Universiteit Utrecht

# Breaking the barrier

## Keeping young women more interested in STEM by the extra-curricular project GirlsClub WIN

**Master thesis**


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# Abstract

There is a notable shortage of women working in Science, Technology, Engineering, and Mathematics (STEM). This underrepresentation often begins with young girls lacking interest in STEM subjects, feeling that they do not belong or are unaware of the potential applications of these fields. The aim of this research is to examine whether the extra-curricular project GirlsClub WIN can effectively increase young girls' interest in STEM and influence their career choices. The GirlsClub WIN is a project designed by Utrecht University for girls in their second year of secondary school consisting out of five project days spread over a year. It focuses on cross-disciplinary education of the subjects mathematics, computer science and physics. This research uses a mixed-methods approach, including observations, questionnaires and interviews. The findings indicate a significant increase in interest in STEM subjects among the participants, suggesting that such projects can positively impact girls' perceptions and willingness to consider STEM careers. Resulting in the fact that a majority of the participants chose a STEM-related subject combination. The GirlsClub also positively influenced the participants' sense of belonging. Students even indicated a stronger sense of belonging during the project compared to their regular school environment. Limitations include the small sample size and the short duration of the study. Future research should focus on long-term tracking of participants to better understand the lasting impacts of such programs.

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# 1. Introduction

There is a big shortage of people working in science, technology, engineering, and mathematics (STEM). The shortage of women in STEM is even more worrying. Even though around half of our population in Europe is female, only 15% of the people working in the tech sectors are female and even only 2,4% in the ICT related fields sector according to the Internation Centre for STEM Education (2021). It is opportune to decrease this gender gap, so more women will work in STEM and solve the shortage of women in this sector. The question is how we can increase the number of women in STEM.

There are multiple factors which influence girls' participation, achievement, and progression in STEM studies. The United Nations Educational, Scientific and Cultural Organization (UNESCO) suggest an ecological framework (*figure 1*) which presents these factors and interventions at four levels. This research focuses on individual-level interventions that can help build children's spatial skills, self-efficacy, interest, and motivation among girls to pursue STEM studies and careers (UNESCO, 2017).

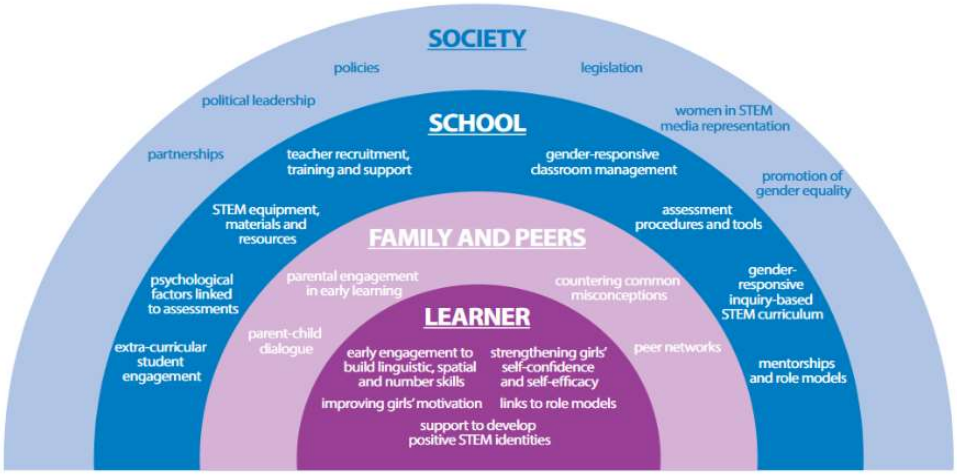


*Figure 1: Ecological framework of factors influencing girls' and women's participation, achievement and progression in STEM studies (UNESCO 2017)*

Many initiatives have been taken; one was more successful than the other. One of those successful initiatives is "Girls who code." They have 6,300 programs worldwide, consisting of clubs for third to 12th graders, summer programs for high school students, and college programs to help alumni succeed. Since 2012 more dan 580 thousand girls followed the program. Of these alumni there are seven times more female students to choose a major in computer science than the average (Girls who code, 2023). This initiative showed a direct effect on girls' interest in the STEM sector. Research showed that the key elements of this success where that they sparked the interest early, sustaining the engagement in high school and inspiring young women in college (Girls who code, 2023). But in this study they focussed on one subject: computer science. Which elements can we take from this initiative and use for the entire STEM field?

The European Union co-funded the GEM [1]project. This project seeks to increase girls' interest in STEM subjects, studies, and careers. One of their initiatives is the GirlsClub summer camp (GEM, 2019). Ten European countries participate in this project and Utrecht University organised the Dutch summer camp. The GEM Consortium used five pedagogical principles to build effective summer schools: context, culture, entrepreneurship, role models and inquiry. Out of these principles they formed designing guidelines for equivalent projects (Appendix G). The camp consists out of three consecutive days. A questionnaire was taken at the start and end of the camp. The results showed an overall increase in their enjoyment and motivation in learning STEM and their feelings about the value of STEM in society (Universiteit Utrecht, 2023). There has not been any further research done about the long-term effects of the summer camp.

Out of these earlier extra-curricular activities we have seen the positive effect on the participants on the interest in STEM and specifically computer science. There are many more initiative to hopefully make women more interested in STEM. To make a difference in the shortage of women in the STEM industry, it is important to figure out of this increased interest results in women choosing a STEM study. The aim of this research is to explore another extra-curricular project which has the goal to increase the interest in STEM for young female students at secondary school just before they will make their first career-related choice.

[1] GEM (Girls Empower) is European project founded in 2020. It stands for empower girls to embrace their digital and entrepreneurial potential.

## 2. Theoretical background

The lack of women in STEM can be explained by a few factors. First of all, women have less interest in STEM. Academic and non-academic interests are found not to be fixed and independent in their development, rather showing patterns of differentiation and integration in the interests over time (Akkerman & Bakker, 2019). Since interest is not fixed, initiatives can influence students' interest. Research (Akkerman & Bakker, 2019) revealed how interest expands when combining multiple objects of interest. STEM-interested students find it important that a study program allows them to pursue multiple interests. The findings stress the importance of taking a multiple interest perspective on interest development and educational choice (Vulperhorst et al., 2018). A project focusing on cross-disciplinary education can positively influence the interest.

In math and physics, relatively little attention is paid to uncertainty, occupations and applications, while girls in particular have a greater need for information about these aspects (Booy et al., 2011). This may play a role in the development of interest towards mathematics (Shapiro & Williams, 2012). This was also highlighted in the article, "Break the bro-culture in STEM education to retain female talent" (NRC, 2023). It turned out that girls seek a social challenge and broader applications.

People are more likely to pursue a subject if they have high self-expectancy and value beliefs (Starr, 2018). Women tend to have lower expectancy value beliefs about math than men, which might explain the gender gap. Dökme et al. (2022) researched the interest among female students towards STEM fields. He concluded that the interest did not differ according to grade level, high school, or family income. It did differ according to the variables of "having received STEM training", "having participated in STEM activities" or "having a role model working in a STEM field" (Dökme et al., 2022). An extra-curricular project can use those variables to possibly increase the interest of their participants. Research of Saqip (2018) have shown that students who participate in extracurricular activities get all kinds of benefits. For example, higher grades, higher educational achievements, and higher self-confidence (Saqip et al., 2018). The extent to which those benefits are achieved depends on the activity itself. Over-scheduling can decrease the benefits of participation in extracurricular activities. Stringer et al. (2020) investigated differences in STEM extracurricular activities participants and non-participants in their STEM motivation. Results showed that girls who participate in STEM extracurricular activities have a stronger STEM career identity and greater science motivation than non-participant girls (Stringer et al., 2020).

Another explanation of the lack of women in STEM is the feeling of not belonging at STEM. Underrepresented groups often report a lower sense of belonging. There is a need to identify and better understand the ways in which organizations of STEM can support these groups (Rainey et al., 2018). Individuals are shaped by the social identities associated with group belonging. The values of these peer groups may contradict the values associated with STEM. Girls can experience the feeling of rejection from their peers regarding STEM fields (Leaper,

2015). According to Eccles's (2011) expectancy-value theory, people are most strongly motivated to achieve in domains that they value and in which they feel competent. Peer groups may affect this feeling of competence. In these cases, girls do not feel like they belong in the STEM field.

In the current world math and science are still perceived as male domains and scientists as predominantly male. The findings of Makarove et al. (2019) suggest that gender-science stereotypes of math and science can potentially influence young women's and men's aspirations to enrol in a STEM major at university by showing that a less pronounced masculine image of science has the potential to increase the likelihood of STEM career aspirations. Research by Rainy et al. (2018) showed that female representatives increase the sense of belonging. More female representatives change the way students see the culture of STEM. When students think about someone in STEM they typically see a male or masculine traits. Female representatives could change this stereotype (Rainey et al., 2018). However, most of the researchers and professors are male. So female students often have male supervisors and teachers which underlines the gender stereotype and decreases their sense of belonging in this field. According to Buccheri, Gürber and Brühwiler (2011), gender and stereotypical gender roles play a significant role in a career choice in STEM.

## 2.1 Focus of my research

An initiative by Utrecht University is the GirlsClub WIN[2]-days with the intention to make young girls more enthusiastic about STEM. This project is organised by U-talent in close contact with GEM. The initiative consists of five days of workshops and activities about mathematics, computer science and physics (Appendix C). The purpose of the content of these days is to connect the high school subjects with each other and with the world outside school.

The aim of my research is to find out how the participating female students experience the GirlsClub WIN project and how it impacts the interest in STEM subjects, studies, and careers. A lot of research has been done to find ways to make the STEM sector more appealing for girls. In comparison to a summer camp these GirlsClub WIN-days are spread out over a year. I am curious if this regularity over a longer period of time influences the impact of the project. Earlier research (Dökme et al., 2022) showed that motivation can improve by participating in STEM activities or having a role model. The GirlsClub WIN project is developed so girls can participate during extracurricular activities. During those days, the girls will meet many female representatives. They can be a role model for the girls and change the stereotype. This contributes to the sense of belonging. The participating girls form a peer group with the same interests and values. They can feel like they belong in this group which change their feeling of belonging and expectance for the STEM field. We expect the GirlsClub WIN project

[2] WIN is a Dutch abbreviation for Mathematics (wiskunde), Computer science (informatica), Physics (natuurkunde)

to have an effect on the motivation, consisting of self-confidence and interest. The question stands what the long-term effect will be. Most of the research does not show what the effect is on the long-term. Only with longitude studies we can answer this question. In the third year of secondary school the students make a choice for a subject combination. This can be the first indication of students participating in STEM studies and later careers in STEM.

### 2.1.1 Research question

Which leads to the main research question:

> *How do the participating female students experience the extra-curricular project "GirlsClub WIN" with regards to their interest in STEM subjects?*

We expect the GirlsClub WIN to have a positive effect on the interest in STEM of the participating students. Hereby we expect three key elements which influences the positive experience of the students the most. First, the high sense of belonging at the GirlsClub. As Makarove et al. (2019) indicated one of the explanations of the shortage of women in STEM is the lack of sense of belonging in this field. The project focusses on creating a sense of belonging. Secondly, we expect the extra-curricular project to be a valuable addition on the regular program at secondary school based one research of Stinger et al. (2020). Therefor we expect the majority of the students to choose a science subject combination. It is valuable information to know if the participating students make career related choices towards the STEM field, if we want to make an impact on the shortage of women in STEM. The first step of studying and eventually working in STEM is the choices they make in their second year.

