Programming language & Gender

Degree project
Abstract
Once women were the pioneers within the tech industry, but during the last decades the amount of women who choose a career within computer science has decreased rapidly. Programming languages have evolved during the last decades and because of the growing gender gap in the industry, they have done so involuntarily in the absence of women. The imbalance raises the question if the tech industry and the programming languages have been adapted for a more masculine way of developing software. A quantitative study and a literature review evaluates if there is a need for a computer language developed towards women. The study comes to the conclusion that there is no need for a female inspired computer language, but the way computer languages are taught suits the male way of thinking better than the female way.
Preface
Thank you, students at Stockholm University, Computer Science program spring 2015, the networks, WinIT Stockholm and The CodePub, for your time to answer the questionnaire for this study.
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1 Introduction

The chapter gives an introduction and background to the subject covered by the report.

1.1 Introduction/Background

Programmers are one of the largest professional groups in Sweden and the most common profession in Stockholm today, but only one-fifth of all programmers working are women, concluded in a study by L.Larsson and M.Delin [1]. Once, women were the pioneers in the tech industry, but during the last decades the amount of women who choose a career within Computer Science have decreased rapidly. This has created a growing gender gap in the tech industry [1].

By the year 2020, it will be a shortage of 1 million programmers in EU, according to a report from the EU commission [1]. The demand for people with post-secondary computer training will increase significantly during the coming years. But still the forecast shows that the amount of women with a degree in computer science, in EU, will reduce from 35 percent in year 2012 to 26 percent in year 2035 [1].

E.Dockterman gives an insight on how large companies every year are trying to recruit more females and encourage them to a career in development and programming. In their effort to minimize the gender gap millions of dollars are spent on education, scholarships and events [2].

The reasons for the increasing gender gap and the shortage of women are widely discussed in the industry. Studies are made and the subject has been evaluated from different angles, although we still have an increasing gender gap. During the last decades, the computer languages have evolved and have done so involuntarily in the absence of women, with a majority of male developers.

The lack of women during so many years in an industry rapidly evolving raises the question if a part of the tech-industry, for example the computer languages, has been adapted for a more masculine way of developing software.

1.2 Previous research

The ongoing trend reported from Europe and the US, with a decreasing amount of female students in computer science programs, are not reflected in Malaysian universities, as found in a study by M.Othman and R.Latih [3]. Their study shows that female students often exceed the number of male
students pursuing a computer science degree at Malaysian Universities. Computer Science has never been seen as a technical or difficult subject in Malaysia [3]. The Universities have a large number of female role models, which indicates that more female role models in the industry will make more women interested in Computer Science.

Male students are more confident in using technology for learning than female students in higher educations according to a study of the gender inequality performed by HK.Yau and ALF.Cheng [4].

Sashanni, reports a similar finding and adds that women often use the “we can but I can’t paradox”, meaning that even though female students have negative feelings about their own ability and interest in learning computers, they perceive women in general to be component computer users [5].

The confident issue as well as the absence of female role models can be adjusted if computer languages are taught in a different way, according to P.de Palma [6].

Women are skilled mathematicians and computer languages should be taught in a more mathematical way to increase women’s interest in Computer Science [6].

1.3 Problem definition

If men and women have different ways of learning a computer language, is it possible that women could be more interested in learning a computer language if the language is developed towards a more female way of thinking?

This report is expected to answer the question, if there is a need for a computer language developed towards women?

1.4 Purpose and research question/hypothesis

The purpose of the report is to give an insight to if there is a gender-difference in the way women and men learn a new computer language. The report is expected to evaluate the hypothesis that women’s interest to work within Computer Science would increase if a programming language developed towards women were available.

1.4.1 Research questions

RQ1. Can gender affect our choice of programming language?
RQ2. When men and women learn a programming language, are the difficulties they experience the same regardless of gender?
RQ3. Can a programming language affect women’s interest in programming?
RQ4. Is it possible to develop a programming language oriented towards women?
1.5 Scope/limitation
The study will be limited to respondents who are interested in programming in the higher education age. The restriction is made on the basis of the size of the study and course time.

1.6 Target group
The report is intended for companies in the IT sector, staff and students at university, colleges and schools with specialization in Computer Science, as well as people with interest in the gender-difference in the tech industry.
2 Background/Theory

The chapter contains the background and history of women in Computer Science, current theories on gender and computer languages, and explanatory information on the subject.

Silicon Valley is the nickname of the southern portion of the Santa Clara Valley of Northern California, in the United States. It is also the home for many of the world’s largest high tech corporations.

In Silicon Valley new ideas are born, but not all innovators get recognition for their ingenuity. A well-known occurrence in tech industry is that innovative people get erased from companies histories, which is so widespread that it in Silicon Valley is known as “The Creation Myth” [7].

