, and does not appeal to all students. Despite these limitations, there are many opportunities for using podcasts as a supplement while giving a course. You can use them to give out news and updates, answering questions sent in (for example by email), and/or give general feedback to students. Another possibility would be to highlight the key points you stated in class and have extended discussion about them, and/or conducting interviews with external people adding or reinforcing the material addressed. Podcasts is also a way of providing hands-free instructions to students conducting laboratory work or using different computer programs. In addition we can imagine letting students do project reports using podcast as they develop good oral skills and share their experience with the others. In the wider educational setting podcasting could be used for recruiting and marketing, recording meetings and conference talks, and broadcasting for specific groups such as alumni, sports teams, or cultural groups.

Despite this rich range of potential applications, currently the most common approach to podcasting at universities is to provide the students with the traditional lectures as a podcast. This does have some value, giving them a second, or first if they missed it, chance to listen to it, which is particularly appreciated by students whose first language is not English. In many cases it also means that people outside the university community can benefit from having access to the lectures. However, this does not represent a major advantage over existing lecture recording systems that publish the audio or even video on the web.

7.4 Podcasts at Other Institutions

A number of institutions have started to offer podcasts. Duke University’s “Duke Digital Initiative” was one of the first institutional experiments with ubiquitous portable audio devices, when in August 2004 all of the first-year students were given a 20G iPod to use as a learning tool (Duke University, 2005). The intention was to facilitate innovative use of technology on Campus. Applications that emerged included course content dissemination, classroom recordings, field recording, study support and, file storage and transfer. The students found the iPods useful for study support by using them for repeated listening, audio books, going over rehearsals (drama and music), and vocabulary lists. However, there were relatively few Podcasts (three podcasts were reported after the first year), and it appears that the major educational use was more student-driven: 60% of students reported using their iPod for recording material, and 28% for music and hard drive storage. A total of 75% reported using it to support their learning.

A number of universities have started making some of their lectures avail-
able to the general public through podcasting. For example, Harvard is into the second year of podcasting their course “Computer Science E-1, Understanding Computers and the Internet” (http://www.fas.harvard.edu/~cscie1/), and it has many followers – it has appeared in iTunes’ top 100 Podcasts. Berkley University has among 30 faculty members who have agreed to clip on a microphone in class so that their courses’ audio can be recorded and then posted online (http://itunes.berkeley.edu/). Princeton University’s University Channel (http://uc.princeton.edu) let different universities contribute recordings of lectures, seminars, panels and interviews to a virtual pool of academic content under their own name.

The public podcasts of lectures allow anyone to sit in (“audit”) a course, albeit without the full student experience. Access to these lectures in a mobile environment is valuable for the casual listener, and particularly for other educators who can pick up pedagogical ideas by listening to another teacher at work. This open-source ethos is to be applauded, and reinforces the idea that institutions should control qualifications, not the knowledge itself. It can also improve the quality of the education since the teacher is exposing their teaching to such a wide audience, increasing the opportunity for feedback.

University of Southern California had two 2006 spring courses with lecture podcasts being evaluated and according to Wolff (2006) the outcome was positive in both cases. However the reasons differed as one course had a large number of students for whom English is a second language who listened to the whole lectures again, while the participants of the other course valued having the recording to replay specific explanations to understand difficult material.

From an online survey for the podcast pilot in 2005 at University of Washington, Lane (2006) reported that 70% of the students found that podcasts supported their learning and to be helpful when preparing for homework and exams. The response rate was low, 41 out of 148 enrolled students completed the voluntary survey, but can indicate the perceived value of podcasts. Interestingly, 81% of students used a desktop computer rather than a portable player to listen to their podcasts. It appears that when listening to a lecture podcast, it is valuable to sit at a desk and use notes and handouts, in which case a desktop computer provides a better interface for listening to audio than a portable device. This reinforces our contention that simply podcasting lectures does not take full advantage of the potential of podcasts to facilitate mobile learning, and for this application learning may be better facilitated by using tools such as the Audio Notebook (Stifelman et al., 2001) and AudioGraph (Jesshope, 1999), which provide a richer capture of the lecture.

Furthermore, making lectures available in a flexible manner can potentially inhibit learning. Students can postpone listening to lecture material indefinitely. In an earlier experiment with video-recorded lectures, we observed exactly this behaviour: once the video-lectures were made available, attendance at lectures dwindled because the students could catch up
through the video at any time, but they never realised their intention to do so (Bell et al., 2001). This is not likely to be a problem for motivated students (e.g., for mature students and/or professional courses which could benefit greatly from this mode of getting lecture material), but for less mature students we suggest structuring curriculum delivery in a way that encourages them to keep up with the class schedule.

7.5 Podcasting Experiment

To evaluate the potential of podcasts as supplementing lectures, we ran a podcasting experiment for two first-year Computer Science courses, COSC-122 (“Algorithms”) and COSC110 (“Working in a digital world”), at the University of Canterbury, Christchurch, New Zealand. Approximately 150 and 250 students were enrolled in the courses respectively. We released weekly podcasts that supplemented the lectures rather than record them in their entirety. We did, however, also provide three recorded lectures for each course, without announcing our intention to do so, to see whether students would take the opportunity to review the material.

At the start of the COSC110 we surveyed students to determine what sort of access they had to digital audio players, and if they had any experience with podcasts. We found that 64% of the students had a portable device, and that 82% regularly listen to audio on a computer. Those that had portable devices estimated that they spent an average of 7.6 hours per week listening to them, and 16% reported listening to them for 10 or more hours per week. The most popular situation for listening to them was while walking (33%), but other activities are popular too, including on the bus and in the car (21% each), while exercising (15%) and on a bike (10%). Only 13% of the students had listened to a podcast before, and only 3 students in the class reported listening to podcasts daily. This is likely a reflection of the lack of adoption of podcasting in New Zealand due to relatively high charges for Internet use. Despite the lack of experience with podcasts, 87% of the students reported that they intended to listen to the first podcast.

The initial survey also asked students to report their level of interest (5-point Likert scale from 1 for not interested to 5 for very interested) for three types of material in the podcast. The number of students showing an interest level of 4 or 5 (i.e. more than neutral) was 50% for recordings of lectures, 72% for summaries and extra information, and 65% for topical issues relating to the course, indicating a student preference for the supplements, although the inevitable demand for re-runs of lectures.

Both courses were given weekly podcasts. The COSC122 podcasts were about 20 minutes long, with one presenter, while the COSC110 podcasts used two presenters, and ranged from 15 minutes to almost one hour. The entire fourth podcast of COSC122 is accessible as an example at http://www.cosc.canterbury.ac.nz/tim.bell/podcastExample.mp3. The COSC110 podcast was made available to the public through http://uccsse.
For both podcasts, the general format was to review the material from the past week, discuss topics coming up later in the course, remind students about any deadlines and provide discussion about current topics, especially if they related to current events. Each COSC122 podcast had a competition with a small prize to encourage students to email in their comments. In one of the COSC122 podcasts a section of the course text book was read aloud (with some additional commentary).

