

The background features a vibrant color gradient from red at the top to grey at the bottom. Overlaid on this are several geometric shapes with thick black outlines: a large circle in the center, a triangle pointing right on the right side, and various overlapping squares and rectangles in the top right and bottom right corners. The text is positioned in the lower-left quadrant, set against a dark grey rectangular background.

**USING
GRAPHIC
DESIGN TO
ATTRACT
FEMALE HIGH
SCHOOL
STUDENTS
TO THE FIELD
OF CREATIVE
CODING**

Using graphic design to attract female high school students to the field of creative coding

Hendrika Wilhelmina Johanna "Hanneke" Goud

February 9th, 2024

Graduation Thesis Creative Technology, University of Twente, Enschede
Faculty of Electrical Engineering, Mathematics and Computer Science

Supervisor: M. A. Gómez Maureira
Critical observer: T.S.L. Bergsma
Client: I. Kniestedt, Grafisch Lyceum Utrecht

Abstract

In this research, graphic design has been used to strive to attract female high school students to the field of coding to increase representation of women in the field of coding and its education direction. A design is established to create an animation that grabs, and keeps, attention. This animation conveys the message that coding is social, fun, and not hard. The animation's visuals aim to arouse interest and attract a gender-neutral audience, while being white label. The animation can be used in the context of open days or info markets, and is produced in a white label design, meaning that there is no connection to any one school or university, and the design could be used by all schools and universities.

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1 Introduction

Technology is the invention and appliance of new techniques. It is everything we do to create things and make sure they work well. It is an important part of our future and development, and it is ever-changing. Technology exists in many fields, for example when building houses, bridges or machines, managing health, and coding. All over the world, fields of technology are dominated by men. According to statistics from the Nationaal Bureau of Statistiek (Van den Brakel, 2020), women are underrepresented in all fields of technology, which includes the field of coding.

1.1 Problem description

The problem of underrepresentation is not just visible in the working field of coding, but also in education and studies in that direction. Graphical Lyceum of Utrecht (GLU) is one of the schools in the Netherlands that offers studies in the direction of coding. Their so-called Creative Software Development tracks attract, and thus consist of, mostly male students. GLU is looking for a way to use graphic design to attract a more gender-diverse audience to their tracks. The task is to design something graphic that can be displayed at a stand with information about studies in the direction of coding, that will be used at info-markets, outreaches, and the like. The challenge of this research is to find a way to use graphic design in a way to captivate the attention of females and attract them to a study in the direction of the field of coding. Additionally, the design should be able to grab, and keep, the attention of people walking past. Moreover, the design needs to be *white label* (not having a style connected to a certain school/university), so that it can be used not just by GLU, but by any school or university.

1.2 Research question

The research question below highlights the key elements of the study: graphic design, making coding interesting, and the target group (female high school students).

How can graphic design be used to make coding interesting to female high school students? (RQ)

To be able to answer this question, sub questions are formulated below. The research question is split into three parts: the grabbing and keeping attention using graphic design, the question of making coding interesting to the target group and how graphic design can be white label for this design.

How can (the field of) coding be made interesting to female high school students? (SQ-1)

How can graphic design grab and keep attention? (SQ-2)

How can graphic design be white label for this design? (SQ-3)

1.3 Methodology

To answer the research questions, an iterative five-stage design thinking model is used. The stages, empathizing, identifying, ideation, prototyping and testing, will be iterated in phases. In every phase, a different problem will be dealt with that is a part of the research question(s) and recommendations will be given for the next phase. This way, the research questions get answered increasingly.

1.4 Research outline

To fully understand the research, it is important to understand related literature. Literature of graphic design, the target group, designing for attention, animations, colour, and white label design is discussed in Chapter 2.

The methods used to conduct the research are discussed in Chapter 3, especially the five-stage design thinking model. Additionally, limitations of the method and the requirements of the research are discussed.

Finding a way to make coding interesting to female high school students and the development of the research takes form of an iterative design process, consisting of three phases. Each phase has five stages: emphasise, define, ideate, prototype and test. Each phase is discussed and analysed thoroughly to identify areas of improvement that can be revised in the following phase.

In Chapter 4 (Phase 1), a deeper dive into the problem is made. Relevant insights from the background literature are discussed and expert interviews are held. The question that is answered in this phase is defined as *How can (the field of) coding be made interesting to female high school students?*. A message is created as well as colour palettes.

In Chapter 5 (Phase 2), the message is revised and improved and a different method of creating colour palettes is used, which results in multiple mood boards.

In Chapter 6, the final message is discussed and a story board created. Additionally, a still of the animation is developed.

Then, in Chapter 7, the process of the execution is shown in detail, typography is chosen and the final design is realised and presented.

In Chapter 8, the results, limitations and recommendations for future work will be discussed.

Lastly, the research will be concluded in Chapter 9.

2 Background Research and Approach

Before starting the ideation and design process, a clearer understanding is needed of the background of graphic design and its connection with the target group and gender-diversity. Moreover, subjects that will be discussed include designing for attention, animations, colour and *white label* design.

2.1 Graphic design

To be able to use graphic design to attract more female high school students to the field of coding, it is necessary to understand what graphic design includes. The fundamentals of graphic design are line, shape, form, texture and balance. These visual aspects need to be in balance to make the design appealing (GCFLearnFree, 2017). In communication processes, a graphic designer can be considered an encoder or interpreter of a message (Wong, 1995 as cited in Wikipedia, 2023b). Graphic design is a broad concept. It can include design of websites, flyers, posters, banners, advertisements, marketing, interface design (UX) or motion design (animations). To be able to design graphically, certain design software are needed. Among the most widely known software is *Adobe*. Adobe has a wide variety of software specific for different kinds of design. *Adobe Illustrator* for illustrating in vector graphics, *Adobe InDesign* for designing print, *Adobe After Effects* for motion design, *Adobe Premiere Pro* for video editing, and many more.

2.2 Designing for attention

Attention to the content of the design is crucial to attracting more females to the field of coding. Especially in this era of information overload, grabbing, and holding, attention is necessary to make sure the message is being conveyed. To be able to design specifically for attention, research was reviewed about attention spans and how content can be made attractive.

Attention spans seem to be getting smaller and smaller. A *Microsoft Canada* report (2015, as cited in Galloway, 2017, p. 969-970) suggested that the average human attention span was 8.25 seconds. However, this research was not peer-reviewed, and many studies questioned this, like Gausby (2015, as cited in Galloway, 2017, p. 972), who argues that *tech savvy consumers*, i.e. people that are proficient in the use of digital products, are more proficient at processing information and remembering that information. The target group of 14- and 15-year-olds can be considered tech savvy consumers. Lindgaard et al. (2006) suggest that the time people need to decide whether they like or dislike what they see is merely 50 milliseconds. The attention span in the target group might be small, although on the other hand, they are getting better at processing and memorising information.

Whether the eight-second claim is true or not, to be able to design for attention the key question is how to grab attention and make content attractive. The digital technology of today offers a great freedom to grab attention, what with all social media platforms and other ways of reaching people's attention. However, in an *over-saturated media world*, as Wallace (2022) named it, grabbing attention requires understanding about the audience's mindset to be able to act upon it. Wallace (2022) suggests brands can grab and, more importantly, keep attention with well-designed *creative*, that is creative ideas or material. Nielsen (2022) suggests creative is the most important element of advertising effectiveness, and can account for about half of sales. Wallace (2022) claims perfectly accomplishing the messaging, visual, placement and experience makes one successful in the field of creative. These aspects are important because of a phenomenon called *banner blindness*: "users have learned to ignore content that resembles ads, is close to ads, or appears in locations traditionally dedicated to ads" (Pernice, 2018). On top of that, the creative "needs to be striking and beautiful, emotional, methodical, amusing and unique" (Wallace, 2022). As

animations make good use of creative and are visually appealing, they are likely to be highly effective at engaging an audience.

2.3 Animations

Grabbing attention is crucial for this research to be able to convey the message, and animations are a great way of doing this. Therefore, it is necessary to research exactly what animations are, and how they can be designed.

Audio, video and animations are suitable to make content more attractive. Steg (2014) argued that clarity and speed is desired in receiving information, and people no longer wish to read long texts. Moreover, to keep customers focused, content should be presented in an accessible and entertaining way. Animations can be a solution for grabbing and keeping attention. It combines audiovisual aspects such as text, audio and video, in order to convey a message quickly and clearly, explains Van Hall (2013). Animations can be used for a great deal of purposes, since their audiovisual aspects make content attractive, clear and quickly accessible. Explaining, informing, training, introducing, or a mixture: for example, a video on how to vote from the Dutch government (MinBZK, 2023).

Animations have many advantages, being beneficial for interaction, storytelling and association with the brand. Animations are linked to higher conversion (Donker Media, 2023; Van Hall, 2013), a wider reach (Vergouwen, 2023; Skeldon, 2022) and more connection with the target group (Skeldon, 2022). Additionally, Van Hall (2013) suggests that videos, presented with correct metadata, e.g. title, description and tags, improves the search engine traffic, meaning Google increasingly provides video results. Moreover, animations can radiate professionalism (Vergouwen, 2023), improve focus on a product or service (Skeldon, 2022; Van Hall, 2013) and tell a rich story (Skeldon, 2022). Vergouwen (2023) argues that animations can invigorate a message, since more content can be provided compared to a still image. There are endless possibilities like linking multiple products, conveying numbers in a notable manner, or explaining *how to* do something. Vergouwen (2023) also claims that social media posts using an animation make the viewer linger for a longer amount of time because it is moving, people are intrigued by the content and what will come next. However, she suggests, make sure the animation does not take too long. According to Silveira (2023), if a message can be conveyed in 30 seconds, there is no need to make it any longer. Moreover, it is more time-efficient. No hard rule can be given for the perfect length. Instead, the platform and surroundings of the animation should indicate what to aim for.

2.4 Colour

Since colour is a basic – and important – aspect of graphic design, knowledge about its effect on the human mind is necessary to be able to design specifically and responsibly.

2.4.1 Colour and emotion

Colours are related to emotional reactions, although gender makes no difference. Ou et al. (2004) suggest that gender has no effect on the relation between colour and emotion. Alkawaz et al. (2015) suggest, confirming by the colour theories of, among others, Von Goethe and Claudia Cortes, the strong correlation between emotion and human biological responses. A study by Bubl et al. (2010) indicates a strong correlation between depression and lower retinal contrast gain, meaning depression affects the perception of the vibrancy of colours, thus making colours appear duller than they are. Additionally, in a study by Barrick et al. (2002) an association between depression and impaired colour sensitivity is suggested. Carruthers et al. (2010) found darker colours to be negative and lighter colours to be positive. Furthermore, Valdez and Mehrabian (1994) found that warmer colours, i.e. high saturation and low brightness, induced greater activity than cooler colours, i.e. low saturation and high brightness. Therefore, it can be concluded that colours are related to emotion. However, the question of the way in which colours relate to emotion remains. The

relationship between colour and emotion is essential to understand to adequately design concepts that evoke the appropriate emotions.

Emotional reactions have a strong relation with colour brightness and saturation, meaning, to a certain extent, emotional reactions to colours can be predicted using these colour aspects. Valdez and Mehrabian (1994) found a highly predictable strong relationship between emotional reactions and colour brightness and saturation. Their research was conducted using the Pleasure-Arousal-Dominance emotion model. Their results suggest that pleasant colours are bright and saturated, with brightness being twice as important. Additionally, arousing colours are linearly dependent on saturation, where a high saturation results in high arousal, and a lower brightness level is more arousing than a higher level. Moreover, dominant colours increase linearly to saturation and decrease linearly to brightness. Thus, it can be concluded that colour brightness and saturation are important factors to the relation between colour and emotions.

In contrast to the strong relation between emotional reactions and colour saturation and brightness, emotional reactions relates weakly to colour hue. Valdez and Mehrabian (1994) suggest, although the influence of colour hue on emotion is weaker than that of brightness and saturation, colours with shorter wavelengths, like blue and green, are more pleasant than colours with longer wavelengths, like yellow and orange. Overall, "blue, blue-green, green, purple-blue, red-purple, and purple were the most pleasant; whereas yellow, green-yellow, and red-yellow were the least pleasant; with red being rated at an intermediate value of pleasantness" (Valdez & Mehrabian, 1994, p. 406). Thus, it can be concluded that emotional reactions are somewhat dependent on colour hue.

2.4.2 Colour and personal experience

Personal experiences, like nurture, environment, even language, affect one's colour perception. Nijdam (2009) concluded that colour perception is situation, history and personal dependent. Likewise, Casaponsa (2018) argues that colour is not merely concerning perceiving what is: it is about the way our brain interprets our perception, which is subjective, and thus prone to personal experience. The human eye is able to perceive thousands of colours, although, Casaponsa suggests, the way we communicate about colours means we have to classify them into identifiable categories. Different languages and cultural groups interpret colours differently. Some languages solely use the terms dark and light to describe colours, while other culture groups have no word for *colour* and describe it using an abundant vocabulary referring to texture, sensation and purpose. Understanding the way personal experiences affect colour perception is helpful for using colours in design and designing for a specific target audience.

Personal experiences create expectations about (an object's) colour. Witzel and Hansen (2015) that the way one perceives colour is dependent on one's personal experience. Expectations regarding what will presumably happen in the future are developed by experiences one has had in the past. Witzel and Hansen (2015) argue the concept that personal experience shapes conscious perception is supported by memory colour effects. Memory colour effects indicate an association between an object and a specific colour. Witzel and Hansen (2015) argue that this association is the result of the observer's experience with the object. Although memory colour effects suggest personal experience affects colour perception, they do not signify colour perception to be completely subjective and inconsistent.

"The influence of memory colors on color appearance goes in a direction that stabilizes the association between the perceptual impression of color and the characteristics of objects in the environment. In this way, memory color stabilizes the perception of the object as it naturally occurs in the visual environment" (Witzel & Hansen, 2015, p. 24).

Psychological disorders such as depression and seasonal affective disorder affect colour perception. As stated before, depression affects the perception of the vibrancy of colours

(Bubl et al., 2010), making colours appear duller than they are. Moreover, individuals with seasonal affective disorder, as suggested by Roecklein et al. (2013), have a lower post illumination pupil response. A study by Boyatzis and Varghese (1994), when asking children about their association with colour, got many different answers. "one said yellow made her sad because "my Mommy told me yellow doesn't look good on me"" (Boyatzis & Varghese, 1994, p. 83) and "one girl remarked that pink made her happy because "my bed covers pink and I have a lot of pink dresses"" (Boyatzis & Varghese, 1994, p. 83). All this supports the claim that personal experiences affect colour perception.

