Missing information

Anything you think you will address in the next phase of case studies based on what you learned in this study?

In the next phase of case studies, ovos will make sure to use the COMnPLAYer app as part of the activities; not only for students to download afterwards.

For the first phase of case studies, which took place in February, the app was not yet available in German and therefore separate questions were developed for the pre- and post-activity survey. However, these were manually filled out by the students before and after the activity.

Furthermore, it would be ideal to find an activity that is stretched out over a whole day or at least more than four hours as the children appeared slightly overwhelmed by all the things they had to do, such as listening to the introduction and guidance of the facilitator, the introduction by ovos, the pre-and post-surveys and the interviews during the activities (which distracted the children from their work for which they had little time anyhow).

In this context, we think that observing the children and facilitators might be an additional method to go forward.

Case study report

1. Partner

Partner name: ovos media GmbH
This is the Case Study Report for Ovos as part of the COM'n'PLAY-Science Horizon2020 Project delivered in cooperation with Games Institute Austria and the DaVinci Lab.
Objectives: objectives for this particular study, possibly a research question for this case study (briefly)
Case selection:
The report covers one workshop session of a project called Youth Hackathon (YH) that took place in Austria. The YH wants to raise interest in science learning and computational thinking with Austrian students.
A second part of the report presents data from surveys taken with the COMnPLAYer app.

2. Abstract

Background: The report covers one workshop session of a project called Youth Hackathon (YH) taking place Austria in order to raise interest in science learning and computational thinking with Austrian students. The project was chosen as it offers an interesting case of bringing together coding and game design to enhance the interest in science (STEM) learning. Additionally, it shows how an informal learning project tries to influence and change formal learning in Austrian high schools. Besides that, surveys were

taken from students who also took part in the Youth Hackathon by doing surveys in the Ovos COMnPLAY app.
Research Areas/Questions: Can interest in science learning and computational thinking be leveraged by bringing projects like the YH to Austrian schools?
Methodology:
Findings: The project gives a first insight and a positive learning experience in connection with coding and game design. It helps create and reinforce a positive image of coders and game designers in the eyes of the students. It also shows students that following a career in coding or game design is a possibility that might be also open to them. In general, you can say that a workshop or project like Youth Hackathon is well suited for activating and fostering the science capital in students.

3. Method

1. Overview and context

When the study was done: 26 April 2019 (8 am to 12 pm)
Where: Vienna, Austria
Setting: Non-formal and informal in a formal (classroom) setting; school computer lab with desks arranged facing the teacher desk in front, roughly three desks adjacent in one row: children seated in teams of two (two students seated alone on request) in front of one computer at which they work together
Type of activity: Coding

2. Participants

Participants: 24 children / 1 facilitator / 2 researchers
Age of children: 13 (eight students) and 14 (sixteen students)
Gender: 15 male students, 6 female students, 3 unspecified gender
Language: German
Background of participating children:
The students that were interviewed as part of the case study do not have any computer science subject at school at this level. They start out with it later. The other subjects that are part of STEM like mathematics, physics, biology, geography and the like do not cover any computer science at all. Many students came into the workshop without any knowledge in coding besides the small amount of knowledge they gained in the same workshop a year before and still remembered.
Background of facilitator(s): All have jobs in technology-related professions. They had experience in coding and in giving coding workshops. Some of the facilitators did not bring much experience in doing the Youth Hackathon workshops. None of them had experience in game design or in teaching at schools.
Selection process: The students were all from one class and they knew each other before the project started. The participants were chosen as part of the Youth Hackathon project. The project leaders gave the research team several dates for workshops in the same school and one was chosen to be studied. The choice was not based on specific factors within the group, but on the availability of the research team at the time of one of the workshops. There are more than a hundred of these workshops as 103 school classes are participating in this run of the Youth Hackathon, which is happening for the second time.
The students taking part in the Ovos app survey took part in the Youth Hackathon project and filled in the survey in the app in connection with the 4Gamechangers Festival.