The podcasts were recorded using digital audio editing software, with a studio microphone. Off-site interviews were recorded with a portable digital audio recorder, although there are many other devices including mobile phones, laptops and digital cameras that could be used for this. A theme tune was used to add interest, provide context, and give personality to the podcast. It was also useful for covering background noises such as pages being shuffled. Interviews were edited into the podcast – in fact, many of the COSC110 interviews were recorded as one of the authors traveled around the world, which demonstrated truly mobile teaching with several interviews recorded on a conference on a ship on the Yangtze river, as well as commentaries recorded while waiting at airports. Although intricate editing is possible with the software we were using, the podcast genre typically has a “live” style, with minor glitches left in the recording. Recording in one take makes creating the podcast much less effort, and gives a personal and dynamic feel to the episode. Podcast recording software such as “Castblaster” and “PodProducer” assume this one-take mode of operation, whereas editing systems such as “Audacity” and “Garageband” encourage the podcaster to edit the content. We found that interviewees were often a little nervous as it was a new experience, and in these cases the offer to edit out any hiccups was greatly appreciated. Generally very little editing was needed once the interview got underway.

For COSC122 we were able to compare actual downloads with the students’ expectations in their survey. Unfortunately in the first week of term a major server crash occurred that made access to the podcasts very difficult for students. However, in the second week when the system was working properly, the second podcast was downloaded 69 times, which compares favourably to the 87 students who said they intended to download it, although it represents just under a half of the class, and we were unable to count unique downloads. The three lectures were downloaded 37, 33 and 33 times each, which is under half the download counts for the first five podcasts (50, 76, 35 (missing data in the logs), 79 and 73).

The COSC110 podcast was made available to the outside world through iTunes, and the number of downloads often exceeded the number of students in the class. Feedback from outside listeners included one ex-student who was using the podcast to catch up with developments since taking the course.

Feedback and Summary Questionnaire: We were keen to receive feedback from the students to gauge the podcasts’ effectiveness and to help us tailor future podcasts to better suit their needs and desires. We tried a variety of
techniques to encourage feedback, including a draw for free coffee for students who emailed or text-messaged us to say they had listened. Response rates to the draw were very low, with only two to five responses per week, but low response rates are a known phenomenon for podcasts, even when they are heavily downloaded. One explanation for the low response rates is that listeners are often occupied with other activities (such as walking, cycling and driving) making it inconvenient to respond on impulse. The few responses we did receive were generally positive. Giving answers to student questions in the podcast was well received, and the summaries and extra information seemed to be the most valuable. Reading from the text book drew one unfavourable comment despite it representing a genuine time-saving for students who intended to read the text anyway. Some students asked for all lectures to be made available, although we chose not to for the reasons given earlier. Some students worried about the cost of downloads, although in fact we had set it up so that it would be free.

After five weeks of podcasting COSC122 (including the three sample recorded lectures), we administered a questionnaire in a regular lecture to gain insights into the extent of use of the podcasts, the students’ on-going intentions, and their perceptions of the podcasts they had listened to. 56 completed surveys were returned — approximately 38% of the class. Of those, 37 (66%) reported that they had not downloaded any of the podcasts. The most common reason given for not downloading the material was that they “still plan to” (16), and that they had problems accessing the podcasts from home (13). Four stated that they “were not interested”, five stated that they forgot, and six stated they had “technical problems”. This suggests that if we overcame technical problems and made it easier for students to remember to download then the number who used the podcasts could more than double, and the majority of the class would be listening to podcasts. This is likely to be the case as the technology matures.

Nineteen participants (34% of responses) stated that they had downloaded some or all of the podcasts. Of the five podcasts, most people listened to all of the material, except for podcast 2, which had a higher ‘switch off’ rate. This is unsurprising as podcast 2 included the relatively long (8 minutes) reading from the text book; but it shows that students’ tolerance for “dull” podcast material is relatively low.

We asked five questions regarding the problems that they had encountered with the podcasts, again rated on a five-point Likert scale from 1 (major problem) to 5 (no problem): remembering to download, remembering to listen, quality of audio, finding a device and getting distracted. Of these, remembering to download was the biggest problem (mean 3.5, s.d. 1.5), followed by getting distracted (mean 3.7, s.d. 1.2) and remembering to listen (mean 3.9, s.d. 1.0). Neither quality of the audio (mean 4.7, s.d. 0.6) nor finding a device (mean 4.4, s.d. 1.2) appeared to be a major problem for these respondents who had successfully accessed the recordings. The relatively high problem rating for getting distracted is a concern, particularly because students may be listening to the lectures while carrying out
activities such as cycling and driving.

The COSC110 class used a different format, with a 2-person discussion which usually went for 30 to 60 minutes. Informal feedback from students indicated that this is too long for many, and that the podcast should be kept short and to the point.

It was clear from the feedback that there is a small but significant group of students who have almost no interest in this mode of learning, but those that regularly used the podcasts the feedback was extremely positive, including comments such as “Great – keep it up!” and “Nice addition to study kit”.

### 7.6 Conclusion

These experiments with podcasting indicate that it can be a low-effort and effective supplement, but not substitute, for traditional lecture-based courses. The students who used our podcasts greatly appreciated them, and many of those who had not yet accessed the recordings indicated that they thought it was potentially useful and interesting, and that they intended to access them “later”.

A number of suggestions for podcasts content are given earlier in the paper. In the light of our experience we offer the following tips for those considering using podcasts to supplement introductory undergraduate courses:

- Keep podcasts short and to the point – 15 minutes per week is probably about right for most students unless the podcast is expected as part of the contact time for the course.
- Use a system such as RSS to push the information out to students; this is likely to result in a higher uptake than if they students have to manually download the files.
- Be aggressive in overcoming technical problems at the start, such as making sure files are easy to download both on-campus and at home.
- Include motivating material in the podcasts such as interviews and topical news articles.
- Maintain a live feel to the podcasts, and inject personality. Recording the podcast with minimal editing dramatically reduces the work for the producer and creates a dynamic mood for the episode. Apart from the initial overhead of setting up the recording system and background music, the time taken to produce a podcast will not be much longer than the podcast itself.
- Do not be surprised or concerned about low response-rates to requests for feedback in the podcasts. This is a known phenomenon for the podcast medium. Based on our experience, podcasts seem to be an attractive tool to help engage students, build a class “culture”, and disseminate the important and fascinating problems that the discipline addresses.
If you are podcasting recordings of lectures, students are more likely to be listening to them in a non-mobile situation because of the length and to avoid the distractions of a mobile environment, in which case you should consider posting other course materials online as most students will be at a personal computer and can make use of links to other references.

