Research Plan

IT3010 - Research-based Innovation Methodologies in Computer and Information Science

Title of the study	Self-evaluation-application in Python programming for beginners
Responsible people	Fredrik Christoffer Berg and Håkon Ødegård Løvdal
Time period for the study	Fall and spring semester; 39 weeks
Amount of resources in PM planned	3120 hours
Web address for the project	None

NTNU

Norwegian University of Science and Technology

1 Purpose

Information Technology, Introduction (ITI) is a mandatory course for first year students attending most technology studies at the *Norwegian University of Science and Technology* (NTNU). The course is an introduction to procedure-oriented programming and theory about information and communications technology. The course is important, as it gives students an introduction to programming, an important skill to have in technical fields of work [1, p. 218–219]. It also gives students a basic understanding of the computer information systems we use everyday.

Learning to program is difficult. Students that have been interviewed after having introductory courses in computer science, claims that it requires a different way of thinking [2, p. 135]. This way of thinking separates itself from other fields like mathematics and chemistry, in that it requires a deep understanding of concepts not seen in other fields. Although this statement is particularly applicable to object-oriented programming, it is highly relevant to simpler concepts like basic program control flow as well. Additionally, programming enables problem solving that is not rooted in proven methods, unlike many other fields. Winslow argues that the ability to solve these kinds of problems is largely based on experience, and that it requires hands-on programming experience in order become competent [3, p. 18–19]. A goal for this research is to find methods that incentivize students, so that they get the experience necessary to become competent programmers.

Several efforts have been made to help people learn how to code, such as the e-learning platforms *Khan Academy*[1] and *Codecademy*[2]. Codecademy is a website that guide people through the basis of coding, by providing simple coding tasks they can do in the browser. Khan Academy is an educational website, providing videos and tasks in several fields to help children learn. Thompson discusses the effect of using Khan Academy in elementary school [4, p. 4]. Although that study was conducted in math classes, it still highlights the motivating effect such tools have on children. *Scratch* [5] is a visual, drag-and-drop based programming language created at *Massachusetts Institute of Technology*. The majority of the Scratch-community are children between the ages 8 and 16, and it is a successful effort to help children get interested in coding. Millions of projects have been created, showing that its motivating and fun.

Students are older and more experienced than children, and it might require different methods to motivate them. This includes concepts such as *gamification*[3], system feedback and automatic selection of tasks based on skill level. Law claims that good e-learning systems can provide infrastructure and faciliation to students learning programming [1, p. 227]. The research will focus on the use of such tools in ITI. The *artifact*[4] that is to be created will incorporate elements from e-learning systems. Note that the focus is on creating a supplement to mandatory exercises, not replace them.

- **RQ 1:** How can students be motivated to learn computer programming?
  - **RQ 1.1:** How does design elements from e-learning systems motivate students?
  - **RQ 1.2:** How strongly does motivating factors affect the learning outcome for students?

[1] A personalized online learning resource. `https://www.khanacademy.org/`

[2] An online resource rethinking learning `https://www.codecademy.com/`

[3] Applying game-design elements and game principles in non-game contexts

[4] An IT product

2 Contributions

The contribution from this research project will be a master's thesis due in June 2017. The thesis will cover an analysis of research done on similar systems, and the effect they can have on students learning rate. This research will form the basis of a prototype that will be created. The most important outcome however, is the testing and evaluation of this prototype. This phase will provide extensive information on students experience with the different functionality in the prototype. This information is vital to help determine both students motivation and learning outcome with such systems.

The raw data gathered from the data collection process is also an important aspect of the research project. The data collected will provide indications of students study routines. This includes data about how much time they spend on ITI, and which tools they use to learn apart from the exercises. The research project will lead to useful information about students and their relationship to ITI, which can be used by the ITI-staff. Additionally, it will contribute to general information about how e-learning systems can be efficiently used in universities.

3 Research Method

In order to define the research questions, a literature review on relevant studies were conducted. This was done in order to find theory used and discussed in similar systems, and served as a foundation for the conceptual framework of the research. In order to create an artifact addressing the research questions, the design and creation strategy will be used. First of all, a suggestion for an artifact that might solve the problem will be presented. From there, the design and creation (development) will follow. This will lead to an evaluation of the artifact, in an attempt to find out whether or not it can have a positive effect. Furthermore, observations and interviews have been chosen as the data collection methods, resulting in a qualitative data analysis. The research requires a diverse set of data samples. Thus, it is important to consider students with different competence in programming, ranging from novice to experienced. In order to generate a good conclusion, these three steps will be executed in an iterative manner. The research process is illustrated in figure 1.

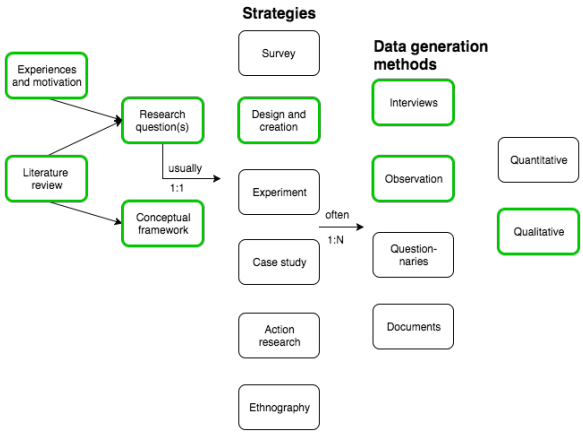

Figure 1: Model of the research process [6, p. 33]

4 Participants

This research involves mainly three participants. Berg and Løvdal are the researchers, and their work is to plan and perform the literature research, data collection and evaluating the collected data. Additionally, they are responsible for designing and developing a prototype, and test this with students as the targeted user group. The last participant is the research supervisor, Guttorm Sindre. Sindre has extensive experience with lecturing and organizing ITI at NTNU. He will contribute

with guidance and follow-up on the research, as well as provide insight into design principles for the prototype.

The participants of the data collection are first year students at NTNU. Recruitment of students will be done with help from Sindre, who can reach out to students through email. Additionally, relevant information about a student needed for the research will be gathered. Thus, the proper consent from *Norwegian Centre for Research Data* (NSD) will be requested. Ethical and legal aspects will be presented to the respondents before conducting observations and interviews. The data collected will not be shared publicly, and will be limited to use within this research. Notes will be taken during observations and interviews, but no personal data will be recorded during these sessions.

5 Research Paradigm

Design and creation is the chosen research strategy, which involves analyzing and designing an artifact to solve the difficulties of learning programming. Design and creation can be argued to take either a positivistic or an interpretivistic approach. Observations and interviews are approaches that leads to qualitative data. Additionally, the data gathered from observations needs to be interpreted and contextualized. It is near impossible to perform these tasks without having somewhat of a bias. These arguments forms a basis that leads towards an interprevistic approach.

6 Final deliverables and dissemination

The final result of this research will be presented in two deliverables: a master's thesis and a functional prototype demonstrating the artifact. The master's thesis will contain the research that forms the basis for the prototype, as well as an evaluation of the prototype.

References

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