How to include the girls?

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1. A description of the project

Gender equality and diversity among students and employees are central parts of KTH's core values[1]. The arguments for a more equal and diverse university and society concerns quantity, efficiency and demands. More engineers and scientists are needed for growth, innovation and sustainable development, i.e. we need women working in this area. Mixed teams result in more efficient problem solving and more creativity[2]. In general, it is good to have wider perspectives and different experiences in the same team. It is easier for women to identify new markets and see the needs and solutions for female consumers and users.

In order to reach more girls and contribute to a long-term gender balance, we need to motivate and interest girls to apply for the programs in natural sciences and technology in upper secondary schools[3], which entitle them to continue studying at KTH.

Interest and motivation for a subject can depend on many different things. For example, knowledge of what the subject means, how the students are met and get feedback, role models, subject culture etc.[4] Attitudes and motivation towards science and technology among fifteen year old students in over 40 countries have been studied in the ROSE (The Relevance of Science Education)-project[5] .

Vetenskapens Hus[6] offers hands-on activities in science, technology and mathematics for K-12 students. The aim is to inspire everyone, regardless of gender or background, and in the long run to increase the number of students that apply to higher education in natural sciences and engineering. The environment at Vetenskapens Hus is suitable for studying learning situations as the activities for K-12 students are implemented repeatedly. We continually improve the design and content of the activities. The activities are led by tutors, students from KTH that also act as role models.

In this study we will focus on one chosen activity and study its design and content with respect to gender. Especially we want to investigate the effects of two factors:

1. *Usefulness* - putting the knowledge in a broader, interdisciplinary context[4, 7], by emphasising the purpose and different applications of the knowledge.
2. *Cultural Identity* - doing the instruction material gender neutral[8], by adapting the language and examples used and highlighting both female and male role models.

Through this project we want to investigate the research question:

How does an increased emphasis on either *usefulness* or *cultural identity* in an activity affect the students' attitude to the subject?

2. Data collection process and analysis

The student activity

The student activity that was studied was in *Robotics and programming*. The length of the activity is 90 minutes. The activity consists of four major parts: an introduction, guided programming, a programming task, and a presentation of the programming task.

During the introduction robotics and programming as a task is discussed and put in a context. Questions such as ”What is programming?”, ” What is a robot?”, ”Is a robot smart?” are discussed with the students. Short films showing examples of robotics, and the use of robots are shown and discussed.

During the guided programming the tutor guides the students through three exercises of programming. The students follow the tutor step by step to learn how to make their robots move back and forth, how to use loops and a couple of sensors. Questions related to programming are discussed.

After the students are familiar with the robots and the programming language, they get a task for them to solve on their own. During this part the tutor is available for support and questions. The tasks are performed on a special robotics table.

At the end of the activity the students gather around the robotic table and presents the tasks of their robot to each other.

We did three different implementations of the activity, the original activity and two redesigned implementation where we put a greater emphasis on usefulness and cultural identity, respectively.

The parts of the activities we changed between the different implementations were the pictures and films in the introduction and the description and presentation of their programming task.

In the original implementation (reference) the pictures and films introducing programming were a picture with lego mindstorm robots, a film about the humanoid Asimo robot[1], a film about industry robots[2], and a picture describing robots at the planet Mars.
The programming tasks were simply one of the following. On the robotic table: ’follow the black line’, ’react in any chosen way when detecting crosses of different colors’, or ’move a small block on the table’.

In the second implementation (usefulness) the pictures and films introducing programming were a picture were an old person gets help from a robot, a film about Furhat[3], a film about a surgery robot[4]

[1] https://www.youtube.com/watch?v=ts000IjjpTQ

[2] https://www.youtube.com/watch?v=sjAZGUcjrP8

[3] https://vimeo.com/201006348

[4] https://www.youtube.com/watch?v=2fnv_3qn3Yc

and a film about a pollution sniffing robot[5].
The programming tasks were named after some specific application. The students could chose to make: ’a hospital-robot’, ’an inventory-robot’, or ’a garbage-robot’.

In the third implementation (cultural identity) the pictures and films introducing programming were a picture of Wall-E and Eve, pictures and story of Ada Lovelace, a film about soft robots[6] and a film with a female professor at KTH telling about her work with robots[7].
The programming task was introduced with the sentence ‘Your name is Ada and you are a manager for a big hospital. Your task is, with the help of a robot, to…’: ’transport medicine between the medicine factory and the hospital’, ’identify lost medical equipment’, or ’fetch medical equipment’.

Data collection and analysis

We invited six different school classes, in grade 7, from two schools to implement the activity. The classes had even gender distribution and had similar socio-economic background. The activities were carried out in half class. In total we implemented the activity with 12 groups of student. The total number of participating students was about 150. Four groups of students took part in each implementation. All groups were led by the same female tutor, a student from KTH.

Data were collected from the participating students and teachers, the tutor who led the activities, and the authors.

The students filled out a questionnaire twice, approximately one week before doing the activity, and one right after doing the activity. The same questionnaire was used both as the pre- and post-questionnaire. The questionnaire and its 16 questions are given in its full form in Appendix 1 together with a list of abbreviations and a translation. The questionnaire included questions concerning importance of the subject, self-efficacy, and interest in studying and working in the field of programming and technology. A statistical analysis was done on the data from the questionnaires.