We hope that we will see more podcasts that supplement courses rather than just take audio content from lectures, as we believe that this adds considerable value, and need not be onerous to produce. This could range from a cognitively demanding podcast such as teaching a language, through to lighter material such as interviews with practitioners that can be followed despite the distractions present in a mobile environment, giving a good return to the student for a relatively small investment of time and effort.

Bibliography


Doyle, B. (2005), ‘The first podcast’.


Was It Pod Worthy?

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Abstract

Students and teaching staff in higher education are constantly looking for new tools to help them study and teach more efficiently. The University of Canterbury began Project Podcast to introduce podcasting to a number of subjects as an add-on to the current course curriculum. Podcasting is being used to enhance mobile learning and enthuse both students and lecturers. Previous podcasting evaluations show that there exists a need for both audio content from lectures, or so called “LectureCasts” as well as supplementary material or “Sup!Casts”. In this study, the evaluation of Project Podcast will be performed in-house. We have chosen an established six step methodology to avoid criticisms that often arise when evaluations are performed by internal members of the project. The evaluation is aimed at both the student population as well as the lecturing staff in order to gain knowledge about their impressions of podcasting. Prior podcasting surveys have received low response rates, due to the choice of time, location and medium. Hence, our evaluation plan has been created with the goal of encouraging feedback from students and lecturers. In this paper we present our preparatory plan for evaluating Project Podcast.

Keywords: educational technology, evaluation, higher education, mobility, podcasting

8.1 Introduction

The current generation of students in higher education are rapid adopters of new technology, with lecturers always looking for new and exciting methods to encourage students to continue their studies outside the classroom. Podcasting is seen as an innovative way to engage students in their course work. The simple act of utilising technology as part of their learning is often seen as a more attractive option to students than the thought of sitting down to read course material. Several universities have picked up on this and are producing their own podcasts to aid students in their studies.

Podcasts are multimedia files, usually in the MP3 format, distributed by subscription to an RSS-feed that allows downloads to be “pushed” onto digital playback devices. Some universities are providing audio content of lectures, while others are producing supplementary material, with the hope of stimulating interest in the subject area. By nature, podcasts are informal recordings often made in one continuous session with little or no editing done before release. However, the addition of introductory and/or background music track gives a more professional feel to the podcasts. Despite often large audiences, inducing feedback from listeners is one of the most difficult tasks for podcast creators. This is especially important in the educational situation, where teaching staff need to know whether their efforts are being
wasted on producing podcasts or whether the material covered could be adjusted to further benefit student’s learning. There has also become an ever increasing need to convince management that time and money is being spent appropriately. The best way to provide evidence of the worthiness of a concept is through evaluation.

This paper describes the preparatory planning for evaluating Project Podcast – an initiative at the University of Canterbury to encourage lecturers from a variety of departments (including Computer Science, Economics, Japanese, Music and Education) to provide podcasts for their courses. In this paper, we first give examples of how podcasts are currently used in higher education and then consider evaluations of podcasting that have already been conducted and the shortcomings of these. We then describe our preparatory planning for the creation of the Project Podcast evaluation. The evaluation includes both the student population and the teaching staff who are producing the podcasts. We also discuss our thoughts on how to encourage participation, especially from the students involved in the project.

8.2 Podcasts in Higher Education

Lecturers are often keen to embrace any new technology that will aid them in teaching or helping their students to learn. Podcasting is a technology that has proven itself on the Internet, and has now caught the attention of universities. What makes podcasting especially attractive is the large percentage of students who already own portable media devices combined with the numerous opportunities for listening (e.g., commuting, exercising, doing household chores).

Universities have taken two different paths in providing podcasts for their students. The first is to provide the recordings of the lectures, allowing those who miss all or part of them to catch-up. We call these “LectureCasts”. The second is to produce podcasts containing supplementary material to that given in lectures, labs or tutorials, which may or may not form part of the examinable course content. We call these “SuplCasts”, this nomenclature derives from two sources: “supplementary” and from the colloquial abbreviation of “What’s Up?” – “Sup?”. The question mark is replaced with an exclamation mark in recognition of podcasting being a one way medium. This name is used to describe podcasts that provide teaching material as well as news and information.

8.3 Previous Evaluations of Podcasts in Higher Education

Podcasting in higher education has caught on but evaluation data is scarce and only a few universities have published their results – this section summarises their experiences. An online survey for the podcast pilot in 2005 at
University of Washington reported by Lane (2006) found that 70% of students said that the LectureCasts supported their learning and were helpful when preparing for homework and exams. The response rate was low, 41 out of 148 enrolled students completed the voluntary survey, but this may indicate the perceived value. Interestingly, 81% of the students used a desktop computer rather than a portable player to listen to the podcasts. The University of Southern California had two spring courses in 2006 with their LectureCasts being evaluated and the outcome was regarded as positive in both cases (Wolff, 2006). However, the reasons for their success differed as one course had a large number of students for whom English is their second language who listened to the whole lectures again, while the participants of the other course valued having the recording to replay specific explanations to understand difficult material.

At the University of Canterbury an initial survey asked students to report their level of interest (5-point scale from 1 for not interested to 5 for very interested) for three types of material in the podcasts. The number of students showing an interest level of 4 or 5 (i.e. more than neutral) was 50% for the recordings of lectures, 72% for summaries and extra information, and 65% for related topical issues. Overall the students indicated a preference for the supplements, although the demand for LectureCasts is present (Bell et al., 2007). A deeper analysis of the collected surveys in this study revealed that students are very reluctant to respond to open ended questions. Likert scale or tick-box style questions were far more likely to be answered. This is important for future questionnaires as some respondents may have been ‘turned off’ by the large amount of writing required.

The results from the previous evaluations have lead us to believe there is a need for both LectureCasts as well as Sup!Casts. It appears that podcasted lectures are especially useful for students for whom their native language differs from that of the course. Also, the opportunity to be able to replay all or certain parts of a lecture is valuable when the material is complex, if the student lost focus or simply did not attend. It seems that LectureCasts are used in conjunction with other study equipment, e.g., looking at/writing notes, reading textbooks and viewing websites for additional material. This reinforces our view that podcasting lectures does not take full advantage of the potential of the medium to facilitate mobile learning in the way that Sup!Casts do.
stages, with steps one, two and six relating to context, and the remaining three focusing on the details of the study. In this section we describe these steps and how they will be followed in the evaluation of Project Podcast:

(1) Identification of Stakeholders. Stakeholders are all of the people that have some interest in the project or the evaluation of it. In the case of Project Podcast we have three groups of stakeholders: the administrators, the lecturers and the students. The administrators include the funding body and the staff involved in organising and promoting the project. The lecturers are those in various departments who have volunteered to be involved in the project and produce podcasts for their courses. Finally, we have the students who will be listening to the podcasts.