Other: Whatever else is relevant

3. Procedure

Number of occurrences: With the same group. The whole project took 1 half day from start to finish.
Duration: The session with children took 4 hours**.**
Phases and schedule:
The case study itself used two surveys to research the informal learning happening within the workshop, one before and one right after the workshop was held. Additionally, we did short team interviews with the participants while they were in the workshop. The facilitator also filled in a survey and two other facilitators of the same project handed one in, too. So, we received 3 facilitator surveys, 24 student surveys from before the workshop and 24 from after the workshop. Additionally, we recorded 13 interviews with the students.
Besides that, other students took part in a survey integrated in the Ovos COMnPLAYer app. They answered 16 questions concerning their experience with STEM learning and the science capital they acquired before and throughout the use of the app.

Group work / individual work:
As part of the Youth Hackathon workshops, the students worked alone or in groups of two or three. The first phase of the workshop gave a traditional presentation that introduced the students to the relevant topics. The game design phase of the workshop was done in groups.
The survey in the app was taken by individual students.

Type of facilitation:
The facilitator switched between the roles of helper and supervisor. He helped the students when they had questions and answered them or showed them where they could find the answers. If this wasn't the necessary, he switched to the role of supervisor of the activity.

Instructions to participants:
There was an initial ninety-minute presentation to introduce the students to the topic, the project lead provided the students with tutorial videos on common problems in designing games with Scratch and then in the design phase of the workshop the facilitator gave help and assistance where needed.

4. Resources

What materials were used how and why were they chosen: The tools and material used within the Youth Hackathon project are provided by the project lead DaVinci Lab and include the website for the project, which offers learning material, especially videos that explain the use of Scratch for specific tasks in game programming. The facilitator also offers a presentation and a talk to introduce students to the topics of Scratch and of game design.

Additionally, every team (two students in a team) is provided with a computer (the workshop was held in one of the computer labs of the school) as well as a copy of the free Scratch programming tool. The students are shown several examples of existing Youth Hackathon games to find out about what they could do and what seems reasonable in questions of design and scope of their game. Every class has only

one workshop, but the class that took part in this case study already participated in the Youth Hackathon for the second time. Therefore, many of the students knew what to expect before.

In the surveys taken as part of the app the students only used the COMnPLAYer app on smartphones or computers. They worked alone and did the surveys in class or at the 4GameChangers Festival with their teachers helping if needed.

5. Data collection

What kind of data was collected:

The case study itself used two surveys to research the informal learning happening within the workshop, one before and one right after the workshop was held. Additionally, short team interviews with the participants while they were in the workshop were done. In total, we received 3 facilitator surveys, 24 student surveys from before the workshop and 24 from after the workshop. Additionally, we recorded 13 interviews with the students. The combination of before-and-post-surveys and short interviews plus facilitator survey seemed appropriate for the study, as the program of the workshops is dense and there is not much time for additional things to do.

The surveys offered five possibilities to answer most of the questions, completely untrue, mostly untrue, partly true, mostly true and completely true. Some questions asked for written answers, two in the pre-survey (No. 8 and no. 15) and seven in the post-survey (No. 6, 7, 8, 11, 13, 14 and 15).

The first two questions about age and gender gave different possibilities to answer, i.e. specific age and gender. Question number 10 in the pre-survey about the time spent to play video games a week, offered the following possibilities to answer, 0-2 hrs, 2-4, 4-10, 10-20 and ‘more’. With all of the answers, where it seemed appropriate (besides the first two of course), more than one answer was possible.

The surveys and interviews contained the following questions:

<u>Students pre-survey</u>

1. How old are you?
2. What gender do you identify as the most?
3. Do you have a big interest in STEM?
4. Is this interest fostered by your school?
5. Do you ever use (informal) learning opportunities outside school to follow this interest?
6. Are you interested in coding?
7. Have you collected any experience in this field so far?
8. In which context did you collect this experience?

9. Are you interested in video games?
10. How much time per week do you spend on playing video games?
11. Have you collected any experience in game design so far?
12. Have you ever worked with Scratch before?
13. Are you interested in a job connected to coding?
14. Are you interested in a job connected to game design?
15. What are your expectations for the workshop?

Students post-survey

1. Did you enjoy the project?
2. Would you like to participate in another Youth Hackathon?
3. Would you like to participate in other projects in STEM?
4. Were you able to implement former knowledge in science and technology within the workshop?
5. Were you able to implement former knowledge in STEM subjects within the workshop?
6. What have you learned about coding within the workshop?
7. What have you learned about game design within the workshop?
8. What was especially challenging for you in the workshop?
9. How well did you get along with Scratch?
10. Were you able to finish your prototype?
11. What would you like to add to the workshop?
12. Did the workshop raise or foster an interest in you about coding or game design?
13. What would you like to change in a future workshop?
14. What did you learn about game designers in the workshop?