2.4.3 Colour and meaning

Different colours have different meanings, and these meanings can again differ in different contexts. Von Goethe (1840) identifies yellow and blue as the most fundamental and simple colours. They are contrasted: warmth versus coldness, light versus shadow, brightness versus darkness and force versus weakness (yellow versus blue respectively). He gives meaning to the following colours. He describes yellow as light, pure and beauty with a serene and softly exciting character, it is warm and agreeable. Red-yellow represents more energy, power and splendour, it is warm and gay, it represents the glow of fire and the sun. Yellow-red is increasingly energetic and powerful, and radiates happiness. Von Goethe (1840) characterises blue as comforting yet cold and distant, gloomy and describes red-blue as passively-active, restless. Lively without gladness. Blue-red represents this unquiet feeling even more. Red is satisfying and dignified, graceful and attractive. Green is the union of the contrasting yellow and blue colours. Green balances the qualities of both sides, mixes them in perfect equality so that neither predominates. Thus, many different meanings can be dedicated to different colours.

Colour can indeed carry meaning. Elliot and Maier (2014) agree that colour can carry meaning. They describe red as the colour of blood, and therefore the colour of life, and, when spilled, death. It is poignant and prominent. Blue and green are characterised as natural colours, blue sky and water for blue, and green foliage and vegetation for green. Both are associated with positive content: openness and peace for blue (Kaya & Epps, 2004; Mehta & Zhu, 2009), calmness and success for green (Clarke & Costall, 2008; Moller et al., 2009). As these meanings of colour are so different to Goethe's, it suggests that the essence of colour can be defined in many different ways.

A large amount of theories and models exist to map colour to meaning. However, no conclusions can be drawn from it. Nijdam (2009) studied colour theories and models of Von Goethe (1840), Claudia Cortez, Naz Kaya, Color Wheel Pro, Shirle Willett and Yan Xue, and concluded Naz Kayas's colour summary to be the most promising model, as it was supported by Claudia Cortez' work. He stated colour meanings are difficult to work with, since they are deep and wide. As colour meanings can be dependent on personal experience, as already mentioned before, and numerous theories and different models exist, this aspect of colour will need further research before conclusions can be drawn from it.

Although specific meanings of colour cannot be concluded, colour can be used to assess colour choice in multiple clinical situations. Carruthers et al. (2010) found a colour wheel with 38 colours to be an easy to use method of assessing colour choice. This is helpful in clinical situations where verbal communication might not work, such as with children.

2.4.4 Colour and accessibility

Accessibility of graphic design is important because designing for an inclusive audience provides equal access to everyone, including people with (visual) disabilities. It promotes diversity and inclusivity as well as usability and it is the considerate thing to do.

Colour vision deficiency (colour blindness) affects about 5% of the world population. The most common is red-green colour blindness, which affects 8% of males and 0,5% of females (Erfelijkheid.nl, 2023; Mulligan, 2019). This form of colour vision deficiency is caused

by the sensitivities of the green- and red-sensing cones overlapping, which creates confusion across the colour spectrum (Mulligan, 2019). Another type of colour vision deficiency is yellow-blue colour blindness, which is experienced by about 0.007% of both males and females (Erfelijkheid.nl, 2023). This type is caused by a destruction of the blue-sensing cones (Oogfonds, 2022).

Web Content Accessibility Guidelines (WCAG) is a recommendation guideline for the accessibility of web content. WCAG 2.2 (Campbell et al., 2023) is the most recent version of recommendations. In the guidelines, accessibility is scored in levels A to AAA, with A being the lowest and AAA being the highest. Level AAA is recommended for small text, i.e. body text, and requires a contrast ratio minimum of 7:1 (WCAG 2.2 Success Criterion 1.4.3). For bigger text, i.e. headings and titles, level AA is sufficient, which requires a contrast ratio minimum of 4.5:1 (WCAG 2.2 Success Criterion 1.4.6). Online, many contrast checkers exist to determine whether or not a design is accessible, which use the WCAG 2.2 recommendations, for example Colour Contrast Checker (2023).

2.5 The target group

To be able to design accordingly, it is necessary to research the target group and get a clearer understanding of its generation, trends and preferences. The target group is defined as female, 14 and 15 year old Dutch VMBO (Pre-Vocational Secondary Education) students, that will choose an MBO (Vocational Education) study programme in the coming two years.

2.5.1 The target group and generation Alpha

In the next few years, the target group will fall in both *Generation Z* and *Generation Alpha*. The birth years of Generation Z are 1997 until around 2012 (Wikipedia, 2023a). Currently, this generation is 11 to 26 years old. The birthyears of Generation Alpha are from around 2010 to around 2025 (Wikipedia, 2023a): anno 2023, this generation is 0 to 12 years old. Generations blend together, they overlap. As can be seen in the years aforementioned, Generation Z and Generation Alpha overlap in the early 2010s. Designing for the target group, 14- and 15-year-olds, we find ourselves in a unique transitional phase. The last babies of Generation Z will fall into the target category in 3 to 4 years, while the first babies of Generation Alpha will fall into the target category in 2 to 3 years already.

Designing for and researching Generation Z would not be durable, since they will leave the target group in four years. Consequently, the design might become outdated within five years. To make the design durable and sustainable, focus will be on Generation Alpha. The last babies of Generation Z babies and the first babies of Generation Alpha will have similar environmental circumstances growing up due to the blending of generations. Both generations grew up in a world that uses the internet, smart devices and trendy apps (Drugaş, 2022). Therefore, this research will focus on Generation Alpha as the (future) target group.

Generation Alpha is the first to be born entirely in the 21st century. Definitory for Generation Alpha is being in front of screens and growing up with social media apps, Drugaş (2022) claims. What makes the use of technology by Generation Alpha different than by Generation Z? Drugaş suggests that Generation Alpha had technology integrated in their education earlier because of the COVID-19 pandemic. Bonchiş (2022, as cited in Drugaş, 2022) suggests that Generation Alpha are quick at browsing the internet, have a need for immediate answers and prefer multitasking. In the development of critical thinking, which is needed to decide if the information on internet is reliable, these are all obstacles. Apaydin and Kaya (2020) claim Generation Alpha is more curious, creative and self-determined than Generation Z. To conclude, Generation Alpha is similar to Generation Z, but has a few characteristics that seem to be more present, for example curiosity, creativity and self-determination.

Generation Alpha are digital masters, the new *old fashioned*s, creative entrepreneurs, activists and post-stereotypes. A study by Beano Studios (2020) has found these five trends

in generation Alpha. It is no surprise that the children of generation Alpha, who were almost born with a smartphone in their hands, are digital masters. However, despite their mastery in the digital world, generation Alpha are showing signs of being the new *old fashioned*s, as it was branded by Beano Studios: generation Alpha likes to play outside rather than inside and are encouraged to play independently. Generation Alpha is *tech-empowered, not tech-dependent* (Beano Studios, 2020): 48% of generation Alpha kids often spending time away from devices, compared to just 29% of generation Z. Beano Studios (2020) found that 86% of kids from generation Alpha enjoy designing, making and building things. More specifically: 55% enjoys making creative videos, 47% enjoys tinkering with electronics, about 66% likes digitally creating new worlds, 43% enjoy robotics and 36% enjoys computer coding.

Additionally, generation alpha children question everything from climate change denial – they strongly feel that it is their responsibility to care for the planet – to stereotypes on gender, which brings us to the fifth trend: generation Alpha is post-stereotypes. Girls from generation Alpha are encouraged to reject gender stereotypes of themselves and to reimagine womanhood as something empowering and liberating. To conclude, generation Alpha has characteristics like curiosity, creativity and self-determination that are expressed in these trends: digital mastery, new *old fashionedness*, creative entrepreneurship, activism and post-stereotypicality. Generation Alpha being curious and creative influences their response to graphic design. Generation Alpha will respond to design that is creatively curious, and a variety of visual styles that are messy, surprising, optimistic and playful (Week, 2022).

2.5.2 The target group and colour preferences

Girls tend to have pink or purple as their favorite colour, whereas adult women rarely have pink or purple as their favorite colour. Jonauskaitė et al. (2019) claim the colour pink to be positively valenced only. No negative colour-emotion association was suggested by their study, although they claim the colour pink to be highly charged with a feminine stereotype. The question remains, do women start to dislike pink as they get older, or rather like other colours better?

2.5.3 The target group and social media

The target group is mainly using three types of social media. Hoekstra et al. (2023) suggest that teenagers' daily use of *Instagram* and *Facebook* decreased, and their daily use of *Snapchat* and *TikTok* increased. Between the years 2022 and 2023, the daily use of Instagram decreased from about 60% to about 55% and the daily use of Facebook decreased from approximately 20% to about 10%, while the daily use of Snapchat increased from about 50% to approximately 60% and the daily use of TikTok increased from about 40% to about 50%. Additional to these known platforms, a new platform, *BeReal*, has become popular among teenagers, with a little over 20% of teenagers using this app daily. In conclusion, Snapchat, TikTok and BeReal are the social media platforms the target group is most active on.

The optimal timespan of an animation depends on the platform. Delgado (2023) suggests TikTok videos should be between 10 and 15 seconds in length. Any longer than that will risk losing viewers' attention. Snapchat (2021) claims ads between 3 and 5 seconds often drive action, and recommends not to make ads longer than 5 to 6 seconds, "to mirror the bite-sized and linear storytelling of regular *Snaps*". BeReal is strictly for photos and uploading a video is not possible (Truly, 2023).

2.6 White label design

The goal of this research is to get more females interested in the field of coding. This goes beyond reaching just the current target group. If the result of this research could be implemented not just at GLU, but at other universities, schools, or organisations offering courses in coding as well, the impact could be significantly bigger. However, this also brings along restrictions. The package cannot be designed specifically for GLU, using their corporate style

(colours, typography, logo's). The package would need to be a so-called *white label* design. White label products are templates that a brand purchases the rights to (MasterClass, 2023). This way, it can put its own logo and branding on it and be able to sell it as their own. Examples can be clothing, mugs, pens, water bottles, etc. White label products can also be digital, e.g. software, websites or graphic design.

3 Methods and requirements

This research aims to use graphic design to attract female high school students to the field of creative coding. The research question was defined as *How can graphic design be used to make coding interesting?* In this chapter, the methods that were used to approach the research question and its limitations will be discussed. Additionally, the research requirements will be considered. First, the five stages of the five-stage design thinking model will be discussed in detail. Secondly, its limitations will be analyzed. Lastly, the requirements of this research will be listed and considered.

3.1 Five-stage design thinking model

Approaching the research questions is done using the five-stage design thinking model, an iterative design cycle that makes use of five stages. This model was proposed by the Hasso Plattner Institute of Design (Stanford d.school, 2010), and is widely backed and used (Dam, 2023; Voltage Control, 2023; Stevens, 2023; Gibbons, 2016; Popovic, 2022). This five-stage design thinking model utilizes five stages: empathizing, defining, ideating, prototyping and testing. The five-stage design thinking model is an iterative model. From the last stage, *testing*, new problems might arise that again need empathizing, defined, ideation, prototyping and further testing. Every iteration is a phase, meaning during each phase all five stages will be discussed. Every phase ends with a summary and recommendations for the next phase. The amount of iterations depends on the satisfaction of the research population and the requirements.

3.1.1 Empathizing

The first stage is *empathizing*. During this stage it is important to gather an understanding of the target group and its needs, in order to identify the problem at hand (Voltage Control, 2023; Dam, 2023). Methods used during this stage are drawing conclusions from the background research, conducting additional research and talking with the target group. An additional method is interviewing experts on their opinions and expertise in their field. In this research, two experts have been interviewed in the fields of graphic design and animation.

3.1.2 Defining

The empathizing stage leads to the next stage of the five-stage design thinking model: *defining*. In this stage, the problem is defined. Findings from the empathizing stage are pieced together to formulate a problem statement (Stevens, 2023; Voltage Control, 2023; Dam, 2023). This statement is a guiding statement that frames the problem, inspires ideation and is discrete, i.e. focused on a specific problem, without trying to solve all things to all people at once (Stanford d.school, 2010). The defining stage gets ideators in the right mindset and point-of-view to start the ideation phase.

3.1.3 Ideating

In the ideation stage the problem is looked at from different perspectives, and innovative solutions are ideated (Dam, 2023; Stevens, 2023). Ideation techniques like mind mapping or brainstorming, i.e. sparring with others, are used at the start to generate as many ideas as possible, which are then sketched and mood boarded (Stanford d.school, 2010; Lucidspark, 2023).

3.1.4 Prototyping

Following the ideation stage, the most promising ideas according to the requirements are prototyped in the prototyping stage. Prototypes are inexpensive, quick versions of the ideas, so they can be tested on the target group (Dam, 2023; Voltage Control, 2023; Stevens, 2023). In graphic design, prototyping could be (digital) drawing or quick digital designs of stills from the storyboard.

3.1.5 Testing

Prototypes will be tested. Small design choices might be based on small tests with peers and bigger design choices will be tested with a research population. Testing methods for small and bigger design choices might include split testing, which compares two versions against each other in performance (Hotjar, 2022), 5-second testing, which tests the viewers gut reaction to the visual style (Whitenton, 2018) or open word choice, which asks viewers to use three to five words that describe the design (Whitenton, 2018). Testing methods with the research population might include surveys and focus groups.

3.2 Limitations

There are some limitations to of using an iterative design cycle. First, it can be endless, since there is no clearly defined ending point. Research can always become better and dive deeper. In this research however, the time constraint will help the research come to an end. A second limitation is that iterative design cycles can be time consuming, especially when doing significant testing and feedback rounds. Additionally, research participants will have to come back many times, or many more research participants will need to be recruited. This last limitation will be the most limiting factor in this research, due to the time constraint and age of the target group. Collecting consent of all parents of many research participants that belong to the target group takes too long to arrange.

3.3 Requirements

Animations are great to grab – and keep – attention, because of their use of movement. Animations are likely to be highly effective at engaging an audience. Additionally, they can make content attractive, if they make good use of creative and are visually appealing. Thus, it can be concluded that animations are suitable for this research, thus an animation will be made. This animation will be meant for use at an information market stand or outreach to schools.

