



**DEPARTMENT OF APPLIED INFORMATION
TECHNOLOGY**

Women learning programming from women:

A study of Pink Programming workshop

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Program and/or course:	International Master's Program in IT & Learning
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Abstract

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Keywords: Computer Programming, Women Learning Programming, Informal Learning, Pair Programming.

Purpose: The general aim of this research is to understand how women learn to program through collective initiatives. This is examined through participants' engagement in a programming workshop organised by Pink Programming in the Gothenburg Region.

Theory: "Situated learning theory" by Lave and Wenger was chosen as the basis for this study.

Method: The study can be described as a qualitative study where observation and semi-structured interviews were used to produce the findings. Both the observation sessions and semi-structured interviews were recorded and transcribed and thereafter the gathered data was examined through thematic analysis.

Results: The findings reveal that despite being underrepresented in the IT field, women still choose Pink Programming, an informal learning platform to learn computer programming in a collaborative manner together with other women in order to develop some basic programming knowledge for their future careers or career advancement. Most participants also had positive feedback on learning programming through Pink Programming. However, it should be taken into consideration that the results also indicate that learning computer programming collaboratively and in a single workshop were not be suitable and sufficient for all interviewed participants.

Foreword

I would like to thank my supervisor, Thomas Hillman for his guidance, advice and prompt feedback in completing my master's thesis. I would also like to thank the Pink Programming organisation, its volunteers and participants for their support and making this research possible.

Abbreviation

IT	Information Technology
STEM	Science Technology Engineering and Mathematics
ICT	Information and Communication Technology
OOP	Object Oriented Programming
CoP	Community of Practice

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1. Introduction

In recent years computer programming skills are being introduced and taught to increasingly diverse groups of people. Children, from kindergarten up to upper secondary school level, are being introduced to programming skills, but what about adults, especially women who are traditionally underrepresented in the computer science sector (e.g. Beyer, 2014; Sauppe et al., 2015)? More opinions are arising that programming skills are becoming an important skill for many job scopes (e.g. Piteira & Costa 2013; Tuomi 2018). These skills are commonly taught in a formal environment, which would be in their school setting. However, avenues such as public libraries, after school club facilities and also online communities, provide platforms to teach programming skills in an informal setting.

Of late, women and girls are also encouraged to learn computer programming skills. However, the involvement of women and girls in the information technology (IT) field, specifically in learning or working with computer programming is still debatable. Through observation, it is found that IT related jobs are competitive and socially isolating, hence discourages women from learning or working within the IT field (Werner & Denning, 2009). Nevertheless, there are still a number of women who choose to learn computer programming. The reason could be that these women, as a child or teen, have been exposed to a variety of computer skills and also have a genuine interest in problem solving (Denner et al., 2015).

The focus of this study is to observe how women learn computer programming skills from other women in an informal environment. In the past, some studies have indicated how logic and algorithms affect individuals on learning computer programming (e.g. Wiedenback, 2005; Malik et al., 2019; Faria et al., 2006; Mannila et al., 2006). Studies have been conducted to see how children from preschool, primary school and secondary school perceive computer programming. However, little research has been done on peer to peer learning and for adults. For example, how a woman learns computer programming taught by other women, in an

informal setting, is scarcely scrutinized. The person who learns may come from a wide spectrum of social, academic and professional background. The person who teaches may be an authority in the subject matter. Both parties interact in an informal setting such as monthly workshops and meet ups. Previous studies show that collaborative learning by pairing girls to learn computer programming is more effective to make them perform better and build their confidence (Werner & Denning, 2009).

The aim of this study is to better understand women learning programming from other women in an informally organised initiative. This study was conducted during a programming workshop in Gothenburg which was organised by Pink Programming. Pink Programming is a non-profit organisation which is sponsored by IT companies around Sweden and organizes code events for the female, transgender, and non-binary communities. The target participants of the specific workshop under scrutiny here are women, with little or no prior knowledge in computer programming. Normally there are several different groups of participants representing different competences and different programming languages are taught in different groups. For the purpose of the present study, several women choosing to learn the computer program Javascript were observed in the initial phase. Thereafter, three participants from the workshop were asked and accepted to be interviewed. The following research question will be addressed through this study: “*How do women learn computer programming through Pink Programming workshops?*”

The structure of the thesis is as follows:

Chapter 1 will be the introduction section, where the background, aim and the research question will be addressed. Chapter 2 will be an analysis of existing and relevant literature in parallel to the research question. Chapter 3 will be followed by framing the overall research to the theoretical background. Thereafter Chapter 4 will be about methods and data collection, where observation and semi-structured interview are the focus. Chapter 5 will present the results of the data collected and including extracts from the interviews. Chapter 6 will include a discussion and conclusion of the overall study.

2. Literature Review

A thematic review was conducted for this study and main themes and possible gaps were identified from the existing literature. The chapter starts off with computer programming where a brief definition of computer programming is introduced, mainly keeping in mind what is relevant to this study especially in relation to the participants with diverse backgrounds that were interviewed.

Thereafter, a review is done in accordance with the thesis project about learning computer programming, its difficulties, challenges and a very brief review about available resources used in learning computer programming.

The subsequent theme is a review about learning computer programming in an informal learning environment. Free choice learning is also considered to be part of an informal learning environment and motivation in learning computer programming.

Thereafter, the following theme is about women's perception towards learning computer programming and the more general challenges working in the IT industry as computer programmers. Role model and family influences were also central to the review of the literature on women learning computer programming.

The final section of the review is about collaborative pair programming relevant to this thesis project. The review is about the similarities of collaborative learning and collaborative pair programming. The benefits of collaborative pair programming are also discussed in the review.

2.1 Computer Programming

Computer programming is a practice of code creation with a set instruction that operates computers and it is a process of telling computers what to do (Breslin, 2013).

People who work to write codes are typically called computer programmers. A computer programmer's title is further divided into the work scope that is being carried out. For example,

a programmer can be called a full stack developer, front-end developer or back-end developer. A full stack developer is responsible to develop a system which consists of front-end and back-end, whereas the front-end developer is only responsible for user interaction with a front end of a system, mainly the interaction of user interface. The back-end developer is mainly responsible for the core computational logic for a system.

Programming languages itself comes varied as each of them can be categorised for an example object-oriented programming (OOP), procedural, functional, logic and scripting. Since the focus of this study will be on Javascript, the language is categorised to be an OOP language. Javascript, an OOP language was created by Brendan Eeich at Netscape in 1995 to let non-programmers create websites with client-side executable codes (Richards et al., 2010).

2.2 Learning Computer Programming

Computer programming skills have become a valuable competence in many jobs scope (Piteira & Costa, 2013). Tuomi et al. (2018), writes that programming skills are becoming important in the work environment and society and these skills are promoted by corporate organisations, non-profit organisations, science centers and hacker fest. Basic programming skills are required in workplaces such as banks, universities, libraries and so on to troubleshoot and automate solutions to simple problems. To acquire these set of skills, students from various courses besides computer science, are required to take an introductory computer programming course (Wiedenback, 2005). Tuomi et al. (2018) argue that there is an increased demand for non-programmers to have skills and competence in computer programming.

