SATIN 2 – How to Support Self-Efficacy and Diversity in End-User Development

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Abstract: We live in an era where information technology services and devices are more spread than ever, forming a basis for new innovations, even among ordinary people. And yet, producers of these services and devices are mostly men with programming skills. This means that women’s participation as producers of computer-based products is far from as influential as that of men. An approach to this situation is to provide end-user development environments where ordinary people with no programming experiences have the opportunity to develop their own smartphone applications. SATIN 2, a collaboration project between two universities, and IT-companies, funded by EU Structural Funds, has taken such an approach, with a focus on supporting particularly female end-users. Qualitative observation studies of 11 subjects have focused on how to support computer self-efficacy, and end-user programming strategies that women prefer to a higher degree than men. Observations indicate that the women were as positive to making use of the system as the men. The test subjects also showed signs of motivation as well as creativity while exploring the system. To support women’s own perceptions of self-efficacy related to developing computer-based systems is challenging, still indications of acceptance and enthusiasm for the system were observed.

Keywords. End-user development, Gender in end-user programming, Inclusive design, Self-efficacy theory, Diversity, smartphone applications
1. Introduction
We live in an era where information technology services and devices are more spread than ever, forming a basis for new innovations, even among ordinary people. And yet, producers of these services and devices are mostly men with programming skills. This means that women's participation as producers of computer-based products is far from as influential as that of men. One possible approach to changing this askew situation is to provide end-user development environments, where ordinary people with no programming experiences or skills have the opportunity to develop their own smartphone applications. SATIN 2, a system for user-driven service innovation, is a collaboration between two universities and a number of IT-companies, funded by EU Structural Funds. This project has taken such an approach, with a focus on supporting female end-users in particular.

The task of designing an app-building environment is by no means as simple as just doing it; there are a number of challenges to consider. The challenges considered in this paper ranges from the organization of such a project, including tools, methods and approaches, to how to support female strategies in end-user programming, what the typical problems in end-user programming are, and how to design the system to give support to users with these strategies and problems in mind.

1.1 Aim and objective
The objective of this paper is twofold. First we describe a possible foundation for succeeding with incorporating a gender and diversity perspective into a design development project, and present how we have collected our and former experiences in a web-based toolbox. We also account for how we have investigated a number of design ideas to use – or approaches to follow – in order to overcome challenges reported in previous research on gender and end-user programming.

1.2 Organization of this paper
The paper starts by introducing the SATIN 2 project and its objectives, section 2. Then we account for literature related to the objectives of this paper in section 3. Methodological considerations follow in section 4. In section 5 the outcome and results of the SATIN 2 project are shortly described from the gender equality perspective, related to project organization as well as design aspects. Finally, in section 6, we give a number of conclusions and ideas of how to continue studying the present problem areas.

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1 http://www.satinproject.eu
2. The SATIN 2 project
The overall aim of the SATIN 2 project has been to enable end-users without prior programming skills to create their own smartphone apps. The ambition of the project has been to raise an interest for app creation, broaden the group of people who create apps and in the long run attract more women to ICT in academia as well as in industry. Design of an inclusive SATIN app creation platform is one of the criteria for a successful project and is also aimed to attract a more diverse group of people for app creation. With diversity in this project we primarily mean gender, age and ethnicity. Integration of the gender equality and diversity perspectives in the core activities of the project is one of the strategic decisions already taken in the project application phase.

2.1 Gender and diversity perspectives in SATIN 2
Gender equality is of crucial importance to the sustainable development of the ICT sector in Sweden and Europe. Knowing that the proportion of women ICT workers is as low as 19% in Sweden (Digitaliseringskommissionen, SOU 2013:31) we face a big challenge. The question is why there are so few women studying and working in the field of ICT. The ICT sector lacking women and being gender-segregated has been frequently discussed and reflected on in the SATIN 2 project meetings, workshops and seminars. How can we broaden our perspectives? How do we make the ICT sector more attractive for men as well as women? How do we create more sustainable ICT businesses in northern Sweden? Both users of ICT and the ICT sector will lose if universities and companies do not succeed to attract more women into ICT.