### 2.1.2 Sub-questions

This research will focus on those three key elements which leads to the following sub-questions:

1. *How does the GirlsClub WIN contribute to the sense of belonging for girls in STEM fields?*
2. *What is the added value of the project for the STEM subjects compared to the regular school subjects?*
3. *How does the GirlsClub WIN have an influence on the related career choices in upper secondary school?*

## 2.2 Context

The extra-curricular GirlsClub WIN project is especially designed to complement the program of their secondary school in the Dutch school system. We delve into this system to get a better understanding of how the Dutch school system works and the career related choices a Dutch student have to make. Also, we take a further look in the organisation U-talent, which is responsible for the GirlsClub project, to fully understand the project.

### 2.2.1 Dutch school system

This specific project is related to the Dutch school system. The Dutch school system consists of three stages: primary education, secondary education and higher education. At twelve years old the pupils will start secondary education and enrol in one of the following tracks:

- Pre-vocational secondary education (vmbo, duration of 4 years)
- General secondary education (havo, duration of 5 years)
- Pre-university secondary education (vwo, duration of 6 years)

In the third year of secondary school students will choose courses they will follow the upcoming years of secondary school.

We will focus on Pre-university secondary education. The subject's mathematics, Dutch, English, physical education and a second foreign language are compulsory. In addition to the common compulsory subjects, pupils choose one of four subject combinations (Ministry of Education, 2014):

1. Science and technology NT (Compulsory subjects: Science and Physics)
2. Science and health NG (Compulsory subjects: Science and Biology)
3. Economics and society EM (Compulsory subjects: Economics and History)
4. Culture and society CM (Compulsory subject: History)

Then the pupils have the option to choose one or two optional subjects related to their subject combinations and one other optional subject. In order to follow all STEM subjects' pupils must choose NT or a combination of NT with NG. With those subject combinations a pupil can study every possible STEM study. In figure 2 the number of students choosing a subject combination is displayed, split on gender. Almost double the number of male pupils (14,485) choose the subject combination NT in comparison with female pupils (7,320). This indicates that less female pupils will study a STEM related study and therefor end up with a career in STEM.

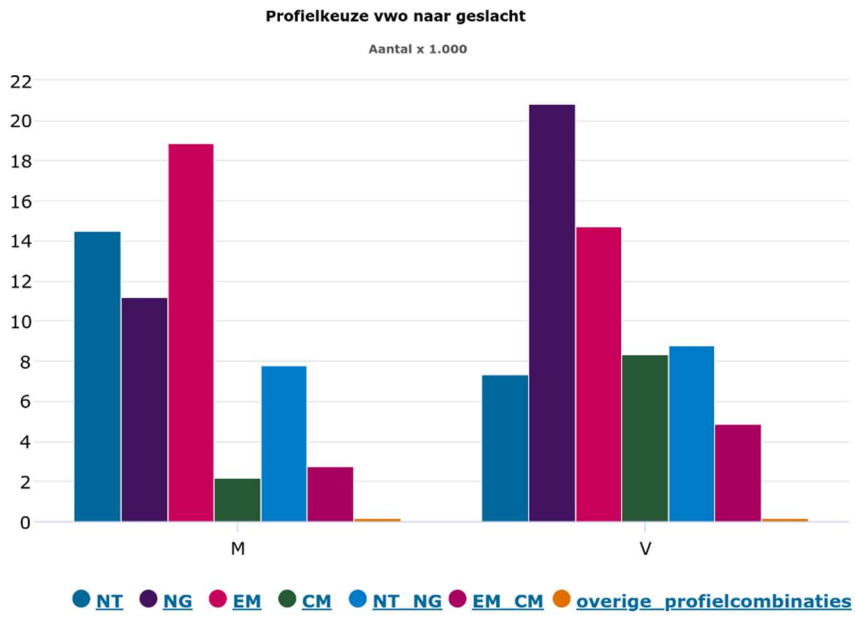


*Figure 2: Subject combination choices in 2021-2022 (CBS, 2022)*

Even though there are more female students in scientific education the ratio of men to women in specific fields are striking. In the field computer science, the number of male students (12,775) is triple the number of female students (4,206), shown in figure 3. Ten years ago (figure 4), it was even quadruple the number of female students. In mathematics and natural science, the ratio is changing. In 2020/2021 the number of male and female students are coming closer together (20,395 male versus 18,961 female). Ten years ago, the difference was much greater (12,155 male versus 8584 female). In the health care sector, it is the other way around. This could indicate female students with a science profile choosing a study related to healthcare instead of STEM studies.

**Hoger onderwijs; eerste/ouderejaarsstudenten, richting 2010/'11-2021/'22**

: Gewijzigd op: 22 april 2022

**Migratieachtergrond:** Totaal migratieachtergrond

**Perioden:** 2021/'22*

| | | | Onderwijssoort Geslacht | | |
|---|---|---|---|---|---|
| Onderwerp | | | Wetenschappelijk onderwijs | | |
| Studierichting ISCED 2013 | | | Totaal mannen en vrouwen | Mannen | Vrouwen |
| Totaal ingeschrevenen | Totaal | aantal | 344 721 | 160 086 | 184 635 |
| | 01 Onderwijs | aantal | 10 610 | 1 578 | 9 032 |
| | 02 Vormgeving, kunst, talen en gesch... | aantal | 25 541 | 10 105 | 15 436 |
| | 03 Journalistiek, gedrag en maatschappij | aantal | 77 231 | 25 007 | 52 224 |
| | 04 Recht, administratie, handel en za... | aantal | 96 508 | 50 129 | 46 379 |
| | 05 Wiskunde, natuurwetenschappen | aantal | 39 356 | 20 395 | 18 961 |
| | 06 Informatica | aantal | 16 981 | 12 775 | 4 206 |
| | 07 Techniek, industrie en bouwkunde | aantal | 37 396 | 26 497 | 10 899 |
| | 08 Landbouw, diergeneeskunde en -verz... | aantal | 4 297 | 1 538 | 2 759 |
| | 09 Gezondheidszorg en welzijn | aantal | 33 878 | 10 502 | 23 376 |
| | 10 Dienstverlening | aantal | 2 511 | 1 378 | 1 133 |
| | Onderwijsrichting onbekend | aantal | 412 | 182 | 230 |

*Figure 3: Field of study at university in 2021-2022 (CBS, 2022)*

**Hoger onderwijs; eerste/ouderejaarsstudenten, richting 2010/'11-2021/'22**

: Gewijzigd op: 22 april 2022

**Migratieachtergrond:** Totaal migratieachtergrond

**Perioden:** 2010/'11

| | | | Onderwijssoort Geslacht | | |
|---|---|---|---|---|---|
| Onderwerp | | | Wetenschappelijk onderwijs | | |
| Studierichting ISCED 2013 | | | Totaal mannen en vrouwen | Mannen | Vrouwen |
| Totaal ingeschrevenen | Totaal | aantal | 242 381 | 117 337 | 125 020 |
| | 01 Onderwijs | aantal | 9 378 | 1 329 | 8 049 |
| | 02 Vormgeving, kunst, talen en gesch... | aantal | 24 340 | 9 531 | 14 807 |
| | 03 Journalistiek, gedrag en maatschappij | aantal | 52 124 | 18 624 | 33 497 |
| | 04 Recht, administratie, handel en za... | aantal | 74 454 | 41 047 | 33 393 |
| | 05 Wiskunde, natuurwetenschappen | aantal | 20 739 | 12 155 | 8 584 |
| | 06 Informatica | aantal | 4 648 | 4 044 | 602 |
| | 07 Techniek, industrie en bouwkunde | aantal | 24 304 | 19 234 | 5 070 |
| | 08 Landbouw, diergeneeskunde en -verz... | aantal | 2 871 | 920 | 1 951 |
| | 09 Gezondheidszorg en welzijn | aantal | 28 443 | 9 834 | 18 606 |
| | 10 Dienstverlening | aantal | 596 | 338 | 258 |
| | Onderwijsrichting onbekend | aantal | 484 | 281 | 203 |

*Figure 4: Field of study at university in 2010-2011 (CBS, 2022)*

### 2.2.2 U-Talent

U-Talent is a partnership between Utrecht University, Utrecht University of Applied Sciences and fifty partner schools in secondary education in the Utrecht region. U-Talent builds a bridge between secondary and higher education. They organize activities for students and teachers, with the aim of contributing to an increase in the quality of education and a good connection with higher education. At U-Talent, havo and vwo students get the chance to develop their talents. U-Talent consist out of several project teams. One of those teams is the STEM project office. They are part of the Freudenthal Institute and the Faculty of Science. They are responsible for the projects University Pioneers and GirlsClub WIN.

GirlsClub WIN is an initiative for girls in the second year of vwo who find math, computer science and physics interesting. During this project U-Talent organized fun meetings with interesting topics from mathematics, computer science and physics. Together as a group of girls they will work on these topics and meet students and scientists in mathematics, computer science and physics. In total you will come to Utrecht University five times. Twice in 2vwo and three times in 3vwo. For example, you will go programming, perform experiments and do fun games with math, computer science and physics. The Dutch manual and English description of each meeting can be found in Appendix C.

GirlsClub WIN was founded by U-Talent in collaboration with the Departments of Computer Science, Physics and Mathematics, with the goal of encouraging more girls to choose studies and careers in mathematics, computer science and physics.

# 3. Methodology

## 3.1 Research strategy

This study uses a mixed-method approach with a combination of observations, questionnaires and interviews to get insight in the experience of the students. Zohrabi (2013) emphasized that using different types of procedures for collecting data and obtaining that information through different sources can augment the validity and reliability of the data and their interpretation.

A pre- and post-test is taken of the students at the beginning of the first meeting and at the end of the last meeting. The test contains several statements about the interest in the school subjects STEM, the opinion and use of STEM and the program itself. Also, it contains questions about their experiences and personal information. The answers of the questionnaires will give an overview of the group to answer the research question and specifically the second sub question "*What is the added value of the project for the STEM subjects compared to the regular school subjects?".* The interview is used to get a better understanding of the reasoning behind the answers of the tests. The interview especially helps to understand why these students made certain career related choices to figure out the role of the program to answer the third sub question *"How does the GirlsClub WIN have an influence on the related career choices in upper secondary school?".* The observations of the behaviour of the group mostly help answer the first sub question *"How can the GirlsClub WIN contribute to the sense of belonging of girls in STEM fields?".*

## 3.2 Setting

The GirlsClub WIN days took place five times over the past year at Utrecht University. The content and structure of the WIN-days are designed by a team form U-talent at Utrecht University led by Marjolein Gelauff. The first day was in April 2023 and was an introduction about all three subjects: mathematics, computer science and physics. The following three days were all different combined pairs. Each day had its own theme. The fifth and last day was in February 2024, just before they chose their definitive subject combination for next school year. This was a concluding day about all subjects.

## 3.3 Participants

The participants are thirty girls between the ages of thirteen and fifteen. These girls are in their second year of secondary education when the program starts and will be in the third year when it ends. Schools connected with the U-talent program of Utrecht University can enrol students, with a maximum of three students per school. A maximum per school has

been set to prevent groups are already formed instead one new group of all the participants. The thirty students come from fifteen different school around Utrecht. The students indicate to the school if they want to participate, the project is voluntary. There are a few criteria:

- Student must be in the second year of pre-University secondary education
- Student must be interested in physics, computer science and mathematics
- Student must be able to come to Utrecht University and miss five days of school
- The parents of the student support the student during the project
- Student agrees to follow the entire project

Students should have an interest or curiosity in STEM. They do not need to be “good” at it, there is no grade limit. Consequently, our sample consists of girls who are interested in extracurricular STEM activities and volunteered to join the intervention. The program is quite an investment of time for the participants, and only interested students will be able to successfully complete it.