However, many are still finding it difficult to learn computer programming. There could be many possible factors for this, and one of them is difficulty in understanding the concepts of computer programming (Wiedenback, 2005). Algorithms for problem solving and logic are the typical concepts that make it difficult to learn computer programming.

Piteira & Costa (2013) writes that learning computer programming could potentially be a difficult process as it requires certain skills including memorisation amongst others.

A study by Malik et al., (2019) indicates that different learning styles could affect the learning outcomes, whereby some prefer visual learning, whilst others may prefer auditory learning or even kinesthetic learning.

Tan et al., (2009) studies suggest that it could be easier to learn computer programming and its concepts by having a very practical hands on approach and interaction. In addition, another study by (Tom, 2015), shows that programming concepts need to be practiced well in order to be understood efficiently.

Furthermore, a review by (Denner et al., 2015) also shows that family background in computing education and occupation plays an important role and has a strong influence on students in learning computing.

Another aspect to consider in learning computer programming is the type of resources used in learning these skills. Garner (2003) writes that learning resources are contents or material for courses that can help students construct their knowledge. Traditionally textbooks and lectures were the common available resources for learning computer programming, however, nowadays more resources are available through online tutorials, quizzes, online forums, mobile application programs, etc. (Garner, 2003). A review by (Hao et al., 2016) it is argued that, students tend to seek help online first when they have problems with their programming tasks, however Hao et al., (2016) also argue that students would rather seek help from their peers when they have challenging programming problems. Another study by (Eyitayo, 2013), also shows that students generally use the long and hard way to learn and use the resources just because they did not know how to do solve the programming problem.

2.3 Informal Learning Environments

Formal learning is typically understood as learning within an educational context which involves teacher and learner in the learning process (Looi, 2019). It is highly structured in its curriculum, having assessments and a qualification at the end of the student's learning process (Lai et al., 2013).

Lai et al., (2013) also indicate that an informal learning environment is learning that takes place outside school, not exam-oriented, happens incidentally, spontaneously and the learner has more freedom to choose what to learn as it is more student centered and thus participatory.

Little research has been done to discover if learning in an informal learning environment could motivate learners. It is especially unclear whether motivation itself takes place for learners who learn computer programming in an informal learning environment.

A fun and informal place for learning events makes a good learning platform which attracts various learners as compared to traditional classroom settings (Nandi & Mandernach, 2016). In contrast to (Nandi & Mandernach, 2016), there are studies that show that informal learning environment such as hackathons could be motivating factor for learners to collaborate and learn. A study by (Teague, 2002) indicates that single events such as workshops in computing do not have any influence on learners to learn computer programming or to choose IT field for work.

2.4 Women learning computer programming

STEM (Science, Technology, Engineering and Mathematics) and ICT (Information and Communication Technology) education are quite well known in major higher education institutions. Both STEM and ICT provide education for students to learn computer programming courses.

Although computer programming courses are widely popular among students, studies show that women are still underrepresented in this educational area. In a study by Werner et al., (2004) it is stated that women perceive computer programming courses to be an individual activity, isolating and lonely, which could be one of the reasons for fewer women choosing to learn computer programming.

Educational institutions for learning computer programming are not the only place where women are underrepresented. An uncomfortable working place could also be a barrier for women choosing to learn computer programming (Buhnova et al., 2019).

Another study by (Shapiro & Sax, 2011), also shows that having fewer female role models in STEM education may be a factor for fewer women to choose to attend computer programming courses.

There are a few studies that show reasons for women to be motivated to learn computer programming. Motivation itself can be defined as intrinsic and extrinsic motivation. Intrinsic motivation factor focuses on the individual's attitude, expectation, goals and emotions. Whereas, extrinsic motivation focuses on the environment external to learning (Law et al., 2010). A study by (Teague, 2002) shows that women are motivated to learn computer programming due to employment advantages and it also revealed in the study that women are likely to earn better in the IT field.

Despite all the challenges for women learning or working in the IT sector, there are quite a number of women who pursue to study and work with ICT or computer programming for their career advancement. The study by (Stanworth, 2002), indicates that computing skills are becoming a core competence and an employment skill that will be needed for many jobs in the future and also for work occupied by women.

2.5 Collaborative Pair Programming

Collaborative learning is described as two or more people working together to attain common learning goals (Jeong, & Hmelo-Silver, 2016). Whereas, pair programming is defined as two programmers sitting side by side on one computer solving the same programming task (Werner & Denning, 2009).

Traditionally most computer programming language courses are offered to students as an individual course during their study period and they were limited from working with their peers, who were also working with the same material (Werner et al., 2004). A study by (Shapiro & Sax, 2011) also shows that women often feel discouraged as success is always measured by competitive individuals' grades rather than collaborative learning or cooperative learning forms.

However, at the present time, pair programming or collaborative pair programming has been gaining wide popularity among computer programming students.

In a study conducted by (Goel & Kathuria 2010), it is shown that pair programming could be beneficial and enhance students programming skills. However, in the same study the authors also argue that pair programming could have a major setback, as one student can be a dominant programmer whereas the other could be dormant.

According to a study by (Tom, 2005), collaborative learning encourages students to enhance their communication skills and creativity. Another study by (Jubas et al., 2006) also indicates that collaboration helps learners to build their networks and their communication skills.

Research has been done about pair programming and collaborative learning among students in schools, after school programs, out of school and in higher education settings. However, little research has been done on collaborative pair programming among women in informal learning settings.

Summary of Literature Review

As the literature review indicates, scholars have stated that having basic programming skills and knowledge is important for various types of jobs. Regardless of the challenges and difficulties in learning computer programming, women who are underrepresented in the IT field continue to choose to learn programming in order to acquire job skills.

These studies however did not provide much information on how women learn computer programming from other women in an informal setting. As a result, the thesis aims to investigate and better understand how women learn computer programming collaboratively with other women.

3. Theoretical Background

There are various learning theories which emphasize different learning aspects and purposes. Situated Learning theory was chosen as a framework for understanding participation and learning in this study as it focuses on the social aspects, learning as embedded in and Community of Practice (CoP) (Li, et al., 2009).

The essential characteristics of situated learning theory is a process called legitimate peripheral participation.

“Legitimate peripheral participation draws attention to the point that learners inevitably participate in communities of practitioners and that the mastery of knowledge and skill requires newcomers to move forward to full participation in the sociocultural practices of a community. It is about the relations between newcomers and old-timers, activities, identities, artifacts, and communities of knowledge and practice. It is a process where newcomers become part of the community of practice and the person’s intentions to learn are engaged and the meaning of learning is configured through the process of becoming a full participant in a sociocultural practice.” (Lave & Wenger, 1991, p.29)

Lave & Wenger (1991), have also stated that learning through legitimate peripheral participation takes place no matter what type of educational form provides the context for learning, or whether at all it is an intentional education form. For instance, all interviewed participants have acknowledged that they have learned programming skills through Pink Programming workshop which is an informal learning environment.