(2) Selection and Refinement of Evaluation Question(s), based on the Stakeholder Analysis. Before commencing the evaluations, the questionnaires and the core interview questions will be shown to members of the administration and teaching staff to ensure the evaluation will provide them with all of the feedback they require.

(3) Selection of Evaluation Methodology. In any evaluation there is the choice between qualitative and quantitative methods. The area of learning technology is inherently multidisciplinary and we believe it is better to choose the evaluation method best suited to the situation instead of keeping to one paradigm. In our case we aim to mix the two, triangulating in order to achieve valid results.

(4) Selection of Data Capture Techniques. For the students this will mainly be through questionnaires and technical data collection but also some semi-structured interviews will be conducted. The questionnaires must be presented to students in a fashion that will encourage the most participation. There are two possibilities for this: an electronic online version or a paper based version. Electronic questionnaires are preferred, as they have several data collection advantages. Firstly, they allow easy data collation when the survey is completed, reducing the chance of answers being misread or incorrectly entered into a computer system. Secondly, online systems allow easier dissemination to a large group of users. The main disadvantage of electronic surveys is that the response rate is usually less than that of paper based ones, exasperating the problem of low feedback rates that podcasting already suffers. We will try to circumvent this by using a web-based questionnaire, with the possibility of including a reminder system for those who do not complete the survey in a timely fashion.

Past experience has shown that the student group will be less willing to provide feedback. Student questionnaires will be anonymous and completed online, however interested students will also be able to volunteer for focus group discussions via a tick-box. We will also use technical records available from the podcast servers to create statistics on the number of downloads per podcast and where the podcasts were requested from, be it university, at home or whether there is interest from overseas. It should be noted however that this data will be the number of accesses and may not be related to the number of times the podcasts were actually listened to.
The evaluation of the lecturer’s experience will be through questionnaires and semi-structured interviews. The teaching staff will be completing their questionnaires and interviews during and after this project under very different prerequisites than the students. They will have actively chosen to be part of this project and hence are likely to be more willing to provide feedback and discuss their experience. In the first instance a questionnaire will be used to gather basic statistical data, thematically grouped on our assumptions. Following the questionnaires, the lecturers will be interviewed to allow us to gain a more in depth knowledge and understanding of their experience and issues they had faced. The lecturer will not be left to their own devices during the project-training and advice will be given and reports of the problems they encounter throughout their podcasting experience will be noted.

(5) Selection of Data Analysis Techniques. Analysis of tick-box style questions will be performed with standard statistical analysis tools. The written comments from the questionnaires and the recorded interviews/focus group discussions will be combined into a report. The results from the evaluations will firstly be disseminated to the stakeholders, and used to improve the podcasting project. They will also be published to the research community to allow others to learn and benefit from our experiences.

(6) Choice of Presentation Format. Both a formative and a summative report will be presented to the stakeholders of Project Podcast.

8.5 Project Podcast Preparatory Evaluation Plan

In this section we discuss our plan for conducting the evaluations of both the student and lecturer populations, including considerations for timing, survey form and limitations.

Timing: The time(s) at which the evaluation(s) are given during the course should be considered carefully. Our previous experiences have found that the last lectures of a course are often poorly attended and so this is not an ideal time to get feedback. Running a survey half-way through a course may offer more benefits, as the lecturers are able to respond to feedback and adjust their podcasts appropriately. The online questionnaires give us the flexibility to choose the best time for each course, however we intend to run them both half-way through, as well as at the completion of the course. Some students may also be interested in participating in focus group discussions regarding their podcasting experience. These students will be rewarded with small gifts (such as vouchers to be used at the local university caf) for giving up their time. Project Podcast will include continuous dialog with the lecturers involved, allowing us to tap into their experiences. We will also send out online questionnaires and conduct interviews/focus group discussions after the course have finished. This will allow them to give us feedback on their complete experience, including how lecturers adjusted their podcasts after the student surveys midway through the course.
Survey form: The questionnaires (see appendix 1 and 2) we have created contain questions regarding age, gender and language proficiency to allow us to determine whether the medium is better suited to certain demographic groups. The Likert style questions are used to estimate the level of satisfaction a person has concerning podcasting. The questions are separated into four categories based on our assumption of a practical thematic division: technical/environmental issues, podcast content, pedagogical issues and overall impressions. The semi-structured interviews/focus group discussions will be based on a core set of questions from each of the four categories, with free conversation and comments encouraged.

Limitations: Drawing solid conclusions from surveys that have a low response rate is risky. Our survey has been designed to allow it to be as easy as possible for students to complete and to encourage feedback from the greatest number of respondents. However, if the survey is not widely disseminated then drawing conclusions will still be risky. One will often find that it is the students at the extremes (either those who love the idea or those who hate it) that are the ones who will make themselves heard the loudest. The medium is likely to be better suited to particular learning styles or demographic groups (e.g., auditory learners or student with English as a second language) and this is expected to show through in the results.

8.6 Conclusion

The aim of this work was to generate a preparatory evaluation plan to enable us to effectively and efficiently assess Project Podcast. From our experiences and that of others we have found that students are reluctant to give feedback on podcasts. To circumvent this we will use closed questions, with tick boxes and conduct the questionnaires using a web based system. This data will be combined with that gathered in the semi-structured interviews and focus group discussions. The survey will include the lecturers, as we think they have been overlooked in the past in mobile learning projects. This will allow for more rounded conclusions on the perceived value of podcasts to be drawn, with perspectives from both the teaching staff and students involved. Finally, positive results will be used to encourage management and funding bodies to continue their support for technology based projects of this kind.

Bibliography


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Appendix 1 : Student Questionnaire

Following are several questions about your perception of and experience with podcasting. Please tick the appropriate boxes.

Age group: ☐<20 ☐21-25 ☐26-30 ☐31-35 ☐36-40 ☐>40
Course: ☐Computer Science ☐Economics ☐Japanese ☐Music ☐Education
Gender: ☐Male ☐Female
English language proficiency: ☐Native Speaker ☐Fluent Speaker ☐Average skills ☐Basic skills

LC: LectureCast
SC: Sup!Cast

Technical/Environmental Issues

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downloading the podcasts was easy</td>
<td>LC ☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>I listened to the podcasts on a mobile device</td>
<td>LC ☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>I found the podcasts were distracting when I was performing other activities</td>
<td>LC ☐</td>
<td>☐</td>
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<tr>
<td>I had to focus intensely to follow the podcasts</td>
<td>LC ☐</td>
<td>☐</td>
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</table>

Podcast Content

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The podcasts had substance and were interesting to me</td>
<td>LC ☐</td>
<td>☐</td>
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</tr>
<tr>
<td>I listened to all of the podcasts</td>
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<tr>
<td>The length of the podcasts was about right</td>
<td>LC ☐</td>
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<tr>
<td>I only listened to sections of the podcasts</td>
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</table>

