Design, Code, Stitch, Wear, and Show It! Mobile Visual Pattern Design in School Contexts

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***Abstract*—Much attention in learning about programming has focused on designing video games and supporting pupils to build playable artefacts. Gender differences in playing behaviour and game preferences raise concerns about possible gender inequalities when games are used as a motivation to explore coding. The Code'n'Stitch project (2018-2020) funded by the Austrian Research Promotion Agency (FFG/FEMtech) introduces a gender-sensitive pedagogical framework for handicraft lessons in Austrian secondary schools creating "wearable computing technologies" by using mobile visual pattern design with the Pocket Code App. As part of this project, we have extended the app with the function to program embroidery machines and used the interests of the target group of teenagers, particularly girls, and teachers at a very early stage of the development cycle of the app extension and materials. In this "Research to Practice Full Paper" we present our target group using personas and insights of the workshops for a requirements analysis of the app and the learning material. Furthermore, we explore how to effectively support non-Computer Science teachers in such coding activities, or the difficulties in transferring designs initially drawn on paper to programmed artefacts. The main methods used during the exploratory workshops include on-site observation notes, questionnaires, interviews, and analysis of designs. The results of this paper describe the atmosphere in the classroom, explore this approach more broadly by providing insights into the experience of learners and teachers, and presents the results of the initial usability evaluation of the app using a Thinking Aloud test.**

***Index Terms*—creative coding; maker tools; handicraft lesson, secondary school education**

I. Introduction

The importance of learning about digital technologies for young people, such as developing computational thinking or problem-solving skills, has been heavily discussed in the media and by governments [1], [2]. In response to national demand, we have seen the introduction of a new compulsory subject "Digital Basic Education" [3]. In this new subject (starting 2018/19) students should acquire digital competences within a period of four years in the scope of two to four hours per week. Teachers of all subjects should train their students to use these skills, even if they may not be trained in Computer Science (CS) on their own or have little or no personal experience with CS content. An engaging approach to new technologies requires a general understanding of the logical and technical aspects behind them [1]. The situation is very similar in Germany [4], Switzerland [5], and Spain [6]. From Grade 5 to Grade 10 (students between 10 to 15 years old), CS is often only a voluntary subject. For example, in Germany, the situation is very confusing due to the large differences in CS offerings in individual states and school types [4]. For Lower Saxony in Grade 5 to 10 CS is optional as well. Here, for the year 2023, CS will become a compulsory subject, first in Grade 10 and in the year 2024 also in Grade 9 [7]. However, the state has an insufficient capacity of CS teachers. Many of these challenges result from the fact that the CS curricula is not standardized at international or national levels [1]. Furthermore, voluntary courses tend to mostly attract the male audience and exclude girls [8].

To support teachers in their new role and all young designers, E-Textiles and Wearable Devices show a new way to teach creative coding in schools. To follow this trend, we have added a new extension to our Pocket Code coding application. This extension has been introduced to three schools in Graz/Austria. The lessons were designed for the subject "handicraft" with teachers who are not CS teachers. With this so-called embroidery extension which allows the creation of digital designs, we aim to promote interest-driven, student-centered lessons that highly engage them and support rich learning through the process of creating personalized artefacts. Creating artefacts supports students' authorship of their own identities or senses of self within the discipline. This can be especially important in a field such as computer science (CS). CS is known as a field that is historically exclusive and in which many students, especially girls, often struggle to develop a positive sense of belonging [9].

In this paper we share our analysis of the first design workshops, as well as findings from personas and usability tests. Based on these findings we were able to develop the embroidery extension especially for the target group of young girls between 13 to 15 years old. Therefore, the goal of this paper is twofold; first, we want to find out who our target group is, what their requirements are for the app, and which designs they prefer for their clothes. Second, we want to focus on teachers without a CS background in handicraft lessons in order to find out how best to support them in teaching digital design skills. To accomplish this, we created teaching materials and lesson plans for them and evaluated them during class.

This paper is structured as follows: in Section II, we present a literature review on the distinction between different types of e-textile activities and address the requirements for a "Gender Conscious Pedagogy". In Section III, we introduce the app Pocket Code and the corresponding project "Code'n'Stitch". Section IV describes the methods used for analysis, and Section V shows our preliminary findings. The discussion and conclusion is illustrated in Section VI, and Section VII presents the projects' next steps.