The animation will be shown on a monitor of at least 80 cm, diagonally measured, if available, and will otherwise be shown on a laptop. Both will have a landscape oriented screen, so the animation will be in landscape orientation with a resolution of at least 150 dpi, so it keeps its quality better when scaled. The aspect ratio will be 16:9, as standard for most monitors and laptop screens, with dimensions of 1920 by 1080 pixels. The length of the animation depends on the platform on the environment in which it is viewed. Since the animation will be used at information markets and outreaches, the length of the animation should be about 30 seconds. This way, people walking past do not have to stand still for long, but a clear message can be conveyed. The animation should be able to be viewed by at least three people simultaneously from a distance of at least 2 meters. The design needs to be white label, meaning that no specific style or logo from a company can be used in the design. The requirements are also listed below:

- Landscape orientation
- Resolution of at least 150 dpi
- Aspect ratio of 16:9
- Dimensions of 1920 by 1080 pixels
- Length of 30 seconds
- Viewed by three people simultaneously from a distance of at least 2 meters
- White label

4 Phase 1

During this first phase, a deeper dive will be made into the problem. Relevant insights from the background research will be discussed and expert interviews will be reviewed. The main question that needs answering in this phase is SQ-1: *How can (the field of) coding be made interesting to female high school students?*. (The field of) coding can be made interesting to female high school students by (1) refuting stereotypes, i.e. showing that coding is creative, (2) using movement, i.e. animation, and (3) using the right colour palette, i.e. colours that have neutral gender associations but are not boring. During the ideation stage, mind maps and sketches will be discussed. Prototypes will be made in the form of visuals and a message, which will be tested separately and feedback will be received.

4.1 Empathize

The main goal of the *empathizing* stage is to gather an understanding of the target group and its needs. From this, a problem can be defined in the next stage. In this section, conclusions will be drawn of the background research and any questions that rose from this research will be answered.

4.1.1 Using animation to design for attention

From the background research, it can be concluded that animations are great to grab – and keep – attention, because of their use of movement. Animations are likely to be highly effective at engaging an audience. Additionally, they can make content attractive, if they make good use of creative and are visually appealing. Thus, it can be concluded that animations are suitable for this research.

4.1.2 Colour perception

From the background research on colour perception, it can be concluded that the effect of colour on the human mind is significant. Not only is colour perception subjective and affected by personal experiences, colour can also evoke emotions. The effect of colours on the human mind can be generally explained by emotional response, although in addition, personal experience will always affect perception of colour. Emotional response can be accounted and designed for, yet to take each person's personal experience into account is impossible for a designer. On the other hand, a target audience might have a common experience, in example a culture, environment or language.

To keep sustainability and durability in mind, designing for generation Alpha is preferable over designing for generation Z. Generation Alpha is already part of the target group and in four years the full target group will consist of children from generation Alpha. Generation Alpha is similar to Generation Z, but has a few characteristics that seem to be more present, for example curiosity, creativity and self-determination. Generation Alpha are digital masters, the new *old fashioned*s, creative entrepreneurs, activists and post-stereotypes. Generation Alpha being curious and creative influences their response to graphic design. Generation Alpha will respond to design that is creatively curious, and a variety of visual styles that are messy, surprising, optimistic and playful. Therefore, it can be concluded from the background research that designing for generation Alpha is preferable to designing for generation Z.

4.1.3 Interview with an expert in the field of graphic design

From the background research on graphic design a few questions still remain about how graphic design can be measured, if print has an additional value to digital design and how females can be attracted using graphic design. To answer these questions, a semi-structured interview of about an hour was held with an expert in the field of graphic design.

Graphic design is not measurable in its effectiveness up front. However, it is measurable through testing. According to the expert, knowing whether a design is considered *good* can

not be determined without testing it. The *goodness* – or effectiveness – of a design is measured in whether or not the desired goal is achieved. For example, when a call to action is made to donate, the effectiveness can be measured through the amount of donations made. Or if the goal is to gain subscribers, then the effectiveness of the design can be measured through the amount of subscriptions. The expert often puts their design on social media to test the reach. The effectiveness is analysed by a social media specialist, and if the design is not effective, it gets redesigned.

Adding print additional to digital design, the expert says, can add tangibility. Even a small card with a QR-code will be harder to miss than a digital article in the back of someones mind. Moreover, people are more likely to look at it again when, for example, travelling back home or finding it in their bags or pockets. Another way in which the expert uses print is when there is a desire to share extra information. For example, if a digital design sparks interest, a brochure can be handed out explaining more of the context. This refrains people throwing out print they do not care about since only interested parties received the print.

When asked about designing for attracting females to the field of coding, the expert warned about using stereotypical colours. They advised to think about adding a female touch to the design, in the sense of using a more feminine font and showing female characters, without overdoing it. And when using female characters, thinking about inclusivity: women come in all different shapes and races. To make design stand out, it should be thought-provoking, funny and positive.

4.1.4 Interview with an expert in the field of animation

The background research on animations covers many uses of animations. However, a few questions still remain. What does the process of making an animation look like? How can animations be made white label? A semi-structured interview of about an hour was held with an expert in the field of animations to be able to answer these questions.

The process of creating an animation, as explained by the expert, starts firstly with a briefing which includes detailed requirements and a message that needs to be conveyed. Secondly, a script is created. This can either be the text of a voice-over or character, or, in the case of little to no spoken text, a *visual* script that roughly sketches what can be seen. This script is finalised closely with the client, since it is the base of the message that will be conveyed. Thirdly, a storyboard is worked out in sketches, a storyline is created that conveys only the story. Then, the visual style is created. Input from the corporate style of the client is used as input and a so-called *style-sketch* is made: a concept version of the visual style in the composition of one or two stills from the storyboard. If the client is on board, the design gets elaborated for the whole storyboard. The expert uses Adobe Illustrator for designing the style. Adobe After Effects is then used to animate the stills. Lastly, when the whole animation is finished, music and sound effects are found or made and implemented.

White label design for animations is possible. Templates can be made into which new text, colours or images can be put. This requires specific export-settings in Adobe After Effects. Such a template can easily be used and edited in Adobe After Effects when needed. The editor of the template would need to use Adobe After Effects as well to ensure the template works correctly.

4.2 Define

The main question that needs answering in the first phase, which is the first sub question (SQ-1). The research starts with this question because it forms the basis of the research. From there, the message that is to be conveyed can be formed. The design should reflect this message. Therefore, it is important to start with how (the field of) coding can be made interesting to female high school students.

How can (the field of) coding be made interesting to female high school students?

This question raises more questions:

What is coding?

How can something be made interesting to female high school students?

What stereotypes do female high school students have of coding?

The third sub question (SQ-3) is about white label design. The question about how the message and visuals can be white label has to be considered in the design process.

How can the visuals be white label?

4.3 Ideate

The problem statement, how to make (the field of) coding interesting to female high school students, was approached firstly using a mind map, that can be seen in Figure 1, in which personal views to and explanations of coding were mapped.

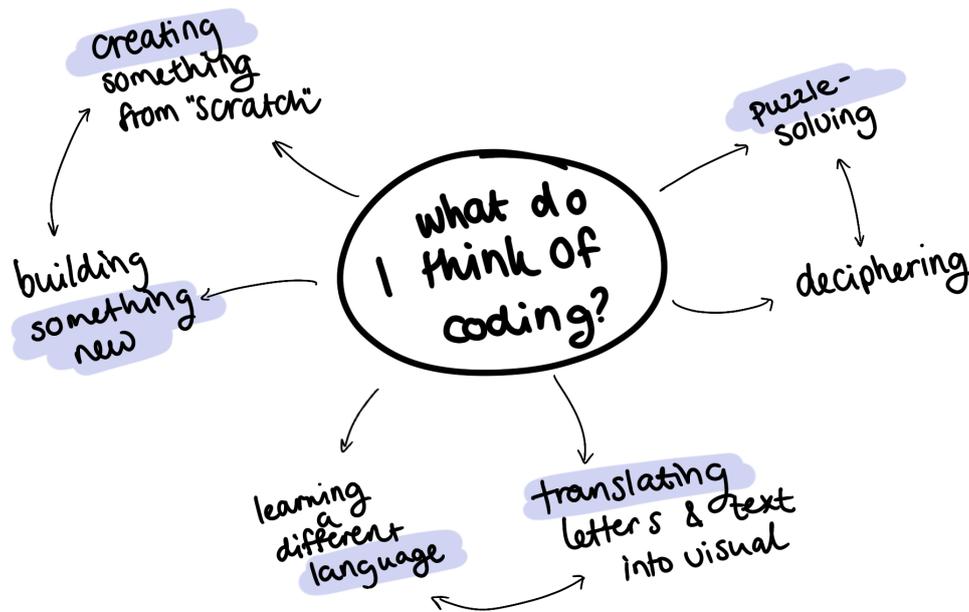


Figure 1: Mind map about personal views to and explanations of coding.

Taking the mind map in Figure 1 as a starting point, a few digital sketches were made that combine multiple aspects of the mind map to a visual, see Figure 2, 3 and 4.

4.3.1 Shapes

Like colours, shapes are not gender-neutrally associated. Stroessner et al. (2020) claim that basic shapes, more specifically squares and circles, are associated with the male and female gender respectively. Squares and circles are also judged using stereotypes: masculinity and being agentic for squares, and feminism and being warm for circles. From this it can be concluded that puzzle pieces can be considered gender-neutral, because they consist of both the basic square and circle shapes. Additionally, (jigsaw) puzzles are creative (Stanford University, 2022), they involve creative energy to solve since there are many possible solution paths and strategies.

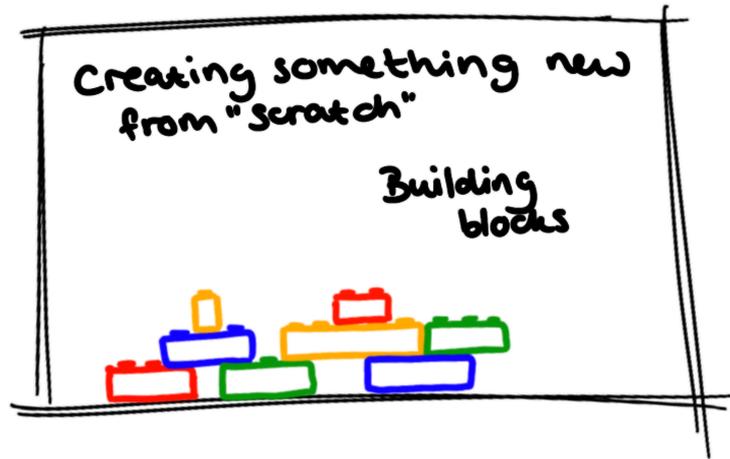


Figure 2: Sketch combining the aspect of building blocks and creating something from scratch.

Combining the aspect *creating something new from scratch* with the aspect of *building blocks* could create the building blocks as can be seen in Figure 2. The blocks portrayed are similar to LEGO's. Since they are squared and LEGO blocks are stereotypically dedicated to boys (Reich et al., 2018), this visual representation of the aspect of creating something new from building blocks does not fit this research. Using building blocks like functions, variables and conditionals, a fully functional code can be created.

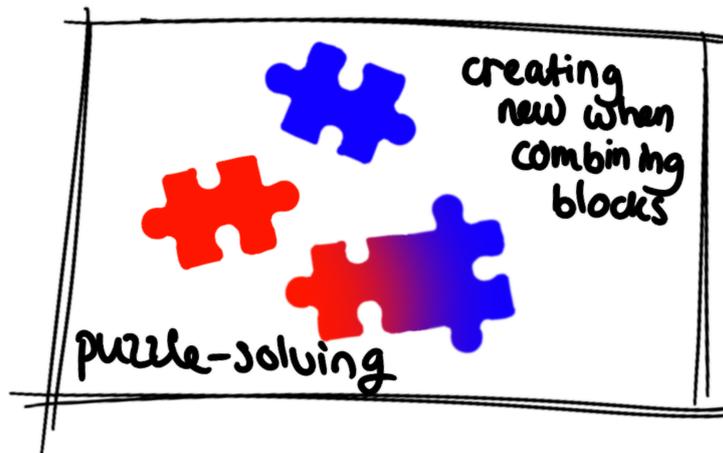


Figure 3: Sketch combining the aspect of solving puzzles and creating new things using building blocks.

The aspects of *solving puzzles* and *creating something new using building blocks* can be created like Figure 3. Two jigsaw puzzle pieces are shown, one red and one blue. When put together, they create a new colour; purple, which represents the creation of new things using existing building blocks.

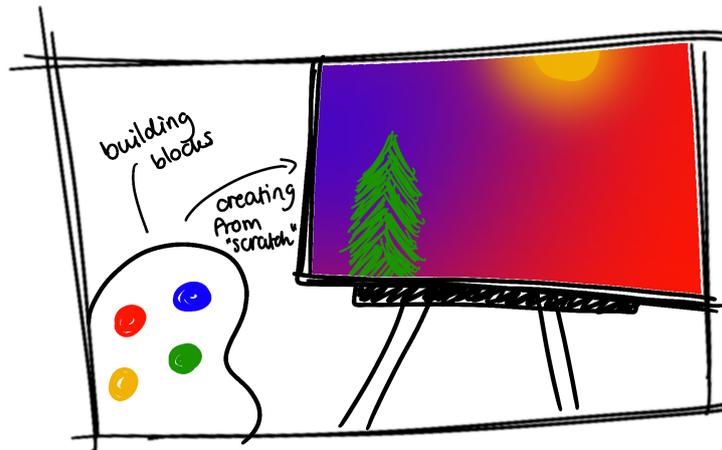


Figure 4: Sketch combining the aspect of building blocks and creating something new using building blocks.

In brainstorming the aspects of *language* and *visual*, paintings came up. The way a painter can convey a message without words and speak to the mind of the viewer is also a language, a visual language. Coding is also a language. It translates text, functions and variables into visuals.

4.3.2 Message

Additional to diving further into the visual design, it is essential to perfect the visual message of the animation so that a storyboard and visuals can be drawn up from there. For the visual message, the research started with a mind map that can be seen in Figure 5.

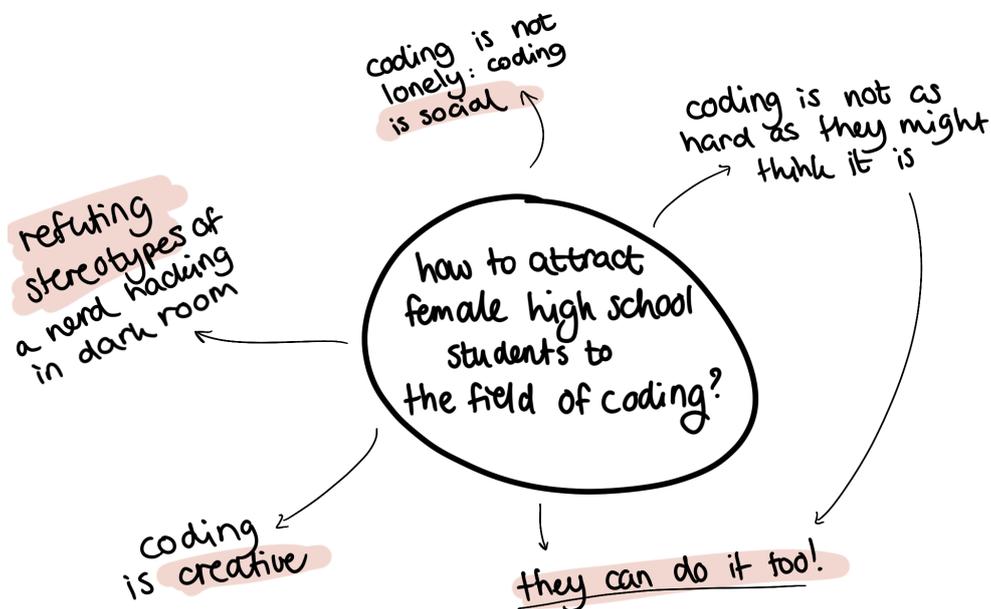


Figure 5: Mind map about how to attract female high school students to the field of coding.