L.Sydell gives a description of something that is not as well known in the context: the number of influential women who has been forgotten by “The Creation Myth” [8]. According to the study two very important female characters who often are not mentioned in the history of tech are Ada Lovelace, born in 1815, also known as the Countess of Lovelace, and Betty Jean Jennings, born 1945.

Ada Lovelace was the daughter of Lord Byron, a romantic poet who had very little time in Lovelace's life. Her mother, Lady Byron, did not want the daughter to turn out to be like the father and therefore she decided for her to be tutored almost exclusively in math, in hope that she would not be in to poetry [8].

Lovelace, who saw the poetry in math, became an excellent mathematician. In a London salon Lovelace met Charles Babbage, who became a very good friend and mentor. Babbage showed her the plans he had for a machine that he believed to be able to do complex mathematical calculations and asked her to write an article about it for the scholarly journal. In the article Lovelace not only described the machine, but also envisioned that a computer can do words, pictures and music, not just numbers. She also showed an example of a complicated sequence of Bernoulli numbers, which is programming.

Babbage never built the machine described in Lovelace’s article but a century later the notes and his design were read by the designers of the first computer [8].

Betty Jean Jennings was one of six women who programmed the Electronic Numerical Integrator and Computer, ENIAC, during the World War II. The ENIAC was the first all-electronic digital computer and the six women who programmed it did so without manuals or programming languages [7].

In February 1946 the ENIAC was showed at the University of Pennsylvania, but according to V.Vick, it was only the men who had created
the hardware who was recognized [7]. The six women who had created the software were not even invited to the event. The Computer was never used in the war, but was considered a milestone in the tech evolution [9].

During the last decades programming languages have progressed from machine languages to high-level language. As explained by T.Gaddis a high level language makes it possible for the programmer to write complex programs without great knowledge about the CPU\(^1\) and without low-level instructions [10]. Most high level languages use words that are easy to understand and allows the programmer to concentrate on the task he/she wants to perform with their programs, rather than the details of how the CPU will execute the program.

According to S.Henn year 1984 was the year women stopped coding. The decades before 1984 the number of women studying computer science was outnumbering the men [11]. Henn describes that there is no single identified reason to why the percentage of women in computer science after 1984 flattened and then plunged. But in the US, studies have shown that the amount of women in computer science started to fall when personal computers started showing up in the homes.

According to Henn, the first home computers were not more than toys and these toys were marketed almost entirely to men and boys [11]. In the 1990s, Jane Margolis, researched the subject of the computer gender inequality and found that families are more likely to buy computers for boys than for girls, even when their girls were really interested in computers [11]. Henn describes further that when these kids go to college it became a big deal who had got a computer to play with at home, because the science professors increasingly assumed that their students had grown up playing with computers at home. The result was that the boys were way ahead of the girls in computer science classes. The girls felt excluded and many of them chose to drop out of the computer course [11].

2.1 Introduction theories

Relevant theories about learning styles, role models, women’s high demands and knowledge are presented in more detail in the following part of the chapter. Ariel Schlesinger has presented a theory that a female computer language would affect the gender-difference in the tech industry [12]. The language presented by Schlesinger is not concluded to be a functioning language, nor have the complete study been published when this report is written. Therefore this theory will be excluded.

\(^1\) CPU, Central Processing Unit – A part of the computer that processes and executes instructions from code in programs.
2.2 Learning styles and gender

One of the most common methods for learning styles is Neil Flemings VARK, which stands for Visual, Auditory, Read-Write and Kinaesthetic [13]. Even though the VARK method sort people into the categories above, the psychologists agree that almost no one falls into only one of these categories. People are often categorized into one, but they may have a secondary learning style as well that works significantly better than another.

Studies show that not only do people have different learning styles, it is also a gender difference in how we learn new things. NASSPE explains that girls and boys differ when they are taught math. When girls learn, they want to keep it real and relevant to establish what they are taught in to the real world. Boys can focus on the properties of numbers itself and still be interested and learn [14].

The choir director of the National Cathedral School for Girls and the St.Alban’s School for boys, gives an example on how context enhances learning for girls and often just bores the boys. When teaching high school girls a new song he starts by sharing a story about why the composer wrote this piece and who it is written for to give the girls some context and to get them interested. The boys are just the opposite. If the choir director starts by giving the same story the boys respond by looking at their watches, getting restless and asking if they just can learn the song already [14].

2.3 High demands

According to Mcrad, girls have higher standards in the classroom and evaluate their own performance more critically than boys [14]. In school, girls tend to do better than boys but are more likely to be excessively critical in evaluating their own academic performance. Boys on the other hand tend to have unrealistically high estimates of their own academic abilities and accomplishments.

