Participatory design of a mobile application for teenagers’ language homework

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ABSTRACT
In this paper we focus on the design, and in particular the design process of a mobile application for teenagers’ homework in Swedish as a second language. We have used participatory design methods, with the aim to have a user-driven design process. The design process was iterative with several interventions with the students and their teachers. We discuss to what extent the design methods used and applied supports user-driven design. The analysis of the design process showed that it was not to be considered as fully user-driven but it is instead reasonable to consider it as a balanced design process, where the students’ design work was essential for the final product. The application was used in two field tests. The field tests were evaluated using pre- and post questionnaires focusing on the attitudes and opinions of the students using the application for their homework. Results from the questionnaires showed that fully supported mobile learning activities are needed in order to achieve positive attitudes from the students towards using the mobile application for learning Swedish.

Author Keywords
Participatory design, teenagers, second language learning, homework, mobile learning, field testing, student attitudes.

INTRODUCTION
In this paper we describe and analyze the design process of a mobile application for teenagers’ Swedish language homework. In the project we have used participatory design methods, with the aim to have a user-driven design process. We wish to discuss how these design methods relate to the concept of user-driven design, and how the results of the design process are related to the participants, and their contexts. The final design of the application, called the Mobile study assistant, was evaluated using pre- and post questionnaires focusing on the attitudes and opinions of the students using it for their homework.

The current project was a collaboration between researchers, a mobile learning software company and an organization promoting Swedish culture and use of the Swedish language in Finland. The aim of the project was to increase the motivation for learning Swedish as a second language in Finland. Swedish used to be the official language in Finland, widely used by e.g. public authorities. Nowadays only a minority speaks Swedish even if it is an official language, alongside Finnish. Swedish is still an important language for many professional positions in Finnish society. However, the interest for learning Swedish has decreased in Finland. Swedish as a school subject has been under political discussion for quite a while now, and it is no longer a required subject in the final exams from upper secondary school. The development of a mobile application for Swedish language homework is one part of the promotion in order to enhance interest for Swedish. In addition, we have investigated if and how the students’ motivation in learning Swedish changes when introducing a mobile learning tool in that activity.

A research and development team organized the main design process in the project. The design process involved 36 students, which were involved in the development of the application using an iterative design process via design workshops (Löwgren & Stolterman, 2004). The students participating in the workshops were in the age of sixteen to eighteen, engaged in the school subject Swedish as a second language in three secondary upper schools in different parts of Finland. The methods used for the workshops were inspired by the relatively long tradition of

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cooperative/participatory design (Greenbaum & Kyng, 1991). The general idea of using these methods was that they have been proved to be successful for extensive user involvement in software development. In the project three different workshops were arranged with the students. The development team worked with analysis and various design activities in between the workshops.

The study of the students’ attitudes towards learning Swedish using the mobile application was carried out independently from the design process and the work of the development team. We will report the results of this study after describing the design process, and the analysis of it.

Research questions
With a focus on the design of the Mobile study assistant, and how much the students contributed, we formulated the first research questions as follows:

How user-driven was the design process when designing the Mobile study assistant?

In order to say something about how successful (or not) the design and its process was, we have analyzed the design process, but also investigated its outcome – the Mobile study assistant, the product, and the students’ attitudes towards it when they were using it. From this a second research question was formulated:

Did the use of the Mobile study assistant have any positive effects on the students’ attitudes towards learning Swedish?

DESIGNING FOR LEARNING
The concept of design is a rising concept in educational science, and it concerns several aspects and processes. One important movement is the so-called design-based research (The Design-Based Research Collective, 2003) emphasizes the relationships among theory, artifacts, and pedagogical practice. The design of artifacts does not necessary mean only digital learning environments, but a rich flora of materials. The design-based research perspective views educational interventions as interactions between teachers, students and materials.