The accompanying teacher and the authors made observations during the activity, looking for i.e. engagement, number of times of interaction, and understanding. The observations were done following a protocol (Appendix 2). The notes from the observations were summarized.

An interview with the tutor was carried out right after all the student activities were completed. The interview was semi-structured with a number of key questions. The key questions were followed by a number of follow-up questions depending on the answers to the key questions (Appendix 3).
All three author were present during the interview which took about 90 minutes. The interview was recorded and transcribed. The most important parts and quotes from the interview were summarized.

[5] https://www.youtube.com/watch?v=1HNYX1TtcY0

[6] https://www.youtube.com/watch?v=A7AFsk40NGE

[7] https://www.youtube.com/watch?v=slKx9YNtVcM

3. Results

The student questionnaires

The full record of the statistical results of the student questionnaires is given in the tables of Appendix 4.

The questionnaire data spans the dimensions school class (7A, 7B, ...), gender (f, m), phase (before, after), scenario (reference, usefulness, identity) as well as the timestamp of each individual respondent. These data dimensions are the ones being relevant in the statistics analysis, further dimensions includes recorded notes, method (paper form, web form), time of visit (before lunch, after lunch).

The responses are in a 1-5 Likert scale. '5' is considered the highest score and is the most positive result, meaning that the respondent has a positive attitude towards, or knowledge in, technology. '1' is considered a low value with respect to the respondents attitude towards, or knowledge in, technology. Three of the questions are posed in a negative manner with the highest score as the most negative and the lowest score as the most positive response. These questions are referred to as flipped and the scale for those questions are reversed in the calculations and presentation of the data. A response to a question is denoted response, score, value or attitude from this point and on.

The study includes 289 responses counting both before and after the student activity. An overview of the number of participants is shown in Table 1. Note that approximately 6% and 8% of the respondents chose to not specify their gender.

Phase	female (f)	male (m)	unspecified (xy)	Sum
Before	63	75	8	146
After	64	67	12	143
Sum	127	142	20	289

Table 1. This table shows the total number of participants before and after the visit at Vetenskapens Hus with respect to gender.

Mean values are calculated over all scenarios and genders, and details are shown in Appendix 4, Table 4. This data do not reveal any gender or scenario dependent relations but rather the overall attitudes of the students with respect to the question.

The three highest scoring questions (most positive responses) are, in falling order, *daily* (I use technology daily) with a mean value of 4.4 and the *flipped* question *fun* (I think technology is boring) with 4.1 and *impSoc* (Technology is an essential part of a good and sustainable society) at 4.0.

The three lowest scoring questions are *workTech* (I want to work with technology as an adult) and *repairHome* (When something is broken at home I want to learn why) both having a mean value 2.7 and *inspByOthers* (I get inspiration by people interested and talented in technology) with mean value 2.9.

The mean values and standard deviations over all scenarios are presented in table 5 and 6 of Appendix 4. This data provides a broad perspective on gender related attitudes and does not reveal any scenario dependent attitude correlations.

The highest scoring question for boys and girls is *daily* and that question has the smallest standard deviation of all questions, meaning that it is the most certain response of the survey (when calculated over all scenarios). Other questions that scores high for both boys and girls are *fun* and *impSoc*.

The lowest scoring question for boys is *repairHome.* For girls the value of the same question ranks as the second lowest.

The lowest scoring question for girls is *workTech.* For boys the corresponding values are also on the lower side of the spectrum, but significantly higher than for girls.

The questions that have the biggest positive changes (+0,2 - +0,3) for the girls are: *workTech, inspByOthers, prgImport, interesting, benefits;* the biggest negative change (-0,2): *impSoc*

The questions that have the biggest positive changes (+0,2 - +0,3) for the boys were: *workMeaning, freeTime, benefits, activeSchool.*

Overall, the mean values for the girls are lower than the corresponding values for boys.

In tables 7 - 12 the mean values and standard deviations for girls and boys are presented for the three scenarios; 'reference' (ref), 'usefulness' (ufn), and 'identity' (id).

In Figure 2. we show the mean values, calculated over all questions per scenario per gender, before and after the student activity. We are interested in the general response of boys and girls for the different scenarios.

We note that there is no change for girls for the 'reference' scenario and a small positive changes of 0.1 and 0.2 for the 'usefulness' and 'identity' scenarios, respectively.

For boys the change is positive for the 'reference' and 'identity' scenario, but negative for the 'usefulness' scenario. Values are 0.3, -0.1, 0.3, respectively.

For the respondents that did not specify their gender, the net change was strictly positive over all scenarios. The change in attitude for the 'reference', 'usefulness', and identity' scenarios were 0.4, 0.5 and 0.8 respectively.

In general the changes are not significant due to the low number of students. However, they show a trend and by increasing the amount of data more reliable numbers can be obtained.