CoP is defined by Lave & Wenger (1991), that through the process of sharing information and experience within a group of members with common interest, they learn from each other and have the chance to develop personally and professionally. As an example, one of the

interviewed participants did mention that learning through Pink Programming workshop has developed more knowledge on programming skills both professionally and personally.

The term CoP was also first used to describe the learning process through practice and participation.

In an article by Li, et al., (2009), it is stated that CoP has been further described by Wenger as a type of informal learning organisation. In this study Pink Programming is considered a CoP as it is an informal learning organisation and the participants come together to learn from each other.

The relevance of situated learning theory in this study relates to the concept of legitimate peripheral participation, which describes the process of how new members become more experienced members in a CoP. As an example, two out of three Pink Programming participants who were interviewed for this study, were once new members and eventually became more experienced as they had participated in a couple of workshops.

This study has adopted the situated learning theory as Lave and Wenger's study shows that all learning is based on social practices and knowledge is created and transferred. The theory is also relevant to this study as learning computer programming through Pink Programming is through social practice and can be regarded as a CoP, where knowledge is created and maintained among the participants during the workshop.

4. Methods

4.1 Settings and Participants

The data collection for this study took place as part of a computer programming workshop called 'Pink Programming' by means of semi-structured interviews and observations.

Pink Programming takes place Sundays once a month in Gothenburg. These workshops are typically sponsored by various IT consulting organisations and are conducted by female volunteers from the IT industry in Gothenburg. The workshop is free for all women who are members of Pink Programming. However, members still need to register through social media a couple of days prior to the workshop to be able to participate.

Typically, the participants are allowed to choose what they want to learn through the workshop, as they offer different types of computer programming lessons such as C++, Java, Javascript, Python, HTML, CSS and so on. However, the main focus of this study will be on a Javascript workshop which was a full day program. All participants need to bring their own laptops to be able to practice and work on their tasks.

According to the Pink Programming workshop team leader, there were more than thirty women who had shown interest to participate in the Javascript workshop. However, due to space constraints, only thirty participants were allowed to attend, and some were also on the waiting list. During the workshop, participants were also provided with breakfast, lunch, desserts, fruits, coffee and tea by the sponsors.

4.2 Observations

Participant observation was chosen as a method to collect data from Pink Programming workshop. Participant observation method involves researcher engaging in a situation, observing, recording and taking notes of the observation (Iacano et al., 2009). In relation to this study, notes and some photographs were taken from the Pink Programming workshop. Cotton, et al., (2010) argued that observational method to collect data has its own advantage and disadvantage. The article has stated that observational method could be used to collect real life and natural event rather than artificial situation; as an advantage. Whereas the disadvantage of the method is that, there could be potential issue of participants behaviour is influenced by the act of observation. However, Cotton et al., (2010), also argues that the issue could be tackled if researcher is known to the participant.

The aim of the observations was to study how female participants engage and learn programming through the Pink Programming workshop. For this particular workshop, Javascript programming language was the curricula. The workshop began at nine o'clock in the morning, with arrival of participants and settling in for the lesson and it ended in the evening at four o'clock. The learning process however ended at three thirty in the evening followed with a half an hour question and answer session.

The event started with female volunteers giving a short presentation of themselves, advice and motivation to learn computer programming and possibly start a career in the IT or software field. The volunteers in Pink Programming could be regarded as tutors or instructors for teaching Javascript to the participants. The workshop started with a brief introduction of Javascript and the installation process of relevant programs such as Sublime text editor to write codes. Figure 1 shows the sublime text editor website being projected so that all participants would be able to download it. It is observed that most participants and the tutor had different models of laptops, due to this not all participants could install Sublime text editors without

technical issues. The volunteers did help to solve the technical issues; however, they could not facilitate all of the participants individually. During this time other fellow participants who completed the installation process successfully helped those who faced problems.

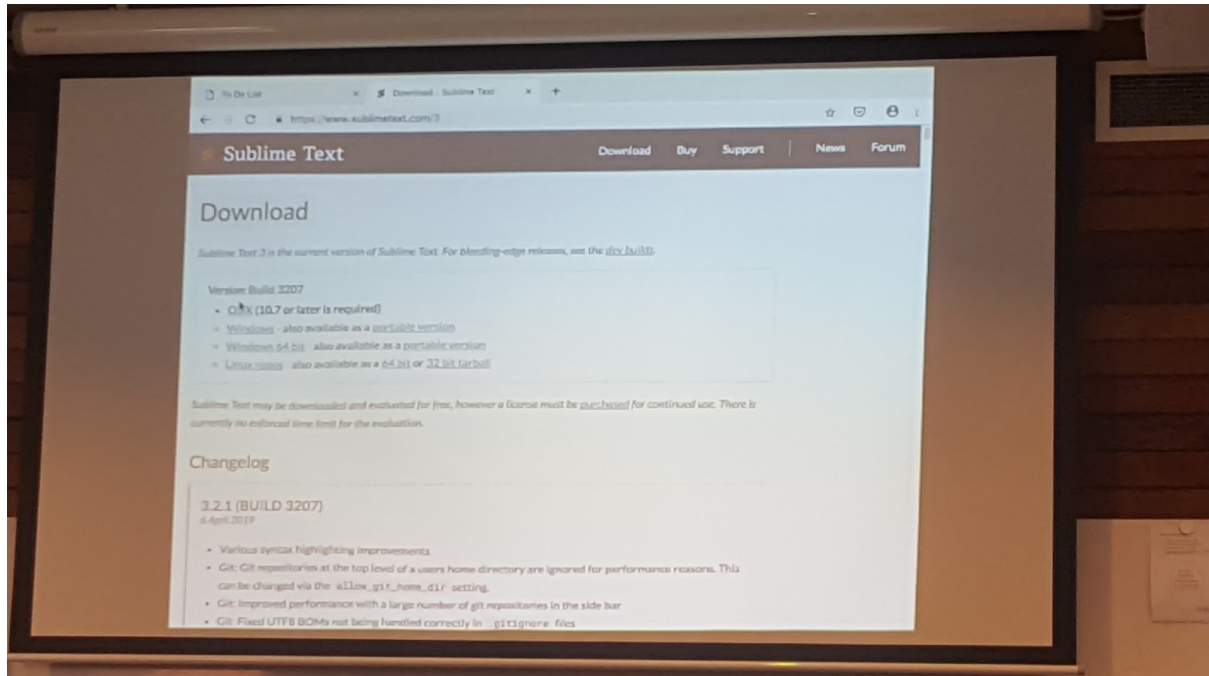


Figure 1. Download site for Sublime Text editor

The female instructor presents and explains briefly about the 'To do list' page and starts writing some codes in the Sublime text editor. Figure 2 shows the 'To Do List' website to be created by participants. A sample code written by the instructor is shown in Figure 3. In certain scenarios, few participants had some issues and problems but were helped throughout by the instructors or other participants. In addition, some participants referred to other resources when they have problems solving certain tasks. Examples of other resources used are like Youtube videos, websites like w3schools.com (as shown in Figure 4), wordpress.org and forums like Stackoverflow.