This perspective is useful for interaction design of learning environments because it adds didactic design to the traditional processes of interaction design. We cannot ignore the very important fact that learning is the main design objective. We also have to relate to the fact that students’ learning already take place, in many cases without any digital material. Students are already carrying out their language homework within the already established educational setting. So, what does digital technology, and mobile technology in particular add to these activities of learning Swedish as a second language in Finland? We will not give the full answer to these questions, but we will reveal a discussion of the issues with the teachers and students that were participating in the project.

The main research objective of the project was to create a user-driven design process, and carry out research about this particular process. This means that the workshops carried out might have been changed a bit during the design journey to the ‘product’, and also between the more or less repeated design workshops carried out in different schools in Finland. In other words, the design process of the artifact was more important than carrying out the design workshops in a strictly scientific manner. This might be seen as a challenge of doing research close to pedagogical practice.

Cooperative or Participatory design (Greenbaum & Kyng, 1991) meets the requirements of the design-based research methods, it is close to praxis, and it might involve both teachers and students. Participatory design has been applied to the learning area in several projects (see Druin 1999; Taxén et al, 2001). According to Mazzzone, Read and Beale (2008), teenagers is more seldom a targeted group of users compared to children, at least in the last decade children have been forming its own area of interaction design research. How difficult is it to invite teenagers into the design process, and even let their ideas be the ones to develop? If learning is the main goal for design, how can we at the same time make the ideas of the teenagers prominent? These were important challenges for the design process.

How user-driven is user-driven design? We have used the analysis tools developed by Janet Read et al (2002) as a support for us to analyze and reflect on the participatory design processes during the design of the homework application. They use a model including different levels of participation, and contributions of domain experts in the design process: Informant, Balanced, and Facilitated design (IBF). Furthermore, we have used the IBF participatory continuum model and its variables Environment, Knowledge, Skills, and Security in order to analyze the details of our design activities. We think that this model will help us to analyze and reflect on our design activities, and put light on important issues when designing for learning.

Overview of design and research process
The project collaborated closely with three schools in different areas in Finland. This was a wish from the main stakeholder of the project, a Finnish organization promoting the Swedish language and culture in Finland. It was also important to get in contact with teenagers that have different language contact with Swedish, and also have different digital habits, especially with the focus on use of mobile phones. The students participating in the project were chosen by the schools.

School 1: Northern Finland, 13 students participated. Swedish was the main language used to communicate with the
students. One teacher who was attending the workshops translated Swedish into Finnish when necessary.

**School 2:** Western Finland, 14 students participated in the workshops. Swedish and Finnish was used to communicate with the students. No teachers participated in the workshops.

**School 3:** Southern Finland, 9 students participated in the workshops. Swedish and Finnish was used to communicate with the students. No teachers participated in the workshops.

In all workshops data were mainly collected via drawings and text written by the students. Video, photographs and notes were used as secondary data sources. Every workshop lasted for about two hours depending on other activities and the conditions in the schools.

**Pre-studies**

In order to get to know the field of homework, and the teachers’ procedures about them, a questionnaire was sent out to teachers associated to the network of the main stakeholder in project. Nine teachers answered the questionnaire, and the findings were that homework in Swedish was given two to four times a week. A simple homework exercise concerned vocabulary and grammar, and a more advanced homework involved reading and writing. Homework was normally followed up by oral discussions in class.

**Participatory design and prototype development**

Two types of design workshops were carried out. The first was a Future workshop and the second focused on paper prototyping by the students. The results from the workshops were used as a very important material for the prototype development. PowerPoint-prototyping was used for communicating the design ideas with a pedagogical advisory board connected to the project as well as programmers. The mobile prototypes were developed using Java ME.

**Prototype evaluation and product development**

Students from the three schools evaluated the first prototype. A group of teachers evaluated a refined and further developed version of the prototype. After the workshop with the teachers a full-fledged version of the Mobile study assistant was developed.

**Evaluation of the Mobile study assistant in schools**

The Mobile study assistant was evaluated in a larger field test during the autumn of 2009, and in a smaller field test with one teacher and her students during the spring of 2010. Pre- and post questionnaires were used as a tool for investigation.

