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# Report on the Youth Hackathon Workshops 2019/20 with regard to their effectiveness

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## 0 THE MAIN RESULTS AND FINDINGS (GERMAN)

Dieser Bericht wurde vom exploration space der Österreichischen Akademie der Wissenschaften ([ÖAW](#)) unter Fachaufsicht und Koordination von [Eveline Wandl-Vogt](#) erstellt.

Er reflektiert über die Effektivität der Youth Hackathon (YH) Workshops als eine Form der Intervention im Schulsystem zwecks Steigerung der digitalen Kompetenzen sowie der 21st Skills (4Cs) bei den SchülerInnen und LehrerInnen im Rahmen der Umsetzung der Digitalen Grundbildung an den österreichischen Schulen. Der methodische Forschungsansatz umfasst: Beobachtungen von YH Workshops im und außerhalb des Schulsettings, quantitative Erhebungen sowie eine Research Studie im Bereich der modernen Learn Science.

Das primäre Ziel des YH Formates, das im Schuljahr 2018/2019 vom Verein MadebyKids in Zusammenarbeit mit DaVinciLab konzipiert und umgesetzt wurde, zielt darauf ab eine positive Einstellung zu MINT-Fächern, dem Programmieren und zu digitalen Inhalten durch einen konstruktivistischen Lehr- und Lernansatz, "team-based learning" und einen gender-neutralen pädagogischen Ansatz an Jugendliche (mit Schwerpunkt Mädchen) zu vermitteln. Nach diesem Ansatz bauen Lernende ihr eigenes Verständnis und Wissen über die Welt auf, indem sie Dinge selbst erfahren und daraus lernen. Durch das teambasierte Lernen werden auch soziale Kompetenzen wie Kommunikation, Kollaboration sowie Problemlösungskompetenz gestärkt.

Neben den SchülerInnen wird gleichermaßen beabsichtigt die Schulen samt Lehrkräften, die sich für die integrative Umsetzung des Faches *Digitale Grundbildung* entschieden haben, zu unterstützen. Hierfür ist in Aussicht gestellt, ein dezidiert praxisbezogenes, im Klassen-Setup ohne zusätzliches Investment umsetzbares Format zu nutzen und fertige Open Educational Lernressourcen (OER), die in Zusammenarbeit mit der Katholischen Pädagogischen Hochschule Wien-Krems entwickelt worden sind, zum Download zur Verfügung zu stellen.

Das Konzept der zeitlich und räumlich dislozierten "Youth Hackathons" integriert sich in das Konzept der digitalen Grundbildung (Schulstufe 1-12) und den Lehrplan *Digitale Grundbildung* der Sekundarstufe I des österreichischen Bildungssystems. Das YH Format bietet den Jugendlichen Chancen über Berufe der Zukunft in einer digitalen Welt im Rahmen des Unterrichts zu reflektieren (Berufsorientierung) sowie die wichtigsten informatischen Konzepte in einer teambasierten Projektarbeit (Game bzw. App Entwicklung) anzuwenden und somit die Grundlagen des *Computational Thinking* und des Programmierens dadurch besser zu verstehen. Die freiwillige Möglichkeit der Teilnahme an den außerschulischen Aktivitäten und YH Wettbewerben ermöglichen den Jugendlichen einen Bezug zwischen Erlerntem und Realwelt-Kontext herzustellen sowie das für die intrinsische Motivation notwendige "WHY" für das Lernen zu erleben.

Insgesamt haben seit der Initiierung der Youth Hackathons knapp 5.000 Schülerinnen und Schüler (SuS) aus über 100 Schulen in allen Bundesländern in Österreich teilgenommen. An den YH Workshops 2019/20 nahmen COVID bedingt nur 24 Schulen (AHS, BHS, NMS) und 2 CoderDojo Gruppen mit insgesamt knapp 1.500 SuS teil. Die geographische Verteilung konzentrierte sich vor allem auf den Osten und Norden Österreichs.

Durch Anwenden eines Scaffolding Ansatzes sowie mit Hilfe der OER digitalen Lernkarten, die wie Lego Bausteine zu eigenen Spiel- bzw App-Projekten zusammengestellt werden können, konnten alle teilnehmenden SchülerInnen, auch ohne Programmierkenntnisse ihre Projekte innerhalb des vorgegebenen Zeitrahmens der Workshops (4 Stunden) abschließen. In Bezug auf die sozialen Aspekte wie Geschlechterbewusstsein und Gleichstellung führt die Verankerung der YH-Workshops im schulischen Kontext zu besseren integrativen Ansätzen, um sowohl Buben als auch Mädchen gleichermaßen zu erreichen, etwas das bei der Umsetzung im außerschulischen Bereich nicht im selben Ausmaß gegeben ist.