From this mind map, Figure 5, the returning aspects are the stereotypes that need to be refuted. The stereotypes that need refuting are that coding is hard, lonely and for boys in a dark room: the *Hollywood hacker* type, see Figure 6 for a visual explanation. To get more girls interested in coding, these stereotypes need to be refuted.

A 2019 study by Moha, Muller, and Thijssen (2019) found that young people often view technical studies to be hard. Coding also has a stereotype of being hard. The opposite of coding being hard might be that coding is easy. However, since coding can actually be hard sometimes, this stereotype can be refuted by coding not being as hard as some might think it is.



Figure 6: Visual explanation of the Hollywood hacker type. Image from iStock (2024).

The stereotype that coding is lonely can be refuted by coding being social. An example: the so-called rubber duck method.

"The *Rubber Duck Debugging* theory is commonly used by programmers. The idea is that when a programmer needs to debug their code, they should explain the program line-by-line to a rubber duck. Often, the act of explaining the problem step by step will cause the solution to present itself." (Giannini, 2022)

Since the rubber duck method works because the act of explaining step by step helps to solve problems, it can be concluded that explaining step by step to another person instead of rubberducking would be at least as effective, if not more effective since the other person could help solving about the problem. Therefore, working together improves coding and thus can coding be social.

The stereotype that coding is just for boys can be refuted by showing girls that coding is for everyone by showing both girls and boys in the final design.

4.4 Prototype

The prototyping of the first phase consists of two sections: a prototype of the visual style and a prototype of the message.

4.4.1 Message

The animation will convey a message. Defining this message at the start of the design process is important, since it will shape the animation. Every choice will be based on this message so that the result will always lead back to this. What the animation should do is refute stereotypes and show female high school students that coding is in fact creative, social and cozy. For the first prototype of the message, the starting point is the main message that *coding is creative*. It would be interesting to show different sides of coding. The side people might expect, like websites, apps, stereotypes (like the *Hollywood hacker type*), etc., and the side people might not expect, like digital art and games. From this, the message below was drawn up. It is divided in three parts:

Main message: *coding is creative*

Scene I: "What is coding?" This scene shows stereotypes, *expected* examples of coding: websites, apps, code. Maybe a man behind a computer in the night.

Scene II: "You know what is also coding?" This scene shows *unexpected* examples of coding, like digital art. For example a character standing in the middle of bouncing/floating/dancing shapes, ribbons, etc. This scene will have much movement.

Scene III: Call to the viewer. A short "you can do this too!" and then the GLU logo.

4.4.2 Visuals

From the sketch of the puzzle pieces, see Figure 3, a quick visual was made in Adobe Illustrator, see Figure 7. The visuals of the design should be white label, i.e. not pertaining to a specific school or university. This means that no specific corporate identity of a school or university can be used for the visuals and colours. The design should be fully self-contained. Therefore, the colours in this quick visual are standard colours.

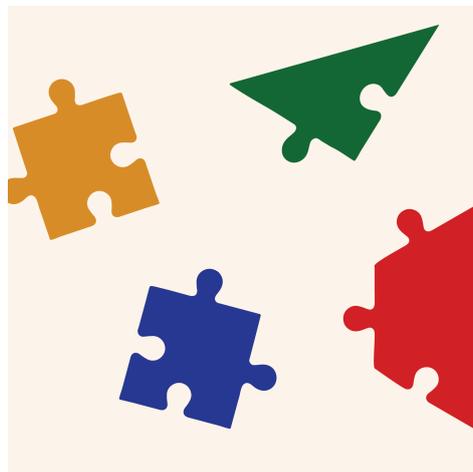


Figure 7: Visual representation of puzzle pieces, created in Adobe Illustrator.

In Figure 7, four puzzle pieces with random shapes can be seen. From top to bottom, left to right the colours are yellow, green, blue and red respectively. The background is an eggshell white colour.

4.5 Test

The two prototypes, the message and the visuals, will be tested, analysed and discussed separately.

4.5.1 Message

The message as formulated in Section 4.4.1 was sent to the client, discussed with the critical observer, and read by two peers. Results indicate that focusing on the fact that coding is creative is a good approach. However, showing the stereotype in Scene I might not be necessary. Most people will already know the stereotype and therefore it is not needed to show it again. Additionally, if people do not know the stereotype, it should not be enforced. Showing different aspects of coding is interesting. However, digital art, though it is coding, is not what coding studies are about. Yes, it might be possible to create digital art using code, but the animation should not give potential students the wrong impression of the study programme. Sticking to the *expected* examples of coding, i.e. websites, apps, code,

is enough. Using this feedback, the message will need to be revised in the second phase of the design process.

4.5.2 Visuals

Adobe Illustrator has an AI generated *recolour* feature. The artwork can be recoloured using an AI prompt. The prompt used for recolouring, which lead to Figures 8, 9, 10, 11, 12 and 13, is "gender neutral". This recolouring feature was used on the original artwork six different times.

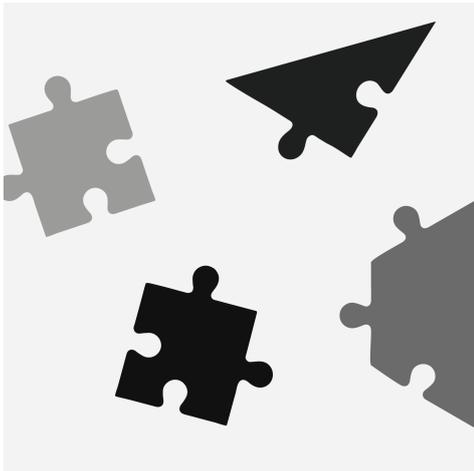


Figure 8: AI recoloured artwork of Figure 7 - 1 of 6.

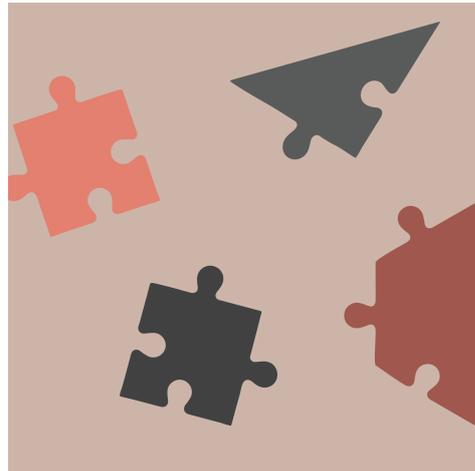


Figure 9: AI recoloured artwork of Figure 7 - 2 of 6.

A lack of saturation means that the colour is not stereotypically gendered. The whites, greys and blacks of Figure 8 have a complete lack of saturation. The greys, browns and neutral colours of Figure 9 are also barely saturated. Undersaturating might be the least interesting way of avoiding gender associations with colour. As the animation needs to be interesting, undersaturated colour will not be used further.

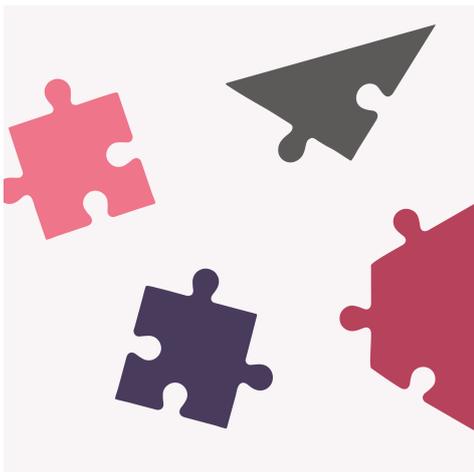


Figure 10: AI recoloured artwork of Figure 7 - 3 of 6.

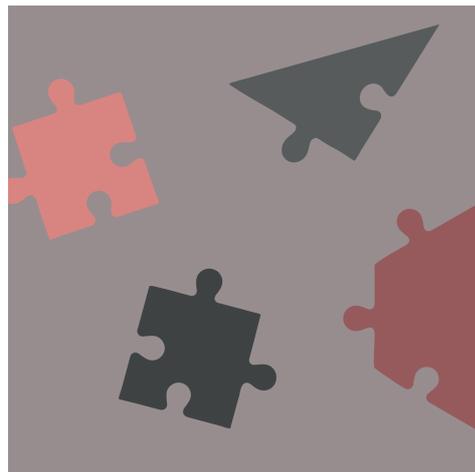


Figure 11: AI recoloured artwork of Figure 7 - 4 of 6.

Interestingly, even though pink is a stereotypically female colour (Jonaskaite et al., 2019), it seems to appear often in the *gender neutral* AI recoloured artworks. This can be seen in Figures 10 and 11.

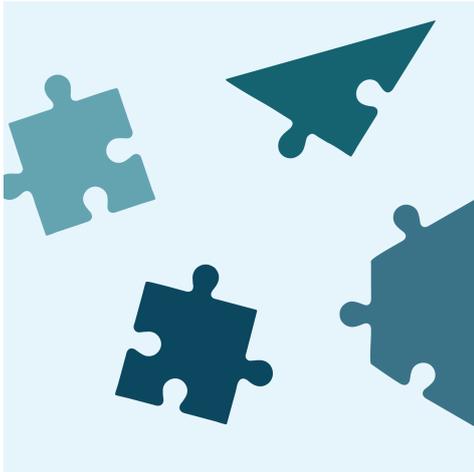


Figure 12: AI recoloured artwork of Figure 7 - 5 of 6.

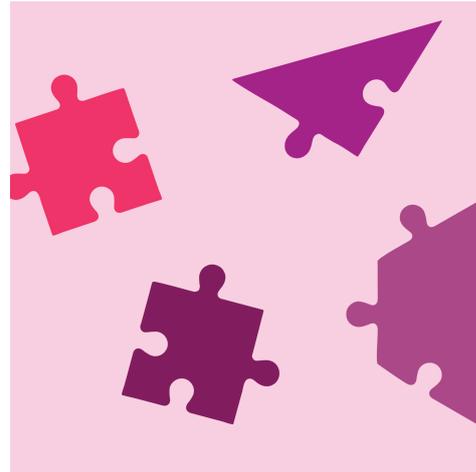


Figure 13: AI recoloured artwork of Figure 7 - 6 of 6.

Even more interesting results can be seen in Figures 12 and 13, which were also generated using the prompt *gender neutral*. However, they seem to be properly blue and pink to the extent that this would most likely be considered stereotypically coloured.

For the visuals it is extremely important to choose the right colours, as it is the first thing people notice. Using Adobe Illustrator's AI generated recolour feature From the test in Adobe Illustrator it can be concluded that its AI recolour feature does not induce the desired outcome. Therefore, this method will be eliminated. Other ways of finding the right colour palette will need to be used.

4.6 Summary

In Phase 1, a deeper dive into the problem was made. Relevant insights from the background research was discussed, expert interviews were conducted and two questions were answered:

How can (the field of) coding be made interesting to female high school students?

- Refuting stereotypes, i.e. showing that coding is creative.
- Using movement, i.e. animation.
- Using the right colour palette.

How can the visuals be white label?

- Being self-contained, i.e. not using a specific corporate identity.

During the ideation stage, a mind map and sketches were made about personal views on the explanation of coding. Another mind map was created about how to attract female high school students to the field of coding. Prototypes were made: a message and a quick visual, which were tested separately. The method of testing for the visuals did not produce colour palettes that will be used. The message was tested and feedback was received. In the second phase, the message will be reviewed with the feedback and improved, and another way of creating colour palettes will need to be found.

5 Phase 2

In Phase 1, it was stated that (the field of) coding can be made interesting to female high school students by (1) refuting stereotypes, i.e. showing that coding is creative, (2) using movement, i.e. animation, and (3) using the right colour palette. A message and visual were tested separately. Feedback on the message was received, which will be processed in Phase 2 and the message improved. The Adobe Illustrator AI recolour feature was deemed not fit for this research in Phase 1. In Phase 2, another method of creating colour palettes will be used.

5.1 Empathize

The method of developing a colour palette in Phase 1 did not yield the desired results. In Phase 2, a deeper dive will be made into the background research of colour as discussed in Section 2.4.

5.1.1 Colour

Emotional reactions have a strong relation with colour brightness and saturation, meaning, to a certain extent, emotional reactions to colours can be predicted using these colour aspects. Valdez and Mehrabian (1994) found a highly predictable strong relationship between emotional reactions and colour brightness and saturation. Their research was conducted using the Pleasure-Arousal-Dominance emotion model. Hue was found to be of little significance. However, brightness and saturation did have a significant relation to emotional reactions.

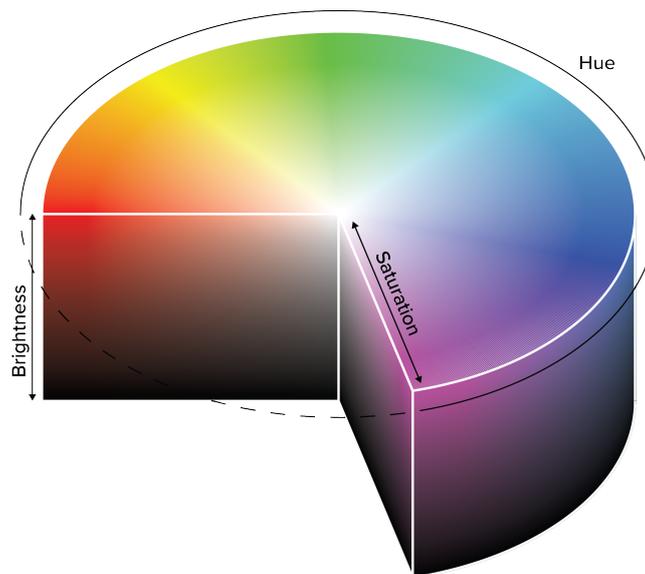


Figure 14: Hue, saturation and brightness explained using a three dimensional visual representation.