Davis describes that studies, particularly regarding lack of confidence in technical tasks, have shown a “we can but I can’t” phenomenon. For example if a woman agrees that women in general are just as good as men at a technical skill, she’ll frequently still say that she personally is not good [15].

2.4 Women and mathematics

There is a difference between how the genders learn, and if programming would be taught in a more mathematical way it would be easier for women to relate as concluded by de Palma [6]. He describes a five-step hypothesis on how to teach girls programming. De Palma means that girls should not be taught how to play computer games or search the Internet. Instead they should be taught how to write a program. When they are taught how to write
programs, it should be in a way that is as close to pure logic as possible, like solving a math problem and discover a pattern with logic.

The programming should, according to de Palma, be taught without microcomputers and the first programs to write should be short. Most importantly, as claimed de Palma, is that the programming languages is treated as notational systems and that they not are changed until the students have developed a good deal of sophistication.

2.5 Role models

As mentioned earlier, not all countries report the shortage of female students in the CS programs at their Universities [3]. Malaysia is one exception where female students outnumber the males, and no gender difference is reported regarding to how Computer Science is perceived by young Malaysians. The lack of female role models and mentors in the field is not a problem for the Malaysian students, where a high percent of the professors and PhD holders at the University are females.

According to M.Othman and R.Latih, Malaysians have a different perception of Computer Science compared to the Western world. Young women in the US and EU perceive Computer Science to be technical and difficult, because that view has been ingrained in them since childhood. If steps are taken to remedy this it is possible to overcome the shortage of women in CS programs [3].
3 Method

The chapter presents the methods used to perform the study.

A systematic literature review and a questionnaire with open and closed questions are used to find the basis for the thesis that a computer language developed for women would make a difference in the tech industry.

3.1 Scientific approach

A quantitative study is performed, in a deductive mode, to answer the first two research questions and a systematic literature review is conducted as a complement to the study. Research question three and four will be answered with analysing the data collected from the literature and the questionnaire.

The quantitative approach is considered the most reliable to test the hypothesis for this study. Because of the possibility that a quantitative study alone can give less detailed data about the result, a systematic literature review is conducted as a complement.

3.2 Human centered approach

To collect the data needed to evaluate women’s approach to computer languages and the gender-differences in software development, a web based questionnaire survey is used. The questionnaire contains open, closed and fixed questions to get an answer to the first two research questions.

The approach was weighed against data collection with structured interviews and the questionnaire approach is chosen because it will give more data and therefore a more reliable result. Structured interviews will be conducted if the result from the questionnaire is inconclusive in any way.

The questions in the questionnaire are based on the first two research questions and the form is divided into sections. The first section contains non-personal questions about gender and education. The questions in the second section are dependent on if the respondent answer that he / she have knowledge in software development or not.

The questionnaire are cross-checked and pilot tested by three persons, two are software developers in the industry and one has no earlier knowledge in software development.
3.2.1 Selection

The respondent group for the questionnaire is strategically chosen and consists of men and women interested in computer science. No age, area or restriction for profession is made and all respondents are anonymous.

The questionnaire are sent out by email to 68 students registered at the course Computer Science spring 2105 at the Stockholm University and shared via link to winIT Stockholm and The Code Pub, two of the largest Swedish networks with women interested in software development and IT.

The networks are chosen based on their sizes and also that they are driven by large companies working to get more women into the tech industry, WinIT Stockholm by Sogeti and The Code Pub by Netlight.

The mixes of women interested in software development in these networks are considered suitable for the survey.

3.3 Analysis

A basic analysis, in four steps, will be performed of the qualitative data collected from the questionnaire. First, all data collected will be read thoroughly. Second, the non-closed questions and comments will be organized and labeled. Third, diagrams of the opened and closed, organized, answers will be constructed. And the forth step of the analysis is to identify patterns, compare result and interpret the information.

The literature review will be analyzed in a similar pattern, where the data will be read thoroughly and organized. The information collected will be interpreted and presented in text form.
4 Results/Empirical data

The chapter presents the results of the survey and the conducted literature review. The results from the survey are presented with the relevant research question. First, the research question presented and thereafter the result from the questions connected to this research question.

4.1 Survey

The questionnaire got a total of 43 respondents in the age between 18 - 54 years. 55.8% of the respondents is in the range of 25 - 34 years, and of all respondents is 79.1% female. 74.4% of the respondents answered yes on the question do you know how to program?

![Pie chart showing the distribution of respondents who know how to program. Yes: 32 (74.4%), No: 11 (25.6%).]

Figure 4.1: The figure shows the amount of respondents that answered yes or no on the question do you know how to program.