## 3.4 Method 1: observations

To answer the research questions, we used several kinds of methods. In figure 5 a timeline is presented with the moments of the five meetings and use of the methods.

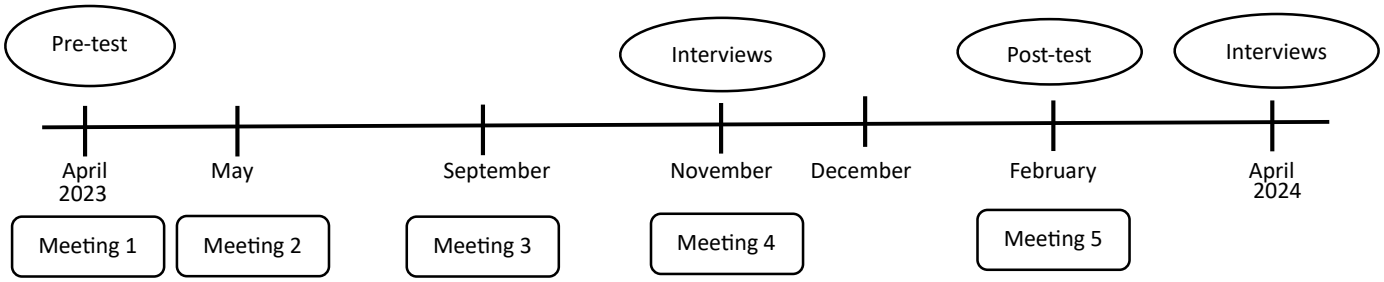


*Figure 5: Timeline GirlsClub program and methods*

### 3.4.1 Instrument

The first method is observation. We observed meeting 3, 4 and 5 of this schoolyear. We observed the overall ambiance during the meetings and the students' reactions to different activities during the GirlsClub. Each activity has its own learning goal and hypothesis based on the literature and guidelines of GEM (Appendix D). In table 1, 2 and 3 the Hypothetical Learning Trajectories (HLT) of the third, fourth and fifth meeting are presented.

*Table 1: HLT meeting 3*

| Activity | Hypothesis | Underpinning |
|---|---|---|
| 30 seconds with mathematical terms | Students form new groups and learn about how to communicate. | GEM guideline: "Allow time for group building especially if girls come from different schools." |
| "Girl of the day": Jasmijn den Hollander (Mathematic student) | Students get a better understanding of what it is like to be a student at Utrecht University. | GEM guideline: "Consider small breaks for girls to unofficially talk to mentors and representants." |
| Presentation dimensions | Students get a better understanding about dimensions. There is already some recognition in the subject. | GEM guideline: "Do include female lecturers but take care to not make it seem like something outstanding, more that it is/should be common, that woman work in those fields." |
| Experiments dimensions | Students get enthusiastic to try the experiments for themselves. They discover new concepts and are able to experiment with it. | GEM guideline: "Create inquiry-based activities during which girls can do science, explore and be creative in contexts." |
| Tic-tac-toe in 3D | Students are competitive and trying to win tic-tac-toe. | |

*Table 2: HLT meeting 4*

| Activity | Hypothesis | Underpinning |
|---|---|---|
| Memory with female scientists | Students realise there are many female scientists. | GEM guideline: "Include female role models" |
| "Girl of the day": Hilde Jongeling (Tech company) | Students learn how others use their STEM skills in the work they do. | GEM guideline: "Invite girls and women to talk about the kind of work they do and how they use STEM skills" |
| Tour in Lilli's protolab | Students learn about the technologies behind the 3D printing. | |
| Drawing and making patterns | Students can be creative to create their own original patterns. | GEM guideline: "Create inquiry-based activities during which girls can do science, explore and be creative in contexts." |
| Programming their logo in 3D | Students have their first encounter with programming. Students will follow the steps to design the logo. | |

*Table 3: HLT meeting 5*

| Activity | Hypothesis | Underpinning |
|---|---|---|
| "Girl of the day": PhD'er Franka Jesse | Students learn about what kind of choices they have to make the coming years. Students learn about the possibilities of doing research in a social challenge. | GEM guideline:<br>"Include female role models, invite girls and women to talk about the kind of work they do and how they use STEM skills"<br><br>NCR (2023)<br>"Girls are looking for a social challenge and wider application of STEM education" |
| Bingo at the Mathematic library, motion lab and physics lab. | The bingo helps students to ask questions and listen to what is said. Students learn about different work environments. | GEM guideline:<br>"Emphasize social aspects, be part of a community." |
| Summary meetings | Students look back at past meetings to overview all the things they learned. Students have feeling of recognitions. | GEM guideline:<br>"Prepare final session for exchanging findings or an exhibition of results." |
| Certificate Ceremony | Students conclude the project together as a group. There is a strong group feeling. | |

### 3.4.2 Analysis

During the observation, we checked if the hypotheses in the HLT were achieved. We use quotes from students to underpin our conclusion with each hypothesis. Also, their general behaviour can help validate the hypotheses. We present the results as an observation in the HLT.

## 3.5 Method 2: questionnaire

### 3.5.1 Participants

The students (N=30) filled in a pre-test at the start during the first meeting and at the end they filled in the post-test of the project after the fifth meeting (N=26). Four students were not present at the final fifth meeting.

### 3.5.2 Instruments

Appendix A and B presents all the pre- and post-test questions. The test contains several statements about the interest in the school subjects STEM, the opinion and use of STEM and the program itself. Also, it contains questions about their experiences and personal information.

### 3.5.3 Analysis

All closed statements are measured on a 5-point Likert scale (1= strongly disagree, 2= disagree, 3= neither, 4=agree and 5=strongly agree). The pre-test and post-test consists out of thirteen corresponding closed statements about the knowledge, interest, and self-efficacy of the students in STEM subjects. This question will be compared based on their average groups scores per statement. Also, we looked at each individual student if their post-score increased, decreased or stayed the same in comparison with their answer in the pre-test. In the pre-test the students had an additional eight questions (Appendix A, Q12_2 till Q12_9) about their opinion of STEM subjects and its value in life. With these questions we hope to get a better understanding of the views of the participants. In the post-test the students answered seventeen more questions about the program. These questions help us to improve the program (Appendix B, Q26_1 till Q26_9), get a better understanding of how they experienced the GirlsClub as a community and in comparison to school (Appendix B, Q16_1 and Q16_2, Q10_13 till 10_17). Additionally open-ended questions were asked to let students elaborate on their answers.

## 3.6 Method 3: Interview

### 3.6.1 Participants

In total thirty students participated in this program. Of those students, five students were interviewed twice. The parents of those students signed a permission form. Only five students were willing to do the interview, so there has not been any selection. The five female students are all fourteen when interviewed. They come from different secondary schools near Utrecht. Due to privacy the students are anonymized and the school are not named.  Information about how the collected data can be accessed is in Appendix F.

*Table 4: Description interviewees*

| | Preliminary subject combination | Finale subject combination | Subjects | Career ideas |
|---|---|---|---|---|
| **Student 1** | NG | NG | Biology, science, Maths A, Geography, Latin | Doctor |
| **Student 2** | EM or NG | NG | Geography, Biology, Science, Maths A, Economics | Teacher |
| **Student 3** | NT | EM | History, Economics, Maths B, Maths D, Business economics | Accountant |
| **Student 4** | NT or EM | NG/NT | Biology, Science, Maths B, Physics, Arts, History | Architect |
| **Student 5** | NG or NT | NT | Maths B, Physics, Science, Biology, Geography | "Something with science" |

### 3.6.2 Instrument

All interviews were conducted in a small focus group of two or three students. They are young girls, interviewing in a focus group will make them feel more comfortable. They can react on each other and compare their thoughts. In this way the young students felt more save and were able to discuss differences between their schools and education. It is a semi-structured interview, so we can be flexible with where the conversation will bring us but still get the answers on the questions. In Appendix E the interview schemes with questions are presented. The first round of interviews were in November. The goal of this interview is to create a clearer idea of why the students participate in this program and what their interests in STEM are. Also, we can get an idea about what kind of subject combinations they have in mind. The second interview was in April a few months after the program is finished. In this interview we look back at the program and discuss the final subject combinations they have chosen.

### 3.6.3 Analysis

The interview helps to understand the results of the questionnaire. Also, we use the interview to form two case studies. Two of the five students are selected for a case study. We select those students based on the change in the three most important categories: interest in STEM, chosen subject combinations and the sense of belonging in this group. For the variable interest we use the average score of the statements *"I like mathematics," "I like*

*physics"* and *"I like computer science*" to indicate the interest in STEM. For the variable sense of belonging, we compare the scores of the statements "*I experienced a positive feeling of belonging during the GirlsClub WIN"* and "*I experience a positive feeling of belonging in class at school".* Based on the three variables student 3 and student 5 are selected. Student 3 changed her subject combinations from science to economics. She showed for the variable interest a significant decrease and also the sense of belonging was significant different. In contrast, student 5 choose the subject combination science and technology and scored the same sense of belonging. However, this student showed an increase in interest in STEM. The other students were in line with student 3 and 5 and therefor left out of the case study.

# 4. Results

In this section the results of each method are given. The observations are linked to the hypothesis of each activity. For the questionnaire, the most important results are given and analysed. With two case studies the results from the interviews are organized. These three types of results are used to answer the research questions in the conclusion.

## 4.1 Observations

*Table 5: HLT with observation meeting 3*

| Activity | Hypothesis | Observation |
|---|---|---|
| 30 seconds with mathematical terms | Students form new groups and learn about how to communicate. | Students sit with someone they recognise from earlier meetings. |
| "Girl of the day": Jasmijn den Hollander (Mathematic student) | Students get a better understanding of what it is like to be a student at Utrecht University. | The students are surprised about the dwindling number of classes in comparison with secondary school. They are realising the big different between secondary school and university. They also liked to know more about the life of a college student. |
| Presentation dimensions | Students get a better understanding about dimensions. There is already some recognition in the subject. | Students understand concept of dimensions quickly. However, dimensions in atoms is too difficult to get a grasp. |
| Experiments dimensions | Students get enthusiastic to try the experiments for themselves. They discover new concepts and are able to experiment with it. | The students were excited to get started. They wanted to try everything. Often the students are curious about what the goal of the experiment is: "Why do we need to do this?". Most students were too excited to read the instructions and first tried the experiments for themselves. Students needed to be challenged or they will get bored. All students wanted to be involved in the group to try things out. The feedback from the students showed the students had fun with all the experiments and liked to try thing themselves. |
| Tic-tac-toe in 3D | Students are competitive and trying to win tic-tac-toe. | Some students are extremely competitive and start a competition. They even think about more ways to make the game even more complicated. Some students do not really understand the 3D aspect and stop playing quickly. |