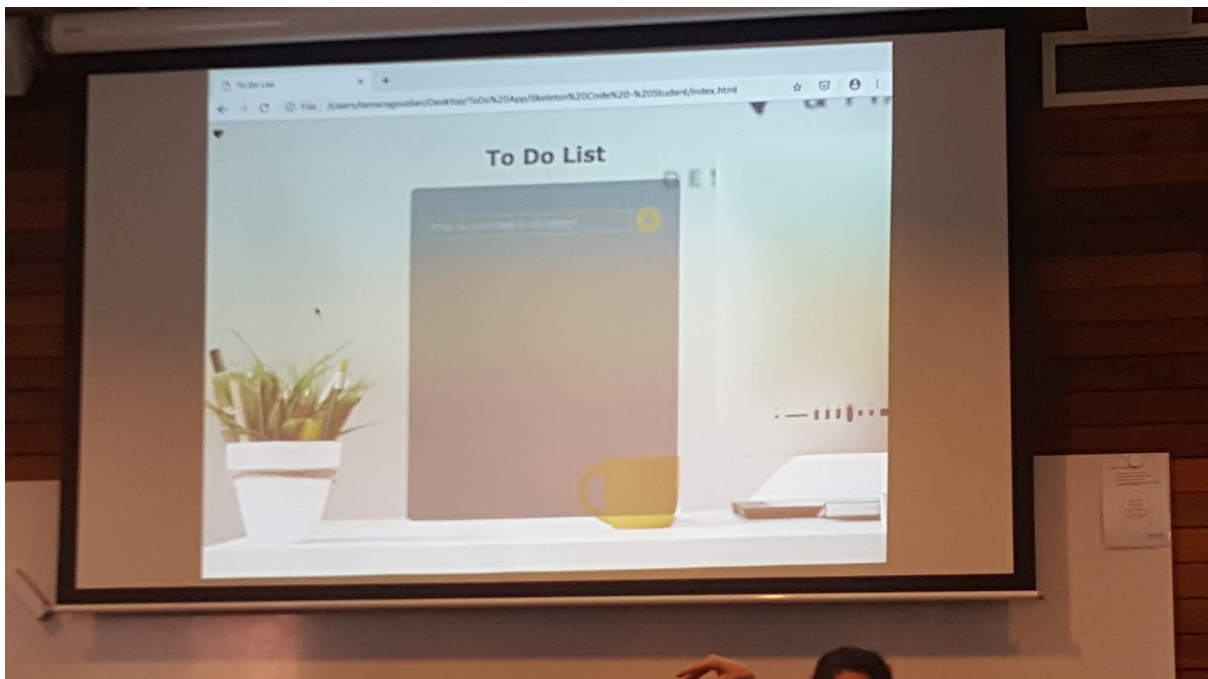


Figure 2. To Do List website to be created by Pink Programming participants

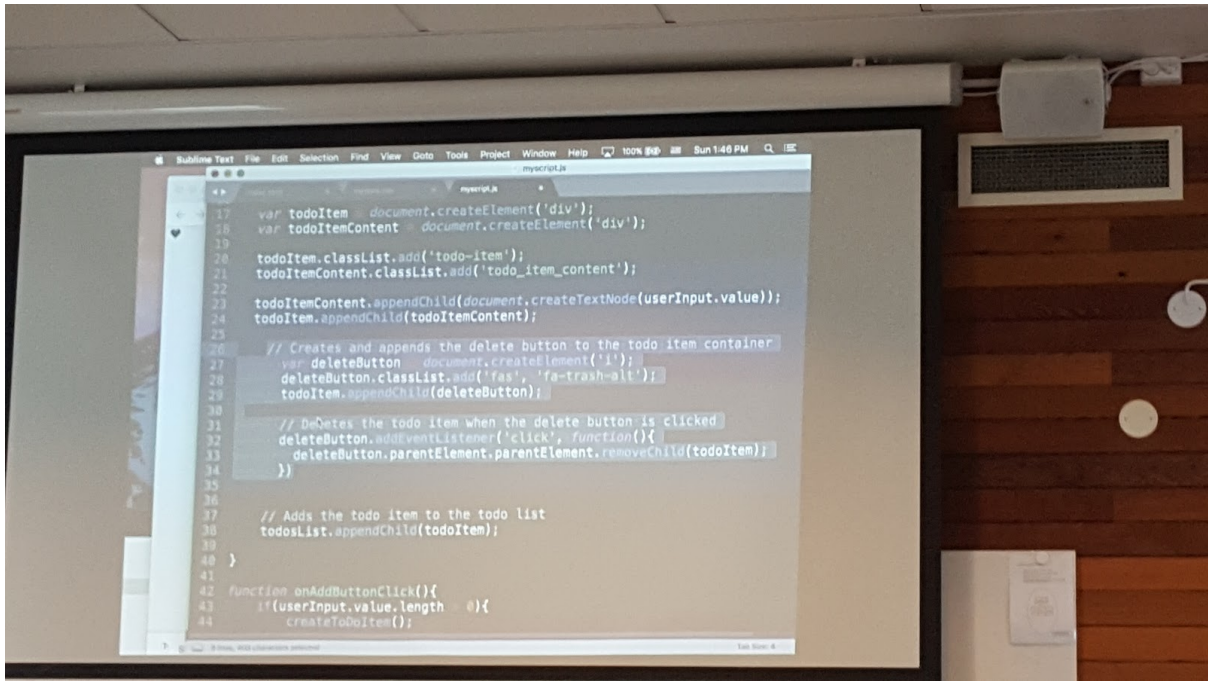


Figure 3. Sample codes written by teachers to show each step in creating the 'To Do List' website