Pedagogical Issues

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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</thead>
<tbody>
<tr>
<td>The podcasts supported my studying</td>
<td>LC ☐</td>
<td>☐</td>
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<tr>
<td>I found them beneficial for the course</td>
<td>LC ☐</td>
<td>☐</td>
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<tr>
<td>The podcasts suited my learning style</td>
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<td>☐</td>
<td>☐</td>
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<tr>
<td>I listened to the podcasts with enthusiasm</td>
<td>LC ☐</td>
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Overall Impression

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<tr>
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<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The podcasts were a great addition to my study-kit</td>
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<tr>
<td>There was a need for podcasts in this course</td>
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<tr>
<td>I would encourage the use of podcasts in more courses</td>
<td>LC ☐</td>
<td>☐</td>
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<tr>
<td>It was worthwhile listening to the podcasts</td>
<td>LC ☐</td>
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☐ I would be interested in participating in an interview/group discussion on my perception and experience with podcasting

Thank you for your time! We would appreciate your comments on podcasting in this course.

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Appendix 2 : Lecturer Questionnaire

Following are several questions about your perception of and experience with podcasting. Please tick the appropriate boxes.

Age group: [ ] 21-25 [ ] 26-30 [ ] 31-35 [ ] 36-40 [ ] 40-45 [ ] 46-50 [ ] >50
Course: [ ] Computer Science [ ] Economics [ ] Japanese [ ] Music [ ] Education
Gender: [ ] Male [ ] Female
English language proficiency: [ ] Native speaker [ ] Second language

LC: LectureCast
SC: Sup!Cast

### Technical/Environmental Issues

<table>
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<tr>
<th>Question</th>
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<th>Undecided</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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<tbody>
<tr>
<td>It was easy to produce podcasts</td>
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<tr>
<td>The support I got was adequate for my needs</td>
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<tr>
<td>I got support when I wanted it</td>
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<td>The recording equipment was simple to use</td>
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</table>

### Podcast Content

<table>
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<tr>
<th>Question</th>
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<th>Undecided</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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</thead>
<tbody>
<tr>
<td>I made a script before recording the podcasts</td>
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<tr>
<td>It was easy to get people to participate in the podcasts</td>
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<tr>
<td>I found it easy to come up with material for the podcasts</td>
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<tr>
<td>I enjoyed working through this medium</td>
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### Pedagogical Issues

<table>
<thead>
<tr>
<th>Question</th>
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<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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<tbody>
<tr>
<td>It supported my teaching</td>
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<tr>
<td>This was a useful medium for me in this course</td>
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<tr>
<td>I think the podcasts aided the students learning</td>
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<tr>
<td>Feedback was easily obtained about the podcasts</td>
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### Overall Impression

<table>
<thead>
<tr>
<th>Question</th>
<th>LC</th>
<th>Agree</th>
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<th>Disagree</th>
<th>Strongly disagree</th>
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<tbody>
<tr>
<td>The students seemed to appreciate my efforts</td>
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<tr>
<td>I was enthusiastic about producing the podcasts</td>
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<td>I would encourage the use of podcasts in more courses</td>
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<td>I found it a valuable use of my time</td>
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Thank you for your time! We would appreciate your comments on podcasting in this course.

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Abstract

The advancement of technology has had impact on almost all the aspects of human activities. Learning as one representative of these activities is going through changes as a result. For example, the use of mobile technologies and devices in the learning domain has lead to a magnitude of research, resulting in the field of mobile learning. Context plays a crucial role in any learning activity, and it is impossible to separate the participants, the technology, the activities and its focus, from the environment where it takes place. The focal point have been mostly on the technical side but as in all real-world situations, they exist in an inherently complex setting where social as well as personal implications comes to play an important part in order to reach sustainability. We believe that the lack of sustainability is a result of a barely existing holistic view of the educational situation and claim this complexity can be addressed with an extended view of context thinking. To accomplish this, we suggest a combination of hard and soft approaches, as practitioners need to become competent in context thinking from both perspectives.

Keywords: context, mobile learning, soft system methodology, sustainability

9.1 Introduction

The evolution of technology has had impact on almost all aspects of human activities. Mobile literacy is prevalent in most societies and mobile devices are present in every day life. Learning is one example of the human activities and it has been subject to these changes as well. Initially, the use of computer-based training, and later on networked-based learning, especially due to the development of the World Wide Web, led to the introduction of the e-learning concept. Moreover, the advancements in mobile and wireless technologies have also had an impact on the educational settings, thus generating a new approach for technology-enhanced learning referred to as mobile learning. Current development trends of the mobile technologies combined with access to content almost everywhere and all the time, allows people new experiences regarding learning in a variety of educational settings. Mobile learning has gained wide acceptance by the research community especially due to the popularity of mobile devices (Rogers et al., 2005) (Syvänen et al., 2005). The progression to enter the educational arena has happened but still there is a lack of sustainable mobile learning situations. Applying mobile devices can offer great flexibility in the learning process but the environment, technology, participants and activities need to be better fitted towards each other. Hopefully this in turn will increase sustainability and also in the long run be able to prove that mobile technology has improved and enhanced learning.
This paper proceeds with a problem area description that led our research. This is followed by our considerations concerning learning and mobility. Thereafter we describe our definition of context. After that we move on to systems thinking and the subset of hard and soft approaches. We continue with our idea of tackling the issues of sustainability for mobile learning with the need to address context from a more holistic viewpoint. Then we introduce Soft System Methodology as a suggestion of a “tool” to extract the expanded view of context. We conclude the paper by stating that a combination of hard and soft approaches is needed in order to fully understand mobile learning situations in an attempt to reach sustainability.

9.2 Problem Area Description

Mobile learning is inherently multi-themed and a very intricate endeavor to take on and the research community seem to be taking a keen interest but there is a need to start generating insightful results and show sustainability. There is also a need to have timely feedback on what works and what does not. Measurements ought to be built into the approach and there is a need for a greater emphasis on learning rather than technological success. Yet we see that the sustainability is lacking and it is time to acknowledge the “mess”. What is before you is complex, and the causal relations are not as simple as they are made to be. The need for approaches is eminent in order to deal with this appropriately. We also need to consider that an approach is closely related to the issues at hand and that one particular approach may not be able to provide all the answers or even come with suggestions. However, it may still provide knowledge concerning those issues that may have impact on the sustainability of mobile learning situation.