4.1.1 RQ1, Can gender affect our choice of programming language?

**Survey Question**

*Do you have an interest in programming today?*

The question was asked to the 32 respondents answering that they know how to program. Of the total 32 respondents 78% were women and 22% men.

All of the respondents answer yes stating that they have an interest in programming today. A majority of the women answer that their interest in programming started when they participated in a computer science course in high school or college. The earliest age to start programming is 15 years old. The interest then started with the influence of a father or brother who were in computers.

Among the men, a majority answered that they started to program in an early age and the earliest age a study participant started programming was 10
years old. The interest started when they received their first computer. A majority of the respondents had knowledge in one or several programming languages when they participated in computer science courses in high school or college.

SURVEY QUESTION

**IF SOMEONE GIVES YOU A CODE TO READ IN A LANGUAGE YOU ARE FAMILIAR WITH AND YOUR JOB IS TO ADJUST THE CODE. WHICH ONE OF THE FOLLOWING STATEMENTS WOULD MATCH WHAT YOU WOULD DO?**

The question was asked to the 32 respondents answering that they know how to program. 78% women and 22% men answered the fixed question, with three alternative answers.

65.6% of the respondents answers that they would read through the code and do the adjustments when they had an overview of the code.

18.7% of the respondents would read through the code and only start doing the adjustments when they understood what every piece of the code was doing.

15.6% of the respondents answer that they would find the piece of code that needed to be adjusted and do the adjustment without reading through the rest of the code.

A majority of the men and women answered that they would do the adjustment when they have an overview of the code.
Figure 4.2: The figure show the respondents reply on the survey question *how the respondent would adjust a code in a language that they are familiar with*. The beige block displays the 66% who would read through the code and do the adjustments when they had an overview. The grey block displays the 19% that would read through the code and only start doing the adjustments when they understood what every piece of code was doing. The brown block displays the 16% that would adjust the code without reading through the rest.

**SURVEY QUESTION**

**How well do you know the following language?**

The 32 respondents, 78% women and 22% men, who knew how to program was asked to answer the closed question with five fixed answers.

A majority of the respondents have basic knowledge in C and Javascript languages, great knowledge in Java and consider themselves to be experts in Java and Javascript.

Objective-C and Ruby are the languages considered least interesting to learn and the same languages are considered the most important languages for the respondents to learn.

A majority of the men answer that they have great knowledge in PHP, Javascript, Python and C# and the women that they have great knowledge in
Ruby, Python, C, Java, PHP, Javascript and C++, when the answers are divided into gender-groups.

Figure 4.3: The figure shows how the respondents answered the survey question *how well do you know the following language?* Yellow staple displays the amount of respondents who don’t want to learn the language. Orange staple display the respondents who would like to learn. Grey staple the respondents who know the basics. Blue staple displays the ones that have great knowledge while the green staple shows the amount of respondents that answered that they are experts in the language.

**SURVEY QUESTION**

**DO YOU HAVE A FAVOURITE PROGRAMMING LANGUAGE?**  
**WHAT IS YOUR FAVOURITE PROGRAMMING LANGUAGE AND WHY?**

The open question was answered by the 32 respondents, 78% women and 22%, answering that they know how to program.

A majority of the respondents answered that Python was their favourite programming language. The reason is that Python is a powerful programming language, simple to use and with an easy syntax that suits the respondent’s way of thinking. Go is also considered to be an easy to use, clean and powerful language.
Among the respondents who choose Java and C languages as their favourite, the most common reasons are that they have known the languages a long time or that it was their first programming language they learned.

Javascript is one of the most popular languages with the arguments that it is easy and fun to use and suited well for web development. The respondents that chose PHP as the favourite language arguments that the syntax is the reason as well as it was their first computer language they learned.

The responses divided in gender results in the majority of women recognizing Python to be their favourite language and Java and Javascript are on second place. The men choose PHP as their favourite language with Python and Javascript in second place.

Figure 4.4: The figure shows how the respondents answered the survey question which their favourite programming language are.
SURVEY QUESTION

**Both of the codes below show how to sum all the numbers in numberList. Which code do you think is easiest to understand and why?**

“Number 1 - because it’s relatively clearly outlined what it does so it’s quicker to read even though there’s slightly more code. In the second example some functionality is performed "under the hood" in the reduce method. You will only understand the code if you know what the reduce method does, while with the first example you just need to understand the basic syntax of the language.” - Unknown respondent

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Both of the codes below show how to sum all the numbers in numberList. Which code do you think is easiest to understand and why?