15. Having done the workshop, where do you see specific challenges for people working in coding or game design?

Student interviews

1. Personal information
2. Interest in STEM
3. What are you working on right now?
4. How are you getting along with the challenge of designing?
5. How do you evaluate the support by the facilitator?
6. What is the biggest challenge for your team in the game design process?

Trainer survey

1. How old are you?
2. What gender do you identify as the most?
3. Do you work within the area of science and technology?
4. Do you work with schools outside of the project?
5. Do you work in other science learning projects outside of this one?
6. What experience do you have in coding?
7. What experience do you have in game design?
8. For how long do you deal with video games outside of this project?
9. For how long do you work with Scratch already?
10. How many workshops within the Youth Hackathon have you facilitated already?
11. What is the biggest challenge with the workshops in your opinion?

12. What kind of school deficits have the greatest impact on the participants' performance in the workshop?

13. What would you add to the workshop?

14. What is the importance of such workshops for the participants' professional career in your opinion?

15. Is an offer such as the Youth Hackathon project especially suitable to fascinate girls for STEM subjects?

The surveys taken from the app users include several different approaches to answer the questions. The survey included in this report is called "Deine Meinung ist gefragt" (What is your opinion) - we ask for students' opinion and altogether 120 students answered the survey. In question 1 several different answers were possible. The questions for gender and age gave several options to choose from. Other questions offered six different options for answering, like 'very important, rather important, not very important, not important, no opinion and I don't know'.

The 16 questions were:

1. Before you start: Are you taking part in another workshop?
2. Where do you live?
3. What gender do you identify the most with?
4. How old are you?
5. How much do you agree to the following statement: The STEM subjects (Maths, Computer Science, Biology, Chemistry, Physics, Technology, …) are important for my daily life and my future. I…?
6. What do you think: Do your parents think that the STEM subjects are essential for your future?
7. Did your teachers encourage you to show interest in STEM subjects also in the future?
8. How useful do you think knowledge and skills learned from the STEM subjects will be for you to be qualified for many diverse professions?
9. Do you know someone who works in the area of STEM?
10. Who do you know who works in STEM?
11. Do you talk with others about STEM topics when you are not at school?
12. If you talk with someone outside of school about STEM topics, who are you talking with?
13. How often do you read books or magazines from the STEM area or research STEM topics on the internet?
14. How often do you go to museums, STEM facilities/science centres, or zoos/aquariums?
15. How often do you take part in courses or workshops for coding, making or other STEM topics?
16. How are you doing in STEM subjects at school?

Why this data:
e.g. Video data was seen more useful than only audio data as we are interested in multimodal data analysis.
The combination of before-and-post-surveys and short interviews plus facilitator survey seemed appropriate for the study, as the program of the workshops is dense and there is not much time for

additional things to do. This is why the students filled in part one of the surveys right before the workshop started and one right after, so that no time was taken away from the workshop programme.

In the second phase of the workshop (phase one presented the theory necessary for the workshop) the students worked on their game. We did not specifically delve deep into the concept of science capital in our surveys and interviews, but many of the questions aimed in that direction as they asked for prior knowledge of the students and their interest in doing more science activities after the workshop.

How much data was collected:
As part of the Youth Hackathon workshop, we received 3 facilitator surveys, 24 student surveys from before the workshop and 24 from after the workshop. Additionally, we recorded 13 interviews with the students.
The survey included in the app was done by 120 students separately from the Youth Hackathon workshop we covered.

6. Data analysis

The results were analyzed statistically. The surveys in the app were developed on the basis of the concept of science capital.

4. Results

The informal science learning project Youth Hackathon is supposed to introduce students to game design and coding with the coding language Scratch. The project homepage states that it tries to foster teamwork and communication, computational thinking, the fun in discovering and inventing, openness to technology and innovation and an interest in technology and science professional careers.