II. Literature Review

Creating games is a popular strategy to introduce students to coding. However, a white paper by Google [10] points out that there are less successful games available for girls as there are for boys, that most games do not appeal to a female audience, and there exists less motivation for girls to become gamers (only 30% consider themselves to be gamers [11]). This gender bias can have a negative impact on women who play [12], [13] and gender stereotyping in games can be damaging (e.g., a princess who needs a male hero to rescue her may serve as a trophy). Strategies that focus more on design and creativity and less on creating games thus provide promising ways to attract the female half of the teenagers for coding as well. With digital designs traditionally activities coded to be more "male" such as engineering and CS can be combined with activities which are considered as traditionally "female", such as crafting and sewing. As a result, e-textiles have a huge potential to attract children of all genders.

A. E-Textile and Wearable Devices

The literature makes a distinction between different kinds of e-textiles [14], [15]. One category can be summarized as "wearable computing technologies" [16]. Examples are the use of microcontrollers on clothing, the integration of LEDs, batteries, or sensors, or combining other kinds of electronics and computation directly into textiles. Other examples include sewing a path with conductive thread or drawing with conductive ink [14]. These craft activities are more "electronic" or "hardware" based and include electronic and/or computer-based elements. In this case the children use the fabric as a "flexible" background, but it is not fabric work in its traditional form. Electronic sewing kits or e-textile tool sets, such as LilyPad Arduino [17], are available for this purpose. A study by Merkouris and Chorianopoulos [18] evaluated the advantages of wearable devices and confirmed that learning to program with ubiquitous target platforms is more effective than just working with the computer. A second category of e-textiles uses software to improve fabrics through programming. Here, the arrangement of lights and sensors can be already predefined and further programmed by children. One example for this category is "TeeBoard", a design platform for e-textiles and wearable computing with conductive bands on which electricity and signals are transmitted [15]. Another option, as used in the current project, is a programmable embroidery machine. Here, objects are programmed by using a visual programming language that represents the needle of the embroidery machine. The movement of the object to different x and y coordinates and predefined stitch blocks result in a file that can be executed by a programmable embroidery machine. Examples for this category are the TurtleStitch platform or Pocket Code.

B. Gender Conscious Pedagogy

Warin and Adriany [19] suggest that a "gender flexible pedagogy" is needed and that teachers develop gender consciousness to assist all students in their learning and production. Medel and Pournaghshband [20] showed that teaching CS material is not as supportive for female students. Examples are established trends of male-centered representation and gender inequality in imagery and language (e.g., character Eve the "eavesdropper"). It is essential to show a realistic picture of women in IT (i.e. real role models) and to make women visible and hearable in language [21]. In practice, gender conscious pedagogy means to inspire students to explore and create their own learning situation [22]. According to Reichel and Wiesner-Steiner [23] key elements of gender conscious pedagogy are: performance-related praise (particularly girls), gender conscious reflection on the given attention, gender sensitive intervention during the project phases, and framing "gender neutral" tasks (e.g., circus instead of soccer scenarios). Furthermore, teachers should spark discussions and dialogues that focus on deeper meanings of individual experiences and understanding of mutual experiences in order to create "safe" environments for students with less or no prior knowledge in CS. Especially in CS-education, many students have an unrealistic perception of future technical careers. This impares their self-efficacy [24], [25]. Furthermore, Ramnarine-Rieks [26] argues that most tools for programming are designed by men and thus, women have to adopt a male perspective when working with these technologies. All these points indicate that more parts of the curriculum are impacted by gender as we may think, e.g., the knowledge and skills that are valued or resources and tools that are made available [27].

A best practice example that promotes robot courses in several European countries hand in hand with gender-sensitive guidelines is the Roberta initiative from Germany [28]. The didactic material and course concept is described as gender-balanced with the aim to raise girls interest in technical topics and strengthen girls' self-confidence. This is done by selecting themes and experiments that are at first, interesting for girls but at the same time do not exclude boys, and to pay the same amount of attention to all genders. For teachers, a gender-oriented course design is provided, that should help them to stimulate communication, to promote creativity and independent work, and to focus on gender awareness and gender-sensitivity. Their findings show a significant improvement in the self-confidence of girls and that the positive effect is slightly better if no boys are attending the course. In addition, they said that boys are not distracted by the girls focused material.

III. Code'n'Stitch & the Catrobat Environmen

The learning tool Pocket Code offers many possibilities to express creativity and to code personalized apps such as games, music videos, or animations with different coding blocks, extensions, and figures [29]. Pocket Code has already been used in many different school subjects, for example, in fine arts, physics, or computer science [30]. The user interface of the app is illustrated in Figure 1. It should support users in their first programming experiences in a way which is very similar to the well-known visual coding environment Scratch [31], but with Pocket Code, no laptop or PC are needed; only a smartphone. In addition, Pocket Code makes access to many sensors; for instance, inclination, GPS, compass direction, etc.), and has further extensions, for example, Lego NXT/EV3 robots, drone, or Arduino. This app has been developed at Graz University of Technology (TU Graz) at the Institute of Software Technology as a FOSS Open Source project with the name Catrobat (https://catrobat.org).