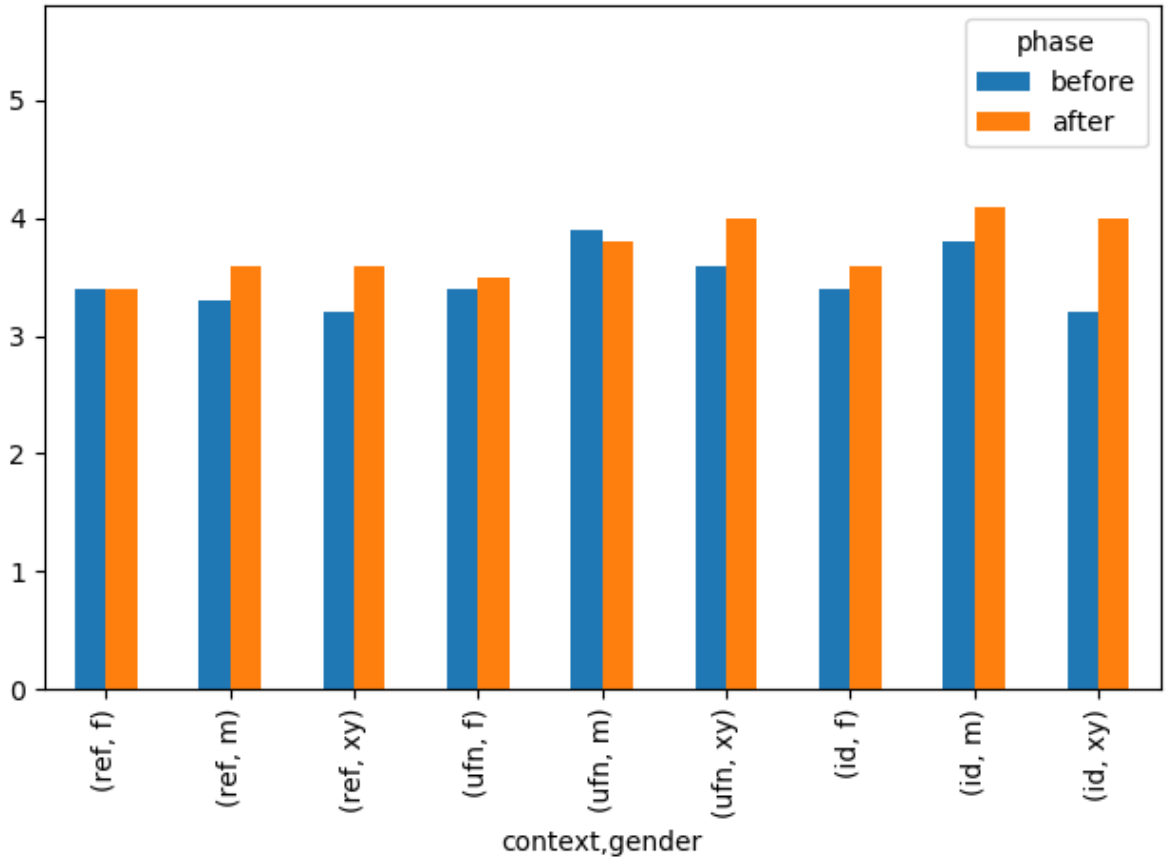

Fig. 2. This diagram shows the mean values per scenario and gender (calculated over all questions) before and after the student activity.

The observations by the teachers and staff

Observations by the staff

Some general observations during the introduction, regardless of context, was that the boys were more active than the girls in the beginning and the boys tended to answer the questions directly without raising their arm. The girls became more active at the end of the introduction and they tended more to raise an arm in order to get attention. However, these were general observations and could vary between groups as well as within a group.

The film that was observed to create most discussions was the film about industry robots, which were followed by a discussion with the students about the usefulness of robots in the industry, as well as negative aspects such as people losing their jobs. In particular the girls raised these questions. Most pictures and films were viewed with interest by both girls and boys with no observable differences.

During the guided programming no big differences were observed. In some cases, the boys were more eager to play with the robots and e.g. try out speed as a parameter.

Two different strategies how to solve the following programming tasks were observed. One of the strategies was a trial and error approach during which the students continuously moved between coding at the computer and testing at the robotics table. In the second approach the groups started with trying to solve the complete task by the computer before testing it at the robotics table. Both girls and boys used both strategies but boys tended to use the first approach to a greater extent, whereas more girls used the second approach.

In the end when each group presented and showed the task of their robot, everyone was enthusiastic to show their programming skills. No general differences were seen between the genders.

Observations by the teachers

The teachers that accompanied the pupils also made observations. Some quotes from participating teachers:

> *"Greater interest (for the task) among girls who worked with other girls compared to girls in mixed groups (gender)"*
>
> *"The boys played a longer time with the robots"*
>
> *"The boys asked more questions to the tutor"*
>
> *"Girls were working systematically"*
>
> *"Girls are a little more structured, planning-programming, testing. Boys-programming,(testing). Often traditional stereotypes."*
>
> *"Boys are "done" faster and the girls are adding more effects and tasks to the robot"*
>
> *"Sometimes one could feel the girls were waiting for their turn after the boys at the robot table, just like it would an unwritten law to let the boys be first in line"*

The interview of the tutor

The main findings from the interview with the tutor concern her experience of the activity itself, and of the students in relation to the activity. The tutor also summoned her own learning from participating in the project.

The tutor's experience of the activity

The pictures and films shown during the introduction, that the tutor found most motivating, had the following characteristics: contained equal number of men and women, showed some current research in the area, created a discussion with the students about the ethics of robots taking or creating jobs, or told about important female historical persons. She also experienced that it helped to catch the students attention if they could relate to the application, or if it was a cool, exciting film.