*Table 6: HLT with observation meeting 4*

| Activity | Hypothesis | Observation |
|---|---|---|
| Memory with female scientists | Students realise there are many female scientists. | Students were busier with catching up then playing the game. |
| "Girl of the day": Hilde Jongeling (Tech company) | Students learn how others use their STEM skills in the work they do. | Students ask a lot of questions about how Hilde uses maps to visualize data. Indication that they were intrigued about how this analysing tool works. |
| Tour in Lilli's protolab | Students learn about the technologies behind the 3D printing. | In the protolab students were eager to touch things and try it out for themselves, it was hard to only listen. They did like to see the lab to get an idea about how their logo will be 3D-printed. "This is something you can't do at school!" |
| Drawing and making patterns | Students can be creative to create their own original patterns. | Students were creative with making all kinds of patterns. |
| Programming their logo in 3D | Students have their first encounter with programming. Students will follow the steps to design the logo. | Students indicated they wanted more time to program to really refine and improve their design. Most students liked the programming to figure things out for themselves, some found the other activities to be too much listening. There was a worksheet they can follow to program the logo, but students rather figure it out for themselves. Students were creative and could make a more simple or difficult version of the logo. |

*Table 7: HLT with observation meeting 5*

| Activity | Hypothesis | Observation |
|---|---|---|
| "Girl of the day": PhD'er Franka Jesse | Students learn about what kind of choices they have to make the coming years. Students learn about the possibilities of doing research in a social challenge. | Students realise the important choices they have to make. They whisper about what kind of choices they consider. Students were interested in the research Franka is doing now about the effect of the melting Antarctica. |
| Bingo at the Mathematic library, motion lab and physics lab. | The bingo helps students to ask questions and listen to what is said. Students learn about different work environments. | I observed the students being more comfortable with each other and the teachers to ask questions and make a conversation. At the mathematics library the students liked that there is a place the mathematicians can come together. At the physics lab they really listed to these terms to play the game bingo. |

| | | |
|---|---|---|
| Summary meetings | Students look back at past meetings to overview all the things they learned. Students have feeling of recognitions. | It is noisy in the room of the student's reaction about all the things they have done and experienced during the GirlsClub. |
| Certificate Ceremony | Students conclude the project together as a group. There is a strong group feeling. | Students were sad this was the last meeting and the last time they will see each other again. |

## 4.2 Questionnaire

Information about the data collection and results is explained in Appendix F. In table 8 the common statements in the pre- and post-test are compared. The number of students who answered the pre-test as well as the post-test differ per question. Also, a lot of students do not have the school subject's computer science and physics at their secondary school. Therefore, they could not answer each statement.

*Table 8: Statements averages pre- post-test on 5-points scale*

| **Statement** | **Average score pre-test** | **Average score post-test** | **Change in %** |
|---|---|---|---|
| I know what the school subject of mathematics entails (N=26) | 4,200 | 4,500 | 7,14% |
| I know what the school subject computer science entails (N=25) | 2,667 | 3,154 | 18,27% |
| I know what the school subject physics entails (N=26) | 4,167 | 4,423 | 6,15% |
| I know what kind of jobs you can have as a mathematician (N=25) | 2,900 | 3,346 | 15,38% |
| I know what kind of jobs you can have as a computer scientist (N=24) | 2,467 | 3,269 | 32,54% |
| I know what kind of jobs you can have as a physicist (N=23) | 3,267 | 3,577 | 9,50% |
| I like mathematics (N=24) | 4,133 | 4,115 | -0,43% |
| I like computer science (N=10) | 3,167 | 3,385 | 6,88% |
| I like physics (N=24) | 3,966 | 3,731 | -5,92% |
| I am good at mathematics (N=25) | 4,133 | 4,038 | -2,30% |
| I am good at computer science (N=9) | 3,455 | 3,231 | -6,48% |
| I am good at physics (N=23) | 3,931 | 3,731 | -5,09% |
| Science subjects are easy for me (N=25) | 3,867 | 3,846 | -0,53% |

In table 9 we took a look at the personal differences between the pre- and post-test for each student. For each statement, the number of students with an increased or decreased score in comparison with the pre-test is noted.

*Table 9: Statements pre- post-test individual comparison*

| **Statement** | **Increase in personal score** | **Decrease in personal score** | **Same personal score** |
|---|---|---|---|
| I know what the school subject of mathematics entails (N=26) | 9 | 4 | 13 |
| I know what the school subject computer science entails (N=25) | 13 | 6 | 6 |
| I know what the school subject physics entails (N=26) | 7 | 2 | 17 |
| I know what kind of jobs you can have as a mathematician (N=25) | 12 | 5 | 8 |
| I know what kind of jobs you can have as a computer scientist (N=24) | 15 | 5 | 4 |
| I know what kind of jobs you can have as a physicist (N=23) | 8 | 5 | 10 |
| I like mathematics (N=24) | 6 | 8 | 10 |
| I like computer science **(**N=10) | 4 | 3 | 3 |
| I like physics (N=24) | 3 | 9 | 12 |
| I am good at mathematics (N=25) | 4 | 9 | 12 |
| I am good at computer science (N=9) | 2 | 2 | 5 |
| I am good at physics **(**N=23) | 4 | 6 | 13 |
| Science subjects are easy for me (N=25) | 6 | 5 | 14 |

First of all, there is a substantial increase in all the statements about knowing what the school subject entails. Especially computer science with an increase of 18.25% and 13 out of 25 students showing an increase. But also, the other school subject mathematics and physics showed a significant increase. There is an outlier in the statement *"I know what the school subject of mathematics entails,"* a student had an increase of their personal score from 1 to 5 which distorts the percentage change. In the statement "*I know what the school subject computer science entails*" the students who do not have computer science at their secondary school had a larger increase in personal score on average than the students with computer science.

Another substantial increase is shown at the statements about knowing what kind of jobs you can have as a mathematician, computer scientist and physicist. Once again the largest increase is with computer science. There are two outliers one students score increased from 2 to 5 for the statement "*I know what kind of jobs you can have as a mathematician"* and for another student for the statement "*I know what kind of jobs you can have as a computer scientist*" the same shift. This influences the average percentage change but *table 9* still showed that 12 out of 25 now know better what kind of jobs there are for a mathematician, 15 out of 24 now know better what kind of jobs there are for a computer scientist and 8 out of 23 for a physicist. In *table 8* the statements "*I am good at mathematics*" and "*I am good at*

*physics*" scored a significant decrease in the post-test score in comparison to the pre-test score. Only four students showed an increase in personal score while 9 students showed a decrease in personal score. Half of the group answered there was no change in how good there are in mathematics and physics after the project. We see the same trend for the subject computer science but only 9 students could answer these statements.

In figure 6 the preliminary and finale subject combination have been displayed. There are still five students who did not know which subject combination to choose at the end of the GirlsClub project. Majority of the students (24 out of 30 students) chose a science subject combination.

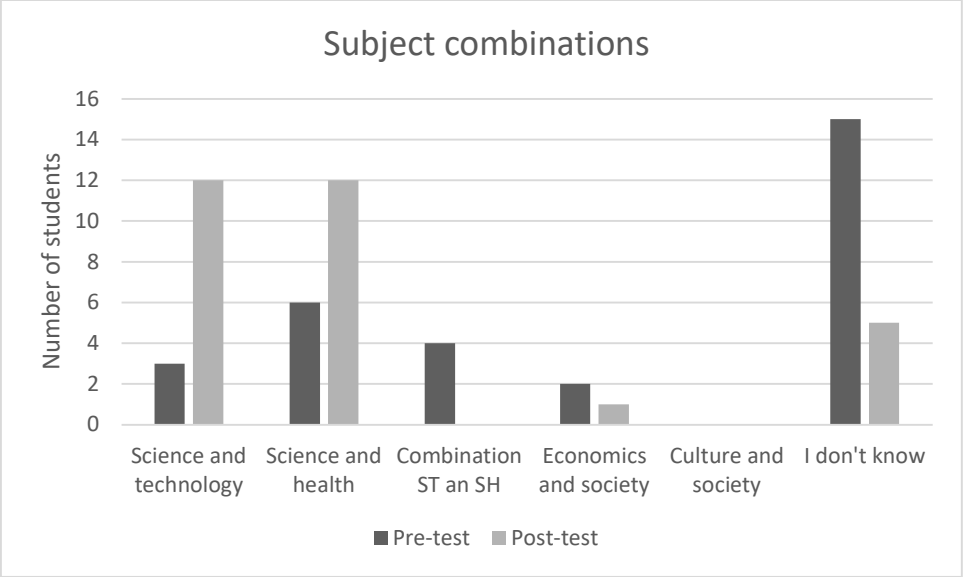


*Figure 6 : Subject combination pre-test versus post-test*

Then there are 13 out of 26 students who indicated the GirlsClub influenced their subject combination decision. Out of those thirteen students, three students indicated that the GirlsClub was the most crucial factor.

In table 10 and 11 we take a look at the sense of belonging. We asked the students if they experience a positive feeling of belonging at school and at the GirlsClub. The average score of the positive feeling of belonging at the GirlsClub is 5,72% higher at the average score at school. If we take a look at the personal scores 7 out of 26 students felt a more cohesive sense of belonging at GirlsClub than at school and 17 out of 26 did not feel a difference.

*Table 10: Statements averages pre- post-test on 5-points scale*

| **Statement (N=26)** | **Average score post-test** | **Change in %.** |
|---|---|---|
| I experience a positive feeling of belonging during the GirlsClub WIN | 4,269 | + 5,72% |
| I experience a positive feeling of belonging in class at school | 4,038 | |

*Table 11: Statement sense of belonging pre- post-test individual*

| Statement (N=26) | More positive at GirlsClub | Less positive at GirlsClub | The same feeling |
|---|---|---|---|
| The feeling of belonging during the GirlsClub WIN in comparison to at school. | 7 | 2 | 17 |

Last but not least, all students indicated they would recommend participating in the GirlsClub project.

## 4.3 Interview

In two case studies we follow the journey of two students during the project. Further information about the data collection and data excess is explained in Appendix F.

### 4.3.1 Case study student 3

Student 3 entered the GirlsClub project after a recommendation of her science teacher. She always has been interested in science and mathematics and is thinking about studying something which connects to this. "*Mathematics is something I just understand, I like all the problem solving." "Physics is something I am not really interested in, but I think that is because of my teacher".*

When applying she was curious about which other students would go with her because it is a bit scary to go alone. But even if she did not know anyone she would have still applied to the project. On the first day of the meeting, she is hesitant to make new friends and asking questions. During the several meetings we noticed that she became more open. She goes up to other participants and is not scared to be seen. Especially at the last meeting, she asked a lot of questions to all the teachers to play the game bingo. She is the first to put her hand up if we need volunteers for an experiment.

She is not used to be in a group with only girls. In her class at school there are six girls in total of twenty-nine. *"At school there is no other girl with the same interest as me,"* so it is refreshing to be in another surrounding with all girls who also like science and math. *"I think if there would be boys, the group would be divided into two."*.

At the beginning student 3 had in interest in many subjects, especially mathematics, science, and economics. She would like to have a broad subject combination so she can do various studies. *"I am scared to make a wrong choice; it feels like so much depends on it that I like to do it all"*. In the end she made the decision to choose the subject combination E&M. The most important subjects were mathematics B and D. The GirlsClub helped her confirm that mathematics is the thing she likes most and is something she would like to do in the future.

She is now thinking about becoming an accountant. She does not think she will need the other STEM subjects as Physics and Science. She now knows better what the subjects entail but this has not convinced her. If she had the choice she would love to have chosen computer science, but this is not an option at her secondary school. The meeting about programming and patrons was her favourite one, especially the combination of computer science and mathematics.

She would recommend others to follow the GirlsClub. It is a safe and lovely place to make friends and experiment with new subjects. She is still in contact with several other students of the GirlsClub and hopes to see some again.

### 4.3.2 Case study student 5

Student 5 was immediately excited about the GirlsClub. Her mother spoke to a physics teacher and told her great stories about it. *"I am eager to learn new things about mathematics and physics".* This eagerness was visible during the meetings. Often she asked intriguing questions to the teachers which made it clear that she was here to learn.