2.2 Gender imbalance in SATIN 2 and ICT in general
As discussed above, the gender imbalance in the ICT sector and the gender segregation of the Swedish labour market are examples of the items that have been reflected upon through the whole project period. The gender-imbalance in the SATIN 2 project follows the same pattern. A third of the project members are women. The technology team has only men, the design team is mixed and the business team has mostly men among team members. The men and women in SATIN 2 have also different positions. The project owner is a man. The project coordinator is a man. The gender researchers are women. It is a challenge to break this pattern. Therefore, knowledge, awareness and support of the researchers and companies are important factors when trying to change attitudes and the culture and structure of the project and organisations participating in the project.

2.3 The SATIN platform and editor
The system development part of the SATIN 2 project has had the goal to produce a fully functional and working web-based portal, including what we call an editor for creating
smartphone applications (apps) based on prefabricated components. The components are not a fixed set, they have mostly been developed for testing, on demand from project members. Most of these components have the purpose to produce some kind of information based on existing Internet services such as Facebook friends, weather forecasts and real estate for sale. Another useful category of components has some kind of GPS-functionality such as current position or location. There are also components that are used as triggers, and other components display resulting messages. New versions of the editor have been implemented throughout the project, but in the tested version of the editor, the components had a circular shape, and the connections between components were shown in coloured parts of the components, and with a dashed pattern, see figure 1.

Figure 1. The tested, earlier, version of the SATIN editor.

3. Related literature
To understand the mechanisms behind the current situation of imbalance between the genders in ICT, we have studied literature within the following areas: gender and end-user
programming, end-user development (EUD) in general, and self-efficacy theory. The insights gained by the literature studies have then influenced how our studies have been designed.

3.1 Gender and end-user programming
An Oregon research group has conducted a large number of studies within the area of gender and end-user programming. Their studies mainly focus on debugging computer-based spreadsheets, and they have investigated differences between how female and male users cope and deal with this specific task. They found significant differences in how women compared to men deal with end-user programming situations, and specifically debugging in spreadsheet software (Beckwith et al., 2006). These findings were mainly differences in perceived self-efficacy. A questionnaire (Compeau & Higgins, 1995) was used in their test for estimating the level of self-efficacy. The test subjects were asked to fill in the questionnaire before and after using the spreadsheet software, and then the differences between these two occasions were compared, indicating the changed level of self-efficacy. Their results show that the female subjects had a much lower level of self-efficacy after using a high-support version of the software investigated, while the men participating in the study showed a slightly lower level of self-efficacy after using the system, than before.

Other studies from the Oregon group show that strategies preferred while debugging spreadsheets differ between female and male users. They also show that the strategies that females prefer to a higher degree than males are seldom supported in traditional software. Strategies mentioned in a number of studies are: relying on a comprehensive view, looking for familiar features, code inspection, predictability, opportunistic usage, pairing, supervised first usage, cost versus benefit (Burnett et al., 2008; Grigoreanu et al., 2012; Subrahmaniyan et al., 2008).

3.2 End-user development
End-user development is characterized by user-driven modification and extension of computer-based systems (Lieberman et al., 2006:2). To support end-users in activities that normally require vast experiences and knowledge in computer programming is without a doubt a great challenge. More specifically, what needs to be dealt with is a balance between specificity and generality. The more general the programming language is, the more skills are required to master it. A domain-specific language on the other hand deals with objects and actions that are known to the user in advance to a rather high degree. Apart from finding a relevant abstraction level, another challenge is to find appropriate representations for the objects and actions to handle, and to find approaches that support the learning process (Lieberman et al., 2006; Repenning et al., 2006).

But the challenges are not only technical and related to a certain way of designing user interfaces. Another acknowledged challenge has to do with how end-users can become confident in their ability to engage in an activity usually performed by highly skilled people,
which is described in Beckwith et al. (2005).

3.3 Self-efficacy theory
In order to understand the mechanisms behind the level of self-efficacy addressed in the Oregon studies, we turn to self-efficacy theory, a sub-field of psychology. One of the most prominent researchers in this field is Albert Bandura who has studied the relation between self-efficacy and the treatment of phobias (Bandura, 1977). There are, according to Bandura, four sources that support self-efficacy, and they are *performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal.*

*Performance accomplishment* is the most influential source of the four. It has to do with earlier successful experiences. If a person has used a computer-based system in a successful way, where expected outcomes have been fulfilled, conceptions of what will happen in the future are likely to be positive. If instead a person has one or several experiences of not succeeding, that person is likely to expect unsuccessful outcomes in the future.

*Vicarious experience* could be a colleague or another acquaintance showing a person how to do something, making it obvious that success is possible. This source is considered the second best for reaching a higher level of self-efficacy.