According to Valdez and Mehrabian (1994), pleasant colours are bright and saturated (with brightness being twice as important) and arousing colours are linearly dependent on saturation, where a high saturation results in high arousal, and a lower brightness level is more arousing than a higher level. Moreover, dominant colours increase linearly to saturation and decrease linearly to brightness. Thus, it can be concluded that colour brightness and saturation are important factors to the relation between colour and emotions.

Hue, saturation and brightness are represented in Figure 14. Hue represent the wavelength and the *colour* we generally refer to, i.e. *red*, *blue* or *green*. Saturation refers to the brilliance and intensity of a colour. White or black can be added to a colour to reduce its saturation.

Brightness refers to the lightness or darkness of a colour (Leigh Cotnoir, 2023).

According to (Eelants, 2020), *interest* is an emotion that falls under the arousal-dimension. As stated previously, a high arousal level is connected to a high saturation and low brightness. Thus, to arouse interest, the colours in the design need to be high in saturation and low in brightness. Therefore, examples of arousing colours can be found in Figure 15.



Figure 15: Examples of arousing colours. The top row has a brightness of 80%, the second row a brightness of 60%, the third row a brightness of 40% and the bottom row a brightness of 20%.

5.2 Define

The second phase, like the first phase, tackles two sides: the message and the visuals. About the message, the question that needs answering in Phase 2 is built upon SQ-1, which was the focus of Phase 1 (see Section 4.2). A clause has been added:

How can an animation make (the field of) coding interesting to female high school students without giving them the wrong impression of the study programme?

The design and visuals should reflect the message that is being created. Therefore, a colour palette should be created that is in line with the message and is interesting. Additionally, it should be neutral in its gender associations. However, a way to create such a colour palette still needs to be found. To target this, an additional question is defined. This question is based on the second sub question (SQ-2), since the visuals need to grab and keep attention.

How can a colour palette be made that is neutral yet interesting while simultaneously fitting the message?

In Phase 1, the visuals were considered specifically when pertaining to white label design (based on SQ-3). Since the visuals should reflect the message, the question about how the message can be white label has to be considered as well.

How can the message be white label?

5.3 Ideate

The feedback on the message that was received in Phase 1 will be processed in Phase 2 and the message improved. Additionally, a new way of developing colour palettes will be found and palettes will be created.

5.3.1 Message

The feedback on the message of the first phase started with it being a good approach to focus on the fact that coding is creative. Moreover, the stereotype that coding is something

people do alone is one of the strongest, even if people might not recognise the *Hollywood hacker type*. However, the reality of coding is that it can be social (see Section 4.3.2). Consequently, the main message will keep the creative aspect and get added the social aspect: *coding is creative and social*. Additional feedback said showing the stereotype in part I is not necessary, since the people that know the stereotype already know it, and the people that do not should not be taught it. If it is important that people are thinking of the stereotype so the refuting of it is stronger, there needs to be found another way of infusing the stereotype without actually showing it. An idea might be to show a situation that could be interpreted in the way of the stereotype, when in fact it is not like that at all.

After deliberations, an idea was made: the start of the animation shows a dark room with one person lit up by their laptop screen. Then, the light turns on, and it turns out there are actually more people there. This way, people might associate the dark with a stereotype of the *Hollywood hacker type*, when in fact it is social and cozy. It could refute stereotypes without actually portraying them. There will be three people in the room. Many more would make it crowded and more time consuming to animate. There will be two girls and one boy. The field of coding currently consists of mostly men. Therefore, showing an animation with three girls could be counter productive and might seem to be *trying too hard* to get females into the field. The last feedback that was received was that the animation should not give potential students the wrong impression of the study programme. Sticking to the more obvious examples of coding (websites, apps, etc.) is good enough.

The previous message included the GLU logo at the end. Since the design has to be white label, the logo might give a feeling that GLU claims it as their own, even though other schools and universities could use the same design with their own logo, which might create confusion as to who the design belongs to. A better idea might be to keep any logo's out of there. Moreover, in the environment of an info market or open day, the school that promotes coding using the design will have the focus, even without the logo in the design. Therefore, it is decided to not show a logo at the end.

The revised message now has four scenes: (I) the dark room, only one face lit up by a laptop screen, (II) the light turns on and it turns out there are three people there, (III) the point of view changes, now the three can be seen from the back and their screen is visible, they are fixing errors and running the code and (IV) we are back to the view from the front, they celebrate fixing their error and then a call to action overlays the animation: *YOU CAN DO THIS TOO!*

5.3.2 Colour palettes

A new way to create colour palettes is used: the colour picker, which uses existing colour palettes to extract colours from. The colour picker function of Adobe Color was used for this method. Four sets of colour palettes are generated from four sets of imagery.



Figure 16: Images for the first set of colour palettes - 1 of 3. Image from Yans Media (2023).

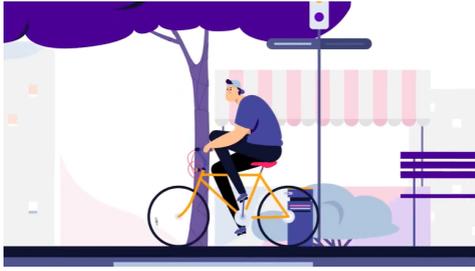


Figure 17: Images for the first set of colour palettes - 2 of 3. Image from Yans Media (2023).



Figure 18: Images for the first set of colour palettes - 3 of 3. Image from Yans Media (2023).

For the first set of colour palettes, a 2D motion graphic from Yans Media (2023) is used. Stills from this animation are put into the colour picker and colour palettes are generated. This animation is chosen to create a colour palette from since these colours can be, partly, considered arousing colours: some colours are low in brightness and all are high in saturation. Since the visuals should arouse interest, and interest is an arousing emotion, and arousing colours are low in brightness and high in saturation, hypothetically, this colour palette should be fairly good for arousing interest.



Figure 19: First set of colour palettes - 1 of 3. LTR: #F291AB #F277C7 #1D0726 #6C51A6 #A6035D and #393073.



Figure 20: First set of colour palettes - 2 of 3. LTR: #A6035D #A6059B #7F0CF2 #2F0459 #730DD9.



Figure 21: First set of colour palettes - 3 of 3. LTR: #F26680 #F299A9 #4B61A6 #142B59 #5E9ABF.



Figure 22: Images for the second set of colour palettes - 1 of 2. Image from Tenzer Animation (2018).



Figure 23: Images for the second set of colour palettes - 2 of 2. Image from Tenzer Animation (2018).

For the second set of colour palettes, Figures 24 and 25, stills of an animation from Tenzer Animation (2018) using a 2D art style, Figures 22 and 23, were used. The generated colour palettes give off old-tv-series-vibes like the Simpsons (The Simpsons), and therefore might attract the audience to nostalgia of their youth and/or their love of such television programmes. From the background research, however, the colours in these palettes are not specifically arousing, since they are higher in brightness than the colours in the first set of colour palettes (Figures 19, 20 and 21). Additionally, the combination blue-yellow is not the most accessible combination for people struggling with blue-yellow colour blindness (see Section 2.4.4), although only 0.007% of the world population have that struggle. All in all, it is still interesting to test this palette with its possibility to arouse nostalgia.

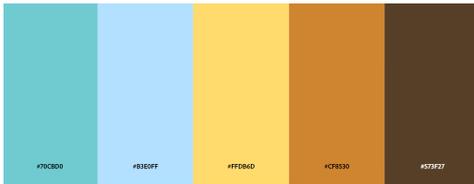


Figure 24: Second set of colour palettes - 1 of 2. LTR: #70CBD0 #B3E0FF #FFDB6D #CF8530 #573F27.

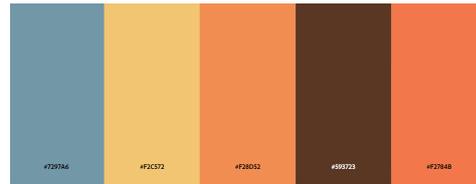


Figure 25: Second set of colour palettes - 2 of 2. LTR: #7297A6 #F2C572 #F28D52 #593723 #F2784B.



Figure 26: Images for the third set of colour palettes - 1 of 2. Image from Silveira (2022).

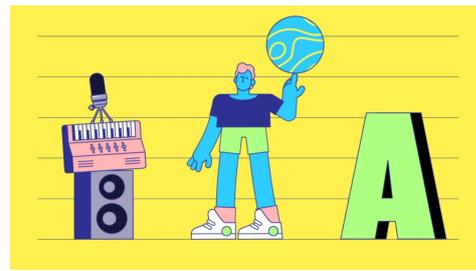


Figure 27: Images for the third set of colour palettes - 2 of 2. Image from Marques (2022).

For the third set of colour palettes, Figures 28 and 29, the imagery used, Figures 26 and 27, is from MOWE Studio (Silveira, 2022; Marques, 2022). From the background literature, these colours cannot be considered arousing colours, owing to the high brightness levels. However, the colours can be considered pleasuring colours, particularly because of the high in brightness. Even though pleasure is not the arousal of interest that is preferable, pleasure is still a positive emotion and will probably cause a positive association with the colours.



Figure 28: Third set of colour palettes - 1 of 2. LTR: #2E338C #2ECEf2 #AEF27E #F2D64B #F2AEAE.

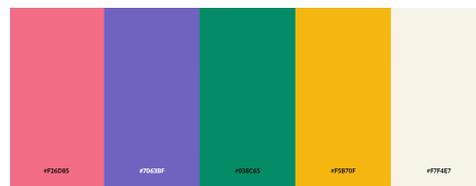


Figure 29: Third set of colour palettes - 2 of 2. LTR: #F26D85 #7063BF #038C65 #F5B70F #F7F4E7.



Figure 30: Chosen art style for image generation, Hotpot art 12. Image from Hotpot AI (2023).

The imagery for the last set of colour palettes was created using Hotpot AI, an AI art generator. The generator requires a prompt and a choice of art style from its collection. The chosen art style is called *hotpot art 12* and can be found in Figure 30. This art style was chosen inspired by *Lofi Girl* (2023a), an online presence character known mostly for their *study/relax lofi hip-hop music* that is live around-the-clock on YouTube (Lofi Girl, 2023b). Different image generations were tried out, and Hotpot AI came closest to the desired *lofi girl* style.



Figure 31: Images for the fourth set of colour palettes - 1 of 2. Image from Hotpot AI (2023).



Figure 32: Images for the fourth set of colour palettes - 2 of 2. Image from Hotpot AI (2023).

The corresponding prompt for Figure 31 was:

"Cozy happy girl wearing a hood or hoodie, sitting cross legged with a blanket on a soft couch with a laptop on her lap. We see her from the front. add a cat, some plants and books."

Interestingly, even though the prompt specifically mentions books and a laptop, they are not shown. Additionally, the couch is not at an even level on the left and right side of the girl.

The prompt for Figure 32 was:

"Cozy happy girl wearing a hood or hoodie, sitting cross legged with a blanket on a soft couch with a laptop on her lap. We see her from the front. add a cat, some plants and books. she has a laptop on her legs, there is one blond girl wearing a tank top and a choker to her left. a boy with red hair in jeans and a sweater to her right. they are smiling".

What is interesting about this image, is that, this time, there is a laptop *and* books generated, but the extra girl and boy described are not generated.

From these results, it can be concluded that AI is not usable for the creation of (stills of) the animation. However, it can be used as a method of brainstorming and ideation. If the use of AI would be needed in the ideation, prototyping and other stages, an option is to use a higher trained form of AI. However, these options often need to be purchased, which is not in the scope of this research.

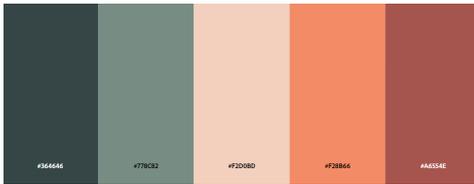


Figure 33: Palettes for the fourth mood board - 1 of 2. LTR: #364646 #778C82 #F2D0BD #F28B66 #A6554E.



Figure 34: Palettes for the fourth mood board - 2 of 2. LTR: #F44940 #524746 #B46F5A #F29985 #F9EBDC.

From these images and palettes, four mood boards can be created in the prototype stage of Phase 2. These four different directions and mood boards create varied options for the user test. It will be interesting to see the results. Literature might be right about darker colours arousing more interest, bold colours might speak more to youth, or nostalgia might play a role.

5.4 Prototype

In this prototyping stage, the revised message can be found. Additionally, four mood boards, created from the imagery and the colour palettes of the ideation stage, can be seen.

5.4.1 Message

The message of the first phase was revised and improved in Section 5.3.1. The final prototype for the second phase can be found below.

Main message: *coding is creative and social*

Scene I: Dark room, the only thing visible is a person (P1), lit by their laptop screen: they are wearing a hood. You can hear them typing on their laptop.

Scene II: Someone (P2) turns on the light in the room. P1, who we can now see is a girl, looks up, smiling and beckons P2 to join her. There is also another person on the left (P3) which we did not see before. P1 is wearing a cozy hoodie with the hood up, it has cat ears. Her long brown hair comes through. She is sitting cross legged under a blanket. P3, a blonde girl wearing a purple tank top, choker and a pigtail. P2, a boy with red hair, comes to join them and sits down. He is wearing jeans and a sweater.

Scene III: We now see them from the back. They are coding. It looks colourful and fun (Processing-like, visual). P3 points at the code where it displays some red lines and/or warning signs, and P1 changes something.

Scene IV: We see them from the front again as they celebrate their minor victory in the code. They high-five each other and then the call to action text overlays the animation: YOU CAN DO THIS TOO!

5.4.2 Mood boards

The mood boards created from the imagery and colour palettes in the ideation stage (Section 5.3.2) can be found next.



Figure 35: First mood board. Blue, pink and purple hues, simple shapes.



Figure 36: Second mood board. Blue, yellow and brown hues, simple shapes.



Figure 37: Third mood board. Bright purple, pink, yellow and green, abstract shapes.



Figure 38: Fourth mood board. Sage, terra and pink hues, illustrated style.

Hypothetically, the fourth mood board might probably be the most effective in arousing interest in the target group. Its colours are low in brightness but high in saturation, making them arousing colours. Additionally, these colours can be considered warm colours, which, according to the background research, has been linked to a higher activity.

5.5 Test

The message and the mood boards were tested simultaneously during a meeting of the client with eleven girls that study *Creative Software Development*. The results are described below.

5.5.1 Message

The overall reaction to the message was positive. The girls like the emphasis on the social and creative side of coding. Additionally, the girls do not like being looked or talked down upon. What was interesting is that the stereotype of the *Hollywood hacker type* was not much recognised anymore. A stereotype that was more known was the *tech-bro*, like Elon Musk.