She liked the group a lot and found it peaceful there were only girls*, "Boys just want to be funny and don't take things serious*." She also said: *"I like to be with girls who all have chosen voluntary to be here*." This makes it a pleasant atmosphere to learn new things. Even though student 5 can talk to everyone, she has not made new friends. She is not in contact with any of the girls after the GirlsClub finished. During the meetings she was busier with the assignment itself than with making chatting and making friends. She rather does an assignment by herself so she can try to find the solution with her own knowledge. The goal for student 5 is to learn new things instead of making friends.

The school subject computer science was new for student 5. *"I liked to learn about a completely new subject, but I still like physics and science more".* She even likes physics more than before. Although she does not think she is better at the subject. The topics discussed during the meetings were different than at school. This made it fun to learn something new, but you did not have the chance to use this new knowledge at school or the other way around.

At the beginning of GirlsClub student 5 mainly was interested in Physics and Science. So, the subject combination N&G or N&T was always her plan and were also her final decision. She choose mathematics B because at some physics and science studies this is required. At her secondary school it is obligated to choose biology when choosing this subject combination. The GirlsClub confirmed her interest in STEM and made it easy to make the decision for her subject combination. She still does not know what she specifically wants to study but the "Girl of the day" showed her there are many options.

# 5. Conclusion

Based on the results of the observations, questionnaires and interviews, we will answer the research question: *"How do the participating female students experience the extra-curricular project "GirlsClub WIN" with regards to their interest in STEM subjects?"*
In order to answer the research question, we will answer the sub-questions.

## 5.1 Sub-question 1

*How does the GirlsClub WIN contribute to the sense of belonging for girls in STEM fields?*

The GirlsClub creates a small community of students with the same gender and similar interests. Students indicate the importance of being with like-minded peers. For some, it is the first time they have been with so many girls who share their interests. Observations show that the group feels unified. During the meetings, the ambiance improved and the students became comfortable with each other. The students scored the positive feeling of belonging 5,72% higher at the GirlsClub than at school in the post-test. Only two out of 26 students felt a higher sense of belonging at school compared to the GirlsClub, despite meeting only five times over the past year versus daily at school.

During the GirlsClub the students met several female science teachers and women who work in STEM. The "Girl of the day" presented a counter-stereotypical image. Students felt they could also belong in the STEM sector. They especially liked seeing different kind of people working in STEM. The fact that only women participated in this project was not the most important aspect; they valued seeing a representative population, ensuring there is always someone they relate to. The "Girl of the day" showcased different STEM studies and careers, exciting students about the possibilities in STEM.

## 5.2 Sub-question 2

*What is the added value of the project for the STEM subjects compared to the regular school subjects?*

The questionnaire and the interviews indicated that the students liked having more room for group work. There is also more space to try things out for yourself opposed to the traditional explanation-first approach of the current school system. Since assignments at GirlsClub are not graded and have no deadlines, creativity is promoted. Students felt motivated to think outside the box because it was acceptable to make mistakes and try again. For nearly all participating students, computer science was a completely new subject. They enjoyed getting to know a new subject and learning about innovating technologies such as programming and 3D printing. The GirlsClub is a cross-disciplinary project where students learn to see connections between the subject mathematics, physics and computer science. The

questionnaire showed a significant increase in the students' understanding of what the subject entails. This understanding raises awareness of STEM possibilities.

### 5.3 Sub-question 3

*How does the GirlsClub WIN have an influence on the related career choices in upper secondary school?*

Up to 80 % of the students chose a science subject combination. This is significantly more than the national average. The GirlsClub helped 13 of 26 students with making their decision for their final subject combination. Of these 13 students, three students indicated that the GirlsClub played the most significant role in this choice. Some students stated that GirlsClub confirmed their interest in STEM, while others developed a greater interest in STEM due to the project. There was a significant increase in the average score on the statement "I know what kind of jobs you can have as …". Students gained a better understanding of the job possibilities with STEM subjects, making them more comfortable choosing a science subject combination.

With these answers to the sub-questions, we can address the research question.

### 5.4 Research question

*How do the participating female students experience the extra-curricular project "GirlsClub WIN" with regards to their interest in STEM subjects?*

The participating female students experienced an increased sense of belonging in the STEM sector, which promotes their interest in STEM. They have a better understanding of the STEM subjects, studies and career possibilities, which increased their interest. As a result, the majority of the participating female students chose a science subject combination. This indicates a desire to pursue careers in the STEM sector.

We can conclude that the GirlsClub WIN had a positive effect on the interest in STEM of young female students. This shows how extra-curricular projects can make a substantial difference, helping to break the barrier and create a more inclusive future in STEM.

# 6. Discussion

## 6.1 Limitations

My findings are largely consistent with the literature mentioned in the theoretical background in chapter 2. This research also confirmed Vulerhorst's statement (2018) that a project focusing on cross-disciplinary education can positively influence the interest. Other variables which influences the interest according to Dökme (2022) such as "having participated in STEM activities" or "having a role model working in a STEM field" are also points our participating students mentioned. Stinger et al. (2020) stated that "Girls who participate in STEM extracurricular activities have a stronger STEM career identity". Our participating girls did indeed have a stronger STEM career identity resulting in choosing a science subject combination for most of them. However, gender roles are getting less important than the literature suggests. One of the reasons can be the diverse definitions of gender. Students seek for recognition in different role models. The stereotype might already be changing if we look at the typical teacher nowadays. The main point is these girls are seeking for a goal or purpose instead of having a female representative.

There were a few defects or things I would do differently in my research. First of all, I joined this program at the third meeting, thus there are no observations from the first two meetings. I have chosen to keep this out of the equation because it did not affect the research question. The knowledge I gained of those first meetings from the organization gave enough information to do the interview and understand the context. Secondly, this is only a small test group of participants and not every meeting group was complete. Also, not every question of the pre- and post-test was answered by everyone. Especially the questions about computer science, since this was a new subject for most students, they could not really answer the pre-test questions about this topic. Comparing scores of the pre- and post-test questions was therefor difficult to do. The focus was on qualitative research instead of quantitative. Therefor I choose not to use statistics with the questionnaire. With a larger and more constant group of participants, this would have been a valuable addition to my research.

## 6.2 Recommendations

After following, observing and analysing this GirlsClub project, I have some recommendations and implementations for secondary schools, new GirlsClub project editions and future research.

### 6.2.1 To secondary educations

There are many aspects of the GirlsClub which we can easily implement at secondary school. One of the positive aspects of the GirlsClub is the self-explorative group exercises. The self-explorative exercises can be a way for students to learn a new subject instead of the usual general explanation. Working in groups with people with the same interest helps students find connections and create a feeling of belonging. A teacher can stimulate making groups based on various aspects. Additionally, the participant emphasizes the importance of understanding the practical applications of STEM subject. The GirlsClub also focuses on combining subjects and showing the students how the subjects connects with each other. In secondary school, we could make this more of a priority. For example, by organizing cross-disciplinary activities or courses. It can also be something small, like taking the time in class to come up with a cross-disciplinary example.

### 6.2.2 To the GirlsClub project

It is in the name the GirlsClub project, because it is especially designed for girls. My research has shown that the students liked being surrounded with people with the same interest and mentality. This does not necessarily have to be girls. Same for the “Girl of the day”, it is nice to hear a girl talk about her career in STEM. But it would be valuable if the “Girls of the day” is a representation of the whole population, men and women from divers origins. The question is, what is the goal of the project? If the goal is to have more females working in STEM in the future, it should be a project for girls. If the goal is to make young students excited for STEM we might have to change the concept. Overall, there should be a place where they feel like they belong. To create a safe environment where they can express themselves and learn more about STEM

### 6.2.3 To future research

This research is conducted only over the period of one year. The subject combinations the students chose, are only an indication of what they might be interested in studying and working at in the future. If we really want to know if these girls end up working in STEM, we should follow them over a longer period of time. This will help us pinpoint when most students leave the STEM pathway, allowing us to better address the challenges and support their continued interest and success in STEM.

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# Appendices

## Appendix A: Pre-test questions

| Question number | Question type | Question pre-test |
|---|---|---|
| Q1 | OPEN | Wat is je voor- en achternaam? |
| Q2 | OPEN | Op welke school zit je? |
| Q3 | MULTI | In welke klas zit je? |
| Q3_3 | OPEN | anders, namelijk: |
| Q5 | MULTI | Ik volg de volgende bètavakken op school: |
| Q5_8 | OPEN | Anders, namelijk: |
| Q6 | OPEN | Weet je al welk profiel je gaat kiezen in de bovenbouw? |
| Q6_6 | OPEN | Ik twijfel nog tussen: |
| Q7 | OPEN | Waarom kies je voor dit profiel, of waarom twijfel je nog of weet je het nog niet? |
| Q8_1 | 5PUNTS | Stelling: Ik weet wat het schoolvak wiskunde inhoudt |
| Q8_2 | 5PUNTS | Stelling: - Ik weet wat het schoolvak informatica inhoudt |
| Q8_3 | 5PUNTS | Stelling: - Ik weet wat het schoolvak natuurkunde inhoudt |
| Q9_1 | 5PUNTS | Stelling: - Ik weet wat voor soort banen je kan hebben als wiskundige |
| Q9_2 | 5PUNTS | Stelling: - Ik weet wat voor soort banen je kan hebben als informaticus |
| Q9_3 | 5PUNTS | Stelling: - Ik weet wat voor soort banen je kan hebben als natuurkundige |
| Q10_1 | 5PUNTS | Stelling: - Ik vind wiskunde leuk |
| Q10_2 | 5PUNTS | Stelling: - Ik vind informatica leuk |
| Q10_3 | 5PUNTS | Stelling: - Ik vind natuurkunde leuk |
| Q11_1 | 5PUNTS | Stelling: - Ik ben goed in wiskunde |
| Q11_2 | 5PUNTS | Stelling: - Ik ben goed in informatica |
| Q11_3 | 5PUNTS | Stelling: - Ik ben goed in natuurkunde |
| Q12_1 | 5PUNTS | Stelling: - Bètavakken zijn gemakkelijk voor mij (wiskunde, natuurkunde, informatica, biologie en scheikunde) |
| Q12_2 | 5PUNTS | Stelling: - Ik ben geïnteresseerd in het leren over bètavakken |
| Q12_3 | 5PUNTS | Stelling: - Ik vind technische vakken meer iets voor jongens dan voor meisjes |
| Q12_4 | 5PUNTS | Stelling: - Ik wil alleen iets gaan studeren wat anderen (ook) bij mij vinden passen |
| Q12_5 | 5PUNTS | Stelling: - Het is de moeite waard om me in te spannen voor mijn betavak(ken), want dat helpt mij bij het werk wat ik later wil doen |
| Q12_6 | 5PUNTS | Stelling: - Wat ik leer in mijn bètavak(ken) is voor mij de moeite waard, omdat ik het nodig heb voor wat ik later wil gaan studeren |
| Q12_7 | 5PUNTS | Stelling: - Het is belangrijk om bèta te kennen om een goede baan te krijgen |
| Q12_8 | 5PUNTS | Stelling: - Bètavakken zijn nuttig bij het helpen oplossen van problemen in het dagelijkse leven |
| Q12_9 | 5PUNTS | Stelling: - Bètavakken zijn nuttig om de wereld van vandaag te begrijpen |
| Q13 | MULTI | Ik doe mee met de GirlsClub WIN, - Selected Choice |
| Q13_9 | OPEN | Ik doe mee met de GirlsClub WIN, - anders, namelijk: - tekst |
| Q14 | MULTI | Heb je al eerder een activiteit bij U-Talent gevolgd? - Selected Choice |
| Q14_1 | OPEN | Heb je al eerder een activiteit bij U-Talent gevolgd? - Ja, namelijk: - tekst |