In the workshops itself the students get the opportunity to develop their own small Scratch games (alone or) in teams of two in a very limited amount of time. They are introduced to Scratch, to game design and to former games done in the project. Then, they are asked to create their own games with Scratch. The workshops only last about four hours, so after a 90-minute introduction to the topics, the students have 2.5 hours to come up with an idea and design their game in Scratch. Most of the challenges that arise when working with Scratch or designing a game are covered by tutorial videos on the project's website. Additionally, the facilitator is there for the students when they are designing their games. He answers questions and helps if needed. When the students are done with their game, they can upload it to the Youth Hackathon library and by this enter the competition of the Youth hackathon and might be invited to receive a prize at a final event, if their game finishes as one of the best three in the competition.

A board of specialists from the games industry plays the games and rates them accordingly. The learning process in the workshops is a mixed one, while the facilitator gives an introduction to the topics in a traditional way, explaining the concepts to the students and discussing them with them, as soon as the students start working on their ideas there is a shift in the learning that happens. Students are faced with a challenge that demands a number of single steps to be able to design their finished game. Students need to - as the website of the project states - work together and communicate, tinker, watch videos,

implement the knowledge from the videos into their designing process, come up with an idea and test its feasibility, implement the idea. They have to code in Scratch, develop a prototype and test it, reiterate on the process until they can hand their game in. As far as the surveys and the interviews showed, the students, mostly dependent on their prior knowledge, were challenged in different ways and in different situations or rather with different topics: Some struggled with an explicit task they set themselves in their game design, like implementing a score system or displaying the high score (three answers), others had difficulties with the coding itself, understanding the tutorial videos or rather the use of Scratch itself (six answers). One team struggled with working together (two answers), others did not find it easy to come up with a good idea for their game or implementing the idea they had (six answers). According to the surveys, the students said they learned how to use Scratch (five answers), how to code (two answers), how to design a game or parts of a game like sound, graphics, sprites (five answers). Some students also referred to the fact that game design is a difficult and complex challenge (six answers) while others said they learned something from the facilitator's presentation about the profession and the complexity and variety of tasks in game design (three answers).

One of our questions focused especially on the profession of game design and the students gave the following answers: They said that game design takes a lot of time and is a complex challenge (six answers), others said that it is an interesting job with a lot of different opportunities (two answers) and that there are many people needed to design games (one answer).

When it comes to the specific topic of coding the students' answers were as follows. They said they learned how to code a game (eight answers), they learned how to code in general (two answers), the different functions of Scratch (five answers) and the structure of simple games (one answer). They also said that they learned that coding is fun (one answer) and that it fosters creativity (one answer).

The science capital gained in such a project is probably hard to measure. It is in general, but the specific nature of the project makes it especially challenging. The students that were interviewed as part of the case study do not have any computer science subject at school at this level. They only start out with it later. The other subjects that are part of STEM like mathematics, physics, biology, geography and the like do not cover any computer science at all. Therefore, taking part in a project like the Youth Hackathon might be sometimes used as a 'remedy' to compensate the lack of computer science classes in this age group. According to this, many students came into the workshop without any knowledge in coding besides the small amount of knowledge they gained in the same workshop a year before and still remembered.

Questions number seven and eight in the pre-survey, and questions four and five in the post-survey asked for former knowledge brought to the workshop. The answers were as follows: In question number seven the students gave diverse answers, two saying they had not gained any experience in the topic of the workshop at all so far, seven said there was little experience, seven said it is partly true that they brought experience to the workshop, three said it is mostly true and only one student answered with completely true.

When asked for further information on where they got this experience from, the students' answers were mostly 'from the same project the year before' (thirteen answers). Others mentioned experience gained in the family (three answers), at school (one answer), on the internet (one answer) and one student answered that he actually learned to code in a course outside school

Question number four in the post-survey asked for former knowledge about science and technology and if it could be utilized in the project. The answers were mostly mixed again with an emphasis on the

middling answers. One answered with completely untrue , eight with mostly untrue, eight with partly true, six with mostly true and again only one (the students who learned coding outside of school) with completely true. The answers to question five in the post-survey were as follows. The students showed with a clear majority that there was no connection between the project and what they had learned before in their STEM subjects. Eight answers stated completely untrue, ten answers mostly untrue, four partly true and two students said mostly true. None of the students answered the question with completely true.