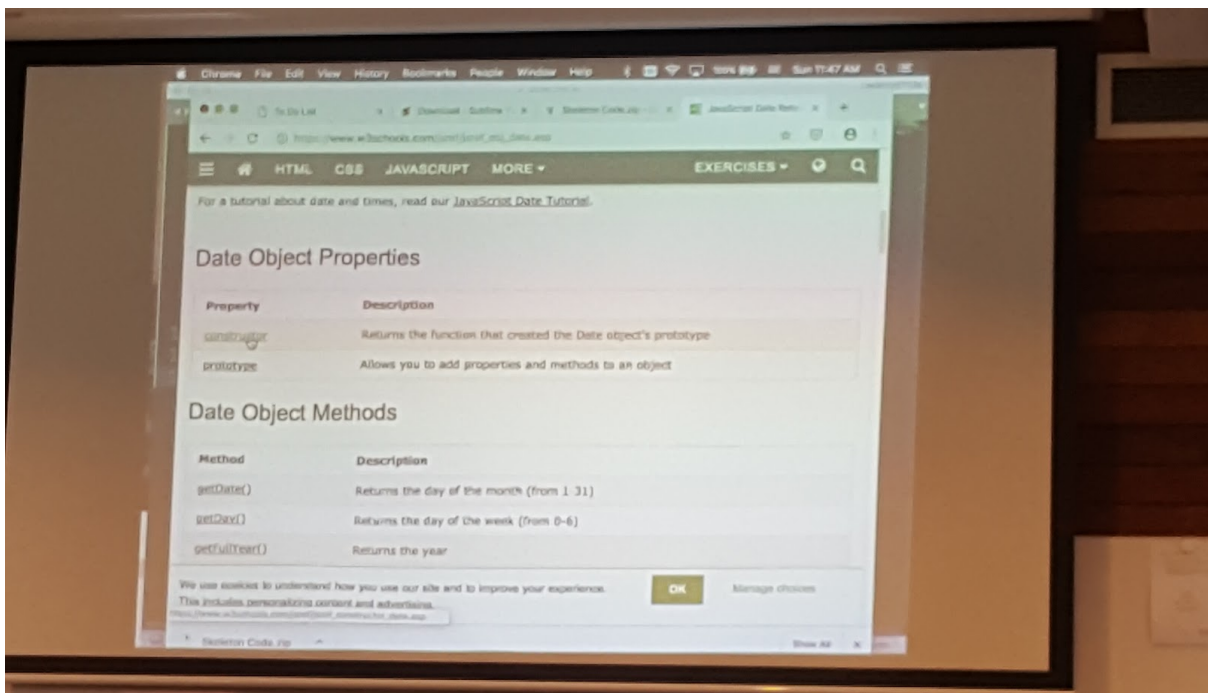


Figure 4. www.w3schools.com, an online resource that was used during the workshop

4.3 Semi Structured Interviews

A semi-structured interview method was chosen to conduct the interviews with Pink Programming participants. This method combines a structured data collection with the flexibility of having interesting topics to appear during the interview. A method that is commonly used for qualitative studies, where there is flexibility, chance to change or add more questions to explore and explain participants' feedback (Elliot, et al., 2016).

The purpose of conducting a semi-structured interview was to get some feedback from the participants about their engagement through the Pink Programming workshop, keeping in mind the focus of this study. Due to time constraints during the workshop, it was not practical to conduct an interview with all thirty participants. Only eight participants agreed to be interviewed initially when the instructors informed about the research. However, most participants including six out of the eight participants who agreed to be interviewed left immediately after the workshop ended and only a few of them stayed back for question and answer session. Two out of the eight participants who initially agreed to be interviewed stayed back for the interview to take place. Since the interview session had only two available participants, an effort to engage with more additional random participants were initiated. However, most of them have declined to be interviewed except for one. Hence, three participants were chosen for the semi-structured interview after an initial short informal discussion to get to know their backgrounds. After the informal discussion, the planned interview took place for approximately 35 minutes for each participant. However, the third participant had to leave the place, but that participant was interviewed on a different date and place, also for around 35 minutes. The interview questions were given to the participants only during the interview.

All interviews conducted were fully recorded. A follow up email was also sent to all three participants with the same questions asked during the interview asking if they had additional responses and feedback (Appendix 1).

4.4 Data Analysis

A thematic analysis method was chosen as an approach for the data analysis. This method is used to recognise, analyse and report patterns or themes within data (Braun & Clarke, 2006).

The data analysis consists of six phases of thematic analysis as listed below, described by Braun and Clarke (2006):

Phase 1: Transcription and familiarisation of data

Phase one consists of transcription of all recordings by carefully listening and taking notes of relevant information from the interview recordings. The recordings were repeated several times and notes were re-read to avoid any important information being left out. It should be acknowledged that a limitation of the study is that I was the only person to engage with the data.

Phase 2: Generation of Initial Codes

After the completion of transcription from phase 1, initial lists of codes were identified for phase 2 and it was done systematically and manually by re-reading the notes that were taken from the earlier phase. A longer list of interesting codes was identified (Table 1), and notes were taken.

Phase 3: Description of themes

As initial codes were identified from the earlier phases, all codes are now analysed and sorted in themes and sub-themes. Some codes are also removed as they have formed a repeated group of similar themes. Figure 5 in the results chapter, shows a visual map the themes identified from the initial codes.

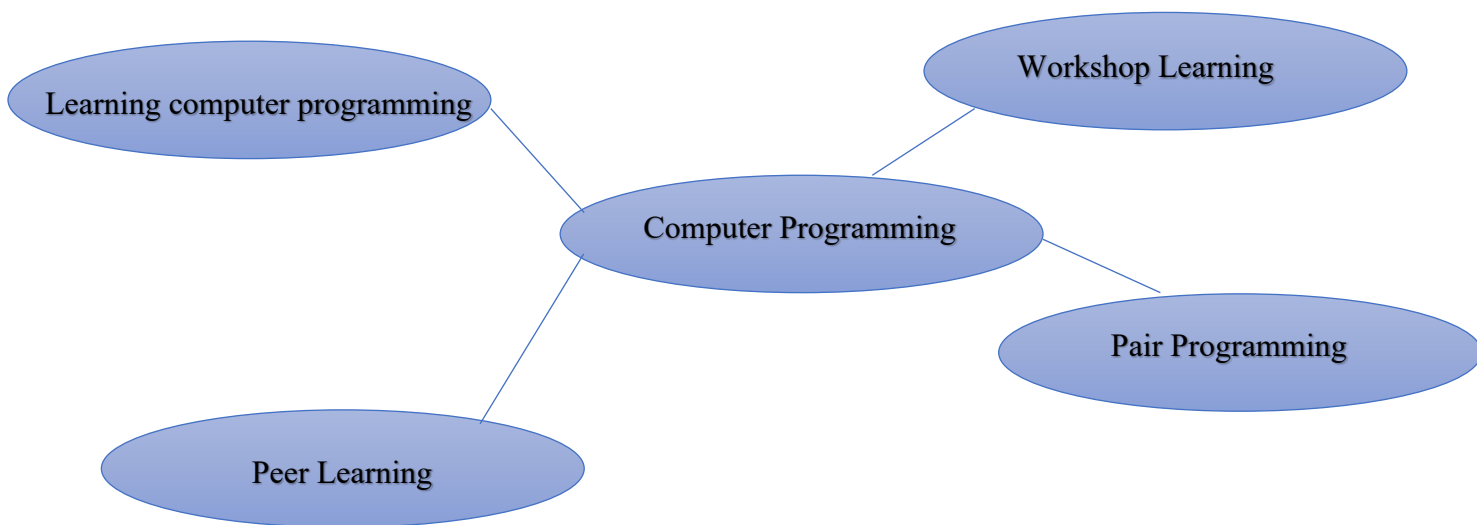


Figure 5. Initial Thematic Map

Phase 4: Review of themes

Themes and sub-themes that were identified in phase three are once again reviewed to be refined in this phase. Some of the themes did not fit quite well, hence, they were removed or renamed to generate a new thematic map. The theme peer programming has been removed,

whereas collaborative and pair programming themes were also removed and combined as one theme called collaborative pair programming. Other theme names were also modified during this process.