## Appendix B: Post-test questions

| Question number | Question type | Question Posttest |
|---|---|---|
| Q1 | OPEN | Wat is je voor- en achternaam? |
| Q2 | OPEN | School |
| Q3 | MULTI | Niveau (vink aan wat op jou van toepassing is) |
| Q3_3 | OPEN | Anders, namelijk |
| Q4 | MULTI | Ik heb gekozen voor het profiel... (meerdere opties mogelijk) |
| Q5 | OPEN | Waarom heb je voor dit profiel gekozen? |
| Q6 | MULTI | Ik heb volgend jaar de volgende bètavakken op school |
| Q6_10_TEXT | OPEN | Anders, namelijk |
| Q7 | MULTI | Mijn keuzevakken zijn: |
| Q8 | OPEN | Wie zijn voor jou belangrijk geweest bij het maken van je keuzes over de vakken die je gaat volgen of het profiel die je hebt gekozen? (Bijvoorbeeld je familie, ouders, docenten, vrienden, meiden van de GirlsClub WIN, …?) |
| Q9 | OPEN | Heeft iets van de GirlsClub WIN bijgedragen aan je profielkeuze? Zo ja, wat? |
| Q10_1 | 5PUNTS | Stelling: - Ik weet wat het schoolvak wiskunde inhoudt. |
| Q10_2 | 5PUNTS | Stelling: - Ik weet wat het schoolvak informatica inhoudt. |
| Q10_3 | 5PUNTS | Stelling: - Ik weet wat het schoolvak natuurkunde inhoudt. |
| Q10_4 | 5PUNTS | Stelling: - Ik weet wat voor soort banen je kan hebben als wiskundige. |
| Q10_5 | 5PUNTS | Stelling: - Ik weet wat voor soort banen je kan hebben als informaticus. |
| Q10_6 | 5PUNTS | Stelling: - Ik weet wat voor soort banen je kan hebben als een natuurkundige. |
| Q10_7 | 5PUNTS | Stelling: - Ik vind wiskunde leuk. |
| Q10_8 | 5PUNTS | Stelling: - Ik vind informatica leuk. |
| Q10_9 | 5PUNTS | Stelling: - Ik vind natuurkunde leuk. |
| Q10_10 | 5PUNTS | Stelling: - Ik ben goed in wiskunde. |
| Q10_11 | 5PUNTS | Stelling: - Ik ben goed in informatica. |
| Q10_12 | 5PUNTS | Stelling: - Ik ben goed in natuurkunde. |
| Q10_13 | 5PUNTS | Stelling: - Ik weet nu meer over wiskunde dan mijn klasgenoten op school |
| Q10_14 | 5PUNTS | Stelling: - Ik weet nu meer over informatica dan mijn klasgenoten op school |
| Q10_15 | 5PUNTS | Stelling: - Ik weet nu meer over natuurkunde dan mijn klasgenoten op school |
| Q10_16 | 5PUNTS | Stelling: - Bètavakken zijn voor mij gemakkelijk |
| Q10_17 | 5PUNTS | Stelling: - Als ik dat zou willen, kan ik studeren aan de universiteit |
| Q11 | JA/NEE | Ik heb vriendinnen gemaakt tijdens de GirlsClub WIN |
| Q12 | OPEN | Licht toe (wie zijn je vriendinnen, hoeveel vriendinnen heb je gemaakt, etc.) |
| Q13 | JA/NEE | Heb je contact met andere GirlsClub-leden tussen de bijeenkomsten? |
| Q14 | JA/NEE | Zie of spreek je wel eens meiden van de GC WIN die op een andere school zitten? |
| Q15 | OPEN | Waarom wel/niet? |
| Q16_1 | 5PUNTS | Stelling: - Ik ervaar een goed groepsgevoel tijdens de GirlsClub WIN |
| Q16_2 | 5PUNTS | Stelling: - Ik ervaar een goed groepsgevoel in de klas op school |
| Q17 | OPEN | Licht toe. |
| Q19 | JA/NEE | Zou je tweedeklassers van jouw school aanraden om zich bij de GirlsClub WIN aan te melden? |
| Q20 | OPEN | Waarom wel/niet? |
| Q21 | OPEN | Welke thema's moeten volgens jou nog meer aan bod komen tijdens de GirlsClub WIN? |

| | | |
|---|---|---|
| Q22 | MULTI | De lengte van de GirlsClub WIN bijeenkomsten is… |
| Q23_1 | 5PUNTS | Stelling: - De bijeenkomsten van GirlsClub WIN waren inspirerend |
| Q23_2 | 5PUNTS | Stelling: - Wat ik deed bij GirlsClub WIN komt overeen met wat ik verwacht had |
| Q24 | OPEN | Licht toe waarom je de GirlsClub WIN wel/niet inspirerend vond. |
| Q25 | OPEN | Licht toe waarom de GirlsClub WIN wel/niet overeenkwam met je verwachtingen. |
| Q26_1 | 5PUNTS | Stelling: - Er kwamen bij GirlsClub WIN genoeg verschillende thema's aan bod |
| Q26_2 | 5PUNTS | Stelling: - Het programma had voldoende diepgang |
| Q26_3 | 5PUNTS | Stelling: - Ik leerde tijdens iedere bijeenkomst/les iets nieuws |
| Q26_4 | 5PUNTS | Stelling: - Ik vond de docenten behulpzaam |
| Q26_5 | 5PUNTS | Stelling: - De docent(en) kon(den) goed uitleggen/presenteren |
| Q26_6 | 5PUNTS | Stelling: - De docent(en) enthousiastmeerde(n) mij over het onderwerp |
| Q26_7 | 5PUNTS | Stelling: - Tijdens de opdrachten kon ik zelf iets onderzoeken en/of ontwerpen |
| Q26_8 | 5PUNTS | Stelling: - Tijdens deze activiteit heb ik dingen gedaan/ervaren die ik op school niet kan doen. |
| Q26_9 | 5PUNTS | Stelling: - De praktische organisatie (zaal, catering & communicatie) vandaag was goed. |
| Q27 | JA/NEE | Heb je tijdens één van de GirlsClub bijeenkomsten een leuk gesprek gehad met een bètastudent? |
| Q28 | OPEN | Zo ja, waar heb je het met deze student over gehad? |

## Appendix C: Manuals meetings

The project consists out of five meetings on Thursdays from 12 to 4 pm. Each meeting starts with the students gathering at the university for a lunch. After the lunch the program will start. At the end of the day we collected pros and cons about the day by the students.

### Appendix C1: Description meeting 1: 13-04-23

Meeting 1: Getting to know each other

On the 13th of April 2023 was the first meeting of the GirlsClub WIN. The theme of this meeting was to get to know each other, the three subjects' (mathematics, computer science and physics) and the university. After arrival and a short welcome, the students filled in the pretest. To kick of the first meeting there were short presentations about each subject by a woman working or studying in this field, these women are the “Girl of the day”. A concept which will return each meeting. For today assistant-professor Nadine van der Heijden talked about physics, assistant-professor Iris Beerenpoot about computer science and student Janneke ... talked about mathematics.

After some getting to know each other games, it was time for the scavenger hunt. The group is divided into five random groups. With their group the go to several points at the campus. At this point they will have to solve a puzzle. If the solve the puzzle correctly they will get a puzzle piece. Who can solve the puzzle the quickest?

After the scavenger hunt the students designed their own logo for the GirlsClub WIN. They voted on their favourite design. This concluded the first day!


### Appendix C2: Manual meeting 1

4M1: Wiskunde, Informatica en NatuTijdurkunde: **Kennismakingsdag** (13 april 2023):

Tijdens deze bijeenkomst komen alle drie de disciplines / schoolvakken voorbij. De tijdlijn van de bijeenkomst is als volgt:

11:20-12:00 ontvangst leerlingen door s.a.'s bij de ingang van het gebouw. Ontvangst leerlingen bij lokaal (MIN 2.02) en uitdelen stickers . Drinken met koekje en kennismakingsgesprekjes. Alles klaarzetten wat nog niet klaar staat.

11:30-12:00 inloop/formulieren ontvangen en maakt een foto van elke leerling met naamsticker (voor wie niet op de foto wilt). M staat op de gang en helpt de leerlingen de ruimte te vinden (KBG/Minnaerthal).

12:00-12:15 Welkomstwoord, uitleg wat is een Universiteit en wat gebeurd hier als aanleiding voor de Nulmeting

12:15-12:30 Pre-test vragenlijst uitleg en helpen met inloggen / openen. Er moeten een paar papieren versies / laptops klaarliggen voor uitdelen, invullen en inleveren als een leerling het niet lukt om de evaluatie te openen.

12:30-13:00 Presentatie Wiskunde, Informatica en Natuurkunde incl. momentje om vragen te stellen.

13:00-13:30 Lunch pakken en kennismakingsgesprekken met kaarten deelt uit, iedereen verdeelt zich over de groepjes: twee rondes van 15 min.)
13:30-13:40 Plaspauze en klaarmaken om naar buiten te gaan.

13:40-15:40 Speurtocht. Zie overzicht Table met welk groepje je meegaat. M staat bij post K met hints!

15:20-15:50 Pauze met koekje, chocolade en drankje MIN ( wacht daar met wat lekkers). Afsluitende activiteit (logo ontwerpen). Na een logo-wedstrijd in de groepsapp wordt het leukste logo gekozen. Dit logo zullen we gebruiken voor de GirlsClub-lidmaatschapspassen die de leerlingen bij de tweede bijeenkomst in mei gaan krijgen! → doel duidelijk maken dit jaar.

15:50-16:00 Sluiting van de middag met post-its

## Appendix C3: Description meeting 2: 25-05-24

Meeting 2: Data and sorting algorithms (Physics and computer science)

The day starts of with lunch again, during the lunch break students played several games to start thing off. The first game was the true or false game to get to know the other students. In groups of three students a student says a statement, the other students must decide if it is true of false. The second game is the sorting game. The students must sort themselves by different assignments, for example sort on age. The third and last game is word-battle. Each students gets a secret word, during conversations with other students they must try to let a students say your secret word.

The “Girl of the day” is Elise Herewijnen, she talks about how she uses artificial intelligence in her work.