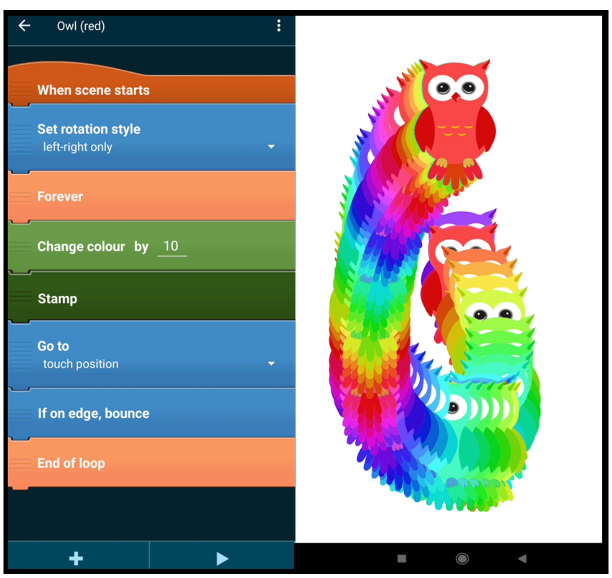

Fig. 1. Left: Bricks in Pocket Code, which snap together and form a script. Right: The Owl is controlled via the touch position of the finger.

For the two-year FEMtech project "Code'n'Stitch" the app has been extended with the option to program embroidery machines. This project has been funded by the Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT) which promotes equal opportunities, raising awareness, and visibility of women in research and technology. The embroidery extension is very similar to the Open Source project TurtleStitch (www.turtlestitch.com). It allows the creation of digital patterns and designs. All that is needed is a programmable embroidery machine, which is already available in many fashion stores and fablabs. This machine acts like a robot and embroiders the stitches according to the programmed designs. With this creative new option, Pocket Code can be used for interdisciplinary project work to combine textile handicraft lessons with programming concepts. In this way, self-created patterns and designs can be stitched on t-shirts, pants, or even bags. Furthermore, the project has a focus on gender-sensitive teaching methods and design. It is a valuable vehicle to evaluate different approaches to learn and teach concepts essential for programming.

IV. Methodology

Different personas of the target group of teenagers were created on the basis of the collected qualitative and quantitative data. Furthermore, data from interviews and questionnaires were collected from handicraft teachers. The first version of the stitching extension in Pocket Code was tested during the summer of 2019 with the aim of obtaining feedback on the app itself and possible difficulties in creating designs. The research was approved by the author's institutional ethical review panel prior to commencement. Following permission from the school and teacher to conduct the research, parents or legal guardians of the students were informed of the research and invited to provide their informed consent (including ethical issues). For the data collection, the researchers went through a process of familiarising, cleaning, and coding the data. The semi-structured interviews were recorded and transcribed.

A. Personas

1) Students: For the user group specification, a bottom up approach was used by developing personas first. A persona is a description of user characteristics and describes the specific aim of people [32]. According to Cooper, a persona should be presented in text and/or image and it is usually generated to help designers to understand, describe, and define user preferences and behavior patterns. The data for the personas for the stitching extension has been constructed on the basis of questionnaires and focus discussions. A questionnaire of 60 children aged 13 to 15 years was evaluated and two focus group discussions, one with a total of 10 girls and one with a total of 6 boys, were conducted. The survey contained questions about programming skills, interests, use of smartphones, or frequently used apps, as well as questions about fashion.

2) Teachers: From May to June 2019 interviews were conducted with four handicraft teachers. Three of them were handicraft teachers from our partner schools. In order to include the male perspective, an additional interview was conducted with a teacher from a Graz secondary school. In addition, a questionnaire was sent out to all secondary schools and compulsory school teachers in Styria in cooperation with the Styrian Department of Education. A total of 27 teachers took part in the questionnaire.

B. Workshops

The primary goal of the study was to understand how we can extend the Pocket Code App as a teaching tool for handicraft lessons, and derive design guidelines for future developers. Furthermore, we aimed to solicit feedback about the existing Pocket Code App so we could improve the technologies to better support the use in classes. To answer our research questions, we conducted observation workshops and usability tests in addition to the personas. Razak et al. [33] suggest that a field study is more suitable for understanding children experience with technology than it is with testing for usability problems.