What is interesting about these results is that the stereotype of the *Hollywood hacker type* is not recognised by the test sample, even though this is the main big stereotype that other people often seem to recognise. This might be due to the age difference: the stereotype may have been recognisable, but might be less existing nowadays, which, if that were to be true, is exactly what is desired. However, it might also be due to the fact that the test sample knows the stereotype is not true, since they are studying coding and might not recognise it there, and therefore might not recognise the stereotype at all. Many speculations can be made why the test sample does not seem to recognise the stereotype. To get to a more conclusive answer, further research with the test sample and the target group is needed.

5.5.2 Mood boards

As for the mood boards, the clear choice was the mood board with a red/green colour palette and a cozy animation style, with 10 out of 11 girls of the test sample favouring it out of the four mood boards. This fits with the hypothesis that was set, and gives a clear visual style to continue with.

5.6 Summary

In Phase 2, a colour picker was used to create colour palettes. From these, four mood boards were created, which were tested. Results show that one mood board and visual style was preferred by the test sample. Additionally, the message was revised and improved,

which was received positively. However, the stereotype that most people older than the target group recognise does not seem to be recognised in the test sample. Phase 3 should focus on diving further into the stereotype of the *Hollywood hacker type* and its recognisability, and decide whether this scene should end up in the animation. Additionally, from the chosen mood board, visuals can now be made in form of one scene of the story board.

6 Phase 3

In Phase 2, a colour picker was used to create colour palettes. From these, four mood boards were created, which were tested. Results show that one mood board and visual style was preferred by the test participants. Additionally, the message was revised and improved, which was received positively. However, the stereotype that most people older than the target group recognise does not seem to be recognised in the test participants. Phase 3 will focus on diving further into the stereotype of the *Hollywood hacker type* and its recognisability, and will decide whether this scene should end up in the animation. Additionally, from the chosen mood board, visuals will now be made in form of one scene of the storyboard.

6.1 Empathize

The target group does not like being talked down to, is the experience of the client. They can do anything, and they should be encouraged in that. Having a closing sentence of *YOU CAN DO THIS TOO!* might be counter productive. Some girls might feel offended that they have to be told that they are able to do something, as if they were not. Another closing sentence would avoid this problem and still invite them in.

6.2 Define

For Phase 3, there are two questions that need answering, one about the message and stereotypes and one about the visuals and animation style.

Should the stereotype with the dark scene stay in the message and story board?
Does this animation style attract the target group?

6.3 Ideate

In this ideation stage, a better closing sentence for the message will be chosen that will replace *YOU CAN DO THIS TOO!* Additionally, a storyboard will be created from the message. For the visuals, a still from the animation, one scene of the storyboard, will be worked out in a full design.

6.3.1 The message

The most important thing about the message is the question if the dark scene should stay in it. This will be tested using the storyboard in the focus group. Since the result of that is not yet known, the dark scene is left in until the results of the testing stage are clear and a decision can be made. At this point, the thing that needs to change in this message is the closing sentence. Instead of telling the target group they can code, the animation should be inviting. The closing sentence should therefore be something along the lines of *JOIN US NOW!* or *JOIN US IN CODING!*, or a simple *JOIN US!* as to not be too compelling or to over-explain it.

6.3.2 The storyboard

In ideation, sketches for the storyboard were created. The starting point was the three people on the couch, as it sketches the main scene the best.



Figure 39: Sketch of the main scene, the three people on the couch.

From this, the same scene but with the two girls waving to the boy, the sketch in Figure 40 was created.



Figure 40: Sketch, two girls on the couch wave to the boy.

The dark scene was also created from the main scene. The only thing that is left visible is the face of the girl wearing the hoodie and the window.



Figure 41: Sketch, the dark scene.

Then, the scene where the camera viewpoint changes. Now we see the laptop and a bit more of the room.



Figure 42: Sketch, the laptop scene.

Lastly, the end-scene is drawn up, where they high five each other and with the text that will be overlaid.



Figure 43: Sketch, the end-scene.

6.3.3 Animation still

To create a still of the animation from the storyboard, a scene needs to be chosen. Since it is not yet clear if the dark scene will be in the final animation, the dark scene (Figure 41), or the scene where the guy is standing next to the light switch (Figure 40) are not the best options to create a still from. Therefore, the scene where all three are on the couch (Figure 39) is chosen to become an animation still. For illustrating, Adobe Illustrator is used. This software allows for vector files, which preserves detail and produces sharper results than pixel images.

First of all, a quick outline of the room is made. This can be seen in Figure 44. This outline was then coloured in basic colours (Figure 45) to form the basis of the scene.

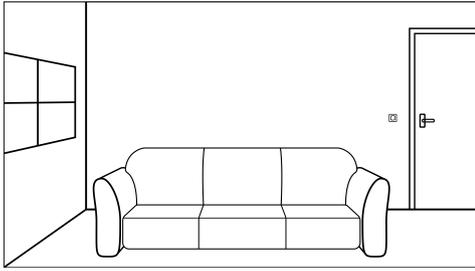


Figure 44: Animation still, the outline of the room.

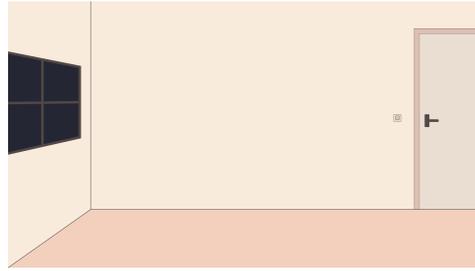


Figure 45: Animation still, the basis of the scene.

The couch can be seen in Figure 46. This couch was modeled slightly after the couch that the author had in their youth, which was very comfortable.

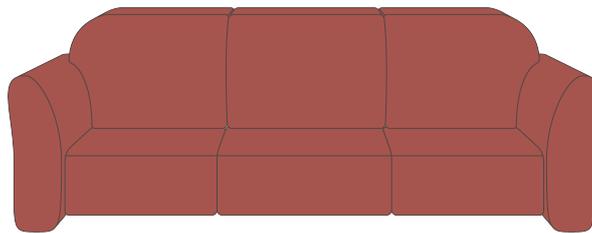


Figure 46: Animation still, the couch.

The book case (Figure 47) is fairly simple. The books are randomly put in, and some plants are added to liven it up.



Figure 47: Animation still, the book case.

From the window, the view is of a city at night. The moon and stars can be seen, as well as many lights coming from other houses. Some plants are added in the windowsill.



Figure 48: Animation still, the window.

The couch (Figure 46), book case (Figure 47) and the window (Figure 48) are all added in the basis of the scene (Figure 45) to create the full environment of the scene (Figure 49).



Figure 49: Animation still, the environment.

Then the characters were created. These were created a little less detailed, since these may change on the basis of the received feedback. The girl with the laptop (Figure 51) is based on the AI generated image that was generated for the colour palettes and mood board (Figure 31). The second girl and the boy (Figures 50 and 52 respectively) are created to be inclusive. There are now three different hair colours and styles, different clothing styles and different ways of sitting.



Figure 50: Animation still, the second girl.

Figure 51: Animation still, the girl with the laptop.

Figure 52: Animation still, the boy.

The prototype of the first animation still can be found in the next stage.

6.4 Prototype

The prototypes of the third phase consist of the message with a new closing sentence, the storyboards and an animation still.

6.4.1 Message

The message with the new closing sentence:

Main message: *coding is creative and social*

Scene I: Dark room, the only thing visible is a person (P1), lit by their laptop screen: they are wearing a hood. You can hear them typing on their laptop.

Scene II: Someone (P2) turns on the light in the room. P1, who we can now see is a girl, looks up, smiling and beckons P2 to join her. There is also another person on the left (P3) which we did not see before. P1 is wearing a cozy hoodie with the hood up, it has cat ears. Her long brown hair comes through. She is sitting cross legged under a blanket. P3, a blonde girl wearing a purple tank top, choker and a pigtail. P2, a boy with red hair, comes to join them and sits down. He is wearing jeans and a sweater.

Scene III: We now see them from the back. They are coding. It looks colourful and fun (Processing-like, visual). P3 points at the code where it displays some red lines and/or warning signs, and P1 changes something.

Scene IV: We see them from the front again as they celebrate their minor victory in the code. They high-five each other and then the call to action text overlays the animation: JOIN US!

6.4.2 Storyboard

From the individual scenes in the ideation stage, a full storyboard is created in the prototyping stage. One additional scene is drawn up to see the transition between the light turning on and the heads of the two girls looking up to wave at the boy. To be able to test and discuss the storyboard with and without the dark scene, the storyboard is created in the two different ways: with or without the dark scene. The storyboards can be seen in Figure 53 and 54.

Storyboard

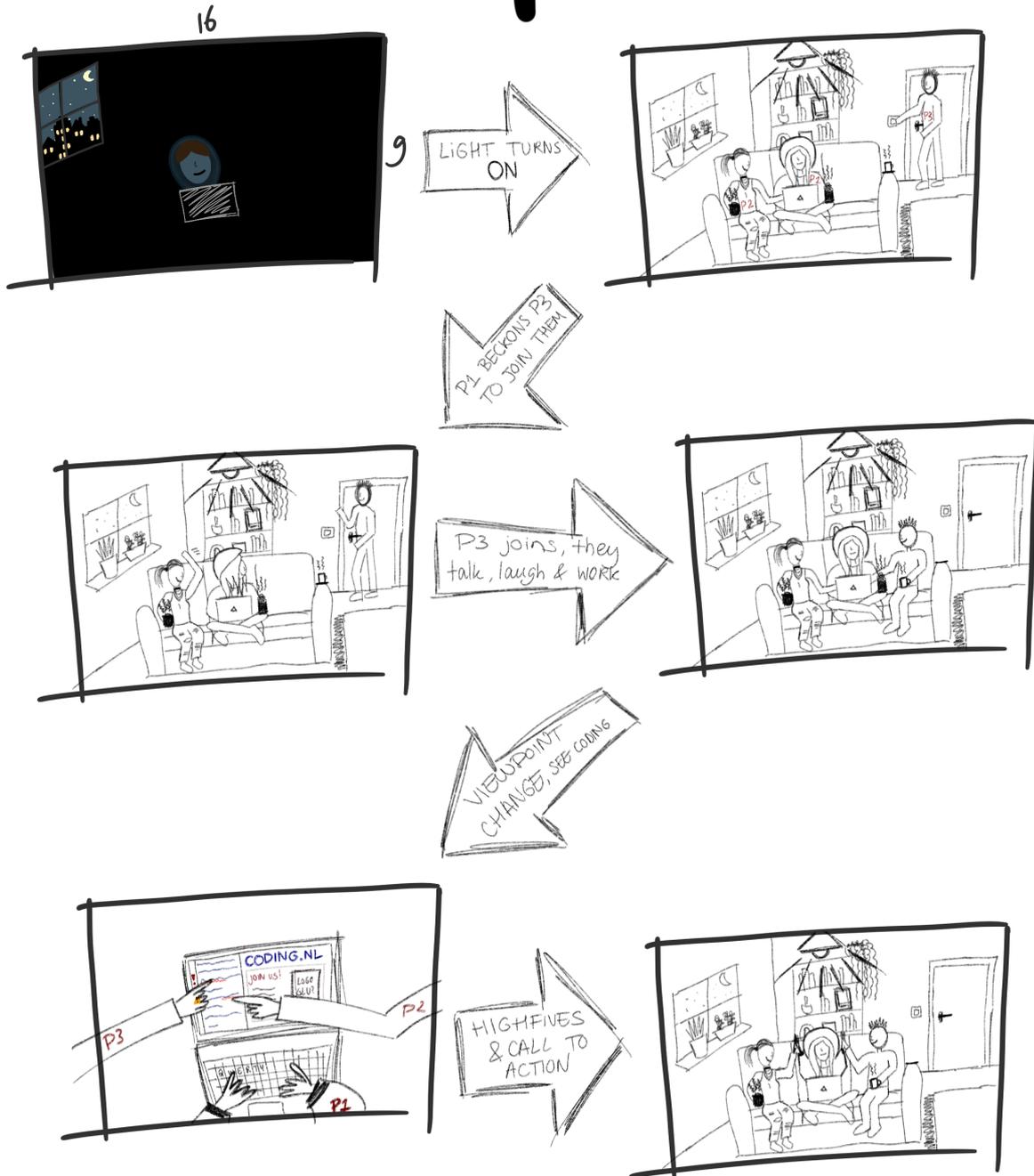


Figure 53: Storyboard.

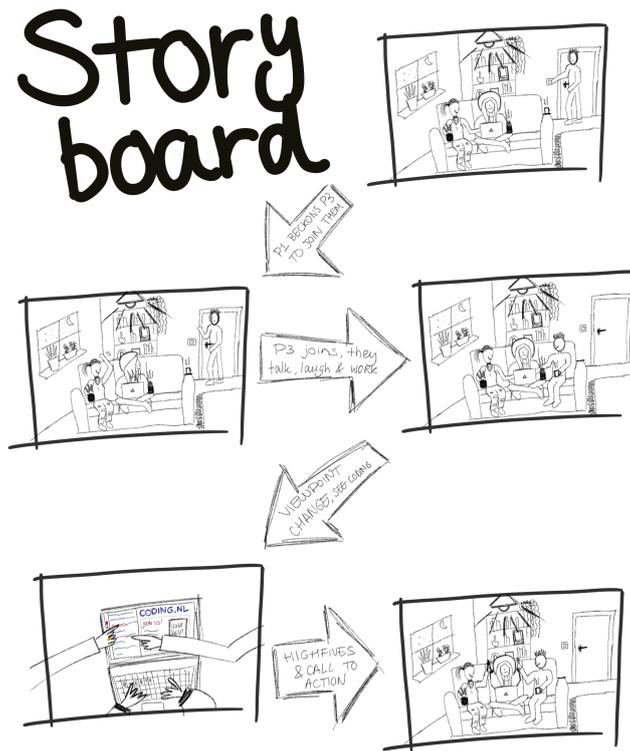


Figure 54: Storyboard without the dark scene.

6.4.3 Animation still

Additional to the storyboard, the prototype of an animation still was created from the individual parts in Section 6.3.3 to test. This animation still was created in Adobe Illustrator.



Figure 55: Animation still, the finished prototype still.

6.5 Test

The message, storyboards and animation still were tested simultaneously in one focus group. Following from the limitation of the time constraint and the age of the target group, testing will be done with research participants over 16 years old. This way, parental consent is not needed and time is saved since participants of 16 years and older can give their own consent. The focus group consisted of four girls of 17+ years old. The full report of the test with the focus group can be found in Appendix A.

6.5.1 Results

The focus group started with questions about their first interaction/contact with coding and how they got to choose the study. What was interesting is that all four girls had started developing an interest in coding (long) before they had to choose a study. All four had started with Scratch (a coding language with a simple visual interface intended for young people), either by their own interest (2/4) or at school (1/4 primary school, 1/4 high school). From there, their interest started to grow and they started doing more and other coding things.