9.3 Learning, Knowledge and Mobility

Despite the changes initiated by the evolution of the technology, the aim of the learning has always remained the same; to gain knowledge. The Oxford dictionary defines learning as “the cognitive process of acquiring skill or knowledge”. Others define learning as social activity that is primarily based on collaboration (Brown and Duguid, 2000). In this aspect the collaboration could occur between actors and with the help of artifacts Hoppe et al. (2005). In this sense the recent mobile learning projects have primarily focused on developing new inquiry tools (primarily based on mobile devices) that could enhance the collaboration and knowledge acquisition. Such cases can be found in some of the projects of our group, for example AMULETS (Kurti et al., 2008). The same objectives can also be identified in other research groups’ projects (Sharples et al., n.d.). Since the inquiry process is an important aspect of learning and knowledge building, we can make an analogy between the mobile learning systems and inquiry systems. This analogy is based on the fact that mobile learning systems show the
characteristics of inquiry systems.

According to Churchman (1971), one of the pioneers of the inquiry system field, the inquiry is defined as “an activity, which produces knowledge”. Therefore learning and inquiry have the same goal; gaining knowledge. Knowledge is a keyword for both of the activities, learning and inquiry. There are many interpretations of what knowledge is in literature. According to Churchman (1971) “knowledge can be considered as a collection of information, or as an activity, or as potential”. Nyíri (2002) gives another definition of knowledge and reveals concisely the fundamental role of context, with “knowledge is information in context”. The Nyíri definition clearly states the intimate connection between information and knowledge. It describes this connection as something more than just simple collection; it describes the need of context as a catalyst for knowledge creation. Mobile learning can be described in terms of a data-information-knowledge-wisdom chain as illustrated by Figure 9.1.

The chain starts with data that usually resides on the system side. To transform the data into information there is a need for rules or protocols that should be defined by knowledge. This set of rules or protocols can for example be an alphabet or any communication protocol such as TCP/IP etc. This transformation usually happens on the system side. To transform information into knowledge there is a need of putting the information into context. The challenging part here is to define the context. In cases when context is defined from the system side we deal with some kind of system awareness, while if a user defines the context then it becomes more of a design input. The knowledge over time becomes wisdom or experience, which represents the last stage of the chain. From this perspective, the main challenge is to identify the methods for defining the context in mobile learning. Context became increasingly important in the mobile learning era and Frohberg (2006) classifies the context of mobile learning into five different categories: free, formal, digital, physical, and informal context. However, he does not address the issue of modeling the context. We believe that mobile learning research needs to acknowledge the complexity of context in order to reach sustainability. In the following sections we will describe our perspective on context and how to deal with it in respect to mobile learning.
9.4 Defining Context

Research increasingly indicates that the inability of students to apply concepts learned in formal contexts is in many cases due to the abstraction and de-contextualization of the learning (Brown et al., n.d.). But it is not the abstraction of knowledge as such that distracts learners, but rather that the abstractions are not illuminated with examples to put them into context. Understanding and learning is a product of the context and activity. Context provides a frame that guides and supports the learner. Situated cognition argues that learning is simplified by embedding concepts in the context in which they will be used (Brown and Duguid, 2000). There have been numerous attempts to define context. For example, Hull et al. (1997) defined context as “aspects of current situation”, which is a very broad definition. Another definition from a computer perspective is given by Brown (1996) where he defines context as “elements of the user’s environment which the computer knows about”. Dey and Abowd (1999) gives a human centric definition when they define context as “any information that can be used to characterize the situation of entities (i.e. whether person, place or object)”. In Figure 9.2, Tarasewich (2003) illustrates context as a combination of environment, activities and participants. These continuously change internally as well as in relation to each other which is indicated by the arrows. The timeline is there to stress that context is a sequence of snapshots.

Context is defined by Sharples et al. (2005) as “context should be seen not as a shell that surrounds the learner at a given time and location, but as a dynamic entity, constructed by the interactions between learners and their environment”. Our view of context differs slightly from these definitions, and is based on the idea to define context from the activity perspective and scale it down to attributes. Thus, we define context as “information and content in use to support a specific activity (being individual or col-
9.4 Defining Context

This definition of context relies upon a three-pole structure consisting of the following attributes; location/environment attributes, activity/task attributes and personal/interpersonal attributes. These attributes depend on time, and are placed on a time line. The attributes of this structure are interdependent, meaning that information about who the user is, where the user is, what the user is doing and the interplay between these activities needs to become valuable inputs to the design process. Winters and Price (2005) claim that the context in which an activity is taking place is crucial. In Figure 9.3 we make an attempt to model a context applicable to mobile learning. A central component of this model is the Learning Activity System, best described as a computational system and content repository that provides the technological infrastructure for integrating educational content into the context where the learning activity is taking place. The participants interact with the Learning Activity System and with each other, thus promoting different modes of collaboration.

The square of the conceptual model in Figure 9.3, basically defines one frame of context where the activities are taking place. The frame is defined by a snapshot in time. The Learning Activity System is the central component and provides the technological support for the collaboration between learners in the context that these learning activities are taking place. From a technical perspective, the implementation of the Learning Activity System relies upon the use of different software components and mobile technolo-
gies, as well as sensors in order to contextually support indoor and outdoor activities and collaboration.

9.5 Mathematical Representation of the Context

Our view of context is built upon a space-time paradigm. Space is defined by three-pole structures. The time dimension becomes important especially when it comes to historical dependencies that could affect user profiles (i.e. personal/interpersonal attributes), activities and location/environment. The space part of our context model is built upon the three-pole structure, which in turn is represented as three coordinate axes (cf. Figure 9.4). Each axis represents one of the attributes of our context model. It should be noted that this represents just one snapshot at a certain point in time ($t_1$).

If we perceive the learning activity as a spatial function and use the three pole attributes of the context, then the mathematical representation of a context definition will be a function:

$$f(X_{LE}, Y_{PI}, Z_{AT})$$

This basically means that context is a function of location/environment attributes ($X_{LE}$), Personal/Interpersonal attributes ($Y_{PI}$) and Activity/Task attributes ($Z_{AT}$) and time. The time factor is important especially when it comes to historical dependencies and their impact on context. Each of the $X_{LE}$, $Y_{PI}$ and $Z_{AT}$ variables are functions of sub variables as well. These dependencies are presented in Table 9.1.
9.6 Context as a Data Model

As Table 9.1 shows, the context is basically comprised of infinite dimensions that can be grouped into three major (location/environment, activity/task and personal/interpersonal) groups. McCarthy (1993) claims that contextual dimensions are infinite. Using this mathematical representation it is possible to build an infinite number of three-pole structures, which could be of use when representing context.