When it comes to fun and enjoyment, we think it is relatively safe to say that the students mostly liked the experience of taking part in the workshop as the answers to **questions one and two in the post-survey** show. In question number one of the post-survey, the students said that they enjoyed the workshop, none stated completely untrue or mostly untrue, one answer was partly true, while four students said mostly true and a majority of 19 students said that it was completely true. We received similar answers to question number two. None said completely or mostly untrue, one said partly true, five gave the answer of mostly true and 18 answered with completely true.

When students were asked whether they liked to take part in other science learning projects, the answers were not that overwhelmingly positive but still they asked for more projects in this area. No one chose completely untrue, four said mostly untrue, ten partly true, seven mostly true and three completely true.

Our survey also asked the participants if they had any experience with coding or game design before their participation in the workshop. Considering game design, the students gave the following answers: No one said that they had no experience at all before, five answers said there was almost no experience (mostly untrue), nine said partly true, eight mostly true and again one student answered with completely true.

Considering the experience with Scratch, the students' answers stated the following: completely untrue (nine), mostly untrue (four), partly true (two), mostly true (two) and completely true (seven).

The participants' attitude towards such projects was covered with **questions six and nine in the pre-survey** and question number 12 in the post-survey. Question six asked for the participants' interest in coding. Five students selected completely untrue, seven mostly untrue, seven partly true, three mostly true and two answered with completely true.

The interest in computer games was relatively high within the class, as could be expected (due to the popularity of the medium in this age group in general). None of the students selected the answer completely untrue, two with mostly untrue, four with partly true, five with mostly true and twelve with completely true.

According to that, **question eight**, which asked for time spent weekly with games gave a similar impression. Seven students ticked zero to two hours a week, three said two to four hours a week, four said four to ten hours, three students ticked answer three and four, six answered ten to twenty hours a week and one student even ticked the highest answer, saying that he or she spends more than 20 hours a week playing video games.

Creativity is a skill that is hard to measure, too, especially by using surveys and interviews. But still, some of the answers on the surveys explicitly mentioned creativity. **Question 15 on the pre-survey** asked for the students' expectations for the workshop. One student explicitly mentioned being creative as his

expectations, two others answered that they were going to design a game, a task that needs creativity, too.

Question number six of the pre-survey asked what students had learned in the workshop. Once again, one student answered 'being creative'. Beyond that, creativity was not mentioned in the surveys nor in the interviews, even though designing games is a creative endeavour.

The Youth Hackathon project with its focus on learning to code and designing small games has a strong connection to the concept of empowerment as it enables the participants to do their first steps in coding as well as in game design, both skills that prepare for further development in these areas. Both topics are relevant in today's and tomorrow's society and might be relevant for the participants' further career path. Additionally, in the teacher survey, we asked the facilitators whether they thought that the Youth Hackathon is an initiative that fosters the interest in STEM topics and careers especially for girls, too. When asked for the importance of such projects for the participants' later career paths, all three facilitators asserted that these projects might spark engagement and excitement for such careers and skills, especially as the facilitators with their jobs in technology-related professions might be a role model for the students. The facilitators themselves worked in science and technology (two facilitators) as well as for the project lead DaVinci Lab and thought that projects like the Youth Hackathon were a great starting point to find out about your interest in coding and game design.

The project mostly happens in schools and uses the school's computer labs for the workshop. The software Scratch is a free block-based visual programming language that is available for everyone and works on practically all PCs. In connection with the tutorial videos that are offered by the Youth Hackathon team, it can easily be used to program simple games like the ones in the workshop. Only some of the students struggled with translating their ideas into code and almost all of the problems could be solved with the videos and the help of the facilitator. The greatest limitation on the project is the lack of time in the workshops and the fact that only one facilitator is present throughout the workshop. Four hours are often not enough to design and finish a prototype of a game that can be handed in to the competition.

In general, Youth Hackathon is an important project to enable students to gather their first experiences in coding and game design. The workshops are very short and can only offer a first glimpse at these professions and that is actually also the most asked-for aspect about the project. Most of the students and the facilitators explicitly asked for more time as well as the presence of more than one facilitator in the workshop. Still, the project gives a first insight and a positive learning experience in connection with coding and game design. It helps create and reinforce a positive image of coders and game designers in the eyes of the students. It also shows students that following a career in coding or game design is a possibility that might be also open to them.