**DESIGN WORKSHOPS AND PROTOTYPING**

The future application that the development team had in mind at the beginning of the project was loosely defined as a mobile application for Swedish homework to the students. This was the frame, and the starting point presented to the students in a first series of workshops, which were conducted as a Future workshop following the line of Participatory design. The purpose of a Future workshop is to gather information about the users current situation, and their ideas of a future application suitable for their needs.

**Future workshops**

The future workshops started with a presentation of the project, its partners, and its future goals. We also introduced and discussed with the students the interplay between avail and joy in learning, and how it was important for the project to combine “business with pleasure”, when learning Swedish.

After a short intro of the whole journey from the first workshop to product development (the Mobile study assistant), we started to discuss what learning a second language is about, what kind of knowledge and skills are necessary in order to use a language. We gave the students some time to think on the different aspects of learning Swedish by asking the question “How do you learn a second language?” After that we developed a mind map of language learning together with the students. The idea of this part was to visualize language learning, and put up the frame for the next step.

Following the Future workshop concept developed originally by Kensing and Halskov Madsen (1991) we started with a critique phase, in which the students should try to identify all problems they saw with the current learning situation, the future application, homework, and schoolwork on mobile phones. In order to frame the discussion even more we asked the following questions: 1. What is hard when learning Swedish? 2. What problems do you have with your homework? 3. How do you use your cell phone today? 4. What problems do you see with mobile phones and schoolwork?

After that, during the fantasy phase of the workshop, the students went from problems to solutions using brainstorming in small groups. Every student wrote one idea on a post-it note and they posted all ideas on one large paper belonging to whole group. The brainstorming session ended up with a presentation of the different ideas for the whole large group.

As a last step they took some ideas further, and developed them into a language exercise that might work in a mobile phone. It was possible for them to borrow ideas from each other for the implementation step. We choose this as our implementation phase, and we did not at this moment exclude any of the ideas developed by the students. It was up to
them to choose the most stimulating idea, and describe it in more detail.

**Results**
The workshop resulted in a “mind map” of language learning, and more than 100 ideas for how to learn Swedish using a mobile phone. Although the workshops was not an investigation of student’s attitude and knowledge of learning Swedish, we dare say that they seem to have a quite good picture of what is necessary in order to learn a second language. There were differences between the student groups when discussing how to learn Swedish. Some students were more into learning the formal aspects of Swedish, while some other students also emphasized the cultural aspects when learning Swedish. However, as the project does not investigate these differences we will not dig further into this, but it says something about how different students are, and that we need to design for this.

**Prototyping with users**
After the first workshop, the design team analyzed the workshop material and matched it against realistic possibilities of mobile technology. The criteria used in the analysis covered technical possibilities and pedagogical aspects. This analysis resulted in eight design proposals:


The second series of workshops started with a detailed presentation of how the students’ ideas have been developed from the first workshop. The eight design proposals were explained, and we also carefully told the students what had been added by us as designers. We wanted to show the students that all their ideas had been useful, and that many of them were still in the design process. After this introduction, three design methods that we wanted them to work with were explained. The methods were: sketching, creating scenarios of use, and drawing and writing storyboards explaining the use of a design proposal. The large group was divided into three or four smaller groups.

![Figure 1. Paper prototyping during one of the design workshops.](image)

In the first session of the second workshop we let each group choose proposal, and we also instructed them to work with two proposals to get a good penetration of each design proposal. However, we changed this in the two following workshops, because it was a very demanding task for the students to work with more than one proposal.

**Results**
The workshop resulted in more knowledge about the students’ views on how each design proposal could work in a mobile application for homework. After this the team started to create digital prototypes using PowerPoint, in order to get a better idea of the different concepts developed by the students. These prototypes were then used in our communication with programmers and the pedagogical advisory board, in the process where a prototype running on a mobile phone was developed.