### Table 9.1: Spatial Context Representation

<table>
<thead>
<tr>
<th>Location/Environment $f(X_{LE})$</th>
<th>Personal/Interpersonal $f(Y_{PI})$</th>
<th>Activity/Task $f(Z_{AT})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_{LE} =$ longitude</td>
<td>$Y_{PI} =$ person</td>
<td>$Z_{AT} =$ type</td>
</tr>
<tr>
<td>latitude</td>
<td>group age</td>
<td>rules</td>
</tr>
<tr>
<td>building</td>
<td>membership</td>
<td>subjects involved</td>
</tr>
<tr>
<td>humidity</td>
<td>collaboration with</td>
<td>outcome</td>
</tr>
<tr>
<td>temperature</td>
<td>etc.</td>
<td>division of labour</td>
</tr>
<tr>
<td>light intensity</td>
<td>etc.</td>
<td>etc.</td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.6 Context as a Data Model

Using the three-pole attribute of our context definition we build a data structure based on XML. This data structure is extensible and relies on four child nodes. Three nodes represent the three-pole structure while the fourth node of the XML file represents the snapshot attribute. The Snapshot attribute consists of time and date elements. The data structure is designed according to the XML schema illustrated in Figure 9.5. The XML file that complies to this schema structure represents one snapshot of the context or one context frame as illustrated by Figure 9.3. Each of the nodes of the XML document represents one variable of the context spatial equation. Elements of these nodes represent different sub variables as presented in the Table 9.1. The context data model can be used as metadata model that accompanies content (such as pictures, audio files, video files, document etc.) that can be shared and distributed in the activities. Using metadata to capture context is advocated by Lehikoinen et al. (2007), where they argue that context-based metadata could improve and enhance movement and transmission of the content. Therefore we consider that having a structural organization of the context based on the three-pole structure, as metadata for different types of content can support and enhance collaboration between participants in mobile settings.

9.7 Thinking in Terms of Systems

The context thinking in regard to mobile learning seem, up to this point, to be rather limited in view and the key as we see it is to look at mobile
learning from a more holistic standpoint. This in turn will hopefully lead to practitioners gaining insights at all levels of mobile learning and be able to prove the potential improvement and enhancement of their efforts. It is important to realize that a thorough grip on context is the key to reach sustainability for mobile learning. In other words, we have to deal with things contextually. In other words, we should not handle the parts of a situation in isolation but rather deal with them as a compound. We have to regard all the attributes of a situation and see how they interact with one another. We cannot change or expect to change one of those attributes without impacting on or having to change some of the others. A sustainable mobile learning initiative would indicate that our mental paradigm (the model of the system in our minds) reflects the situation (real system) well. When little and no sustainability for mobile learning exist this indicates that our mental paradigm does not reflect the situation well. If we want a different outcome from a situation, in this case sustainability for mobile learning we have to come to terms with the system that underpins the situation in such a way that it delivers this output. In order to fully understand the underlying system, you must have a philosophical commitment on how to perceive the world and deal with issues you want to address. It is a way of looking at a situation from a holistic point of view, always searching for all the
attributes it is made up of and looking for the inner and outer boundary.

Churchman (1971) defined that a system has a goal, a purpose to fulfill and is made up of elements somehow related to each other. The elements themselves have a purpose as well but combining the elements has a greater effect than if they operate separately. The system is thus more than the sum of its elements. In order to investigate a particular issue an understanding of the connections and interactions between the elements that comprise the entirety of the system need to be reached. This kind of thinking may be used to study any kind of system be it natural, scientific, engineered, or human. But to think in terms of systems require an eye for seeing events, patterns, systemic structures and mental models. These models are a way of representing situations in the real world and can be expressed in different forms, e.g., conceptual, physical, data, and mathematical. To reach these models either a hard or a soft approach need to be adopted and the difference is summarized in Table 9.2, which has its origin from Pidd (1996).

<table>
<thead>
<tr>
<th></th>
<th>Hard approaches</th>
<th>Soft approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model definition</strong></td>
<td>A representation of the real world</td>
<td>A way of generating debate and insight about the real world</td>
</tr>
<tr>
<td><strong>Problem definition</strong></td>
<td>Clear and single dimensional (single objective)</td>
<td>Ambiguous and multi-dimensional (multiple objectives)</td>
</tr>
<tr>
<td><strong>People and organization</strong></td>
<td>Not taken into account</td>
<td>Are integral elements of the model</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>Quantitative</td>
<td>Qualitative</td>
</tr>
<tr>
<td><strong>Goal</strong></td>
<td>Solution and optimization</td>
<td>Insight and learning</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Product or recommendation</td>
<td>Progress through learning</td>
</tr>
</tbody>
</table>

**Table 9.2: Difference between Hard and Soft Approaches**

Senge (1990) states that all human endeavors are systems and bound by interrelated actions. A system, either natural or mechanical, that is not influenced in any way by a self-conscious being, i.e. humans is best suited for hard approaches. In this research, we are discussing a system that is designed, built, and maintained by humans, and therefore we cannot solely use a hard approach, even though an element is technological. A hard approach enables us to see the elements and take them apart. It is usually the first step in tackling issues, focusing on one attribute at a time and trying to understand everything within that scope. A hard approach is more about understanding how things work in isolation, and more focused on finding differences rather than similarities. In our case, this is too limiting since when we break things down into smaller and smaller attributes, we tend to lose sight of the interactions between them. We need to understand how the attributes behave together in order to suggest improvements. Another problem with a hard approach is that it is a bottom-up approach, so it needs to be complemented with a top-down approach. For a soft approach, the opposite apply.
9.8 Mixing Things Up

A combination of both a hard and a soft approach would enable us to see the attributes and take them apart, while still not losing track of the interactions. The soft approach would be working from outside of the scope while the hard approach is working from within. We therefore feel that hard and soft approaches should be seen as complementary and mutually reinforcing each other. The idea is to think both from a hard respectively a soft approach to maximize the understanding of situations and the issues at hand. The attempt is as much about troubleshooting our own mental paradigms as it is about troubleshooting the situations and issues we face. It enables the perspective of both hard and soft approaches and thus provides more realistic, pluralistic and holistic models to be presented. A fundamental assumption is that everything is contextual and everything interacts with, affects, and is affected by the attributes around it. The key to this approach is that systems are made up of repeating patterns. We see patterns in things, situations etc. This enhanced context thinking enables us to identify the pattern (draw the box) so that we can think outside of it. Context is difficult to deal with as it is dynamic in texture and its elements change all the time and affect each other differently every time they do so. The important thing to realize is that we can train ourselves to think about context in a deliberate way. In other words, it helps when you can define your frame of reference (the box) clearly. Unless you are able to draw the box, you can certainly not think outside of it. Once you have drawn the box, you can escape it and this is invaluable when it comes to our expanded view of context.

Mingers (2000) argue that three purely analytical dimensions or aspects need to be considered in all real-world situations: the material, the social and the personal. The material world refers to aspects of the situation that concern physical space-time, entities and objects. The social world can be seen as the norms, language and practices. Finally, the personal world take into account the intricate power of personal experiences with feelings, beliefs and choices. It is our opinion that practitioners in the field of mobile learning need to develop ways to understand these important dimensions. The main argument we want to bring forward is that all real-world situations, no matter how technical they appear, exist in complex organizational environments, which has social as well as personal implications. As a suggestion to deal with this the benefit of soft approaches are evident and Soft System Methodology can be seen as its flagship bringing a strong structure to the table.