Im Rahmen der Studie konnte beobachtet werden, dass obwohl vor dem YH Workshop ein höherer Prozentsatz von Buben als Mädchen Interesse am Programmieren hatte, nach dem Workshop konnte sowohl bei Buben als auch bei Mädchen eine Zunahme des Interesses festgestellt werden. Darüber hinaus fühlte sich die Mehrheit sowohl der Mädchen als auch der Buben nach dem Workshop selbstsicher in der Anwendung der technischen Werkzeuge, was auf eine positive Einstellung gegenüber der verwendeten Technologie und der Beherrschung der digitalen Werkzeuge hinweist.

Insgesamt wurden die Workshops sowohl von LehrerInnen als auch von SchülerInnen der verschiedenen beobachteten Klassen positiv aufgenommen, was sich auch in den beiden Umfragen widerspiegelte.

Die von DaVinciLab angebotenen Workshops sind eine effektive Ergänzung und Unterstützung für Schulen, um aktuelle Lücken im Lehrplan für *Digitale Grundbildung* zu schließen, Teile davon durch teambasierte Lehr- und Lernmethoden umzusetzen.

DaVinciLab YH-Workshops bieten Unterstützung des österreichischen Bildungssystems in Bezug auf die Stärkung der Innovationsfähigkeit und Empowerment von Schülerinnen und Schülern in Bezug auf deren Lernprozesse und die Entdeckung persönlicher Stärken und Interessen. Die im Rahmen des Lehrplans eingebettete "Youth Hackathons", samt OER Lernmaterialien tun dies, indem sie a) eine lernergetriebene, problembasierte Lernumgebung, b) einen vollständigen Projektzyklus einschließlich Implementierung, c) außerschulische Anreize und Aktivitäten und d) Anker für die Erfahrung individueller Kompetenz und individuellen Erfolgs bieten. Es steht daher in positiver Übereinstimmung mit aktuellen Ideen der Innovationsbildung (Weis et al 2017; Shavinina 2013).

Um das Format verstärkt in das österreichische Bildungsökosystem zu integrieren, wäre eine längerfristige Finanzierung sowie eine vermehrte Integration in Ausbildungsprogramme für LehrerInnen sinnvoll. Weiters könnte eine längerfristige Begleitung von Forschungsstudien, die in Kooperation mit unterschiedlichen Bildungseinrichtungen durchgeführt werden, bei zukünftigen Verbesserungen des Formates sowie der breitflächigen Skalierung hilfreich sein. Ebenso ist die geplante weitere Entwicklung des YH Formates in Richtung eines ausschließlich digitalen bzw. hybriden Angebots, wie es seit COVID19 verstärkt benötigt wird, und derzeit in der Umsetzung dank der Förderung der Innovationsstiftung für Bildung befindet, entscheidend um die Effektivität aber auch die geographische Reichweite dieser erfolgreichen und höchst effektiven Intervention nachhaltig und breitflächig sicherzustellen.

## 1 ABSTRACT

This report is carried out in spring 2020 in the context of an [Innovation Voucher](#) (*Innovationsscheck*) funded by the Austrian Research Promotion Agency (*Österreichische Forschungsförderungsgesellschaft*) ([FFG](#)) between [exploration space](#) @ Austrian Academy of Sciences ([ÖAW](#)) and [DaVinciLab](#) KG under the supervision and coordination of [Eveline Wandl-Vogt](#). The aim of this joint endeavour was more generally to enable small enterprises to initiate cooperation with research institutions, and more specifically to investigate the effectiveness of the learning approaches implemented by DaVinciLab in their YouthHackathon<sup>1</sup> workshops 2019/20. The research context consisted of three elements: 1 - an evaluation of the learning materials and online tools for the workshop categories Game Design, App Design and Game Changer workshops; 2 - in class observations of the workshops and interactions; and 3 - a quantitative, post-workshop surveys for participating teachers and pupils.

## 2 THE DAVINCILAB LEARNING JOURNEY

This section describes the DaVinciLab YouthHackathon (YH) learning journey, with a particular focus on the description of the workshop concept. The learning journey comprises several aspects, including the curriculum which provides the context for the workshops, the workshops themselves, being the implementation of the DaVinciLab product, and the award ceremony at the 4GAMECHANGERS Festival<sup>2</sup> which enables social emotionalisation and provides the connection to the real world context for youngsters, to the business world, and the use and application of what has been learned at school.