*Verbal persuasion* has to do with someone verbally encouraging, suggesting a person to do something. This source is only grounded in someone else's experiences, which makes it the weakest source for an increased level of self-efficacy.

The last one, *emotional arousal,* is a negative source for self-efficacy, thus contributing to a decreased level of perceived self-efficacy. If a person experiences stress, frustration, or anxiety, these emotions are likely to have a negative impact on a person's perceived self-efficacy.

Reconnecting these theoretical findings to the use of computers and computer software provides us with gender-related implications, which are addressed in the next section.

3.4 Gender and self-efficacy
There are several studies showing differences between the genders related to self-efficacy and using computer software. Bush (1995) reports that differences in perceived self-efficacy has been found among college students who were told to estimate their ability to complete complex tasks in spreadsheet software as well as in word processing. Differences between the genders were however not noticed in simple computer tasks. An explanation given for the differences in the complex tasks is that the male students in the study had more computer experiences in programming as well as in gaming. They were also more encouraged by their parents and friends.

Much of the research looking at gender differences in self-efficacy and computers settles with stating that there actually are differences. But it is also crucial to understand why these differences occur. Zeldin and Pajares (2000) have conducted a qualitative study on self-
efficacy beliefs among women who pursue a career in mathematics, science and technology. Their case study approach, reveal a number of contributing explanations to their going against a more traditionally female career, and choosing a career often considered to be typically male. The factors affecting the women participating in the study were family members and teachers encouraging them to engage in activities that raised their interest, rather than choosing gender stereotypical careers. Even though self-efficacy theory claims that a person's own performance accomplishments are the main source for an increased level of self-efficacy, Zeldin's and Pajares' research seem to point to other sources being equally, or even more, important for increasing perceived self-efficacy for a certain task or task domain, namely vicarious experiences and verbal persuasion. And these results only relate to women and their self-efficacy. Men still seem to be more affected by their own successful accomplishments, than by other people's experiences and opinions. Maybe a conclusion to draw from these studies is that women's perceptions of successful outcomes could also be to receive positive feedback and encouragement from people around them.

4. What we have done, and how
The SATIN 2 project has had several objectives, as stated in section 2. In this section we describe the procedures for reaching some of these objectives. Subsection 4.1 describes how we have approached the working process from a gender, equality and diversity perspective, and subsection 4.2 describes how the system has been evaluated for the purpose of finding how to improve the system to make sure to satisfy the demands of female users in particular.

4.1 Working with the gender equality and diversity perspectives
SATIN 2 has focused on three areas: a technical platform, user participation, and business opportunities. The work has been organized in four teams: technology, design, business and gender, equality & diversity teams. The project coordinator and the team leaders have been responsible for the daily management of the project. The steering group has been responsible for the resource distribution and the achievement of the project objectives.

Integrating the gender equality and diversity perspectives in the core activities of the project started already in the project application phase as a result of the experiences gained in the SATIN 1 project. SATIN 1 showed a need for tailored gender and diversity tools and methods when striving to attract a broader group of people to create apps. How to challenge ingrown gender roles and avoid preserving stereotypes have been important items when trying to develop an inclusive SATIN app creation platform.

The gender equality and diversity work in SATIN 2 has grown from the needs of the project, as stated above, and based on gender theory. A gender researcher was appointed as a member of the gender equality and diversity team to validate and ensure the quality of the work. The objectives of the gender equality and diversity team have been to increase the gender-awareness of project management and members, together develop and implement
tools and methods, and offer practical training for the SATIN 2 project management and members. Although the conditions already from the start of the project have been favourable for the integration of the gender equality and diversity perspectives in the project core activities, we have still faced many challenges. A considerable challenge has been the project management and members anticipating quick-fix solutions for a long period of time.

4.2 Observations

We wanted to test whether or not it is possible to design with the purpose of strengthening self-efficacy with features related to the sources behind a high level of self-efficacy. Also features related to the strategies mentioned in section 3.1 were in focus. The method used was observation studies. The observations were recorded using Camtasia, a screencast software that captures all actions taking place on a computer screen, and records sounds following the actions. This took place in the office of the observer, using a Macintosh MacBook equipped with a large external screen and external keyboard and mouse.