1) var numberList = [1,2,3,4,5];
   var sumOfList = 0;

   for (var i = 0; i < numberList.length; i++) {
     sumOfList += numberList[i];
   }

2) var numberList = [1,2,3,4,5];
   var sumOfList = numberList.reduce(function(sum, n){
     return sum + n;
   });

---

Figure 4.5: The figure displays the two alternatives presented for the survey question which code do you think is easiest to understand and why? Alternative one shows an imperative coding style of a list and alternative to a functional coding style of a list.

The question, with two fixed answers, was asked to the 32 respondents that answered that they know how to program. 78% women and 22% men
answered the question. No gender difference is shown in the responses of this question.

A majority, 93.8%, of the respondents agree that code number one, imperative style, is easier to understand. The arguments are that it is easier to get an overview of the code, visualise the result and it has more structure. The respondents also consider code two to have more structure, look cleaner and be more appealing and intuitive.

6.2% of the respondents answer that code two, functional style, is easier to understand. The arguments are that it is easier to understand a better solution and conveys meaning better than a “for loop”.

4.1.2 RQ2. When men and women learn a programming language, are the difficulties they experience the same regardless of gender?

**Survey question**

**Would you like to learn how to program? If yes are you interested in any particular programming language?**

The open question was answered by the 11 respondents, 73% women 27% men, who replied that they did not know how to program.

54.5% answer that they would like to learn a programming language. The most common languages mentioned to learn are the C languages and .NET framework.

45.5% answer that they do not want to learn a programming language and for the reasons that they are not interested or already have a low level of understanding in programming.

“If you had asked me last semester then I would've said yes, but now I have to say no”- unknown respondent

Gender difference is inconclusive because of the low amount of male respondents.

**Survey question**

**What words matches the feeling you have around programming?**

The fixed question was answered by the 11 respondents, 73% women 27%, who replied that they did not know how to program.

63.6% answers that the word they connect to programming is interesting. 71.4% of the total 63.6% who chose this word are women.

27.3% of which 100% are women answer that the words they connect to programming are that they would like to learn, difficult and technical.
9%, of which 100% are women, answered that they are not interested on the question.

Figure 4.6: The figure displays the respondents answers on the survey question about the word that matches their feeling about programming. The beige block displays the 64% that answered *interesting*. The brown block the 9% that answered *really not interested* and the grey block the 27% that answered that they *would like to learn, difficult and technical*.

**SURVEY QUESTION**

**WHAT DOES THE FOLLOWING TEXT MEAN OR DO?**

```plaintext
int numberZero=0; int numberOne=1; int sum=0;
numberZero+numberOne=sum;
```

The fixed question was answered by the 11 respondents, 73% women 27%, men who had replied that they did not know how to program.

54.5%, of which 33.3% men, chose the correct alternative which is to assigning sum with the result of 0+1.
9% of the respondents answered Adding the text numberZero and numberOne to the text sum. The numbers have no meaning. 36.4% of the respondent’s answered that they have no idea.

Figure 4.7: The figure displays how the respondents replied to the survey question showing a piece of code and asking what the meaning of the code is. The beige block displays the 55% that answered that the code was assigning sum with the result of 0+1. The brown block displays the 36% that replied that they had no idea. The grey block displays the 9% that replied that the code was adding the text numberZero and numberOne to the text sum. The numbers have no meaning.
**Survey Question**

When you first learned to program what was the main difficulty you experienced with learning a programming language?

The open question was answered by the 32 respondents, 78% women and 22% men, who know how to program. The common denominators in the answers are matched and the answers sorted into three categories.

Category one is learning how to think. The common denominators for this category are the arguments learning the syntax, structure, how to solve a problem, learning classes, functions, objects and how it all was connected.

Category two is how it all was connected. The common denominators for this category are understand the connections between compiler and code and how things work on a higher level.

Category three is other. The common denominators for this category are that the respondent did not experience a problem with learning the language instead the text editor or surroundings was affecting the learning.

A majority of the replies from the women are mapped into the categories “Learning how to think” and “How it all was connected” while the majority of the replies from the men are mapped to the category “Other”.

![Figure 4.8: The figure shows how the respondents replies categorised for the survey question what was the main difficulty you experienced with learning a programming language? The orange staple displays the category learning how to think, The red staple displays the category how it all was connected and the grey staple the category other.](image-url)
4.2 Literature review

S. Turkle and S. Papert describes a soft and a hard approach towards computers, as the two ideal types that computer users can be divided into[16]. In their study the result show that females are more likely to use a soft approach towards computers. This means a negotiating approach with concrete forms of reasoning and a characteristic, by closeness to the object. The male students are more drawn to the hard approach, meaning abstract thinking with systematic planning and characterized by a distance position to the object.

In the same study, S. Turkle and S. Papert came to the conclusion that female students, in an early age, tends to use a "do it yourself" style of programming [16]. This means that their programs are developed with an overview and each state is a working version of the program. The male students do the opposite and develops programs in a black box style2.