**Usability testing of the first mobile prototype**
The third series of workshops were designed as a kind of on-site usability testing, with aim to test the first prototype of the application running on the mobile phone. The prototype was quite advanced, and was connected to servers in Sweden, carrying out some of the processing for the application. We started the workshop by explaining what had happened since we met the last time – how the design process had proceeded. We also told the students of the feedback from the pedagogical advisory board connected to the project. The students gave us many proposals that concerned different types of exercises during the design workshops, so we decided that it was unproblematic from that respect to include an
existing vocabulary exercise software, called Learn, in the prototype. The new thing was that the function Learn now was connected to a news reader. The Learn function takes words from the texts read and create flash card exercises from it. The user can choose the language direction, i.e. Swedish-Finnish or Finnish-Swedish in our case.

The students were divided into groups (14 groups in total for all workshops), and they got one mobile phone per group to carry out the test with. They were instructed to take turns controlling the phone. They received a short manual for handling the application. They received six exercises on paper, handed out one by one to make sure that all groups were doing all exercises. Every exercise was covering one feature of the application:

1. **News reader** – the student can read Swedish news with this function, and use an integrated dictionary in order to look-up words for translations.
2. **Learn** – the student could make vocabulary exercises connected to the texts from the News Reader with this function.
3. **Music** – a music player with Swedish songs and lyrics as subtitles.
4. **Movies** – a movie player with a short Swedish film with subtitles.
5. **Chat** – a chat function that made it possible for the students to start chatting to each other.
6. **Search** – a search interface to a Swedish-Finnish dictionary.

Every exercise instruction was followed by several questions. In total, 20 questions had to be answered. Seven fields for other comments were also included in the exercise material given to the students.

**Results**
The results of the workshop gave us new insights into what students think are important when doing homework in a mobile application. One important conclusion was that the students wanted more exercises because of the fact that they felt uncertain if one really learn something just reading Swedish news papers or listen to Swedish pop music.

From the lessons learned from the usability tests more effort was put into the developing of a more elaborate application including for instance a grammar exercise engine, and more advanced content and interaction. We used this application in a meeting with a group of teachers, who had expressed interest in using the application in different schools. We let the teachers test the application, and we encouraged them to give us their reflections and comments of the new mobile application. After the meeting with the teachers, the development went into a final phase before the field testing of the application in ten secondary upper schools. This first field test in “the wild” was followed up with a much more supported field test in one school located in western Finland, reported below.

**DESIGN PROCESS – REFLECTIONS**
We will now analyze and reflect upon the participatory design process used during the design of the application. We will use the analysis tool, the participatory continuum model developed by Janet Read et al. (2002) in order to assist this task. According to the model, the participatory design can be described as a continuum with modes of Informant design, Balanced design and Facilitated design (IBF). The model focuses on the amount of participation by the design experts and domain experts. Informant design suggests informing role for the domain expert while design experts lead and realize the design. Balanced design suggests an equal partnership between the domain experts and design experts. Both parties inform and realize the ideas. Facilitated design suggests that the domain experts initiate ideas and lead realizing the design, while design experts facilitate the process. Read et al. (2002) point out that the amount of participation is not static, but may differ during the different phases of design activities.

Both the students and the teachers were recognized as domain experts in the project of mobile language learning. However, in the following analysis only the students are considered. In the project, the students’ role and importance was taken into account from start while planning the research approach. The workshops were initiated and planned in order to facilitate the students’ participation in the project. Their role was also stressed in the beginning of each workshop with them in without neglecting the role of designers. The actual activities varied as the project proceeded. In the beginning of the project, the students identified ideas and developed them further, while towards the end of the project, the students evaluated and tested the prototype. Transparency of various activities was of importance during the process. For example, it was described how students’ ideas were processed by designers and how they made their way through the process.

To put it in Read et al. (2002) terms, the process could be categorized as balanced design. The aim was to recognize the domain expert as equal partners with design experts. Both students’ and designers’ work was essential for the design process. However, it is the design experts that both lead and realize the design. Further, we should keep in mind that the overall aim, learning, as well as decisions on what ideas could and would be developed further, were taken solely by the design team based on various aspects (pedagogical, technological, economic etc.). This indicates power. The various participants might be considered partners, however they are not equal.