During the programming task the tutor found it motivating when the students could refer to the robots with short names which explained the use of it, such as hospital-robot, inventory-robot and garbage-robot.

> *"And that was, it was great fun because it really felt, they really bought those applications. And I think it inspired them. It felt so."*
>
> *"One could hear the way they talked that they connected it to something real"*

She also found it motivating to introduce the task with the sentence 'Your name is Ada and you are a manager for a big hospital. Your task is to…'.

> *"When I introduced it, it felt like linking to earlier parts of the activity and.. So that was great. Just that 'You are called Ada and your task is ...'*
>
> *I thought when I read that. Oh, maybe that will be a bit stiff, but it was not. It became very natural"*

The tutor's experience of the students in relation to the activity

The tutor did not experience any difference between how the boys and girls engaged in the programming task, the problems they encountered, how they chose to solve the task, what questions they asked to solve the task and the result they achieved.

However, she experienced some slight differences between boys and girls in a few situations. Boys more often talked about the speed of the robot, and wondered, and examined, how fast it could move. Boys asked about artificial intelligence. That question never came from a girl. Boys were often more active during the introductory discussion. The girls somewhat more often tried to solve the problem in a 'correct' way, and to do as they were told by the tutor as they wanted to do the task well.

In order to engage and interest all students the tutor emphasized the importance to have enough time for the programming task, to be able to give all students the help they need. She also found it important for the students to be able to show their robot and the task it can perform at the end of the activity. She pointed out that we should inform about programming as an occupation and that it will be a shortage of programmers in the future.

The tutor's own learning from the project

During the project the tutor reflected on, and implemented an activity repeatedly in a structured way. As a result she learned some practical strategies to handle specific situations during the activity.

She described how the project has given her new experience and made her reflect more on how to be more including. Role models, and realizing the usefulness of a learning activity are important for everybody, not just for girls.

The tutor had a strong belief in the importance of role models based on her own experiences as a student and tutor, which was confirmed during the project.

> *"And just that one can recognize oneself, that someone else has done it before, that I think is really important"*

4. Significance of results

The statistics from the questionnaires don't give a clear answer to the question on how the attitudes of the students were affected. Some main results from the statistics are: students are in general aware of the fact that technology is important, they use it on a daily basis and they think it is fun. They are active during technology lessons in school and they consider themselves as rather talented in this subject. But they do not seem to be interested in working with technology nor programming as adults and they are not eager to learn about technical things that, e.g., are broken at home. There seems to be a lack of role models coming from the world of technology. Boys have overall a slightly more positive attitude towards the technology subject than girls.

The student activity at Vetenskapens Hus have, in all but one case, a positive effect on the mean value response. It is only for boys in the 'usefulness' scenario that the shift is negative. The shift is small, but still higher than the mean value response for the girls in the same scenario.

From the observations of the activity we find slight differences between boys and girls and how they approach the task to program a robot. The boys are more eager to ask questions as soon as the get stuck, they are also more prone to take advantage of the test table to try out their robots during the programming process. The girls seem to be more patient doing the programming before they try out the robot. In a mixed classroom there may be a more quiet group of students, both girls and boys, and therefore the tutor need to be aware of that. The implementation of usefulness and cultural identity seem to have no observable effects on either the girls or the boys.

During the interview the tutor described that emphasising usefulness, and placing the knowledge in a broader context with real applications was motivating for her as a tutor. The tutor strongly believed that role models are important to inspire young people, and to show them someone to identify with.

The opportunity to repeatedly guide the same student activity and to make minor changes to the layout between the occasions made her reflect on, and try out strategies to handle practical problems in the teaching situation. She also pointed out that the project made her reflect on, and be more observant on the issue of inclusion.

A more motivated, confident and observant tutor most probably results in a better learning experience for the students.

Even though our first intentions were to increase the interest among girls by emphasising the purpose and different applications of the knowledge, and by doing the instruction material gender neutral by for example highlighting both female and male role models, it turned out to have positive effects on all students, irrespective of gender.

5. Next steps

This study has resulted in both practical, detailed changes of a specific school activity as well as creating time and space for reflection on general approaches in all our activities.

Examples of practical issues considered in developing this school activity are how to use a clearer language, relevant and inclusive pictures and movies in the presentation of the task, placement of the computer with the presentation for the tutor, placement of tables and chairs for the students, and grouping of boys and girls.

The experiences from this work will be shared with both the permanent staff and the tutors at Vetenskapens Hus. These findings will be useful for the permanent staff when developing new and existing activities, and for the tutors to get specific teaching tools and strategies, and to be more aware in their teaching situations

We will continue to observe and further develop other school activities in a similar way as was done in this study with the purpose that they will become more inclusive.

6. Reflections

The question of how to include as many students as possible, and especially girls, is a question we have been thinking of for a long time. This project made it possible for us to study this in a more structured way, with the support of researchers in the field.

We valued to be three persons working together in the project to share experiences and ideas.

During the project we reached some practical knowledge on one of our activities and reflected on how to present it in a more gender neutral way. The work with the project has given us a language and practical tools to continue this work also in other activities.

Most valuable for us has been the time we set aside for reflection.

References

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Appendices:

Appendix 1: Student questionnaire

Tack för att du besvarar frågorna nedan!