Phase 5: Definition and naming of themes

At this stage, it will be the final refinement of themes to be presented for the analysis. It was important to identify the essence of each theme and give names that fit in to the overall research.

Phase 6: Production of report

Phase six begins with writing of the report after the final analysis of themes. Clear examples from the transcribed data have been chosen as themes and subthemes.

Ethical Considerations

For the purpose of this study I first got approval from Pink Programming organisation to conduct the study. Thereafter, all participants were informed thoroughly about the research process and purpose verbally on the same day before the workshop began by the instructors. I was also introduced by the instructors to the participants as the researcher who will be observing and later conduct an interview with the participants. To participate in this study was entirely voluntary and the participants (both participants and instructor) were informed that they could withdraw at any point. To remain anonymous the name of the participants are not mentioned in any part of the thesis. The names of the three female participants that were interviewed were changed to corresponding names, i.e. Lisa, Sara and Victoria. The confidentiality of the sponsor organisation for the specific workshop scrutinised was also taken into consideration and was not mentioned in any part of the thesis.

5. Results

This chapter reports the results of the current study obtained through interviewing the three participants of Pink Programming workshop. The following are the information of respective participants:

Lisa a librarian by profession, currently works for a library in a higher education institution in the Gothenburg region. She has a bachelor's degree in French and also a master's degree in library and information science. She regularly attends Pink Programming workshops. Prior to the Javascript workshop scrutinized for this study, Lisa had already attended at least four or five Pink Programming workshops on other computer programming languages.

Sara is a first-time participant in a Pink Programming workshop. She joined the Javascript workshop after being introduced by a friend. Sara has completed her bachelor's degree in computer science from her home country in Bangladesh and started working as an Information Consultant in a well-known IT consulting company after moving to Sweden and Gothenburg. Sara has good programming knowledge and skills, from her formal education and a bachelor's degree and she was always interested in front end development even during her formal studies. Front-end development is the process of converting data to graphical interface through HTML, CSS and Javascript. Sara currently works at one of the sponsoring organisation of Pink Programming

Victoria, a student currently pursuing her master's degree in computational linguistics at a university in Sweden. She has completed her bachelor's degree in linguistics from the same

university. She has previously worked in the marketing department of an IT company and briefly worked as a video game tester.

The following is a table of expanded codes that that corresponds to the participants and final thematic map throughout the interview:

Codes	Definition	Names of Participants
LCP1D	Learning Programming difficulties	Lisa, Sara
LCP2W	Learning Programming why	Sara, Victoria
LCP3R	Learning Programming Resources	Lisa, Sara
IL1E	Informal learning environment	Lisa, Sara, Victoria
WLCP2CL	Women Learning Programming Challenges	Sara
WLCP4R	Women Learning Programming Role Model	Lisa, Sara, Victoria
CL1A	Collaborative Learning Approach	Sara, Victoria
CL2B	Collaborative Learning Benefits	Lisa

Table 1. Expanded list of codes

Learning Computer Programming

Through the interview, it was discovered that all three participants of Pink Programming workshop have acknowledged that having basic programming skills are important and why they use the platform to learn more on programming language.

In relation to this, the following is mentioned by Lisa:

“My main tasks are the metadata and systems we use to - basically - keep track of literature and peoples’ loans etc. So, while I’m not a programmer, I often encounter situations where basic coding is very helpful for example for transferring, extracting, analyzing and manipulating data. Since we are right now in the process of implementing a still-in-development open source library system called FOLIO, I communicate with developers, at the library and within the FOLIO development community, regarding our systems requirements. Since I’m very curious and eager to learn new things, I try to pick up as much knowledge as possible from these conversations....but then sometimes it is hard to learn just from the workplace ... that is why I decided to join Pink Programming workshops to learn basic coding.”

LCP1D

Lisa has a strong interest in learning computer programming. She does not have any formal education in computer programming. Although it is easy to assume that a librarian has no relation to computer programming in their work, it becomes evident from the interview that her work however does require some understanding and writing of basic coding skills.

Similarly, Sara has also mentioned why she learns programming language through Pink Programming:

“I have always been interested in Front-end web development during my study life and also attended various workshops in my home country for example, on HTML, CSS, Database, Photoshop, Illustrator, etc. I also have some basic understanding about JS but it's quite limited and I have not practiced it for a very long time since I graduated, and I

worry...hmm that I might forget it all together. This is why I attended this workshop in order to enhance my knowledge and skills and it will be very helpful for my work too.” LCP2W

As previous research has shown, several reasons influence women to choose a career in the IT field. Teague (2002), argues that encouragement from family members to be one of the reasons for women to choose a career in the IT field. During the interview, Victoria tells that she has a strong family influence in the IT field:

“Coding was always in my background, my mom was a system developermy dad was an IT consultant. Although I have reasonably good knowledge on programming...hmm..I would say I am better in Python, but I just wanted to learn more....or may be just Javascript. I have used it in one of my projects for my master’s programme and it was very rewarding. May be also for my future career.” LCP2W

Victoria had chosen to complement her skills in programming by learning Javascript through the Pink Programming platform particularly for her ongoing studies and probably also for her future career.

During the workshop, it was also observed that all participants were introduced to w3schools website; an online educational website for learning web technologies, to be used as an online help tool. However, it is observed later in the workshop, that the participants quickly moved on asking for help from participants who were sitting beside them.

Lisa had mentioned that, prior to the workshop, she has only watched Youtube videos as a resource and getting some help from colleagues at work. However, now she has through the

workshop learned to use other resources to get help for her coding problems. She had also mentioned that these resources are not only used during the workshop but also could be used for developing her own projects. According to Lisa, she now knows w3schools could also be used as a tool for help:

“Prior to joining Pink Programming workshops I have always hmm...used F12 to open programmer’s tools in Firefox... and asking developer colleagues to explain what they’re doing or watch some YouTube videos. But...after joining the Pink Programming workshop, I have learned there are other resources available online like w3school, an online educational website for learning web technologies, which I often use now to help me with coding.” LCP3R

F12 developers’ tool is a web development tool that helps in design webpages

Sara, however had a different view on having online tool as a resource. This relates to Hao et al. (2016), who argues that students first seek help from online resources but prefer to seek help from peers when they face more challenging programming problems.:

“I only knew about WordPress and w3schools to seek help when I have problems in programming. But I also seldom use them as I am not doing programming that much and during the workshop I just feel more comfortable asking others to show me and explain it to me while doing ...I don’t know why but I just understand this way much better....maybe for complex problems this way is better and the easier and common problems I use the online help.” LCP3R

In the interview Sara also mentioned her general thoughts about Pink Programming:

“Overall the arrangement was really good,....hmm...but I think they could have more workshops on the same topic or...you know may be split into more sessions or days. I don't think one day was enough to cover all topics related to Javascript and I don't think I will learn or look it up at home unless I really want to develop further on this assignment.” LCP1D

Although Sara's general impression was that the workshop was good, she had concerns about the limited time for learning of programming language in one day. As Law et al. (2010) study identifies, practicing is important to maintain good programming skills, i.e. having additional workshops for a single programming language, as suggested by Sara, may be helpful in practicing it.