Read et al. (2002) have also identified four variables that affect the position of the group; Environment, Knowledge, Skills and Security. Environment refers to both cultural and physical environment in which a participatory design activity takes place. Read et al. (2002) argue that aspects such as room, furniture, seating arrangement and culture and structure of the
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organization as well as relative status of the participating individuals may affect the activities. Knowledge refers to various types of knowledge each participant brings into the design activities and that affect how the participants view their own and others ability to contribute to the participatory design activities. According to Read et al. (2002) cognitive skills, motor skills and articulatory skill will affect the individual’s ability to contribute to participatory design activities as well as functionality of the group. Further, also the individual’s feeling of security will affect how people contribute to participatory design activities.

The workshops in the project were carried out at the particular school sites. The school environment as a physical site and an organization framed also the workshop activities. The workshops were carried out in ordinary classrooms at two schools, while a conference room was used for the purpose in one of the schools. The tables in the rooms were rearranged in order to make group activities possible in smaller groups. Obviously, the rooms had a certain size and furniture and therefore made only partial changes in seating possible. However, workshops equipment such as pens and papers as well as fruit, candy and drinks suggested a somewhat different setting than the ordinary. The school environment suggests certain expectations between students and adults, such as adults being in charge and what would be suitable behavior between them. The environment advocates formal learning activities rather than informal ones. The students participating in the workshops knew each other or at least knew of each other. Many of them took the same classes.

Knowledge the students brought into the activities included familiarity with the task, learning a language. They were also familiar with mobile phones. One of the classes was specializing in information and communication technology, which also was shown in the discussions and suggestions they made using technological terminology. While cognitive skills, motor skills and articulatory skills or rather, the lack thereof might be crucial while working with young children, however, this was not at stake here. Students had no difficulty to take part of the given instructions, carry out the tasks and present and discuss results with others. Even though they were not familiar with a design project per se, the workshop activities included familiar activities such as drawing, writing and presenting.

THE FINAL PRODUCT AND ITS EVALUATION

The final version of the Mobile study assistant was further developed after the meeting with teachers in the beginning of the autumn of 2009. The final version was improved in several aspects based on the feedback from the teachers. The final version excluded some of functions from the prototype versions, but also added new functionality based on feedback from students and teachers.

The teachers could upload texts to a server, which only their student’s have access to using the Mobile study assistant. The News reader was connected to the dictionary, and to vocabulary and grammar exercises (see Figure 2). Music was an improved version of the music player, in which the student could listen to music with or without subtitles. Dictionary (“Ordbok”): Improved interface to the dictionary. My words (“Mina ord”): The student could save words that he/she felt were difficult, and later carry out exercises with them. Preferences (“Inställningar”).

The field tests and students’ attitudes

The students’ views on the Mobile study assistant were investigated with two questionnaires, which they answered both
before and after the first field test in the autumn 2009 and in the spring 2010. The selection of informants was done on convenience basis – they were the students whose Swedish language teachers had volunteered for the project. All the informants were Finnish speaking students who have been studying Swedish 2–8 years, depending on their age and stage of language studies. In the autumn 2009, altogether 112 students answered the pre-questionnaire and 97 answered the post-questionnaire. A little over half of the informants were senior high school students, one third vocational school students and the rest upper level comprehensive school students. According to the informant’s answers to post-questionnaire, only 59 of them had been using the Mobile study assistant one or more times, whereas others had not been able to because of technical problems. The test was therefore repeated in the spring 2010 with a group of senior high school students. This time the functioning of the Mobile study assistant was guaranteed by providing compatible mobile phones to all students. The group of informants, which answered the survey, was considerably smaller this time, as 9 students answered the survey before the test and 15 after the test. This time four of the informants reported that they had been using the assistant once and four not at all during the test period.