The stereotypes they recognised were *coders are introverts, nerdy, gamer-types* and *coding is creative, boring and hard*. They told about their experience with these stereotypes and how other people viewed their liking of coding. Interestingly, the *Hollywood hacker type* stereotype was not recognised by themselves, although they admitted that movies often portray coding like that. They said that if people have never had anything to do with coding before, this stereotype could well be their view of coding, so they liked it in the storyboard. The stereotype that coders are always working in the middle of the night is, according to the girls, to a certain extent true.

When asked what coding was like after they started studying it, the girls described coding to be *social, creative* and *not hard*. These are close to the way the stereotypes are refuted in the message and animation, which tells of a good direction and association with the final message.

When asked how the girls would explain coding to someone that doesn't know what coding is, the things that came up were *puzzle-solving, writing instructions for a computer* and *creative thinking*.

The girls gave many tips to make the final animation feel even more attractive to coders, like *adding a poster on the back wall* or *adding game-cases in the bookcase* and *making the animation a little more dynamic, using zooming in*. The most useful tip they gave was that it felt unnatural to work with three people on one laptop, so they suggested the third person just leaning over the couch and having a quick look instead of him sitting down and it feeling crowded.

According to the test participants, the style of the animation still was overall clean, neat and calm. Focus is brought to the middle person.

6.5.2 Analysis

The fact that all girls had come in contact with and developed an interest of coding before choosing a study programme might explain why they do not recognise the *Hollywood hacker type*. However, as they said, they do think that other people might recognise this stereotype. Therefore, the dark scene will stay in the story.

The stereotypes of coding being lonely and hard, is in line with what the girls used to think about coding. Additionally, refuting these stereotypes and showing that coding is social and not hard is in line with what the girls do *now* think about coding.

Interestingly, puzzle-solving was the main answer to the question of how the girls would explain coding to a layman. This is in line with how author would explain coding, as shown in the mindmap about personal views on coding (Figure 1).

In the background research, *banner blindness* (the ability to ignore content that might be ads) was discussed (Section 2.2). Since test participants pointed out that focus is drawn to the girl in the center, the focus within the animation seems to be at the right place. In the environment, however, few can be concluded since the environment in which the animation will be shown is not defined and consistent. Banner blindness might still occur. However,

animations, and especially its movement, will grab attention better than a static design.

One of the first things the girls said about the storyboard is that working on one laptop with three people is not accurate to reality. Therefore, the boy will be leaning over the couch, instead of sitting down. For the final animation, the style is perceived as clean, neat and calm. That is why it is decided to keep the style as it is in the animation still for the final animation. Additionally, many tips were given. The stickers on the laptop was the one they agreed on instantly, so that one will definitely be implemented. Other additions might take too much time. In the execution of illustrating and animating the final animation, it will be decided if there is time left for these implementations and/or additions.

6.6 Summary

In Phase 3, the message was improved, the storyboard and animation still were created and all three were tested. They were all positively received by the focus group in the testing stage, which means that the message and the storyboard are now concluded. Additionally, the animation still is a good basis to start the execution of the animation. Next, the animation will be created and finalised.

7 Final Animation

In this chapter, the animation is created. This is done using Adobe Illustrator, Adobe After Effects and Adobe Premiere Pro. The animation is created on the basis of the message, storyboard, visuals and still. The concluded message, storyboard and visuals are shown in this chapter before diving into the execution and realisation of the animation.

7.1 Concluded message

The concluded message, as tested in Phase 3, can be found below.

Main message: *coding is creative and social*

Scene I: Dark room, the only thing visible is a person (P1), lit by their laptop screen: they are wearing a hood. You can hear them typing on their laptop.

Scene II: Someone (P2) turns on the light in the room. P1, who we can now see is a girl, looks up, smiling and beckons P2 to join her. There is also another person on the left (P3) which we did not see before. P1 is wearing a cozy hoodie with the hood up, it has cat ears. Her long brown hair comes through. She is sitting cross legged under a blanket. P3, a blonde girl wearing a purple tank top, choker and a pigtail. P2, a boy with red hair, comes to join them and sits down. He is wearing jeans and a sweater.

Scene III: We now see them from the back. They are coding. It looks colourful and fun (Processing-like, visual). P3 points at the code where it displays some red lines and/or warning signs, and P1 changes something.

Scene IV: We see them from the front again as they celebrate their minor victory in the code. They high-five each other and then the call to action text overlays the animation: JOIN US!

7.2 Concluded storyboard

The concluded message, as tested in Phase 3, can be found in Figure 56.

Storyboard

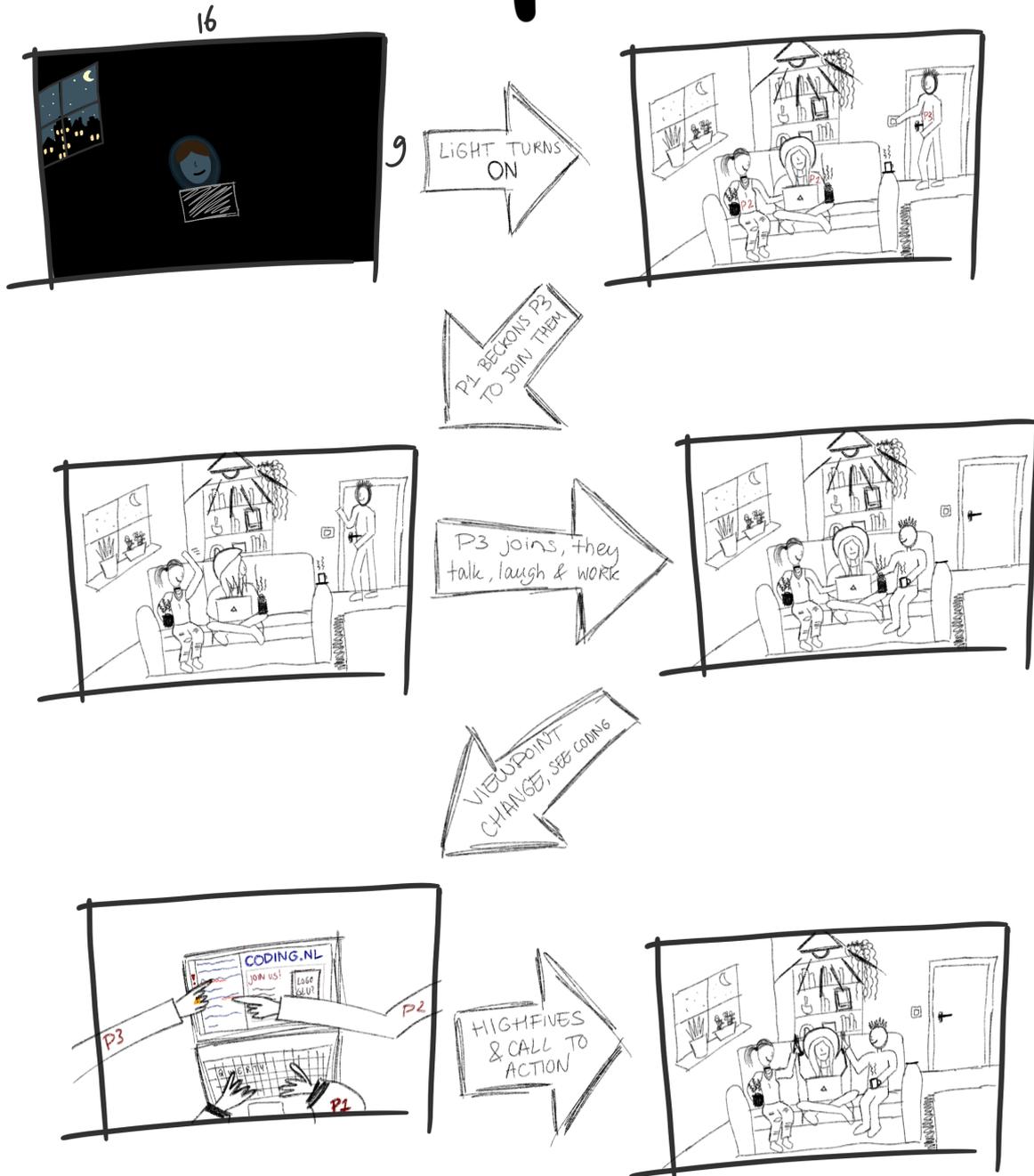


Figure 56: Storyboard.

7.3 Concluded visuals

The concluded visuals, i.e. the style and colour palettes, as tested in Phase 2, can be found below.



Figure 57: Concluded visuals.

7.4 Typography

After searching for typefaces that convey neutrality in gender associations and are interesting, two typefaces are selected: *Anth*, designed by Anthony DiSpigna (DiSpigna, 2024), and *Gigalypse*, designed by James Puckett (Puckett, 2024). They are very different and both promising.

The quick
brown fox
jumps over
the lazy dog

Figure 58: *Anth Bold*, designed by Anthony DiSpigna.

**The quick
brown fox
jumps over
the lazy dog**

Figure 59: *Gigalypse*, designed by James Puckett.

The obvious difference between these two typefaces is the boldness, or emphasis. Both typefaces make use of round shapes, where *Anth*, Figure 58, has sharp serifs and *Gigalypse*, Figure 59, has no serifs at all. A serif is a small line or stroke regularly attached to the end of a larger stroke in a letter or symbol (Wikipedia, 2024). Square shapes are often associated with the male gender, and circles with the female gender (Section 4.3.1). Owing to its round shapes with sharper serifs, *Anth* could potentially appeal to all genders, since it combines circular with square aspects within the typeface. Similarly, *Gigalypse* could appeal to all genders too, owing to its use of the "superellipse known as a squircle; a square with no straight lines" (Puckett, 2024).

From these two typefaces, quick overlays was made to test the typeface in the style of the animation. These overlays can be seen in Figures 61 and 60.



Figure 60: JOIN US! overlaid on the animation in Anth Bold.



Figure 61: JOIN US! overlaid on the animation in Gigalypse.

7.4.1 Typography choice

Figures 60 and 61 were tested on 8 peers. The general conception was that Gigalypse was a better fit, looking at the animation style. However, it was not especially readable for long text. But since it only needs to read *JOIN US!*, that is not a problem. Gigalypse was perceived neutral but not boring, which is promising. Anth was perceived classic but playful. Overall, Gigalypse was chosen above Anth, so that is the typeface that will be used for the final animation.

7.5 Sound

The last decision that was made is that there will be no sound with the animation. Partly due to time restrictions, there are some other reasons sound is not necessary in this animation. First, the environment in which the animation will be played, open days or info markets, is busy. People are walking about, talking. Adding animation sounds to this might be too much. Additionally, the people manning the stand next to the animation, would otherwise have to listen to the same loop of sounds over and over again. Secondly, according to an expert in graphic design, not many people turn on the sound when watching a video on social media, so the visuals should convey enough of a message without sound. People might used to videos without sound, thus, the animation having no sound will not be a problem.

7.6 Execution

The animation was illustrated in individual parts in Adobe Illustrator. The individual parts were Animated in Adobe After Effects, after which the exported animation video was edited in Adobe Premiere Pro to add text and zoom in.

7.6.1 Illustrating in Adobe Illustrator

In the ideation stage of Phase 3 (Section 6.3.3), individual parts for the first still of the animation is developed. Here, the static objects are already created, which can be used in animating. Therefore, these objects do not need to be created here.

The layout of Adobe Illustrator can be seen in Figure 62. On the top and the left, different tools are displayed that can be used. On the right, properties of the selection and layers are found.

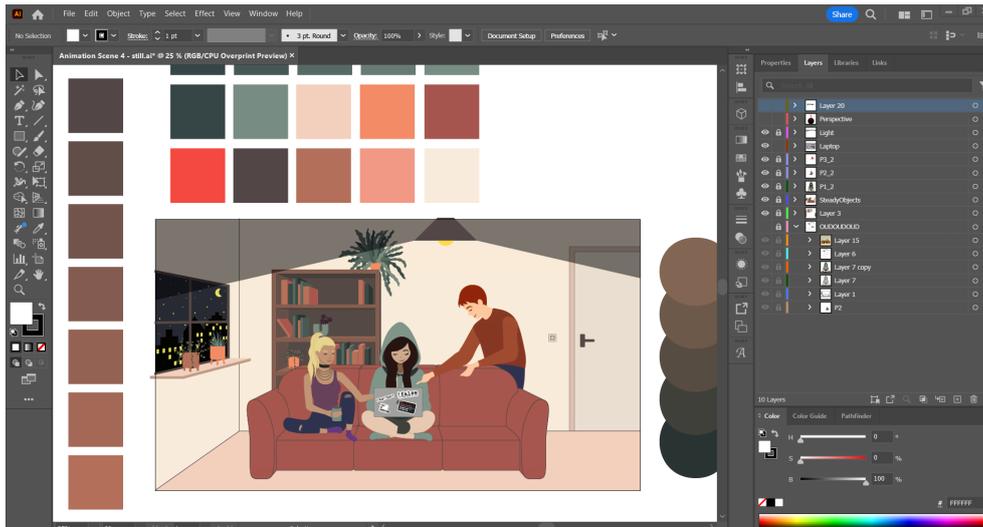


Figure 62: Adobe Illustrator layout.

The characters that were created in the ideation stage of Phase 3 (Section 6.3.3), were remade. This time, more detail was used, and the characters were built up to animate. Meaning that everything that should move on its own, has to be on its own layer. This meant many different layers and many different names. An example of this can be found in Figure 63, where the layers of the boy character can be seen. Separating all different elements into different layers and the naming of these layers, i.e. preparing the file for importing into Adobe After effects, had to be done by hand and was an extremely time consuming process on top of the actual creation.