The female students tend to change their way of developing programs later in life, because of the feeling that their way is not correct. The reasons for changing are that they want to fit in and that the teacher instructed them that a black box approach is the correct way to solve a programming problem. The study concludes that female students who change their approach tend to think less and instead just follow stated rules for programming. They also tend to distance themselves from the computer and see it as just an object.

For decades, women was outnumbering men in Computer Science studies according to S. Henn [11]. In 1984 a significant change occurred and the number of women that participated in Computer Science studies started to fall drastically. Henn explains that in 1984, the first personal computer was sold to the homes in the US and describes that the first personal computers was mainly marketed to boys and men.

Jane Margolis studied hundreds of Computer Science students at Carnegie Mellon University in the 1990s and came up with the result that families were more likely to buy a computer for a boy than for a girl, even though the girl showed interest in computers [11]. In the study Margolis arguments that this was affecting these students in college, because the professors of this time assumed that all students had basic knowledge in computers from home when it was mainly the boys that had computer experience.

The documentary CODE: debugging the Gender Gap, created by Robin Hauser Reynolds explores the gender gap in the tech industry [17]. R.H Reynolds was inspired to create the documentary by her daughter, who was a Computer Science major in College that dropped out because of the doubts she experienced.

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2 Creating software by classes and functions, that can perform tasks individually and are not dependent to know what the rest of the code is doing.
Reynolds daughter was one of two women in the class and she dropped out because of the feeling that everyone else was much further ahead and that the classmates had been messing around with computers and gaming since childhood. In reality Reynolds daughter was the third top student of her class and according to Hauser this is not an uncommon situation for women in Computer Science programs [17].
5 Analysis

The chapter analyses the result from the survey and literature review. The result is first analyzed per theory and thereafter per research question.

5.1 Analyze theories

The result from the literature study and survey are analysed against the theories presented in earlier chapters.

5.1.1 Learning styles and gender

Theory, Girls want to keep it real and relevant, boys can focus on the characteristics and still be interested to learn.

A majority of the females in the survey agreed that they needed an overview of a code before making changes in it. When learning a new computer language the difficulties recognized by the women was how it all was connected and how things work on a higher level.

According to S.Turkle and S.Papert, female students starting their programming careers were more likely to build working versions of programs when developing software [16]. Boys on the other hand did not have problems programming software in a black box style.

The result reinforces the theory that the female and male way of learning is different. Females want an overview and a connection to reality when learning a new computer language, while men are able to concentrate only on the subject they need to learn without the same need for reality connection or overview.

5.1.2 Role models and High demands

Theory, Girls tend to be more critical in evaluating their own academic performance while boys tend to have unrealistically high estimates of their academic abilities and accomplishments. Role models play an important role to get female students interested in computer science.

According to the result of the survey both men and women could identify themselves to be great or excellent in a computer language. Men recognized the word interesting to be connected to their feelings about programming. Women choose the same word, but also identified the words difficult and technical to be connected to their feelings about programming.

A majority of the females started to program when they participated in their first computer science course. One female respondent started earlier than the rest, because of the influence of her brother and father, who both
were interested in programming. The result enhances the theory about the influences of role models.

The theory about females high demands on themselves are reinforced by Margolis [11] and Reynolds [17]. Margolis claims that female students tend to quit their computer science course when they receive bad grades. Reynolds came to a similar conclusion, claiming that female students feel left out and want to quit because they think they are failing and that the boys have more experience in computers.

5.1.3 Women and mathematics

Theory, Women is great mathematicians. Treat programming languages as notational systems and do not change it until the students have developed a good deal of sophistication.

According to the result of the conducted survey, there is no difference between men and women when choosing a more or less mathematical programming language. The result shows that both men and women consider the imperative programming style to be more structured and easier to use.

When learning a new programming language the women identified the problems as syntax, way to think and get an overview of the code and the program they created.

5.2 Analyse result and research questions

The result from the conducted literature study and survey are analysed against the research questions.

5.2.1 RQ1, Can gender affect our choice of programming language?

The favourite computer language recognized among the women is Python, with the arguments that it is a powerful language, simple to use and with an easy syntax. The men recognized the language PHP to be their favourite computer language, with the argument that the syntax is easy and also that it is one of their first computer languages to learn.

According to Henn and the result of this survey, girls start to program later in life than boys [11]. S.Turkle and S.Papert claims that women are more likely to program in a “do it yourself” style of programming when starting to program and also create their software with an overview of each working state of the program while boys can complete the software function by function [16].

The analysis of the result gives favourable arguments that gender can affect our choice of programming language. The result indicates that boys
when starting to program earlier than girls get advantage, not only when using the computers but also exploring different computer languages. The result also indicates that a first language for boys is PHP.