Jag är: ☐ Flicka

☐ Pojke

☐ Annat/vill ej uppge

Jag går i klass (ringa in rätt alternativ): 7A 7B 7C 7D 7E Annat: ____

Hur tänker du kring teknik och programmering? (sätt ett kryss i den ruta du tycker stämmer bäst)

	1 (håller inte alls med)	2	3	4	5 (håller helt med)
Jag använder ofta teknik i min vardag					
Jag vill arbeta inom ett tekniskt yrke när jag är vuxen					
Jag tycker teknik är tråkigt					
Teknik är viktigt för att vi ska få ett bra, och hållbart samhälle					
Jag tycker teknik är intressant					
Jag håller på med någon form av teknik på fritiden					
Jag är aktiv på tekniklektionerna					
Jag är duktigt i teknikämnet i skolan					
Jag blir inspirerad av andra som är intresserade av, och duktiga på teknik					
Fördelarna med teknik överväger nackdelarna					

	1 (håller inte alls med)	2	3	4	5 (håller helt med)
Jag kan inte tänka mig att arbeta med programmering när jag blir vuxen					
Programmering är viktigt för att vi ska få ett bra, och hållbart samhälle					
Jag tycker det är svårt med teknik i skolan					
Jag vill arbeta med något meningsfullt, som bidrar till ett bättre samhälle, när jag blir vuxen					
När något har gått sönder hemma så vill jag gärna ta reda på varför					
Teknikutveckling behövs för att uppnå FNs globala mål (att avskaffa extrem fattigdom, minska ojämlikheter och orättvisor, att lösa klimatkrisen)					

Har du några kommentarer eller tankar kring frågorna ovan får du gärna skriva dom här.

TACK!

Abbreviation key with and flip indication

Abbreviation	Question	Flipped
daily	I use technology daily	0
workTech	I want to work with technology as an adult	0
fun	I think technology is boring	1
impSoc	Technology is an essential part of a good and sustainable society	0
interesting	I think technology is interesting	0
freeTime	I am engaged in technology in my free time	0
activeSchool	I am active during technology lessons in school	0
talentSubj	I am talented in the subject technology in school	0
inspByOthers	I get inspiration by people interested and talented in technology	0
benefits	The pros of technology is higher than the cons	0
workProg	I do not want to work with programming as an adult	1
prgImport	Technology is an essential part of a good and sustainable society	0
simpleSchool	I think technology is a demanding subject in school	1
workMeaning	I want to work with something meaningful and contribute to a better society as an adult	0
repairHome	When something is broken at home I want to learn why	0
goalUN	Evolution of technology is necessary to end poverty, protect the planet and ensure prosperity for all	0

Table 2. This table shows the abbreviations of the question names. The rightmost column indicates if the question is flipped or not.

Abbreviation key to question in swedish

Abbreviation	Question in swedish
daily	Jag använder ofta teknik i min vardag.
workTech	Jag vill arbeta inom ett tekniskt yrke när jag är vuxen.
fun	Jag tycker teknik är tråkigt.
impSoc	Teknik är viktigt för att vi ska få ett bra och hållbart samhälle.
interesting	Jag tycker teknik är intressant.
freeTime	Jag håller på med någon form av teknik på fritiden.
activeSchool	Jag är aktiv på tekniklektionerna.
talentSubj	Jag är duktigt i teknikämnet i skolan.
inspByOthers	Jag blir inspirerad av andra som är intresserade av, och duktiga på teknik.
benefits	Fördelarna med teknik överväger nackdelarna.
workProg	Jag kan inte tänka mig att arbeta med programmering när jag är vuxen.
prgImport	Programmering är viktigt för att vi ska få ett bra och hållbart samhälle.
simpleSchool	Jag tycker det är svårt med teknik i skolan.
workMeaning	Jag vill arbeta med något meningsfullt, som bidrar till ett bättre samhälle, när jag blir vuxen.
repairHome	När något har gått sönder hemma så vill jag gärna ta reda på varför.
goalUN	Teknikutveckling behövs för att uppnå FNs globala mål (att avskaffa extrem fattigdom, minska ojämlikheter och orättvisor, att lösa klimatkrisen).

Table 3. This shows the original questionnaire question in swedish for the abbreviated questions.

Appendix 2: Observation protocol

Observationsfrågor som stöd till observatör under passet

Jag är: ☐ Medföljande ämneslärare

☐ Personal från Vetenskapens Hus

☐ Annat: _____

Datum:

Klass (ringa in rätt alternativ): 7A 7B 7C 7D 7E Annat: ____

Anteckna fritt vad du observerar. Frågorna nedan är bara ett stöd i dina observationer.

<u>Interaktion och växelverkan</u>

- Grad av interaktion/växelverkan (mängden frågor; diskussioner) mellan
  - Elev – elev
  - Elev – besöksledare
- Såg du någon skillnad på hur pojkar och flickor tog sig an uppgiften?
- Vilken uppgift valde flickorna och pojkarna?

<u>Förståelse</u>

- Förstod eleverna vad de skulle göra i de olika momenten? Kunde de göra det de förväntades göra?
- Fastnade eleverna i några moment? Vad behövde de hjälp med?

<u>Övrigt (till lärare som känner eleverna)</u>

- Såg du något du inte förväntade dig
- Är det samma elever som brukar vara aktiva, som är aktiva?