Informal Learning Environment

Two participants, Lisa and Sara, has expressed that the learning environment, helps them to be at comfort while learning programming.

According to Lisa, the office environment in which the Pink Programing workshop takes place, makes it a better place for her to learn as she feels it is almost the same as her own workplace:

“So what attracted me about Pink Programming in the first place was no experience required, it's free, there's plenty of coffee and chocolates, a very relaxing office environment with food provided, just show up! And instead of a rigid schedule and vigorous learning, here I am free to learn and do my task when I want to at my own pace. It also feels like I am almost at my own workplace.” IL1E

Sara have mentioned that main reason for attending Pink Programming workshop was that it was arranged at her workplace:

“What I like about the workshop is, most of the time it is held in my office and not in a University campus or schools. I don’t need to bring any books ...hmm or even my laptop as I leave it here when I know I am going to attend the workshop. It makes me really comfortable to know that I am going to learn in a place that I know.” IL1E

Victoria, however had a different view when it came to the learning environment:

“I love coding, and it's a good way to relax and gather inspiration.... I can study and do programming anywhere as this is not my first time learning it. I have done it in Uni...at home and this workshop...it doesn't really matter to me. I have some knowledge on programming skills but I need to ...or maybe I could say that I need guidance or deepen my skills on an advanced level for the projects that I am doing.”

IL1E

Theoretically, Lave and Wenger (1991) assume that learning takes place no matter what type of educational form provides the context for learning. As for Victoria, it is revealed that learning through the Pink Programming platform in various premises and environments does not affect her learning.

Women Learning Computer Programming

Lisa have expressed that having female role model having from the IT industry, especially professional female computer programmers, was also a very important factor to sign up for and participate in Pink Programming workshops:

“Besides these things, what keeps me coming back is the privilege of getting to spend a day learning with and from/talking to smart and driven people who are there to learn...hmm and also to teach new skills It’s truly inspiring.” WLCP4R

Having female role models to participate as instructors and to be able to communicate with them is also one of the factors brought forward as important to learn computer programming through the Pink Programming organization.

Sara also mentioned during the interview, the motivation for her to learn programming through Pink Programming platform:

“I was really motivated to join the workshop as it gives me the opportunity to know more women who share common interests and thoughts. I also realised that I was not the only one who struggled in the IT field whether to learn or getting a job.”

WLCP4R

It was also revealed during the interview that Sara and some of the volunteers have faced similar challenges in IT field:

“It was also interesting to know that all the volunteer teachers who now have years of experience as programmers had also faced similar challenges and how they overcome it and using this platform to encourage more women to participate and learn coding...I think this is really fantastic.” WLCP2CL

Sara also mentioned that, apart from knowing fellow participants, she also got to know more women from the IT field especially the instructors of Pink Programming workshop and their networks.

Despite having two participants who were motivated by female role models, Victoria had some concerns regarding the instructor’s perspectives on women as discriminated:

“About Pink Programming in general I think it's a great concept. We get to network and see what possibilities are out there, and it's an opportunity to meet and mingle with role models. The participants are usually very nice and friendly. The only part I don't appreciate as much is that sometimes they focus too much on how discriminated women are. Yes, it does happen, and it's awful, but I personally would much rather focus on the actual coding.” WLCP4R

It was also observed during the workshop that many participants were listening to the motivational talk from the female instructor, however it cannot be generalized that all participants were interested in the inspirational topic presented by the instructor.

Collaborative Pair Programming

In the interview with Lisa it was also discovered that as a Pink Programming participant there are few challenges faced, such as for instance not being able to follow or keep up with the task at the same pace as the tutor. However, Lisa mentioned that she really appreciates that she could get help or even help others when they experienced difficulties in coding:

“I think what makes it work in spite of the challenges, is how helpful and open the people there are – once you’ve managed to finish a step, you can show the person struggling next to you (all the while learning by explaining). And the next step, maybe it’s the other way around and I think at every Pink Programming workshop I’ve been, I’ve both given and received help from other attendees. Since there are often big groups, and few tutors, and it’s so easy to get stuck and fall way behind when programming, I think attendees helping each other is absolutely necessary to get workshops to work - it also contributes to the friendly atmosphere (and maybe sometimes it’s easier when you’re a beginner to ask peers for help). It can be a challenge, though, to make sure you don’t fall behind yourself if you spend a lot of time helping others. On the other hand, learning to explain things to others is also an incredibly valuable skill - and when that you cannot learn while practicing alone.”

CL2B

During the workshop, it was also observed that not only Lisa, but all the other participants not only got help but also offered help to other participants who were sitting next to them when the instructor was out of reach.

In the interview, Sara mentioned the contrast on self-learning and learning together with fellow participants of Pink Programming workshop:

“One thing that I can say is, it is totally different from the way I have studied programming during bachelor’s program. Group work was almost non-existent during my studies, but here during the workshop I can work with my partner or whoever sits beside me. We can help each other and that is something that I really like. But the only problem is... sometimes it can be also hard when I am already done with one task, I want to move on to another task,...but...I need to help my neighbor then I am also stuck.” CL1A

In general, Sara were positive to learning programming collaboratively and appreciates learning together as it helps with her coding skills, however she has also mentioned a minor setback, which she could also possibly get stuck on a single problem for a longer period of time while learning through collaboratively. Nevertheless, this may be a one-time situation that only arises for her and cannot be concluded for all the rest of the participants.

However, Victoria had a slightly different perspective when it came to collaborative programming, although she like learning programming with her fellow participants, she also mentioned during the interview that sometimes she prefers to do the task on her own:

“I like to attend Pink Programming’s workshop...I like that we can work together and it is inspiring...I think for the purpose of this workshop I can work together with other participants and I can learn in order to do my own projects, but sometimes I

would rather do own my work as I don't want to wait for others, I want to finish my work fast and in a way, that I can understand". CL1A

Through the interview it is understood that Victoria would like to focus on her own work, where she could be creative with her own codes the way she understands it and not necessarily having to follow detailed codes by the instructor and engage in collaborative work.

Lave and Wenger (1991) identify that learning through the process of sharing information and experience within a group of members with common interest, they learn from each other and have the chance to develop personally and professionally. According to one of the participant, apart from her work, learning computer programming through Pink Programming workshop has been very useful for her own self-development:

"I think I've participated in four or five Pink Programming sessions, the first one almost a year ago. Working with our open source system project, and working close to developers and seeing what they could do (sometimes quickly solving problems I had been struggling with for months), I had grown increasingly interested in learning some programming for my own future projects. I also hope that learning to write any programming language will give me a better understanding of programming overall – making it easier in the future to learn specific languages (sort of like knowing the grammar of one Indo-European language would help me understand how others are structured)." (Lisa)

It was understood from the interview that Lisa has her own interest in learning programming for her own professional knowledge.

It was also observed that there was a question and answer session among participants and instructors after the workshop ended. The session was mainly to address general questions about instructor's work, lifestyle, how to go through technical interviews and also exchanging contacts through LinkedIn for future network. The duration of the session was around thirty minutes.