Three workshops have been conducted with the goal to define a target group specification and to create a list of requirements needed for the app. The workshops have been held in two different schools with approximately 35 students along with 19 girls from a girls youth centre. In the first step, students were told to search the internet for possible graphics or patterns which they would like to have embroidered on a piece of clothing. Second, they drew their designs on paper and thought about geometrical shapes necessary to describe their pattern (for example, cycles, square). This brought us our first insight into the target group's perception for embroidery patterns. In the next step, students were given a short introduction into programming with the web application TurtleStitch. TurtleStitch is browser-based and similar to the visual programming language Snap!. After the introduction, most students had to draw a new design because their original pattern was seen as too difficult or not programmable. Based on these results, first versions of the stitching extension and tutorial cards for teachers were created.

C. Thinking Aloud Test

The first version of the embroidery extension was developed in conjunction with the workshops. All observations were incorporated into this first version. In order to test the prototype, Thinking Aloud tests were carried out at a very early stage with five teenagers aged 13 to 15. A Thinking Aloud Test was chosen because it allows us to collect a huge amount of subjective data [34].

1) Participants: The participants were recruited from the authors' circle of contacts and had different backgrounds (e.g., no prior experiences in coding, one participant had parents with a technical background). Three girls and two boys aged between 13 and 16 years were selected. The prerequisite for participation was that they have their own Android smartphone and are familiar with it because the embroidery extension is only available on Android.

2) Test Setup: The participants were welcomed and the test setup was described to them, see Figure 2. Furthermore, we explained the equipment used. Participants had to sign a consent form, which was also signed by their legal guardians. Before the actual test, they answered a short background questionnaire. It included questions about age, gender, place of residence, school, and programming experience. Then they were briefly trained in Pocket Code and the most important functions of the app were explained. They also got a short demonstration of the Thinking Aloud Test and a short demonstration of the test setting. The teenagers used their own smartphone during this evaluation. To record the screen and voice during the test, the App Screen Recorder was installed on their smartphones. The test was carried out at the TU Graz in a comfortable social room. After the test, we conducted a further interview with the test subjects to talk about the problems that occurred during the test and to get further feedback.

Fig. 2. Test-setup Thinking Aloud test

3) Tasks: For the test, five tasks were defined, which were kept very simple at the beginning. For the last task, the participants had as much time as they needed to create their own designs of varying complexity. The tasks are presented in Table I.

V. Main Findings

In the following, we present our result about 1) the personas, 2) our observation during the workshops, and 3) the Thinking Aloud test.

A. Personas

1) Teenagers: The following personas of teenagers resulted from the questionnaire evaluations and the focus groups:

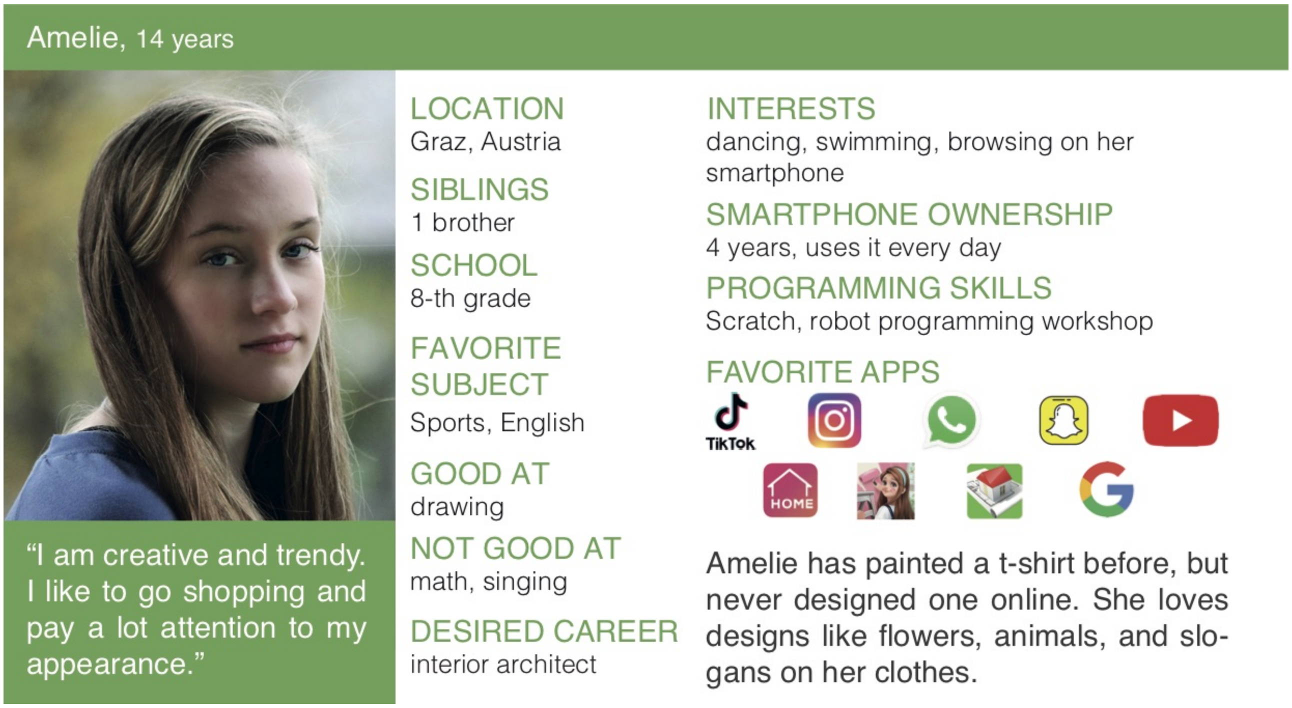

Fig. 3. Persona of Amelie.

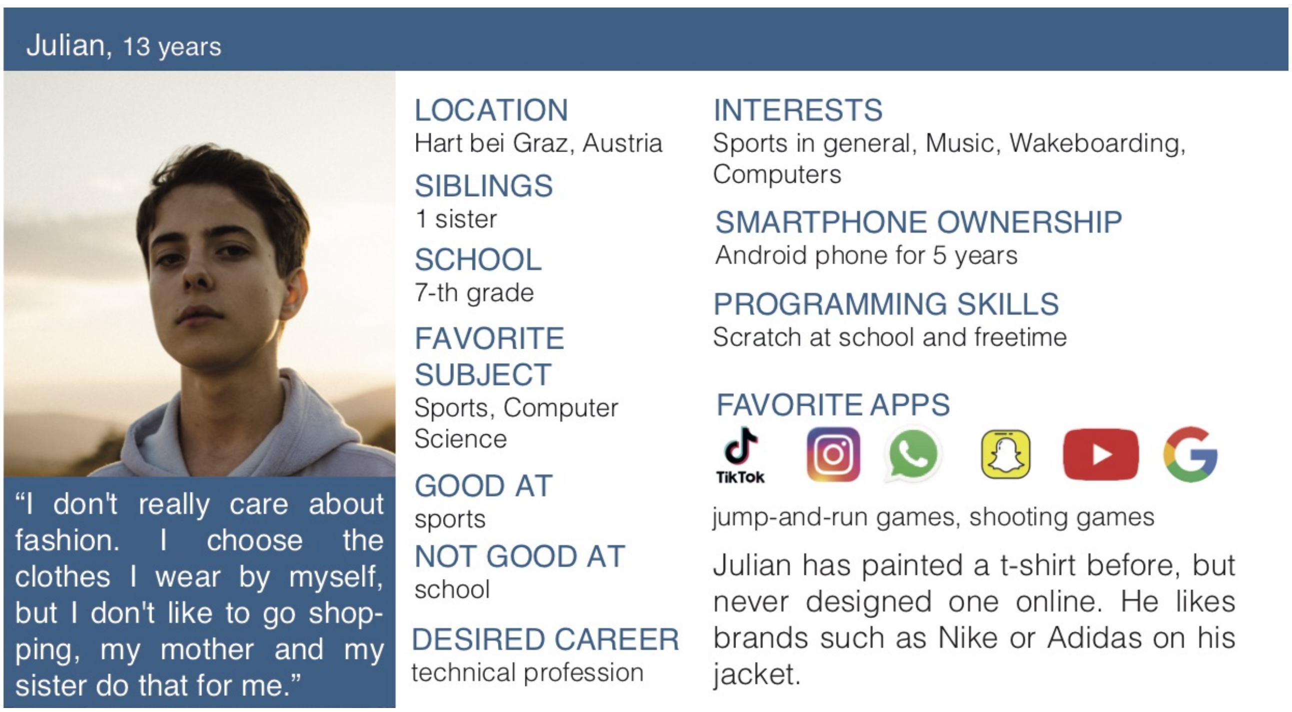

Fig. 4. Persona of Julian.

- Amelie (Figure 3) is 14 years old, lives in Graz, Austria, and has a brother. She is in the 4th grade of grammar school, and sports and English are among her favourite subjects. Her dream job is to be an interior architect. She has owned a smartphone for the last 4 years, has taken classes about programming, and can already do some programming on her own. She loves to play interior design games with her friends; for example, she loves to design kitchens, children's rooms, or gardens.

TABLE I
TASKS FOR THE THINKING ALOUD TEST

# of Task	Task
Task 1	Explore Pocket Code for 5 minutes.
Task 2	Find out how to program a line using the “Stitch” embroidery brick.
Task 3	Program a square with the “Stitch” brick.
Task 4	Design a geometric pattern. Hint: use the “Repeat 10 time” block.
Task 5	Design and program your own pattern.