The test subjects in the observation study consisted of five women and six men. The women were between 20 and 56 years old, and the men were between 23 and 28 years old. Only one person, a man, had extensive programming skills, and also had experiences of app programming. The rest ranged from no programming experience what so ever, to moderate experiences. Since the idea of a system supporting app building for non-programmers is rather new and unexplored among people needing this kind of system, finding test subjects was not an easy task. That resulted in test subjects being chosen from acquaintances of the observer and students.

The idea with the test was to mimic future features not yet implemented in our software. This was done through a thorough review of the software, where the observer first explained all features, and showed examples of how to use them. A fairly complex app was also built and shown to the test subjects. The purpose of this was to provide a vicarious experience, and in so doing, also give the user a chance to have a comprehensive view of the system. Having seen the system in use could also contribute to a feeling of familiarity and predictability. In a future version of the system, this could instead be a well-designed tutorial. Another approach in the observation test was that the observer offered to answer any question emerging during the test session. The anticipation was that this would contribute to performance accomplishment. A second ambition here was to provide some kind of verbal persuasion. To realize these properties some kind of forum and/or chat functionality could be implemented, where users could encourage each other, and answer questions emerging during usage.

4.3 Questionnaires and interview

A complement to the observations was a questionnaire, where we used the same form as Compeau and Higgins developed (Compeau & Higgins, 1995). This questionnaire was also used in one of the Oregon studies regarding self-efficacy (Beckwith et al., 2006). In the
questionnaire users assessed their ability to succeed before and after trying out the SATIN editor, given a number of scenarios. The before- and after-results were then compared.

After that a short interview was conducted where the purpose was to capture the users' thoughts related to accomplishments, strategies used, creativity, and satisfaction.

Finally a short questionnaire, inspired by the one used earlier, was filled in by the test subjects, this time assessing how much five features helped the subjects to succeed with the task of building apps. The questions concerned:
- being shown the functionality and features in the editor
- being shown an example of an app built from scratch
- the on-line help
- the design of the interface
- the possibility to ask questions throughout the session

Each test subject, or user, started with filling in the first questionnaire. After that the observer introduced the system and all its features, and then showed how to build a finished app, and how to run it. Then the test subjects were asked to build a certain app, and were offered all the help they wanted. After building one or two apps (depending on the time the first one took, there were no given time frames though), the test subjects filled in the questionnaire once again, then they answered the interview questions, and finally they filled in the questionnaire concerning the kind of support that they received during the test session.

5. Findings, outcomes and experiences
In this section we account for findings and outcomes concerning the project process and organization as well as actual design propositions that we have evaluated. The following three subsections focus on experiences and outcomes of the efforts of introducing and pursuing an inclusive approach. The last subsection focuses on design aspects related to self-efficacy and strategies.

5.1 The anchoring process
As mentioned above, a considerable challenge has been expectations of quick-fix solutions. Our goal has been that all project members collaborate in joint learning and knowledge sharing processes to ensure that the gender, equality and diversity work continues after the gender researchers have left the teams. After an extended anchoring process a major breakthrough was when the design team decided to put resources into learning and studying how the design of the app-building environment could and should support self-efficacy and reflection as well as female strategies in end-user programming.
5.2 The change process
The SATIN2 change process in terms of increased gender-awareness of the project management and members is validated and documented in a handbook “Innovation and gender – how to boost and measure change” (Wennberg et al., 2013). The handbook, which is the result of collaboration between SATIN 2 and the "Mäta Jämt 2" project, funded by Interreg IVA North, is available on www.gdtoolbox.eu. This toolbox was a key objective for the gender, equality and diversity part of the SATIN 2 project. The interviews, focus groups and observations of the SATIN 2 project management and members, carried out by the gender researchers and process leaders, state that their gender-awareness was increased during the change process. This is also described in the reports of the SATIN 2 project evaluators.

5.3 Tools and methods
Apart from the increased gender-awareness of the project management and members, other results of the gender equality and diversity activities in SATIN2 are collected in a gender and diversity toolbox (gdtoolbox.eu), including a gender app and a list of a group of gender, equality and diversity ambassadors. The gender, equality and diversity ambassadors are important players when striving for more sustainable effects of gender mainstreaming in the ICT sector or any sector.

The gdtoolbox and gender app have been and are valuable door openers when promoting the gender equality and diversity perspectives in SATIN2. Why the toolbox and the app have gained attention both in Sweden and Europe is probably the working model, which promotes tailored tools and more sustainable changes of attitudes and behaviour. The gdtoolbox is available in the database www.jamstall.nu. Jämställ.nu (includegender.org) is a Swedish cooperative venture launched in 2009. The gender app is available in the database of EIGE (European Institute for Gender Equality).