9.9 Introducing Soft System Methodology

Checkland developed Soft Systems Methodology in the 1970s as a systemic approach in order to perceive, predict, compare and ponder on changes for a real-world situation. It should not be regarded as a technique or a
method but a methodology as the name it self points out. Checkland (1999) stresses that the outcome of research is not a method but a set of principles. The starting point for Soft Systems Methodology is that the real world is seen as a complexity of relationships and these should be explored via models of purposeful activities based on explicit world-views. It is critical to formulate the root definition and collect the minimum amount of necessary activities in order to structure these activities into basic conceptual models. The next step is to compare these to the reality. Inquiry is structured by questioning the perceived situation using the models as a source of questions in turn. Action to improve is based on finding accommodations (versions of the situation which conflicting interests can live with). This inquiry is in principle never-ending.

Soft Systems Methodology is a means to learn and communicate about a system where humans are an attribute. The special nature of these means that systems studies concerned with them is always multi-facetted, with many relevant and often conflicting values to be explored. The outcome is never a solution to a problem; it should rather be viewed initiative to start a learning process with no end, to form the basis for action. Soft System Methodology addresses the broader system in a profound, self-perpetuating and reinforcing way. It enables us to deal with the attributes of a situation in combination rather than in isolation. Its power lies in its body of knowledge and techniques. It offers the potential to find the context in respect to any situation. Soft System Methodology is useful when rigor and deep insights are needed under these circumstances: multiple goals, different views and perspectives, different assumptions, different logics, different stakeholders i.e. a very complicated situation.

For the case of mobile learning we clearly see that the above applies and we want to address this complexity with Soft System Methodology, as it provides a “tool-set” to be able to grasp the context from an extended view. This can be the key to fitting the environment, technology, participants and activities appropriately and in the long run reach sustainability.

9.10 Conclusion

Mobile learning is exposed to an inherently complex situation, which results in issues with sustainability. In order to understand the situations and the issues that may impact that sustainability of mobile learning and suggest improvements we need to create an overall picture. Mobile learning must be studied within the context it is deployed in. This concern mutually the material, social and personal world, although their relative importance will vary depending on the situation at hand. It is our belief that in order to promote and achieve sustainability in mobile learning, an extensive view on context needs to be used. Model building in itself should not be seen as a way to provide the “answer” to anything; it is merely a way of creating a platform for reflection and a communication tool. Knowledge of the world is
incomplete and subjective, so the process of creating models is iterative and evolving. A model is used to represent something, and the representation might be true to real life or may be conceptual in its attempt to emulate real-life. Instead of focusing on sustainability in isolation for mobile learning, using hard and soft approaches enables us to better understand the attributes and the context. The hard approach enables us to focus on the attributes on a more technological level. The soft approach is a top down approach aiming for a holistic view and the underpinning philosophy is interpretive and its systematic nature makes it suitable for dealing with complex situations. We therefore feel that hard and soft approaches should be seen as complementary and mutually reinforcing each other. We therefore suggest combining the hard and the soft approach. These efforts would maximize our understanding of the situation and the issues at hand. Both the strength and weakness of this suggestion is that it needs to be done by people truly involved and able to see the attributes at play. Drawing up the box and having a grip of the whole context is a very demanding chore.

Nonetheless, the expanded view of context might provide the palette to reach sustainability for mobile learning. The intention is to elucidate the most important attributes in the context of mobile learning but still having a holistic viewpoint in mind.

Bibliography


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Appendix A

A Mapping to Areas of Concern and Evolution

This appendix shows how different questions during the research can be mapped to an area of concern and an evolutionary stage. Each evolutionary stage is presented, from Idea, to Experiment, to Project, and each stage maps the questions to an area of concern: (T)echnology, (L)earning, (S)ocial and (O)rganization.

A.1 Idea

<table>
<thead>
<tr>
<th>Questions</th>
<th>T</th>
<th>L</th>
<th>S</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do the students have access to portable digital audio players?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do the students have any previous experience with podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much time does a student spend listening to digital audio?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which types of material would the students find interesting?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(recorded lectures, summaries and extra information, topical issues)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do the students intend to listen to the first podcast?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In what situations do the students listen to digital audio?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(walking, bus/car, exercising, on the bike)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
A.2 Experiment

<table>
<thead>
<tr>
<th>Questions</th>
<th>T</th>
<th>L</th>
<th>S</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the students have any problems finding a device?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students find the audio quality acceptable?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Why did the students not download the podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(still plan to, problems accessing from home, not interested, forgot, technical problems)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students remember to download the podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students remember to listen to the podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To what extent did the students listen to the provided podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are the students perception of the podcasts listened to?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the ongoing intention of the students regarding the provided podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many podcasts did the students download?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students listen to all the material? (per podcast)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students get distracted while listening to the podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
## A.3 Project

<table>
<thead>
<tr>
<th>Questions</th>
<th>T</th>
<th>L</th>
<th>S</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the students find it easy to download the provided podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students use a portable device to listen to the podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the lecturers find it easy to use the recording equipment and to produce podcasts?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the lecturers find the support adequate and provided when wanted?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students find that podcasts were needed for the course?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the students willing to listen to all of the podcasts and in their entire length?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the podcasts suit the learning style of the students and did they listen to them with enthusiasm?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students find the podcasts a great addition to the study-kit and useful to support the studies?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the students find the podcasts worthwhile to listen to?</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the lecturers find it easy to come up with material for the podcasts and did they make a script?</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the lecturers find that the podcasts supported the teaching and were useful as a medium for the course?</td>
<td>X</td>
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<tr>
<td>Did the lecturers find that the podcasts aided the students learning?</td>
<td>X</td>
<td></td>
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<tr>
<td>Did the students find the podcasts interesting and that they had the right substance and length?</td>
<td>X</td>
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<tr>
<td>Did the students find it possible to perform other activities while listening, and how much focus did they need to follow the podcast?</td>
<td>X</td>
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<tr>
<td>Did the lecturers find that the students seemed to appreciate the effort?</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>To what extent are demographic characteristics considered? (both lecturers and students) (age, discipline, gender, English language proficiency)</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Would students respectively lecturers recommend podcasts to be used in other courses?</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Did the lecturers find it easy to get people to participate in the podcasts?</td>
<td>X</td>
<td></td>
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<tr>
<td>Did the lecturers find podcasts useful as a medium and enjoyable to work with?</td>
<td>X</td>
<td></td>
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<tr>
<td>Did the lecturers find that it was easy to obtain feedback from the students?</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Did the lecturers find it motivating and a valuable use of their time to produce podcasts?</td>
<td>X</td>
<td></td>
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</tr>
</tbody>
</table>