The two questionnaires consisted both times of three types of questions: multiple-choice questions where students were asked to give only one answer that they prioritize, multiple-choice questions with several options on a Likert scale of 1–5, and open questions where students could freely write about their views. Both questionnaires included questions about the students learning and motivation, attitudes to teaching of languages and Swedish particularly, and about their opinions of the homework given. In the pre-questionnaire, there were also questions about the student’s background and earlier studies, use of languages (Swedish particularly), and their expectations on the Mobile study assistant. The post-questionnaire included respectively questions about the student’s experiences with the Mobile study assistant and their views on using it in studying Swedish. The goal of the questionnaire was to let the students tell their opinion about using the Mobile study assistant and to find out whether the use of Mobile study assistant eventually could be proved to have a positive effect on student’s attitudes towards Swedish language and studying Swedish language at school.

The answers to both pre-questionnaires show that most of the students had very positive expectations for the tool, and they looked forward to try it. Many of the students seemed to have expectations about the experience in itself. They expected to experience something new considering the methods of learning and wished that it would make studying Swedish easier, more interesting, pleasant and motivating. Some of the students expressed concrete expectations about the assistant’s effect on language learning, and wished for increased learning results, e.g. better knowledge of the Swedish vocabulary and grammar. Nevertheless, there were also those who did not expect anything special. The answers also show that the students are used to carrying their mobile phones with them, and the new idea of using it in studying seemed thus like a natural idea for them.

The informants that answered the first surveys in the autumn 2009 form a heterogeneous group considering motivation to study Swedish language, study success and use of Swedish language outside school. On one end of the scale there are those who consider Swedish as an interesting and important school subject, talk Swedish regularly with their relatives or friends, visit Swedish web pages and get good grades in Swedish and feel good about their own language proficiency in Swedish. On the other end of scale are those who are not interested in Swedish and think that it is a pain to have the compulsion to study the language, do not ever use Swedish outside school and report that they get low grades in Swedish and estimate their own language proficiency in Swedish to be low. Compared to the larger sample, the small group of students who answered the survey in the spring 2010 estimated their language proficiency in the pre-questionnaire to be poorer than the group from the autumn 2009, but seemed to have a slightly more positive attitude to Swedish (note that the data is not qualified for statistical significances). Neither of the two groups gave more positive answers considering Swedish language after the test with the Mobile study assistant. It should be noted that though the results can be explained in both groups by the short test period (6–8 weeks). Motivation and attitudes are long term phenomena, which are on the one hand problematic to measure, and on the other hand are permanent and change very slowly (Dörnyei, 2001).

According to the answers to the first post-questionnaire (autumn 2009) students reflected on the technical problems with the internet connections and the compatibility with some mobile phone models, and quite many of them could not use the tool or could only try some of the provided functions. Those who did it criticized the degree of difficulty of the provided texts and exercises, which were experienced to be too easy especially by the senior high school students. The study shows though that the weaker students (those who themselves give low grades for they language proficiency in Swedish) seem to evaluate the test with the Mobile study assistant higher than the students with better language proficiency in both groups. The biggest difference between the two groups can be seen in student’s evaluations of the Mobile study assistant after the test. The larger group from the autumn 2009 gave in general lower grades to the Mobile study assistant than the smaller group from the spring 2010, where technical support and loaned mobile phones were provided. The smaller group agreed on that it was nice to try the Mobile study assistant, and they could think of using it also in other language studies and would like to continue using it in studying Swedish. They felt that they have gotten enough guidance in using the assistant and think that the assistant works well. All these statement got negative grade in the larger group who experienced technical problems.

**CONCLUSIONS**

Important here has been to analyze the participatory design process. Even though our users, mainly the students, were
part of the process and participated in great deal, it would be too much to say that the process was driven by them. The analytical model, as any other model, gives form to the certain analytical outline, but also leaves out others. The model focuses on the design activities in situ, what actually happens during a certain activity, such as a workshop where the suggested domain experts are present. However, a connection to a broader context would also be needed. By looking beyond the certain activities, we can move analysis to bridge the gap between individual (but not any particular individual) and context.

From the questionnaires we can see that compatibility problems caused by real life use of very different mobile phones is an obstacle for mobile learning activities, and that the attitudes towards mobile learning changed when the activities were fully supported. According to the answers in the questionnaires it can be concluded that the students enjoyed using mobile phones in language learning, presupposed a decent technical functionality and a right level of difficulty of the provided material.

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