- Michelle is 14 years old, lives in Graz, Austria, and shares a room with her sister. She loves to listen to music all day long and watches YouTube or apps like TikTok. She has never programmed before and does not know people who are working as programmers. She would like to become a nurse, but she thinks she cannot finish school, so she would prefer to work in retail. She is fashion-conscious and chooses her own clothes.
- Julian (Figure 4) is 13 years old, lives near Graz, Austria, and has a sister. He is in the 3rd grade of grammar school. He loves everything that has to do with computers, and he loves to play jump and run games and shooter games. He has already programmed with Scratch and occasionally does it in his spare time. His career aspiration is to learn something technical, but he does not know exactly what. Julian prefers to wear brand name clothes.

2) Teachers: The typical handicraft teacher is female, over 40 years old and has been teaching handicrafts for more than 5 years. Her second subject is fine arts, German, or English. Fashion design and sustainability in fashion are an issue in their lessons for 74% of the participants surveyed. A percentage of 55.6% of the handicraft teachers surveyed work together with teachers from other subjects. For example, joint projects in mathematics, geometric drawing, computer science, history, social studies, or political education. 52% of the teachers can imagine a combination of programming and handicraft lessons and 74% of them consider it a good idea. The majority of teachers (63%) did not use tools or digital media in their lessons. Four of the respondents have worked with robotics and two have used 3D printing or laser cut. A number of 19 would like to try out digital pattern creation in class and 16 would like to integrate digital processing of designs in class. Other tools handicraft teachers mentioned they would like to use in class were 3D printing (14), laser cut (12), robotics (8), and embroidery machines (9). 89% of the participants use printed instructions for their lessons, 67% introduce online activities/resources, such as videos, and half of them use additional links to resources to support their students. Educational software, especially for arts and crafts, is unknown to 81.5% of the participants. Tools mentioned included, among others, Pontifex, Padlet, and CAD programs. Electronic tools used during handicraft lessons were computers (74.1%), smartphones (48.1%), and digital photo or picture cameras (44.4%). A percentage of 43.4% of participants rated the technical equipment available at their school as poor or very poor. Only 11.1% stated that the school is very well equipped. 63% of the respondents can imagine designing and programming geometric patterns on the computer and 59.3% of them can imagine teaching programming using tutorials/coaching. Finally, 92.6% of the participants mentioned that they have a very positive attitude towards digital media, although, new media is mainly used for internet research (92.6%), teacher presentations (77.8%), or presentations by students (70.4%).

B. Observation workshops

Generally, the participants were enthusiastic about the idea of producing their own designed garment by programming their own designs. Researching on the internet and designing on paper was fun, and a lot of creative designs were put together by the participants. Since the children had no restrictions when creating their first designs, most designs were complicated and not easy or suitable to program, see some example in Figure 5. After the introduction to programming with TurtleStitch, most designs had to be redrawn or simplified. The process resulted in applicable guidelines for teachers. Based on this experience, we could suggest designs to them which were easily programmable. Initially, most participants only reproduced existing TurtleStitch tutorials, like circles, squares, flowers, or other geometric patterns. However, some dared to make their own creations and designs. This influenced all participants heavily, so that many of them wished to produce their own ideas as well.

Fig. 5. First designs for programming.

From the evaluation of the workshops, we learned that girls and boys wanted to create different motifs. Girls were more fascinated by animals, hearts, and flowers, whereas boys were more interested in logos and sports equipment. However, slogans were very popular for all genders. Girls tended to use words like design or create, whereas boys preferred programming and coding. The teachers were rather reserved during the whole workshop. When asked, they said that they would not trust themselves to do their own programming because they do not teach a technical subject and do not describe themselves as tech-savvy. However, they were able to give us a lot of feedback about our teaching materials. We could further observe that it is challenging at a school to organize the computer room for a subject like arts and crafts. It is connected with a lot of organizational effort for the teachers.

Based on these evaluations and first workshops at schools, suitable course cards, tutorials, and app features were developed. These are available at https://catrob.at/codeNstitch and https://wiki.catrobat.org. The first version of learning material is illustrated in Figure 6 and their redesign is presented in Figure 7.

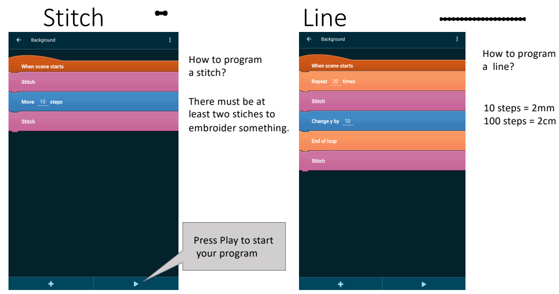

Fig. 6. First version of the learning materials for the workshops.