Summary of Findings

To summarise all three participants of had some similarities and differences on their thoughts about Pink Programming. All three participants have mentioned that Pink Programming has been used as a platform for them to learn programming.

Lisa and Sara had mentioned that having an informal education setting; in this case the sponsoring premises as the learning setting was one of the reasons for them to participate and learn programming through Pink Programming. However, for Victoria the learning environment did not have any implications on her learning.

Both Lisa and Sara have mentioned similar comments in regard to having female role models and participants. Lisa especially emphasized the important role of female role models in programming, which is one of the cornerstones of Pink Programming workshops, as it is described in the website. Whilst Sara mentioned that having female participants and instructors as role models have encouraged her to participate and learn programming.

I would argue that all three participants had some extrinsic motivation to learn programming through Pink Programming platform, as they could utilise their programming knowledge for their work purpose or studies. For an example, both Lisa and Sara had mentioned that their work requires having basic understanding and

knowledge on programming. Victoria on the other hand learns programming for her ongoing studies and possible future career.

In regard to learning programming collaboratively, Lisa and Sara had similar feedback. They mentioned that learning together could hinder one from going forward while helping other participants and as for Victoria it did not have any significant impact on her learning.

6. Discussion

This present study is designed to investigate how women learn computer programming from other women in a non-educational environment. The participants reported positive feedback towards learning computer programming, more specifically Javascript, through the Pink Programming workshop. However, there were also a few challenges identified by the participants in learning programming by participating in this one-day workshop. The discussion section reveals the differences and similarities from the results of data analysis and findings from the literature review. The theoretical point of departure for this study is based on Lave and Wenger's (1991) situated learning theory. Lave and Wenger (1991) describes that learning is a social practice, where knowledge is created and transferred. Wenger (1998) also describes that learning happens as part of social participation. In relation to this, Pink Programming can be defined as a platform where knowledge is created and transferred among its participants. According to the two interviewed participants, they have mentioned that they have gained knowledge on programming language by participating in Pink Programming workshop.

Lave and Wenger (1991), also argues that learning through legitimate peripheral participation as an essential characteristic of situated learning theory. Legitimate peripheral participation describes how new members become experienced members of a community of practice. In

relation to this, two participants, who were once new members of Pink Programming has become experienced members. However, one of the participants was a new member of the community as this is her first time participating in Pink Programming workshop and it is unknown whether she will continue to participate in future workshops and become an experienced member of the community.

Lave and Wenger (1991), assumes that learning takes place no matter what type of educational form provides the context for learning. However, for one of the participants, the learning environment does not have any significance on her learning.

Learning Computer Programming

In line with findings from previous research (Piteira & Costa, 2013; Stanworth, 2002; Teague, 2002; Tuomi, 2018), the three participants interviewed in this study mentioned that learning basic programming skills is important and advantageous for most jobs these days. By participating in the Pink Programming workshop, the interviewed participants revealed that they had developed knowledge and skills on computer programming for the purpose of work. When it comes to maintaining such programming skills, both Law et al. (2010) and Tom (2015) showed in their studies that practice is required to sustain good programming skills. However, an issue that need to be addressed is the duration of learning activities when learning computer programming. One of the interviewed female participants addressed this problem and pointed out that a single one-day workshop is not feasible for both learning and maintaining such skills by practicing computer programming skills.

Informal Learning Environment

Two participants mentioned that the Pink Programming organization as a whole platform motivated them to learn computer programming. Nandi & Mandernach (2016) and Lai et al.,

(2013) concluded in their studies that informal learning that happens spontaneously and incidentally outside of formal education environments, in their cases schools, renders possible an attractive platform for learners. However, the results of this study is somewhat contradictory when it comes to motivation as one of the participants stated that the environment did not have any effect on her learning outcome and thus the results is difficult to generalise.

Women Learning Programming

(Buhnova et al., 2019; Shapiro & Sax, 2011; Werner et al., 2004), have all stated that having fewer female role model and being underrepresented in education institution and workplace could be the reason women are not keen to be involved in the IT industry. Two participants did state that having female role model as instructors and fellow female participants motivated them to learn computer programming through Pink Programming platform. But one also mentioned that she did not like the talk about women being discriminated, but rather wanted the instructors to focus on the content and skills to be learnt.

Collaborative Pair Programming

(Goel & Kathuria, 2010; Jubas et al., 2006; Tom, 2005) writes that learning programming collaboratively has its benefits. In relation to this the interviewed participants had positive feedback on learning and doing programming collaboratively and also mentioned that they can help each other when they had problems or getting stuck on certain tasks.

Learning collaboratively also made the participants rely on their peers most often instead of using the resources that they know either by themselves or which was shown during the Pink Programming workshop. Despite having positive feedback from participants on learning collaboratively, two of the participants did mention that sometimes it is not feasible to do programming collaboratively as they can be left out.

Limitations of the study

One of the challenging tasks for this study was to find enough number participants who would be willing to be interviewed and the limited time allocated for this research. There were thirty participants altogether who signed up for this workshop, however only a few agreed to be interviewed. After the initial interview, further screening was done to carefully select participants with different education and career backgrounds. It was also not feasible to collect data from workshops that were conducted every month; therefore, it was decided to collect data from one-day workshop. Due to this reason, the results cannot be generalised and further research is recommended.

Future work

It would be of interest to study more participants with diverse backgrounds that take part in learning programming through the Pink Programming organisations. Furthermore, it would be interesting to conduct a study on a workshop that has more or a continuation of a single programming language that is being taught and also not specifically bound to one region in Sweden.

7. Conclusion

The aim of the study conducted was to understand how women learning computer programming from other women in an informally organised initiative. In general, this study has shown that Pink Programming is used as a platform for women to learn programming collaboratively with other women and the participants had positive feedback learning through this platform.

The informal learning environment and female instructor as role models has given opportunity for women to participate and learn programming skills that can be practiced for their current career or career advancement.

Conducting a study on a single workshop event is rather small in scope, but the results do raise the question of whether collaborative programming is good fit for all participants. It could be a recommendation for future work that studies could be done on how women learn programming for a longer duration such as at summer camps or bootcamps. This might yield more detailed results on how collaborative programming in such contexts benefits certain participants while being less useful for others.

All in all, the results of this study suggest that the Pink Programming platform and format makes a contribution to promoting the learning programming skills amongst women in a collaborative and well received way.

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Appendix 1.

Interview Questions:

A brief description and background of yourself:

Name: / Your Education and work experience:

Is your current work related to programming? If yes, is it front end/back end or full stack?

Are your current studies related to programming?

Why did you choose to attend Pink Programming's workshop?

How is it different from other forms of learning environment/settings?

Why did you choose to learn about Javascript / Will learn on your own or develop your own project?

What are the resources that you use to learn or code in Javascript?

Did you help other participants when they needed help or vice versa?

How are the tutors' teaching method, was it useful?

What is your overall perception of the workshop?