5.4 Design aspects related to self-efficacy and strategies
The results of the observation study are accounted for here. All test subjects managed to finish building the apps they were asked to build, and almost all of them expressed satisfaction with their accomplishments. A few also showed signs of being pleasantly surprised of their accomplishments.

Signs of creativity were clearly expressed by several of the subjects. One of the subjects had an inaccurate perception of what a certain component could do. She then asked why there was not such a component in the editor because she wanted an app in her smartphone based on that component. A few of the subjects described rather specific ideas of apps to build, if suitable components had been available.

A rather salient observation among most subjects was the importance of having components of good quality. Quality criteria for the components that appeared as important
had to do with information about the components, how they were described, including using relevant terminology. The components also have settings that are almost always essential to set in order to make the app work as expected. Descriptions of these settings were not always clear, and sometimes they were too difficult for the subjects to figure out. In some cases the subjects also forgot how to access the settings, which was done through a small settings icon located on the outer part up to the right of the components, see figure 1. A third observation related to the quality criteria of the components was how to interpret the connections between components, or the dataflow. A fourth observation, not as direct as the others, was on what abstraction level the components should be designed, which is in line with how EUD literature describes typical challenges. Not all test subjects commented on this, but there were indications and comments related to this in the observations.

The results from the questionnaires indicated that most subjects were more positive of their abilities to successfully build apps after testing the SATIN editor than they were before they tried it out, see table 1.

The last question that the subjects were asked in the interview was how much they enjoyed using the editor and building apps. The person showing least enthusiasm gave the experience a five on a scale from one to ten. Most assessments were between seven and nine, see table 1.

Table 1. Information about test subjects, and their assessment results.

<table>
<thead>
<tr>
<th>Subject#</th>
<th>Age</th>
<th>Gender</th>
<th>Prog. exp.</th>
<th>smartphone</th>
<th>Download</th>
<th>Survey</th>
<th>Fun</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>F</td>
<td>minor</td>
<td>No</td>
<td>no</td>
<td>6.9/9.2</td>
<td>7-8</td>
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<tr>
<td>2</td>
<td>25</td>
<td>M</td>
<td>extensive</td>
<td>Yes</td>
<td>moderate</td>
<td>8.2/9.7</td>
<td>7.5</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>F</td>
<td>none</td>
<td>Yes</td>
<td>moderate</td>
<td>2.6/6.7</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>M</td>
<td>minor</td>
<td>Yes</td>
<td>moderate</td>
<td>6.1/4.6</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>24</td>
<td>M</td>
<td>moderate</td>
<td>Yes</td>
<td>some-moder.</td>
<td>6.2/9.4</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
<td>M</td>
<td>&lt;minor</td>
<td>Yes</td>
<td>some</td>
<td>3.5/4.7</td>
<td>7-8</td>
</tr>
<tr>
<td>7</td>
<td>28</td>
<td>M</td>
<td>moderate</td>
<td>No</td>
<td>moderate</td>
<td>2.8/5.1</td>
<td>8</td>
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<tr>
<td>8</td>
<td>25</td>
<td>F</td>
<td>none</td>
<td>Yes</td>
<td>&lt;moderate</td>
<td>7.4/5.8</td>
<td>7-8</td>
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<tr>
<td>9</td>
<td>23</td>
<td>M</td>
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<td>Yes</td>
<td>moder.-oft.</td>
<td>5.9/6.0</td>
<td>6-7</td>
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<tr>
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<td>no</td>
<td>8.8/7.5</td>
<td>8-9</td>
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<tr>
<td>11</td>
<td>56</td>
<td>F</td>
<td>none</td>
<td>Yes</td>
<td>no</td>
<td>4.1/5.4</td>
<td>6</td>
</tr>
</tbody>
</table>

Some of the assessments were hypothetical, given that the quality of the components had been better (subjects 2 and 10).

In the final questionnaire, where the subjects assessed help features, the subjects' answers were not unanimous, see table 2. Still there were tendencies toward them appreciating being shown the functionality and features in the editor, with an average of 6.9, being shown an example of an app built from scratch with an average of 8.1, and having the possibility to ask questions throughout the session with an average of 8.4. The design of the interface was also considered rather helpful with an average of 6.4. Only a few of the subjects used the online help and thus only five of the subjects gave an assessment of that feature ranging from four to eight, where the highest value was given by a subject who consciously decided to try to find information in the on-line help instead of asking the observer.
Table 2. The subjects' assessment of help features.