<u>Övriga kommentarer</u>

Appendix 3: Interview guide

Nyckelfrågor:

1. Hur upplevde du de olika uppläggen av skolprogrammet? (ppt:en och uppgifterna)

    - Följ upp alla tre uppläggen.
    - Är det något särskilt moment i upplägget som du upplever som svårare och där du känner att du tappar barnen?
    - Ser du ett annat upplägg som skulle lösa detta?

2. Upplevde du som besöksledare någon skillnad på hur flickor och pojkar tog sig an uppgifterna?

    Upplevde du någon skillnad på
    - självförtroende?
    - koncentration?
    - att klara att genomföra uppgiften?
    - intresse?

3. Hur tog sig elevernas intresse uttryck under besöket?

    - Var det någon skillnad på pojkar och flickor?
    - Hur upplevde du de olika elevgrupperna?
    - Vilka likheter fanns mellan de olika grupperna?
    - Hur skiljde sig grupperna åt?

4. Vilka verktyg och strategier använder du dig av för att få arbetsro i elevgruppen så att du hinner se och hjälpa alla eleverna?

    - Är det någon annan strategi som du har funderat över?
    - Hur kan man få eleverna att känna sig delaktiga och intresserade ’under kontrollerade former”?

5. De senare två versionerna av upplägget av skolprogrammet har fokus på *användbarhet* och *kulturell identitet* med avseende på teknik. Vad lägger du själv in i dom två begreppen?

    - Vad är skillnaderna mellan begreppen?
    - Likheterna?

6. Vilket upplägg är mest motiverande för dig som besöksledare, och varför?

    - Ser du något problem med något av uppläggen?

7. Om du fick möjlighet att göra om skolprogrammet helt och hållet, hur skulle det då se ut?

- Praktiskt
- Idealt

8. Av de skolprogram inom teknik du kan — vilket (om något) är mest tilltalande för tjejer?
    - Varför?
    - Finns det något som man kan ”kopiera” till andra skolprogram?

Appendix 4: Results from statistical analysis of the student questionnaires

Ranking table (mean values over all scenarios and gender)

#	Questions	Meanvalues
1	daily	4.4
2	fun	4.1
3	impSoc	4.0
4	activeSchool	4.0
5	simpleSchool	3.9
6	benefits	3.9
7	talentSubj	3.8
8	workMeaning	3.7
9	goalUN	3.7
10	interesting	3.7
11	prgImport	3.7
12	freeTime	3.5
13	WorkProg	3.4
14	inspByOthers	2.9
15	repairHome	2.7
16	workTech	2.7

Table 4. This shows the mean values of the responses calculated over all gender and scenarios.

Mean values and standard deviation over all scenarios

f before	m.v.	f after	m.v.	m before	m.v.	m after	m.v.
daily	4.3	daily	4.3	daily	4.6	daily	4.5
impSoc	4.0	fun	3.9	fun	4.2	fun	4.3
fun	3.9	workMeaning	3.9	impSoc	4.2	benefits	4.2
simpleSchool	3.9	simpleSchool	3.9	activeSchool	4.0	activeSchool	4.2
workMeaning	3.9	activeSchool	3.9	interesting	4.0	freeTime	4.1
activeSchool	3.8	impSoc	3.8	benefits	4.0	impSoc	4.1
goalUN	3.7	talentSubj	3.7	talentSubj	4.0	simpleSchool	4.0
talentSubj	3.7	benefits	3.7	simpleSchool	3.9	interesting	4.0
benefits	3.5	prgImport	3.7	goalUN	3.8	talentSubj	4.0
prgImport	3.4	goalUN	3.6	freeTime	3.8	prgImport	3.8
workProg	3.2	interesting	3.4	prgImport	3.7	goalUN	3.8
interesting	3.2	workProg	3.3	workProg	3.6	workMeaning	3.7
freeTime	3.1	freeTime	3.2	workMeaning	3.5	workProg	3.5
inspByOthers	2.4	inspByOthers	2.7	workTech	3.1	inspByOthers	3.2
repairHome	2.4	repairHome	2.5	inspByOthers	3.1	workTech	3.2
workTech	2.1	workTech	2.4	repairHome	2.9	repairHome	3.0

Table 5. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the mean values of respective response.

f before	std.	f after	std.	m before	std.	m after	std.
freeTime	1.4	freeTime	1.3	repairHome	1.4	repairHome	1.4
repairHome	1.4	repairHome	1.3	goalUN	1.2	workProg	1.4
workProg	1.2	talentSubj	1.2	workProg	1.2	workMeaning	1.2
activeSchool	1.2	workMeaning	1.2	inspByOthers	1.2	freeTime	1.2
prgImport	1.2	goalUN	1.1	freeTime	1.2	inspByOthers	1.2
benefits	1.2	workProg	1.1	prgImport	1.2	goalUN	1.1
talentSubj	1.2	activeSchool	1.1	simpleSchool	1.1	workTech	1.1
goalUN	1.2	inspByOthers	1.1	workTech	1.1	prgImport	1.1
interesting	1.1	prgImport	1.1	interesting	1.1	talentSubj	1.1
workMeaning	1.1	interesting	1.1	talentSubj	1.1	activeSchool	1.0
inspByOthers	1.1	benefits	1.0	workMeaning	1.1	interesting	1.0
daily	1.1	daily	1.0	impSoc	1.1	impSoc	1.0
impSoc	1.0	fun	1.0	activeSchool	1.0	fun	1.0
simpleSchool	1.0	impSoc	1.0	benefits	1.0	simpleSchool	1.0
workTech	0.9	simpleSchool	0.9	fun	1.0	benefits	0.9
fun	0.8	workTech	0.9	daily	0.8	daily	0.9

Table 6. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the standard deviation of respective response.