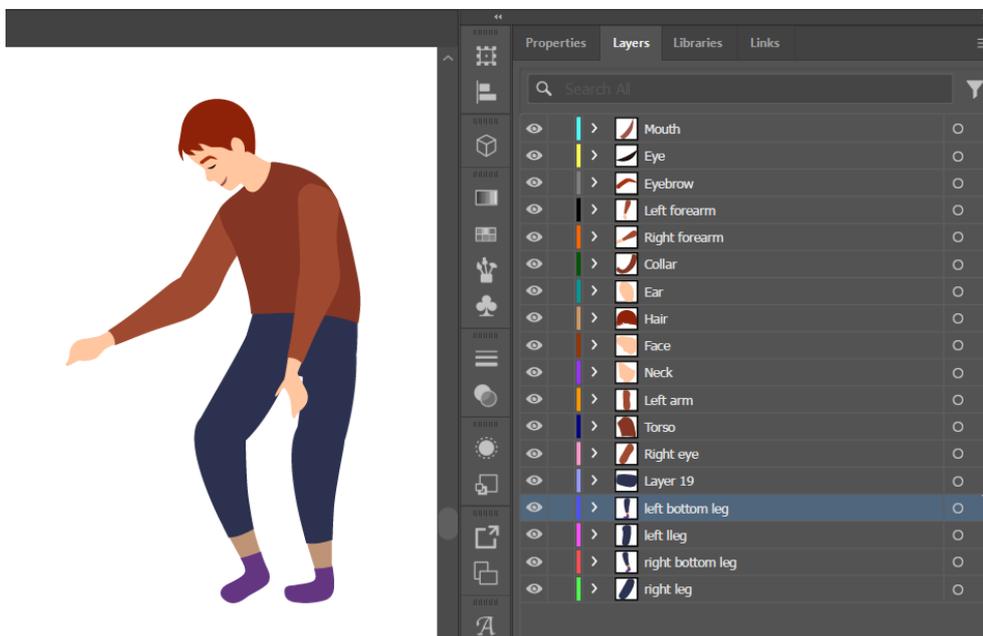


Figure 63: Layers in Adobe Illustrator.

The character remakes can be found in Figures 64, 65 and 66.



Figure 64: Final design of the first girl.



Figure 65: Final design of the second girl.



Figure 66: Final design of the boy.

In total, nine files with countless layers were created to be imported into Adobe After Effects. (1) The static objects and environment, Figures 45, 46, 47, 48 and 49, which can be found in Section 6.3.3 on page 36. (2-4) The three characters, Figures 64, 65 and 66, in three different files. (5) The laptop, see Figure 67, decorated with stickers per suggestion of the focus group the testing stage of Phase 3. (6-7) Two files for the lighted up face by the laptop screen, Figure 68, and the part of the room one can slightly see by the light shining in from outside, Figure 69. And lastly, (8-9) two files for the scene where the viewpoint changes and the characters are seen from the back, so we can also see the screen, see both in Figure 70.



Figure 67: Final design of the laptop.



Figure 68: Light from the laptop shines on the girl's face.



Figure 69: Dark room lit by light coming through the window.



Figure 70: Scene from the other viewpoint.

After importing, the layers were all set in the middle of the animation, see the example in Figure 71. It was time consuming to manually put all the layers at the correct position again. After positioning by hand for all layers and files, the rotation points had to be set correctly. For example, an arm is not rotated in the middle of the arm, but at the part that connects to the shoulder. These rotation points had to be set manually per layer. Overall, the preparation for the import and the import itself was time consuming and cooperation between Adobe's Illustrator and After Effects could be better.



Figure 71: Positioning of layers after importing to Adobe After Effects.

7.6.2 Animating in Adobe After Effects

After the preparation of the animation in Adobe Illustrator, the animating could start. The things that were animated:

- Waving
- High fives
- Walking and leaning over the couch (the boy)
- Looking up towards the boy (the girls)
- Leaning in and gesturing (the second girl and the boy)
- Pointing at the error messages (the boy)
- Arm movements for typing on a laptop (the girl)
- Cat ears, whiskers and tail
- Typing a *semicolon* and pressing *Enter* (the girl)
- Moving the mouse (the girl)
- Moving all items on the website-screen
- Flashing of the type cursor
- Quick flash when the light turns on

An example of the animation process of waving an arm can be seen in Figure 72.

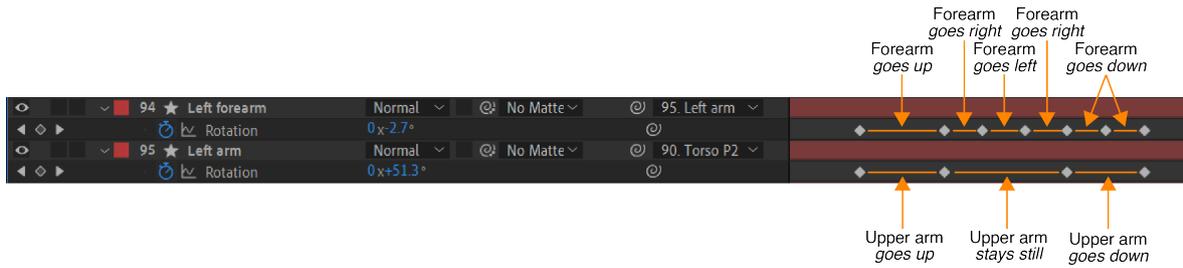


Figure 72: Animating the left arm of the second girl using keyframes of the arm's rotation.

In Figure 72, two layers can be seen, called *Left forearm* and *Left arm*, i.e. the upper arm. These layers have been assigned the red label, since all layers belonging to the second girl had been assigned the red label. The property that was used for the waving movement is the *Rotation*, as can be seen directly under the layer names. In the right part, multiple keyframes can be found. A keyframe is used to set parameters, in this case for the rotation. It marks the point in time where a value for the rotation on that layer is specified. For example, a wave would set the forearm to go from 0 to 30 degrees and back. Of course, going from 0 to 30 to 0 to 30 degrees would result in wooden movement, therefore, a more natural movement would be, for example, from 0 to 28 to -4 to 32 degrees. In Figure 72, the upper arm is tilted upwards, and back down again. The forearm is going back and forth and is therefore making more movement, thus, has more keyframes.

Animating is a time consuming process. It is much trial and error, trying out certain movements and trying to make them feel as natural as possible. As many layers as were used, Adobe After Effects started lagging. After changing anything, a second was needed for the software to get up to speed. When spending much time animating, this can get maddening.

7.6.3 Finalising in Adobe Premiere Pro

After the animating was done, the Adobe After Effects file was exported to an MP4 file. This file was imported into Adobe Premiere Pro. In there, the ending of the video was extended, so that the view could zoom in at one of the high fives. There, a slight overlay was displayed and the text *JOIN US!* added, see Figure 73. As discussed in Section 7.4, the chosen typeface is Gigalypse.



Figure 73: End screen with the text overlay.

7.7 Final animation



Figure 74: Thumbnail of the final animation.

The thumbnail of the final animation can be seen in Figure 74. To view the animation on YouTube, Scan the QR-code in Figure 75, or go to <https://youtu.be/gudY1XhDfA8>.



Figure 75: Scan the QR-code to view the final animation on YouTube.

8 Discussion

During this research, graphic design has been used to strive to attract female high school students to the field of coding to increase representation of women in the field of coding and its education direction. Results of the used animation design indicate that the visuals arouse interest and are white label and the message that *coding is social, fun, and not hard*, which refutes stereotypes that *coding is lonely, boring and hard*, resonates with the target group. These results indicate that graphic design is able to attract female high school students and make them interested in a study in the field of coding.

These results are in line with the literature. The colour palette, being high in saturation but low in brightness, consists of arousing colours. Since interest is an arousing emotion, these colours were hypothesised to be promising. The results show that they are indeed in line with the literature. Additionally, the feedback and results of testing sessions were often positive and the research and animation has been improved as best as possible according to these feedback and results.

During a presentation of the research findings and animation, it was pointed out that the girls struggling with the code, and the boy taking a quick look and fixing everything might enforce the stereotype that coding is for men, instead of refuting it and showing that coding is for everyone. This was an observation that the research should not have overlooked. A solution is to switch the places of the second girl and the boy to avoid this conception. Someone else pointed out that they thought the boy was a girl with short hair, which indicates that the *boy fixing everything* is not perceived by everyone.

The reliability of all results and data, however, is impacted by the small size of the test samples. Though the results definitely show promise for aroused interest in the actual target group, sample sizes of 4, 8 and 11 are too small to be able to claim anything about the whole target population. Moreover, the time restrictions of this research required testing a different age group than the target group. Additionally, graphic design is not measurable up front and can only be measured by testing the result on, for example, effectiveness. Since testing the final animation on a significant sample size of participants is beyond the scope of this research, mainly due to time restrictions, future work could focus on developing a testing process, with larger sample sizes and the correct age group, that makes use of a method to measure interest.

9 Conclusion

In this research, graphic design has been used to strive to attract female high school students to the field of coding to increase representation of women in the field of coding and its education direction. A design is established to create an animation that grabs, and keeps, attention. The animation consists of the message that *coding is social, fun, and not hard*, which refutes stereotypes that *coding is lonely, boring and hard* and invites to join. The animation's visuals aim to arouse interest and attract a gender-neutral audience, while being white label. The animation can be used in the context of open days or info markets, and is produced in a white label design, meaning that there is no connection to any one school or university, and the design could be used by all schools and universities.

Improving representation of women in the field of coding, in all fields of technology, is no easy task. Creating a world in which gender does not play any part in professional fields starts with every individual. This research hopes to encourage girls that they can do anything.

Acknowledgements

I am extremely grateful to my supervisor, Marcello Gómez-Maureira, and my critical observer, Thérèse Bergsma, who guided me throughout this research. Their feedback and support were of invaluable help. Also, a special thanks to Isabelle Kniestedt for providing and trusting me with this research and testing with students for me. Lastly, I'd like to acknowledge my close friends and family for their moral support and belief in me, and all test participants for their feedback.

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Appendix A Testing with the focus group - Results

The test was a focus group setting with four girls of at least 17 years old.

A.1 The message

The focus group started with questions about their first interaction/contact with coding and how they got to choose the study. What was interesting is that all 4 girls had started developing an interest in coding (long) before they had to choose a study. All 4 had started with Scratch (a coding language with a simple visual interface intended for young people), either by their own interest (2/4) or at school (1/4: primary school, 1/4: high school). From there, their interest started to grow and they started doing more and other coding things.

Questions were asked about the stereotypes that they had before they started studying it. These were stereotypes they recognised:

- Coders are introverts: recognised by 3/4 girls
- Coders are nerdy: recognised by 3/4 girls
- Coders are gamer-types recognised by 2/4 girls
- Coding is creative: recognised by 2/4 girls
- Coding is boring: recognised by 3/4 girls
- Coding is hard: recognised by 4/4 girls

One girl explained that when her class started with Scratch, most people found it weird that she liked it. She recognised these stereotypes not just of her own experiences, but also in the way that others viewed her and her interests. The other three girls agreed knowingly, they had had similar experiences.

Interesting: The *Hollywood hacker type* coder was not recognised, although they admitted that movies can show it like that. This was said: In those movies they are typing for 15 minutes, using many monitors, when new windows open up (even though they don't stop typing). While in reality: coding is typing for three seconds, then searching google for 20 minutes to find out about the error it gave, OR typing for 10 minutes and then testing for an hour.

The stereotype that coders are always working in the middle of the night is, to a certain extent, true according to the girls. 2 of 4 girls recognise this in their own lives. Although, was said, movies exaggerate it very much.

Questions were asked about their expectation of studying coding and if they appeared to be true or not.

Mostly, the basics of programming (learning code, creating things) was exactly as they had expected. The things that they did not expect (to a certain extent) were:

- Coding is social: more social than expected: recognised by 4/4 girls
 - The school projects (although they knew from the study programme description)
 - Sparring with others about school projects/exercises or personal coding projects
 - They make it fun
- Coding is creative
 - Some projects were less open to creativity, especially the basics of coding
 - Other projects were super free to get creative, and at least 3 of 4 girls were really happy about this (their faces lit up when telling about a particular project they had made)
- Coding is not hard

- You just have to learn it. If you know the basics, then everything can be led back to that. Sometimes when you don't know how to approach a problem, it might be hard to start it.
- When you know the basics: it is just the syntax of a specific language you need to learn
- There is a *way of thinking*: the penny needs to drop. Step by step you learn a language and then it gets less and less spelled out for you until you start thinking for the solution yourself.

How would they explain coding?

- Solving a puzzle
 - Example: They had to make Tic Tac Toe as an exercise. They were told which functions they had to use and generally what they had to do. Then they had to find a way to put it in de right order and way.
 - Solving a problem by finding a creative solution: solving a puzzle
- Writing a list of instructions for a computer
 - In a language that the computer understands
 - It is like learning another language. (Many coding languages have a similar structure)
 - A computer thinks literally. If you forget to mention something it won't work/will give errors. Example: video of peanut-butter-jelly sandwich (CS50, 2018).
- Creative thinking
 - As solution to a problem

A.2 The storyboard

A.2.1 The dark hacker stereotype

To ask questions specifically about this stereotype, the two different storyboards created during the prototype section were discussed during testing.

After these questions, questions more specific about the storyboard were asked. The storyboard was explained, run through and then the questions were asked. The stereotype of the *Hollywood hacker type* is good at the start, even though it is a movie-type extra-exaggerated stereotype. If people have never had anything to do with coding before, this could well be their view of it. However, the 4 girls did not have such a view, since they already had developed an interest in coding.

A.2.2 The storyboard - tips

Then came many tips (some of which followed from questions, some from themselves):

- Maybe make the time of day a little earlier in the evening. That way it can be like they just forgot to turn on the lights. Like this it is a little bit random why it is they are sitting in the dark.
- It does not feel natural to be working on one laptop with three people.
 - Suggestion: An extra table + laptop where the third person sits down after he turned on the lights.
 - Another suggestion: The third person leans over the couch, watching along and pointing out some things. He is mostly there for the *gezelligheid*.
- Make the animation more dynamic

- Suggestion: In the end: zoom in at the hands in the high five or the window and then put in the overlay.
- Showing code on the screen
 - Suggestion: Quickly show code being changed and then run, and show that now it works.
 - * Someone else said: To show how it works you need to show that it didn't work before.
 - Suggestion 2: Quickly show Stack overflow (we use that often). Show a line selected/getting copied, and then it goes to the code, where that line is pasted. Then show that it is now working.
 - Suggestion 3: Before the storyboard, input a quick scene in which we see the screen where we can see that something is not working (maybe hitting the spacebar without a character jumping). Then, when we see the screen later, change the code quickly and then show the character does jump.
 - Suggestion 4: Web might be easier to represent (and easier recognised). Put stuff at the wrong place, delete a bit of code, type some new code and then all the stuff jumps to the right place.
 - Remark: The storyboard has a split screen: might be easiest to show it quickly (if there are only a couple seconds).

A.3 The animation still

After the storyboard, the animation still was discussed.

Comments:

- Clean, basic art style: neat
- Looks *gezellig*
- Looks calm
- Attention goes to person in the middle, even though the background is not empty

Suggestions:

- 3 of 4 girls said: Add a poster, to fill the empty space at the right. Maybe on the door or the wall. Maybe a generic movie poster with a person and a beam with some text.
- Add coffee.
- Add stickers on the laptop (on which all girls replied "Yes definitely" or something similar)
- Some game-related stuff in the bookcase: A Nintendo Switch, gamecases, etc.
- A joke: In the bookcase, add a framed photo of the same laptop.