The comprehensive data collected within the COMnPLAYer app gives ample opportunity to analyze and interpret. The scope of this report is still limited, so the results of the evaluation of the data remain on the surface. The questionnaires cover a range of questions mostly in connection to the concept of science capital. In general, you can say that there is quite some interest in science-related topics and formats in the target group. This might be due to the fact that the participants were interviewed in the context of science-related events. If this can be said of the target group in general, it cannot be drawn from the data collected.
When there is interest in science-related activities, it is mostly in combination with a high potential of science capital in the participants, as they also show a lot of activities around science in general, having people working in science in their family or in their social group.

When they show this high potential, they also achieve well in science-related subjects in school.
When they don't have these contacts within their family or social group, they also show less interest in these topics and mostly achieve lower grades in these subjects.
In general, the data collected can give interesting insights into the concept of science capital and its relevance to the achievements of the students taking part in the survey.
However, the scope of this report and the large amount of data do not allow a deeper investigation of the data from the point of view of ovos being a technical partner of this project rather than an academic research partner.

5. Lessons learned

Overall, the case study worked out well and brought interesting findings. Of course, a study group of 24 students from one class and three facilitators cannot be regarded as representative and our study can only give a rather small insight into the project and how it is received by the participants, however, the answers we received to our surveys and interviews still created an interesting insight. The situation of the Youth Hackathon project is in general a special one, as we already mentioned in the beginning. The project is designed to create informal as well as non-formal learning, but is at the same time happening in a formal learning context. This led, for instance, to the fact that even though it happened with a specific class, no teachers took part in the activity or helped out with supervising the class. The workshop happened in a setting that seemed separate from school, even though it was held in one of the computer labs of the school.

Besides that, it seems worthwhile to mention that the Youth Hackathon and its facilitators are well aware of the fact that their workshops are very short for what is expected of the participants, (this was the most common request for change in the format by the students) but the project leads still keep the format, as it is their main intention to bring more coding and computational thinking to as many schools and students as possible. Particularly in that age group and in that particular type of school, these skills are not taught at all within the other subjects mentioned before. As funding and financial support for the project is very limited, they try to offer the workshops to as many people as possible. That is why they have to stick to that formula, especially as schools do not want to offer more than a four hour time slot for such projects. If the workshops were longer or consisted of several parts, most of the schools would probably not be willing to take part in the project. So, the project lead is willing to accept the deficits that arise from the format to be able to reach as many schools and students as possible. And as the reactions of the participants show, they appreciate the existence of such a project and would want even more. The second highest demand to change something in the workshop format was the request for more than one facilitator. But as we mentioned, the financial limitations of the project do not allow for more staff to be included in the project.

With regards to our case study, the format worked quite well for the setting. The interviews could have been more comprehensive, as they did not deliver much relevant content for our study, but this was mostly due to time constraints and the fact that students also did not really know what to say to the questions besides that they liked the workshop, got along with the challenges mostly well and that there was a mixed interest in STEM subjects. The surveys worked well, especially the one before the workshop. The second one after the workshop contained a number of questions that asked for written answers. As

the students filled in the survey right after the workshop, there was not much time to fill the survey. This led to the fact that many of these questions, especially the ones at the end of the survey, were not answered by up to 40 percent of the participants. The surveys for the facilitators led to interesting insights, especially when it comes to creating a context for the project, its importance for the students and the challenges that the format brings with it. Overall, we can say that the case study on the Youth Hackathon project reinforced our perception of the importance of coding, computational thinking and design approaches to learning in general. It also confirmed our perception that these 'new' skills are so far not at all represented in the curricula of Austrian schools. Projects such as the Youth Hackathon, which bring more of these skills and approaches to young learners, are very important to create opportunities to find out about and try these new approaches to STEM learning.

As it was only one workshop (of more than a hundred) and the sample size was that of only one class, the data collected can of course not be seen as representative, but only provides a glimpse into the project and its effectiveness.

The data taken from the surveys in the COMnPLAYer app was taken separately from the workshops that are the basis of this case study. That makes it difficult to bring this data together in a useful way. The case study should be done in connection with other specialised institutions that are able to develop a valid scientific framework for a study such as this.