Furthermore, in material, we emphasize the use of gender-sensitive language, show male and female role models (e.g. Steve Jobs and Jade Raymond), talk about games that suit all interests, and show examples that are more gender neutral (maths problems or a recipe to explain an algorithm). The tutorial cards are based on programs and designs proposed by girls and boys and show all kinds of patterns. For example cats, robots, flowers, stamps, stars, ships, hearts and many others. Not only was the material designed to be free of stereotypes, but also the trainers conducting the first round of workshops were trained in gender-sensitive education. In addition to explanations and exercises, the emphasis was on talking about various practical scenarios that are possible in class and in which gender can play a role.

C. *Thinking Aloud Test*

For the usability test, the participants had to fulfill five tasks, as shown in Table I. As our software is in the development phase, a formative evaluation was carried out and therefore, no times were measured for task duration [35]. The team summarizes observation notes and informative comments.

The use of the stitch brick was not intuitive for all test participants. In order to program a single stitch, a stitch must be inserted followed by a movement, followed again by a stitch, see Figure 8. To draw a line, the participants already needed the knowledge of using loops.

All participants had difficulties with using the stitch bricks correctly and therefore could not complete “Task 2” without help. The test showed that the participants needed help with the first use of the stitch brick, but the learning curve was very steep. The reason for this was that all five test users already how to use the stitch brick the second time. Two of the five participants already had experience with visual programming in Scratch. In this case, it turned out that this was a very big advantage, as the test subjects already knew certain procedures.

VI. Discussion & Conclusion

It is essential to know the target group of a certain product. In this paper we analyse firstly the target group of young people between 13 and 15 years and secondly handicraft teachers with regard to the embroidery extension of Pocket Code and gender-appropriate teaching materials for handicraft lessons. On the basis of persona, typical users are presented, who on the one hand could be used in the development of the app and on the other hand supported the creation of the materials. Both the personas and the observations in the workshops show that girls and boys at this age have different interests and approaches when it comes to smartphone use. An interesting result was that two distinct groups were identified among the girls. The active users and the rather passive ones who let themselves be sprinkled by the media and consume the offer instead of creating content themselves. It was obvious that during the workshops the girls used vocabulary like creating and designing, whereas the boys could identify better with programming and coding. Another difference was observed in the drawing of the embroidery designs: girls prefer designs such as animals, flowers and hearts where boys drew logos and brands. Slogans were popular with everyone regardless of gender and age.

The biggest challenge in such a project is to get the teachers to participate and program themselves; whether they are enthusiastic about the fundamental idea. In future, teachers should receive training in programming before they start with the courses, so that they feel more comfortable and the inhibition threshold to start programming is lower. The findings from the Thinking Aloud Test showed an important request for the next app release, namely the implementation of a separate block “Create stitch with length 10”. This allows users to define a stitch type first and then program a movement in Pocket Code as usual with the predefined stitch length. In contrast to the “Create stitch with length 10” block, the already implemented Stitch block is much more accurate in programming geometric patterns, but it has turned out that this accuracy often is not necessary in embroidery. Furthermore, for the next release cycle, the implementation of ZigZag stitch and the development creation of a personalized “flavor” version of the Pocket Code App is planned. This version will have its own logo, name, sample programs, design, and sharing / community website, which will be targeted towards girls and young women. Here, the stitch extension is already activated, with blocks set in place and pre-installed demo programs for different textiles. This version is scheduled for the end of the project in August 2020.

VII. Outlook

From September 2019 to March 2020, six programming and embroidery workshops with six lessons each (50 minutes per lesson) were conducted. The workshops were held in Grade