5.2.2 RQ2, When men and women learn a programming language, are the difficulties they experience the same regardless of gender?

According to the result of the survey, both men and women identified the word interesting on the question about their feeling of the word programming. The women also identified the words would like to learn, difficult and technical to their feeling about programming.

Men were more likely to recognize the correct answer when they were shown code, even though they did not know how to program.

Female programmers identified syntax problems, difficulties to learn, how it all was connected from code to compiler and how things worked on a higher level. Men identified problems in the surroundings, like bad Internet connection and problems with editors.

The analysis indicates that men and women experience similar difficulties when learning a new computer language. Women are identifying programming to be more technical and difficult. According to the result women also identify more problems connected to the computer language when being asked about difficulties, when first learning a new computer language.

5.2.3 RQ3, Can a programming language affect women’s interest in programming?

When the respondents answered the question about difficulties in learning a new computer language, a majority agreed that it was not the programming language that affected their interest for programming.

5.2.4 RQ4, Is it possible to develop a programming language oriented towards women?

The result from the survey and literature review indicates that it is possible that men and women are approaching and learning programming languages in different ways.

The result from the survey shows that women starts to program in high school or college while men start at an earlier age. Women want to get an overview of the computer and programming language. The argument is supported by the female way of learning.

A majority of the respondents agreed that Python, PHP, Javascript and Ruby are their favourite programming languages. The result was very similar for men and women, which can indicate that the programming language itself does not matter between genders.
Females are more likely to use a “do it yourself” approach when first starting to program. This indicates that women and men are using programming languages in different ways.
6 Discussion

The chapter discusses the result and the implementation of the study that has been performed.

6.1 Problem solving/results

When the first home computer arrived in 1984, it did not only start the beginning of a tech evolution. It also started the beginning of the gender gap in tech that we are experiencing today.

Based on the findings of this study there is no need for a computer language developed towards women to get them more interested in programming. Instead, the result shows that there is a need to change the way programming languages are presented and taught to create an interest for programming among women.

When the first home computer came it were marketed mainly to men and therefore it was natural that men were the ones who used it. Today computers are no longer marketed to only one gender but still the result of this study indicates that there is a major age difference in when women and men starts to use computers for programming.

Since the study does not provide enough information to investigate if girls and boys in an early age simply have different interests it is assumed, in this discussion, that that is not the case.

The indications from the result shows that boys, when starting to program, is influenced by the surroundings while girls do not get the same positive inspiration. The one girl in the survey that started to program in an early age was influenced by the interest of her father and brother, who both were into programming.

The study made in a Malaysian University, agrees with the fact that role models are important to create an interest for programming among women, as well as the positive influences from the surroundings [3]. The study reports that Malaysian female students do not identify programming to be difficult or hard while, based on the result of this report, a majority of the female respondents identified difficult with the word programming.

Based on the findings in this study, the gender gap in the tech industry is not created by just one thing. The marketing for the first home computer started a downhill spiral where women ended up behind in technology and have since had a hard time catching up.

The idea that computer languages had developed in the absence of women, that was presented in the beginning of this report, is actually not that wrong. The computer languages themselves do not need to change, as de Palma claims, women are good at math and computer languages have similarities to math [3]. And as the result of this study indicates it is not the computer language itself that is the problem.
What we need to focus on are the differences between the way men and women learn and use the computer language. The hint is that women want to have an overview and a connection to the reality when they learn new things.

Based on the results of the survey, the following suggestions are presented for how the teaching of programming can be altered to fit women better.

A programming beginners course should be developed based on the words overview and connection to reality. The course could, for example, be divided into three parts. The first part explains the computer itself meaning each part of the computer and how it is connected. The next section of the course explains the founding of a programming language. And during the last section of the course the classes and functions of a programming language are instructed. During this part Lego, for example, can be used to give an overview on how it all fits together.

If a programming course for women is divided into this three distinct parts it will give a female the possibility to see the overview on how it all is connected. If the professor, for example, talks about the CPU while giving coding instructions, the female will not only know about the CPU functions but also have a reality connection knowing where in the computer the CPU is located.

6.2 Method reflection

The choice of method was appropriate to get a result in this study. The literature review complemented the survey result well and interviews could also have been a complementary method to the survey.

The survey did not have a high amount of male respondents, which can affect the reliability of the comparisons among men and women in the study. The amount of women responding to the survey was enough to give a reliable result for women’s opinions on the questions. No threat can be considered to the validity of the result for this study. The result presented are based on the information conducted from the survey as well as literature review based on peer review reports.
7 Conclusion

The chapter presents the conclusion of this report.