## Appendix C4: Manual meeting 2

| **Tijd:** | **Planning:** | |
|---|---|---|
| 11.00-11.45 | 11.00 lopen vanaf bbg3.81 met spullen naar 2.05. 11.15 starten met opbouw e.d. | • U-Talentlogo op de deur<br>• Namenstickers, instructie, lunch en ruimte (10 groepjes tafels vormen) klaarzetten en openruimte creeeren voor spelletjes. |
| 11.45-12.30 | Inloop met spelletje Kennismakingsspelletjes | • waar niet waar ; sorteerkring |
| 12.35-13.00 | Lunch – pauze | leerlingen doen het 'woord-battle'spel.<br>12:55 aangeven toilet en opruimen kan nu, daarna presentatie volgen |
| 13:00-13:30 | Girl van de dag | M introduceert "Girl of the day". GvdD zorgt dat haar presentatie klaar staan. Als de spelletjes voorbij zijn, geeft GvdD een presentatie over AI en haar werk.<br>-ruimte voor vragen<br>- chocoladereep en applaus<br>- in de groepjes gaan zitten (kleur en logohoogte) |
| 13:30-14:45 | Sorteeralgoritmes | M introduceert student assisent. Zij gaat met de leerlingen de opdrachten doen, K assisteert en M waar nodig. N sluit later aan.<br>**Objecten**: 10 groepjes, 10 elementen (ipv 8) in blinde fotorolletjeskokers, moeren ipv zand, elk groepje een weegschaal<br>**Begeleiding van P**: ga er goed doorheen, kunnen we nog aanpassingen maken? Werken de animaties e.d. |
| 5min | Pauze met snoepjes | |
| 14:55-15:45 | 'Vitruvius' | N begeleid de opdracht, K en P lopen rond om te assisteren. De leerlingen gaan nu in 5 groepjes zitten (op kleur).<br>Benodigdheden: rolmaat (2x), meterlat 1 m, 30cm-lineaal, kladpapier.<br>Opmerking: haardikte meten als afsluiting. |
| 15.45-16.00 | Afsluiting met chippies en limonade. | Regelen A en M. N doet eerst nog de logo-ontwerpstemming. De leerlingen doen dan de post-its-evaluatie. |

## Appendix C4:Description meeting 3: 29-09-24

Meeting 3: Dimensions (Mathematics and physics)

During lunch the students can play the game 30 seconds with mathematical terms. Jasmijn den Hollander is the "Girl of the day". She talks about her average week as a mathematics student. She explains different study paths they can choose with mathematics.

After the "Girl of the day", the students get a presentation about the theme of today dimensies. What are dimensions in Mathematics and physics? Can you make imagine how more than three dimensions look alike? After the explanations the students went to the lab to do several experiments in small groups. With these experiments they learned more about perceptions, waves and vibrations, and dimensions.

To finish the day the students played tic-tak-toe in three dimensions. It was a nice game to get students to visualize a cube. They can check and help each other.

## Appendix C5: Manual meeting 3

| Tijd | Activiteit | Details |
|---|---|---|
| 10:00 – 11:45<br>BBG 3.85 | Opbouw | 10.00 laatste voorbereidingen in MIN 0.04<br>11.00-11.15 starten met opbouw, lunch klaarzetten e.d.<br>Zie lijstje hierboven, o.a. namenstickers invullen, instructie en ruimte klaarzetten. |
| 11:45 - 12:20<br>BBG 3.85 | Inloop met lunch | Daimy en Marinthe hebben de leiding, welkom heten.<br>Andere aanwezigen helpen leerlingen met naamsticker.<br><br>+ spelelement (30 seconds) |
| 12:20 – 12:40<br>BBG 3.85 | “Girl of the day” | Presentatie |
| 12:40-13:05 | Programma | - Dimensiepraatje incl. Verplaatsen<br>- Marjolein, Daimy en Marinthe zetten spullen klaar<br>Inclusief lopen naar MIN 0.04<br>Marjolein schermt onze plek Learning Plaza af |
| 13:05 – 13:35<br>MIN0.04 | Programma | Ronde 1 |
| 13:35 - 14:05<br>MIN0.04 | Programma | Ronde 2 |
| 14:05 - 14:15<br>MIN0.04 | | Plaspauze: eten drinken, op de gang |
| 14:15 – 14:45<br>MIN0.04 | Programma | Ronde 3 |
| 14:45 – 15:15<br>MIN0.04 | Programma | Ronde 4 |
| 15:15 - 15:25<br>MIN0.04 | Opruimen | Opruimen en teruglopen |
| 15:25 – 16:00<br>BBG 3.85 | Afsluiting | Lekkers met limonade + Post-its<br>--- --- --- -- --- --- ---<br>Opruimen en nabespreken |

## Appendix C6: Description meeting 4: 30-11-23

Meeting 4: Patterns (Mathematics and computer science)

During the lunch the students played memory with important female scientists and researchers. The goal of the game was to show the students some female representatives in the STEM field. The “Girl of the day” is also such a female representative. Today the girl is Hilde Jongeling, she works at a tech company. She uses maps to visualize data.

There are three activities today. The first activity is a tour in Lilli's protolab. They can see how they can 3D-print at the lab. The second activity was drawing and making patterns. After an instruction and seeing examples, students can draw their own patterns and use stones to make different kinds of patterns. For the last activity they use programming to make their logo in 3D to get 3D-printed. There is a worksheet they can follow to make the logo but students rather figure it out for themselves. Students were creative and could make a more simple or difficult version of the logo.

## Appendix C7: Manual meeting 4

| Tijd | Activiteit | |
|---|---|---|
| 11:45 – 12.00 | Inloop met lunch | • Spelletjes<br>• Welkom heten, spelletjes doen, muziek aan<br>• Naamstickers uitdelen, presentielijst bijhouden |
| 12.00 - 12.20 | Programma doorlopen, lunch | • Om 12.00 uur de bijeenkomst officieel openen, spelletje uitleggen. De meiden kunnen daarna nog even verdergaan met lunchen en de spelletjes. |
| 12.20 - 12.45 | Girl van de dag (Hilde Jongeling) | • Hilde zorgt dat haar presentatie klaar staat. Als de spelletjes voorbij zijn, geeft Hilde een presentatie over haar werk- en studieloopbaan (15-20 min) |
| 12:45- 15:45 | Ronde 1 en 2 | Korte gezamenlijke start, daarna:<br>Patronen en ontwerpen |
| 15.45- 16.00 | Afsluiting | • Afsluiten met chips en limonade. De leerlingen doen dan de post-its-evaluatie.<br>• De vijftien producten projecteren en bespreken / genieten van de verschillen en stemmen voor printen |

## Appendix C8: Description meeting 5: 8-2-24

Meeting 5: A visit at....  (Mathematics, Computer Science and Physics)

The last meeting combined all subjects at gave them one last look at applications of those subjects. To start the day of  PhD'er Franka Jesse talked about her research and her career. She took the students through the choices she had to make be where she is now. The first choice is their profile at high school, a choice all students must make this year. Then you will choose your bachelor and master education before you must decide what kind of work you would like to do.

Then the students will visit three places, all connected to different subject. To keep the students engaged they played bingo. For mathematics they went to the liberary especially for mathematicians. For physics they went to the lab to see some research that is happening at this moment. For computer science they went to the motion lab. In this lab they see how motion can be captured and transated to a game.

After everyone gathered again, they filled in the post-test. To conclude the day the winner of the bingo gets a price and every students receives a certificate for their participation at GirlsClub WIN.

## Appendix C9: Manual meeting 5

| Tijd | Activiteit | |
|---|---|---|
| 11:45 – 12.00 | Inloop met lunch | Welkom heten muziek aan<br>• Naamstickers en logo's uitdelen, presentielijst bijhouden |
| 12.00 - 12.20 | Programma doorlopen, lunch | • Om 12.00 uur de bijeenkomst officieel openen. Verder met lunchen |
| 12.20 - 12.45 | Girl van de dag | • Wetenschapper/promovendus |
| 12:45-15:15 | 12:45-13:30<br>13:30-14:15<br>14:15-15:00 | Korte gezamenlijke start, daarna: Rondleiding met werkomgeving<br>• 'Bingokaart' door de lab's met woorden en opdrachten<br>Elk onderwerp 8 items voor de bingokaart |
| 15.15-16.00 | Afsluiting | • |

## Appendix D: HLT meetings

### Appendix D1: Meeting 1

| Activity | Hypothesis | Underpinning |
|---|---|---|
| "Girl of the day" | The students learn about the different subjects. It feels out of the ordinary that all the lectures are female. | GEM guideline:<br>"Do include female lecturers but take care to not make it seem like something outstanding, more that is/should be common, that woman work in those fields."<br><br>Rainey (2018) showed that female representatives increase the sense of belonging. More female representatives change the way students see the culture of STEM. When students think about someone in STEM they typically see a male or masculine traits. |
| Getting to know each other-games | The students are getting to know each other. The atmosphere in de group is becoming more relaxed. | GEM guideline:<br>"Allow time for group building especially if girls come from different schools." |
| Scavenger hunt | | |
| Logo design | Students are creative. Many different types of design are produced. | |

### Appendix D2: Meeting 2

| Activity | Hypothesis | Underpinning |
|---|---|---|
| "Girl of the day": Elise Herewijnen (artificial intelligence) | Students are getting a better understanding about the use of AI in the work field. | GEM guideline:<br>"Include female role models, invite girls and women to tell about the kind of work they do and how they use STEM skills" |
| Games:<br>• true or false<br>• Sorting game<br>• Word battle | Students are getting to know each other. They find common grounds and get more comfortable with each other. | GEM guideline:<br>"Invest in setting up a community."<br><br>GEM guideline: |

| | | |
|---|---|---|
| | | "Don't forget time for ice breakers at the start" |
| Sorting algorithms | | |
| Vitruvius | | |

## Appendix D3: Meeting 3

| **Activity** | **Hypothesis** | **Underpinning** |
|---|---|---|
| 30 seconds with mathematical terms | Students form new groups and learn about how to communicate. | GEM guideline:<br>"Allow time for group building especially if girls come from different schools." |
| "Girl of the day": Jasmijn den Hollander (Mathematic student) | Students get a better understanding of what it is like to be a student at Utrecht University. | GEM guideline:<br>"Consider small breaks for girls to unofficially talk to mentors and representants." |
| Presentation dimensions | Students get a better understanding about dimensions. There is already some recognition in the subject. | GEM guideline:<br>"Do include female lecturers but take care to not make it seem like something outstanding, more that is/should be common, that woman work in those fields." |
| Experiments dimensions | Student get enthusiastic to try the experiments for themselves. They discover new concepts and are able to experiment with it. | GEM guideline:<br>"Create inquiry-based activities during which girls can do science, explore and be creative in contexts." |
| Tic-tac-toe in 3D | Students are competitive and trying to win tic-tac-toe. | |

## Appendix D4: Meeting 4

| **Activity** | **Hypothesis** | **Underpinning** |
|---|---|---|
| Memory with female scientists | Students realise there are many female scientists . | GEM guideline;<br>"Include female role models" |
| "Girl of the day": Hilde Jongeling (Tech company) | Students learn how others use their STEM skills in the work they do. | GEM guideline:<br>"Invite girls and women to tell about the kind of work they do and how they use STEM skills" |

| | | |
|---|---|---|
| Tour in Lilli's protolab | | |
| Drawing and making patterns | Students can be creative to create their own original patterns. | GEM guideline:<br>“Create inquiry-based activities during which girls can do science, explore and be creative in contexts.” |
| Programming their logo in 3D | Students have their first encounter with programming. Students will follow the steps to design the logo. | |

## Appendix D5: Meeting 5

| **Activity** | **Hypothesis** | **Underpinning** |
|---|---|---|
| “Girl of the day”: PhD’er Franka Jesse | Students learn about what kind of choices they have to make the coming years. Students learn about the possibilities of doing research in a social challenge. | GEM guideline:<br>“Include female role models, invite girls and women to tell about the kind of work they do and how they use STEM skills”<br><br>NCR (2023)<br>“Girls are looking for a social challenge and wider application of STEM education” |
| Bingo at the Mathematic library, motion lab and physics lab. | The bingo helps students to ask questions and listen to what is said. Students learn about different work environments. | GEM guideline:<br>“Emphasize social aspects, be part of a community.” |
| Summary meetings | Students look back at past meetings to overview all the things they learned. Students have feeling of recognitions. | GEM guideline:<br>“Prepare final session for exchanging findings or an exhibition of results.” |
| Certificate Ceremony | Students conclude the project together as a group. There is a strong group feeling. | |