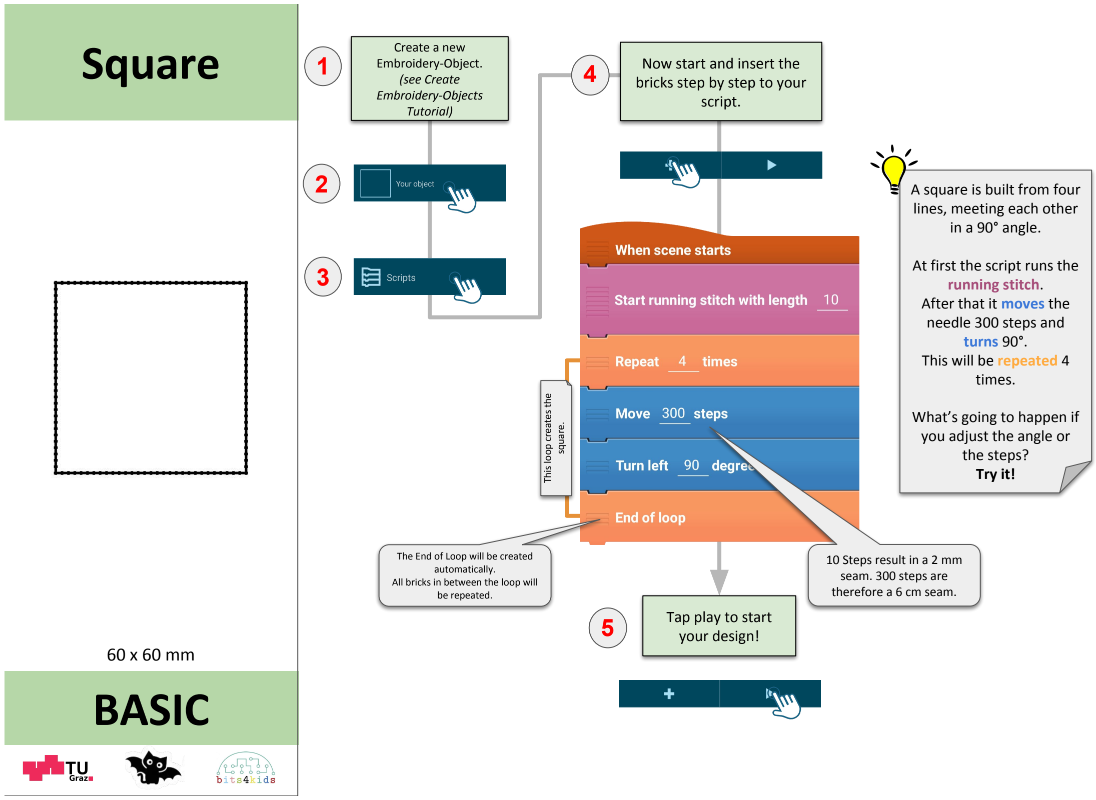

Fig. 7. Revised tutorials that include feedback from teachers.

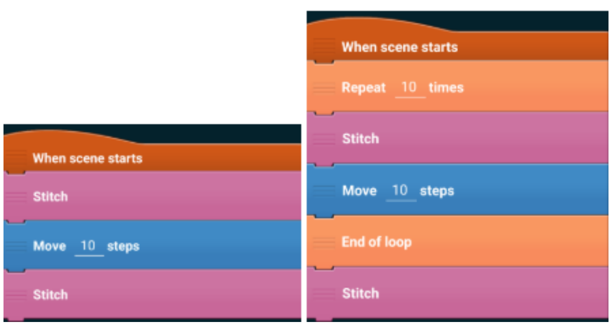

Fig. 8. Program one stitch in Pocket Code.

6 to Grade 8 at three different schools (academic schools and secondary schools). In addition, one double lesson was used as a preparation phase, in which the students could create their own embroidery design. The aim of this introductory phase was to think about possible designs first. Teachers could discuss geometric shapes, different types of stitches (e.g., running stitch, triple stitch, ZigZag stitch, etc.) and different textiles. In the next double lesson, an introduction to Pocket Code and programming was provided. The second and third double lesson was reserved for the creation and finalization of the designs and for embroidery. Therefore, the programs were exported, loaded onto the embroidery machine by using a USB stick and embroidered on fabrics. As a result, the young people had something to wear that they could show to others.

For the target group of non-computer teachers, an own book with general instructions to coding, step-to-step guidance, explanation of geometric shape, and further tutorials will be created.

Together with our partners and we are able to map the entire workflow from the use in schools (conducted by trainers of the "bits4kids" team) to the development of gender-appropriate guidelines for workshops in factories and the practical implementation for fashion stores (our partner "Apflbutzn" a fairtrade t-shirt printing and sales shop). The Apflbutzn team will take part in the last school units and bring their embroidery machine. Thus, the teenagers are able to see how their programmed patterns are directly embroidered on T-shirts and bags. In addition, "Apflbutzn" will create an economical and sustainable concept, which can be integrated into existing (web-)shops and processes. In future, the pattern-files can be sent via mail and the embroidered products can be picked up or shipped. This will make our workflow more sustainable and applicable to schools beyond the project. As a result, the new Pocket Code Stitch App and the published gender-appropriate "guidelines" (also in form of a eBook) should show a way how young women could be motivated and, thus, they should serve as a guideline for others (Fab-Labs, schools, etc.).

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