<table>
<thead>
<tr>
<th>Subject#</th>
<th>Features shown</th>
<th>Example</th>
<th>On-line help</th>
<th>Interface</th>
<th>Asking</th>
</tr>
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<tbody>
<tr>
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<td>7</td>
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<td>4</td>
<td>5</td>
<td>9</td>
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<tr>
<td>3</td>
<td>7</td>
<td>10</td>
<td>-</td>
<td>8</td>
<td>10</td>
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<tr>
<td>4</td>
<td>8</td>
<td>10</td>
<td>4</td>
<td>8</td>
<td>9</td>
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<td>7</td>
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<td>6</td>
<td>8</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

5.5 An illustrating example
As an example, the session with test subject three is described briefly. Test subject number three is a 20-year old female student with no programming experience, and no interest in computers other than using them the way people in general use them.

The first app she built, an app with two components, displaying real estate for sale, took 2.5 minutes for her to build. She immediately chose the correct components, connected them in the correct way, and then asked what to do in order to display the results. The observer informed her that it was embedded in the component to display the results. After that she checked the settings without hesitating, and noticed that the green button indicating a working app had appeared. She asked if she should press the green button, and when she saw the results she was clearly pleasantly surprised, saying something like "wow, it actually works".

In the interview she also expressed that she did much better than she had expected. She appreciated the introduction and thought it would have been difficult to manage without it. The introduction provided her with a comprehensive view of the system, she said.

A difficulty in the editor that the subject expressed was how to find suitable components. At the same time she managed very well with this in the test, which might have had to do with the example shown in the introduction, and the fact that she immediately recognized the icon of the correct component from prior experiences of a corresponding web site.

Even though this subject had no experiences of programming, and had the lowest assessment of the building experience (five), she was the most successful subject in terms of time taken, and reaching a working solution without getting lost in the interaction.

The strategies she used were looking for familiar icons symbolizing the components, and also the reading descriptions of the components.
6. Conclusions and future work
The SATIN2 project has generated results on many levels. Most of the project members have realized the benefits of consulting the gdtoolbox, of pursuing an inclusive project form with recurring gender and diversity items on the agenda, and of trying to design and implement features that benefit female strategies in end-user programming environments. These levels are further reflected upon in the following subsections.

6.1 Development of Tools and methods
The encouraging response to the gender mainstreaming tools and methods developed in SATIN 2 has resulted in a new project, GENOVATE, funded by the EU Framework Programme 7. The aim of GENOVATE with partners in seven European countries is to boost equal opportunities for men as well as women in higher academic positions and enhance research excellence and innovation through gender equality and diversity. In addition to developing gender equality initiatives as a whole, the GENOVATE team in Sweden will focus on developing gender equality in engineering and ICT. Further development of the gdtoolbox together with the GENOVATE partners and stakeholders will be one of the tasks.

6.2 Design of supporting features
The observations showed that the editor could be a tool for building apps, even among users with no programming experiences under the circumstances given. There were also clear signs of motivation, creativity and self-efficacy among female as well as male subjects. At the same time there were also signs of frustration and confusion. It is possible that these experiences originate from the rather poor quality of the existing components in the SATIN editor. Also related to the components is the need to study and try to find an appropriate abstraction level for the components.

Since the observations were conducted, an improved version of the SATIN editor has been implemented. The main differences between the tested version and the new version are an added preview of the app interface, the settings are given a more salient appearance, and finally how to connect components is now more obvious, see figure 2.

A clear difference between the studies made within the Oregon research group and our studies, is that the Oregon group had test subjects that were familiar with the kind of task tested, and were thus probably more motivated and had higher expectations of their abilities than the subjects in the present study.

Even though the subjects expressed that using the SATIN editor for building smartphone apps was almost a surprisingly positive experience, we do not know if the supporting features are possible to implement, and if they are, whether or not they will result in the same positive outcome as here observed. In the present test the users received direct and unlimited support from the observer.
In a future study it would be crucial to test a system with implemented features, and with a higher quality of the available components. It is also desirable to have enough components to support users' own ideas of apps to build. Not until then could we be more certain about the potential of the SATIN environment, and especially the potential to support self-efficacy and female end-user strategies.

References