7.1 Conclusions

A survey and a literature study were conducted to answer the hypothesis that a computer language developed towards women could help in decreasing the gender gap in the tech industry. The study comes to the conclusion that men and women learn computer languages in different ways, they also tend to use different styles when programming. It is no need for a computer language developed towards women, instead there is a need to change the way computer languages are taught to suit the female way of thinking.

7.2 Further Research

The hypothesis for this study was proven wrong, but the study came up with a result that should be further researched. A study should be made that tests the proposal for a female oriented beginner programming course as well as the hypothesis that more women will be interested in programming if it is taught in a more female way of learning.

The survey that has been conducted in this report has a low number of male participants. If a new survey is to be conducted to cross check the result, it should include more people and in particular more males.
References


Appendices

A. Questionnaire

About you
The survey takes about 2-5 minutes to answer. First there are some impersonal questions about you and after that some questions about your relationship to programming and programming languages. The data from this survey will be evaluated and used in a report about programming languages, in the computer science program at Linnaeus University Kalmar.

What is the highest level of education you have completed?*
• Did not attend school
• High school
• College
• Other

What is your age?*
• 18-24
• 25-34
• 35-44
• 45-54
• 55-64
• 65-74
• 75 or older
•

What is your gender?*
• Female
• Male

Do you know how to program?*
• Yes
• No

I don't know how to program

Do you know what the words below are?*
Are you interested in learning how to program?

If yes, are you interested in any particular programming language?

If the answer on the question above is No please give a short explanation why.

Are you interested in one or several of the topics below?

- Technology
- Sports
- IT
- Fashion
- Languages
- Travel
- Books / Reading
- Math
- Cultures

If you would learn how to program do you think it would benefit your personal and/or work life? Please explain?

What words matches the feelings you have around the word programming?
• Interesting
• Something boys do
• I would like to learn but I don’t know how
• You have to be very mathematical to know how to program
• Geeky
• Technical
• Easy to learn
• Difficult
• I am really not interested

**WHAT DOES THE FOLLOWING TEXT MEAN OR DO?**

```java
int numberZero=0; int numberOne=1; int sum=0;
numberZero+numberOne=sum;
```

• Summarizes 1 and 0
• Assigning sum with the result of 0+1
• It has no meaning
• Giving numberZero the value of 1
• Adding the text numberZero and numberOne to the text sum. The numbers have no meaning
• I have no idea
I know how to program

DO YOU HAVE AN INTEREST IN PROGRAMMING TODAY?*

-If not what would need to change to make your interested? If you are when did your interest start and how?

WHEN YOU FIRST LEARNED TO PROGRAM WHAT WAS THE MAIN DIFFICULTY YOU EXPERIENCED WITH LEARNING A PROGRAMMING LANGUAGE?*

IF SOMEONE GIVES YOU A CODE TO READ IN A LANGUAGE YOU ARE FAMILIAR WITH AND YOUR JOB IS TO ADJUST THE CODE. WHICH ONE OF THE FOLLOWING STATEMENTS WOULD MATCH WHAT YOU WOULD DO.*

- I would read through the code and only start doing the adjustments when I understand what every piece of code are doing.
- I would read through the code and do the adjustments when I have an overview of the code.
- I would find the piece of code that need to be adjusted and do the adjustment without reading through the rest of the code.

HOW WELL DO YOU KNOW THE FOLLOWING PROGRAMMING LANGUAGES?*

<table>
<thead>
<tr>
<th>Language</th>
<th>Don't want to learn this language</th>
<th>Would like to learn</th>
<th>Know the basics</th>
<th>Great knowledge</th>
<th>Great knowledge expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
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<tr>
<td>C++</td>
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<tr>
<td>Java</td>
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<tr>
<td>C#</td>
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<td>PHP</td>
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<tr>
<td>Objective-C</td>
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<tr>
<td>Javascript</td>
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<tr>
<td>Python</td>
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<tr>
<td>Ruby</td>
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</tr>
</tbody>
</table>
DO YOU HAVE A FAVORITE PROGRAMMING LANGUAGE? WHAT IS YOUR FAVORITE PROGRAMMING LANGUAGE AND WHY?

BOTH OF THE CODES BELOW SHOW HOW TO SUM ALL THE NUMBERS IN NUMBERLIST. WHICH CODE DO YOU THINK IS EASIEST TO UNDERSTAND AND WHY?

1) 
var numberList = [1,2,3,4,5];
var sumofList = 0;

for(var = i; i <= numberList.length; i++) {
  sumofList += numberList[i];
}

2) 
var numberList = [1,2,3,4,5];
var sumofList = numberList.reduce(function(sum,n) {
  return sum + n;
});

*Please write the number of the code and an explanation*