Mean values and standard deviation for the ‘reference’ scenario

f before	mean.	f after	mean.	m before	mean.	m after	mean.
activeSchool	4.0	daily	4.3	prgImport	4.0	fun	4.3
fun	3.9	impSoc	3.9	fun	3.8	activeSchool	4.2
impSoc	3.9	activeSchool	3.9	impSoc	3.7	impSoc	4.1
workMeaning	3.9	workMeaning	3.8	daily	3.7	daily	4.0
simpleSchool	3.8	fun	3.8	talentSubj	3.7	benefits	3.8
daily	3.7	benefits	3.7	workMeaning	3.4	talentSubj	3.8
talentSubj	3.6	simpleSchool	3.7	activeSchool	3.4	workMeaning	3.7
prgImport	3.6	prgImport	3.7	simpleSchool	3.3	freeTime	3.7
goalUN	3.5	goalUN	3.7	freeTime	3.3	interesting	3.6
workProg	3.4	talentSubj	3.6	goalUN	3.2	simpleSchool	3.5
interesting	3.4	interesting	3.2	benefits	3.1	prgImport	3.5
benefits	3.0	workProg	3.1	inspByOthers	3.1	workProg	3.4
freeTime	2.9	freeTime	3.0	workProg	3.0	goalUN	3.3
inspByOthers	2.8	inspByOthers	2.6	interesting	2.9	inspByOthers	3.2
repairHome	2.6	repairHome	2.3	workTech	2.5	repairHome	2.9
workTech	2.1	workTech	2.3	repairHome	2.4	workTech	2.5

Table 7. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the mean values of respective response.

f before	std.	f after	std.	m before	std.	m after	std.
goalUN	1.5	freeTime	1.4	repairHome	1.5	repairHome	1.6
inspByOthers	1.4	workProg	1.3	daily	1.3	workMeaning	1.5
prgImport	1.4	repairHome	1.2	workProg	1.3	workProg	1.5
workMeaning	1.4	fun	1.2	talentSubj	1.2	daily	1.4
interesting	1.4	inspByOthers	1.2	simpleSchool	1.2	prgImport	1.3
workProg	1.3	workMeaning	1.1	fun	1.2	freeTime	1.3
repairHome	1.2	interesting	1.1	impSoc	1.0	inspByOthers	1.3
impSoc	1.2	talentSubj	1.1	workMeaning	1.0	impSoc	1.2
daily	1.2	goalUN	1.0	activeSchool	1.0	interesting	1.2
freeTime	1.2	simpleSchool	1.0	prgImport	1.0	goalUN	1.1
benefits	1.1	benefits	1.0	goalUN	1.0	benefits	1.1
workTech	1.0	impSoc	1.0	inspByOthers	0.9	simpleSchool	1.0
simpleSchool	1.0	activeSchool	1.0	freeTime	0.9	talentSubj	0.9
activeSchool	1.0	workTech	0.9	benefits	0.8	workTech	0.9
talentSubj	1.0	prgImport	0.8	interesting	0.8	fun	0.8
fun	0.9	daily	0.8	workTech	0.7	activeSchool	0.7

Table 8. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the standard deviation of respective response.

Mean values and standard deviation for 'usefulness' scenario

f before	mean.	f after	mean.	m before	mean.	m after	mean.
talentSubj	4.3	talentSubj	4.3	daily	4.6	daily	4.6
daily	4.2	daily	4.2	activeSchool	4.4	benefits	4.3
activeSchool	4.2	activeSchool	4.2	talentSubj	4.3	talentSubj	4.2
simpleSchool	4.0	simpleSchool	4.0	fun	4.3	activeSchool	4.2
impSoc	4.0	workMeaning	3.8	simpleSchool	4.2	simpleSchool	4.1
fun	3.9	fun	3.8	impSoc	4.1	freeTime	3.9
workMeaning	3.8	workProg	3.5	interesting	4.1	fun	3.9
benefits	3.8	prgImport	3.4	benefits	4.0	interesting	3.8
goalUN	3.6	impSoc	3.4	goalUN	3.8	impSoc	3.8
prgImport	3.2	benefits	3.4	workProg	3.7	workMeaning	3.8
interesting	3.1	goalUN	3.3	workMeaning	3.6	goalUN	3.8
workProg	2.9	interesting	3.3	freeTime	3.6	prgImport	3.6
freeTime	2.7	freeTime	3.1	prgImport	3.5	repairHome	3.4
inspByOthers	2.6	inspByOthers	2.7	repairHome	3.4	workProg	3.3
repairHome	2.5	repairHome	2.5	inspByOthers	3.0	workTech	3.2
workTech	2.1	workTech	2.4	workTech	3.0	inspByOthers	3.0

Table 9. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the mean values of respective response.