# Appendix E: Interview schemes

## Appendix E1: first round of interviews

| Onderdeel | Tijd | Vragen | Koppeling |
|---|---|---|---|
| Introductie | 2 min | Welkom! Bedankt voor het deelnemen aan het interview. Ik ben Lisa en ik onderzoek het effect van de GirlsClub WIN voor mijn masterscriptie. Ik hoor vandaag graag over jouw ervaringen. Ik zou graag het gesprek opnemen zodat ik het kan terugluisteren. Opnames zullen niet gedeeld worden. Stem je hier mee in? | |
| Warm-up | 3 min | Waarom heb je gekozen deze activiteit te volgen?<br>- Hoe ken je het?<br>- Wat sprak je aan?<br>- Was je meteen enthousiast?<br>- Heef iemand anders je overgehaald het project te volgen?<br>- Ken je iemand die al eerder meegedaan heeft? | |
| Overgang | 5 min | Wat waren jouw verwachtingen van de GirlsClub WIN?<br>- Had je een doel dat je wilde bereiken?<br>- Wat verwachte je van de inhoud van het programma?<br>- Wat voor soort sfeer verwachtte je?<br>- Welke onderwerpen van STEM hoopte je dat er behandeld zou worden? | Vragenlijst |
| Hypothese | | Deelnemers willen meer kennis over de toepassingen en de bijbehorende studies. | |
| Hoofdvraag (onderdelen v/d dag) | 5 min | Wat sprak/spreekt jou het meeste aan van de GirlsClub WIN dagen?<br>- Hoe vond je de Girls of the day?<br>- Hoe vond je de experimenten?<br>- Hoe vond je de spelletjes?<br>- Hoe vond je het om in (nieuwe) groepen samen te werken?<br>- Hoe vond je de interactie met docenten en andere studenten? | Literatuur Dökme |
| Hypothese | | Girls of the day zou een rolmodel kunnen zijn waardoor de deelnemers zich meer betrokken voelen. | |
| Deelvraag 2 (School vs GirlsClub) | 5 min | Hoe ervaar je de STEM (Scheikunde, technologie, Wiskunde) vakken t.o.v. wat je op school krijgt?<br>- Hoe is je interesse in STEM t.o.v. op school?<br>- Wat maakt het verschil?<br>- Zijn de onderwerpen anders? Zo ja welke?<br>- Wordt het anders aangeboden? Op welke manier wordt de uitleg gegeven?<br>- Is de GirlsClub anders dan een middag op school? | Literatuur Saqip, Pascarella & Terenzini |
| Hypothese | | De docent-student interactie is noodzakelijk. | |
| Deelvraag 1 (Betrokkenheid) | 5 min | Maakt het voor jou verschil dat dit alleen voor meiden is?<br>- Hoe voel jij je in de groep?<br>- Wat heeft dit voor invloed op jouw ervaring?<br>- Wat maakt deze groep anders dan jouw klas op school?<br>- Merk je dat deelnemers andere interesses hebben?<br>- Voel jij je “thuis” in deze groep? Waarom? | Literatuur Robnett & Leaper |
| Hypothese | | Het belangrijkste gevoel van betrokkenheid komt door het zijn met gelijkgestemde met dezelfde interesse. Dit hoeft niet afhankelijk te zijn van het geslacht. | |
| Deelvraag 3 (Werken STEM) | 5 min | Denk je dat je STEM veel nodig zal hebben later?<br>- Zie je jezelf werken in STEM?<br>- Heb je STEM nodig in het dagelijks leven?<br>- Wat ben je te weten gekomen over STEM studies?<br>- Zijn er STEM studies die jou interessant lijken? | Vragenlijst |

| | | | |
|---|---|---|---|
| Hypothese | | De leerling kan studies en beroepen noemen waarbij STEM noodzakelijk is. | |
| Deelvraag 3 (profielkeuze) | 5 min | Wat zou je op dit moment als vakkenpakket kiezen?<br>- Hoe heb je deze keuzes gemaakt? Waar heb je naar gekeken? Cijfers/Studie/Advies<br>- Wat voor twijfels heb je nog?<br>- Zijn er nog dingen waarvan je meer informatie wil voordat je de keuze maakt? | Vragenlijst + Literatuur Chisari |
| Hypothese | | Uit de vragenlijsten blijkt dat de meeste leerlingen gaan voor een N&G of N&T pakket. Echter zijn er nog veel leerlingen met twijfels | |
| Sluiting | 2 min | Dit was het interview. Is er nog iets wat je zou willen toevoegen of iets waarvan ik op de hoogte moet zijn? Mocht je later nog vragen hebben of opmerkingen hebt over het interview, laat het mij vooral weten. Bedankt voor je tijd en je antwoorden. Nog een fijne dag! | |

## Appendix E2: Second round of interview

| **Onderdeel** | **Tijd** | **Vragen** | **Koppeling** |
|---|---|---|---|
| Introductie | 2 min | Welkom terug! Bedankt voor het deelnemen aan het tweede interview. De vorige keer dat we elkaar spraken, was aan het begin van het schooljaar. Inmiddels is de GirlsClub afgelopen en hebben jullie je profielkeuze gemaakt. Ik ben erg benieuwd hoe het nu met jullie is. Ik zou graag het gesprek opnemen zodat ik het kan terugluisteren. Opnames zullen niet gedeeld worden. Stem je hier mee in? | |
| Warm-up | 3 min | Hoe kijk je terug op de GirlsClub?<br>- Wat voor gevoel heb je eraan overgehouden?<br>- Wat vind je ervan dat het is afgelopen? | |
| Hoofdvraag (onderdelen v/d dag) | 5 min | Welke activiteiten zijn je het meest bijgebleven?<br>- Bij welk thema hoorde deze?<br>- Waarom deze activiteiten?<br>- Is dit iets wat je op school ook meer zou willen doen?<br>- Welke “Girl of the day” is het meest bijgebleven? | |
| Hypothese | | Veel verscheidende antwoorden vanuit de vragenlijst. Zowel informatica (programeren en 3D printen) en natuurkunde (zwaartekracht) kwamen meerdere keren terug. Vooral de “Girl of the day” werd als inspireerd ervaren. | Vragenlijst |
| Hoofdvraag (onderdelen v/d dag) | 5 min | Welke onderdelen of elementen van de GirlsClub dagen heb je het meest positief of negatief ervaren?<br>- Wat vond je het leukst en minst leuk en waarom?<br>- Heb je veel geleerd tijds de GirlsClub?<br>- Zijn er dingen die je zou veranderen?<br>- Zou je het andere aanraden om mee te doen? | |
| Hypothese | | Elke deelnemende leerling geeft aan het aan te raden aan anderen om mee te doen. Gegeven reden zijn met name dat het leuk en gezellig is, je de universiteit beter leert kennen en je andere dingen leert dan op school | Vragenlijst |
| Deelvraag 1 (Betrokkenheid) | 5 min | Voelde je je op je plek bij de GirlsClub?<br>- Waarom wel of niet?<br>- Hoe vond je de onderlinge sfeer?<br>- Hoe voelde je je in de groep? Is dit anders dan op school?<br>- Heb je nog contact met andere deelnemers? | |
| Hypothese | | Uit de vragenlijst blijkt dat leerlingen meer groepsgevoel ervaarde tijdens de GirlsClub dan op school (+0,231%) | Vragenlijst |

| | | | |
|---|---|---|---|
| Deelvraag 2<br>(STEM vakken) | 7 min | Is je interesse in STEM vakken veranderd door de GirlsClub?<br>- Weet je nu meer wat de schoolvakken wiskunde, natuurkunde en informatica inhouden?<br>- Vind je deze vakken nu leuker na de GirlsClub?<br>- Vind je jezelf beter geworden in deze vakken door de GirlsClub? | |
| Hypothese | | Uit de vragenlijst blijkt dat leerlingen nu meer weten wat de schoolvakken inhouden. De interesse in informatica is toegenomen, wiskunde is stabiel gebleven en natuurkunde is gedaald. Echter is er een daling bij alle vakken in hoe goed zou in het vak zijn. | Vragenlijst |
| Deelvraag 3<br>(profielkeuze) | 7 min | Voor welke profielkeuze en vakken heb je gekozen?<br>- Waarop heb je jouw keuze gebaseerd?<br>- Is jouw keuze tussentijds veranderd?<br>- Heeft de GirlsClub invloed gehad op deze keuze?<br>- (Zo ja) Welke invloed heeft de GirlsClub gehad? | |
| Hypothese | | De helft van de leerlingen gaf aan dat de GirlsClub invloed heeft gehad op de keuze. Uit de profielkeuzes bleek dat veel leerlingen nog waren gewisseld van profiel gedurende het project. | Vragenlijst |
| Sluiting | 1 min | Dit was het interview. Is er nog iets wat je zou willen toevoegen of iets waarvan ik op de hoogte moet zijn? Mocht je later nog vragen hebben of opmerkingen hebt over het interview, laat het mij vooral weten. Bedankt voor je tijd en je antwoorden. Nog een fijne dag! | |

## Appendix F: Accessibility to the data

The data was collected in accordance with the ethical guidelines of the Science Faculty. The data consists out of the answers from the pre- and post-test. The answers on the questions are collected and anonymized. Further, the data consists out of five recordings of interviews. These interviews are fully transcribed. The data is stored to ensure the reliability of the research.

Since the 1st of January 2016 all research of Utrecht University must be saved by the faculty for ten years to make sure the work is controllable (DUB, 2016). The questions and answers of the pre- and post-test are saved on a server by the Freudenthal institute. As well as the transcriptions and recordings of the interviews. For the interview each student and their parents have given a written permission to use the interview for the research and permission to save the data for ten years. These forms are also stored and can be requested.

## Appendix G: Guidelines GEM summer camp

('GEM', 2021)

The practical guidelines for organizing summer camps for girls are summarized in a list of DO's and DON'Ts:

DO

• The summer schools should allow for time for group building especially if girls come from different schools are involved.

• Create inquiry-based activities during which girls can do science, explore and be creative in contexts where science makes a societal difference or relates to social scientific issue (Patrick et al., 2009; Sadler et al., 2007; Thuneberg et al., 2018). Prepare final sessions for exchanging findings or an exhibition of results.

• Do include female role models (also as lecturers) but take care to not make it seem like something outstanding, more that it is/should be common, that woman work in those fields. Consider small breaks for girls unofficially talk to mentors and representants of the world of work, a kind of Q&A's.

• In advertising emphasize social aspects of the event and opportunities for girls to work together (e.g. call it a GirlsClub).

• If there are limitations to organize a live summer school (e.g. because of COVID) we recommended to organize a reduced program online. We have good examples of how to organize activities online (see GEM website).

• Invest in setting up a community (e.g. create a WhatsApp-group).

• Encourage two or more girls from the same class/school (makes it 'low floor' and also is helpful for transportation).

• Emphasize the importance of STEM for society and responsible citizenship ('21st century skills').

• Emphasize social aspects, be part of a community, including meetings with role models ('21st century skills').

• Take care that parents know the program and can support.

• Include female role models and organize meet & greets

• Invite girls and women to tell about the kind of work they do and how they use STEM skills.

Don't

• Don’t emphasize that you need to be high achieving in STEM.

• Don’t forget time for ice breakers at the start, meetings with mentors during, and sharing findings at the end of the summer camp.

• Don’t use too sophisticated words (in interaction, in communication)