f before	std.	f after	std.	m before	std.	m after	std.
repairHome	1.6	repairHome	1.5	repairHome	1.3	workProg	1.6
freeTime	1.4	freeTime	1.3	freeTime	1.3	freeTime	1.3
workProg	1.4	prgImport	1.3	inspByOthers	1.3	repairHome	1.3
benefits	1.3	workMeaning	1.3	workProg	1.3	workMeaning	1.3
goalUN	1.2	goalUN	1.2	goalUN	1.2	inspByOthers	1.2
workMeaning	1.2	daily	1.2	workTech	1.2	fun	1.2
prgImport	1.2	inspByOthers	1.1	prgImport	1.1	goalUN	1.2
daily	1.2	talentSubj	1.0	interesting	1.1	workTech	1.1
interesting	1.2	workProg	1.0	workMeaning	1.1	simpleSchool	1.1
inspByOthers	1.2	impSoc	1.0	simpleSchool	1.1	activeSchool	1.0
simpleSchool	1.1	activeSchool	1.0	impSoc	1.0	prgImport	1.0
activeSchool	1.1	benefits	1.0	benefits	0.9	interesting	1.0
workTech	0.8	interesting	0.9	fun	0.9	impSoc	1.0
talentSubj	0.8	workTech	0.9	activeSchool	0.9	benefits	0.9
impSoc	0.8	simpleSchool	0.8	talentSubj	0.8	talentSubj	0.9
fun	0.8	fun	0.8	daily	0.6	daily	0.7

Table 10. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the standard deviation of respective response.

Mean values and standard deviation for ‘identity’ scenario

f before	mean.	f after	mean.	m before	mean.	m after	mean.
daily	4.6	daily	4.5	daily	4.7	daily	4.8
impSoc	4.1	workMeaning	4.1	fun	4.3	fun	4.6
fun	4.0	impSoc	4.1	impSoc	4.3	freeTime	4.5
workMeaning	3.9	fun	4.1	interesting	4.2	benefits	4.4
simpleSchool	3.9	simpleSchool	4.0	benefits	4.1	interesting	4.4
goalUN	3.8	benefits	3.9	freeTime	4.0	simpleSchool	4.3
freeTime	3.6	prgImport	3.9	goalUN	3.9	impSoc	4.3
prgImport	3.6	goalUN	3.8	simpleSchool	3.9	prgImport	4.2
benefits	3.5	interesting	3.7	activeSchool	3.8	activeSchool	4.1
workProg	3.4	activeSchool	3.6	workProg	3.8	goalUN	4.1
activeSchool	3.4	freeTime	3.4	talentSubj	3.8	workProg	3.9
interesting	3.2	workProg	3.4	prgImport	3.7	talentSubj	3.8
talentSubj	3.1	talentSubj	3.2	workMeaning	3.3	workMeaning	3.7
repairHome	2.2	inspByOthers	2.8	workTech	3.3	workTech	3.6
workTech	2.1	repairHome	2.7	inspByOthers	3.1	inspByOthers	3.5
inspByOthers	2.1	workTech	2.4	repairHome	2.7	repairHome	2.8

Table 11. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the mean values of respective response

f before	std.	f after	std.	m before	std.	m after	std.
activeSchool	1.4	talentSubj	1.3	repairHome	1.5	talentSubj	1.3
talentSubj	1.3	activeSchool	1.3	prgImport	1.3	repairHome	1.3
freeTime	1.3	freeTime	1.2	goalUN	1.3	activeSchool	1.3
repairHome	1.2	repairHome	1.2	inspByOthers	1.2	inspByOthers	1.1
impSoc	1.1	goalUN	1.2	talentSubj	1.2	workProg	1.0
prgImport	1.1	prgImport	1.1	simpleSchool	1.2	workTech	1.0
workProg	1.1	workMeaning	1.1	freeTime	1.1	workMeaning	1.0
benefits	1.0	benefits	1.1	impSoc	1.1	goalUN	1.0
goalUN	1.0	interesting	1.1	workTech	1.1	prgImport	0.9
simpleSchool	0.9	workProg	1.0	workProg	1.1	impSoc	0.9
interesting	0.9	inspByOthers	1.0	workMeaning	1.1	benefits	0.8
workTech	0.9	daily	1.0	activeSchool	1.1	interesting	0.8
workMeaning	0.9	simpleSchool	0.9	interesting	1.0	freeTime	0.8
fun	0.8	fun	0.9	benefits	1.0	fun	0.8
daily	0.8	workTech	0.9	fun	1.0	simpleSchool	0.8
inspByOthers	0.7	impSoc	0.8	daily	0.7	daily	0.4

Table 12. This table shows the ranking of the questions for girls before, girls after, boys before, boys after the student activity in terms of the standard deviation of respective response.

Difference

Scenario	gender	before	after	diffference	difference [%]
ref	f	3.4	3.4	0.0	0
ref	m	3.3	3.6	0.3	6
ref	xy	3.2	3.6	0.4	8
ufn	f	3.4	3.5	0.0	0
ufn	m	3.9	3.8	-0.1	−2
ufn	xy	3.6	4.0	0.5	10
id	f	3.4	3.6	0.2	4
id	m	3.8	4.1	0.3	6
id	xy	3.2	4.0	0.8	16

Tabl 13: This table shows the mean value and its difference for scenario and gender.