### 2.1 The Context: Curriculum

The DaVinciLab YH concept is to-date embedded in current curricular innovations in the Austrian secondary education (*Sekundarstufe I und II*), namely in the new compulsory subject *Digitale Grundbildung* (BMBWF 2018). Currently, the implementation of this subject can be realised in two ways: either schools can have a new subject (at the cost of other subjects), or it is integrated and implemented as part of another existing subject. As of now, most schools have opted for an integrative approach, where *Digitale Grundbildung* is taught as part of another subject. This has its benefits, as the particular subject then has possibilities to connect its content related matters in technology; at the same time the integration does not come with compulsory teacher-in-service training. Even initial teacher training does not yet have compulsory courses to work with the digital world in the subject domain.

In a second development, all curricula of the lower secondary education are currently under revision, and the Federal Ministry of Education, Science and Research (BMBWF) has asked curriculum developers to clearly identify contributions to *Digitale Grundbildung* in the subject curricula. Further, several materials, text books, and online courses have been developed to support teachers.

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<sup>1</sup> <https://www.youthhackathon.com/> [last access: 03.08.2020]

<sup>2</sup> <https://4gamechangers.io/de/> [last access: 03.08.2020]

## 2.2 The Implementation: The DaVinciLab-workshop Concept

Since 2018, DaVinciLab, together with educators, has run their YH workshops as both curricular and non-curricular activities with more than 2700 pupils in Austria to-date. The hackathons were designed as a systemic intervention to support teachers in implementing the basic digital education (*Digitale Grundbildung*) in lower and higher secondary education levels, and particularly in their typical location: the classroom. In what follows, we describe in more detail a typical schedule and procedure of a YH workshop.

### 2.2.1 Procedure Of A Typical Youth Hackathon Workshop

The table below gives an outline of a typical YH workshop. Each workshop is conceptualised to last 4 hours (240 minutes). Later on, the pupils and teachers are invited to further work on the projects based on mutual interest and energy. The table gives an overview of the intended duration of each section, as well as of the different content and activity parts of the workshop.

Table 1: Timeline and content of a typical YH workshop

DURATION/ TIMING IN MINUTES (MINS)	YOUTH HACKATHON ACTIVITIES IN THE CLASSROOM
0 - 30 mins	<ul style="list-style-type: none"> <li>● Introductory video to the Award Ceremony during 4GameChangers Festival</li> <li>● Introduction to the aims of the Youth Hackathon</li> <li>● Introduction to the various job descriptions necessary to develop a game/app software solution e.g., game designer/app designer software developer, sociologist, computer animation designer/artist, storyteller etc.</li> </ul>
30 - 60/90 mins	<ul style="list-style-type: none"> <li>● Introduction to different games/apps on the Youth Hackathon website               <ul style="list-style-type: none"> <li>○ Testing games/apps - to strengthen pleasure/motivation</li> <li>○ Self-explanation of game mechanisms and features / self-explanation of app features and “opponents”, aim, game mechanics etc. - Games are being decomposed into elements e.g avatars, etc.</li> </ul> </li> <li>● Single small programming challenges</li> <li>● Present tools for developing your own ideas and testing</li> </ul>
60/90 - 180 mins	Form group + give team name <ul style="list-style-type: none"> <li>● Work on your own project (on a given topic) based on a design template + Access to library with pre-programmed games/apps and learning cards (Lernkarten)</li> <li>● 1 minute final presentation per group (present the Results)</li> <li>○ 3 key questions</li> </ul>
180 - 240 mins	What happens to the projects? <ul style="list-style-type: none"> <li>● Presenting of projects to the class community</li> <li>Publication on website (on a voluntary basis)</li> </ul>
<b>Total: 240 mins (4 hours)</b>	

### 2.3 The Social Emotionalisation: The Award Ceremony

The Award Ceremony marks the final stage in the DaVinciLab learning journey. Since 2018, one ceremony has taken place each year, and in the year 2019/20 this ceremony is part of the 4GAMECHANGERS Festival. There, submitted, reviewed and selected projects from the YH workshops are awarded. Placing the awards ceremony in the context of such a festival, for example, provides the opportunity to connect to the business world and enable the application of knowledge and skills acquired in school in the real-world context.

### 2.4 Objectives Of The Youth Hackathon Workshops

The Youth Hackathon project was launched in 2018 by DaVinciLab in cooperation with the association "MadeByKids - Education in the 21st Century" and took place for the third time in the school year 2019/20. The aim of this project is to convey the joy of designing with digital tools by developing, designing and programming your own digital game or app. The projects are geared towards the UN Sustainable Development Goals (SDGs) and attention should be paid to gender-sensitive didactics in order to get both genders equally enthusiastic about digital design. Schools organise coding and design hackathons as part of their regular school lessons (in the context of the mandatory subject *Digitale Grundbildung*). The aim of the YH workshops is more generally to convey the idea of computational thinking as team-based learning, to convey digital skills to youngsters as they develop, design and program their own digital product (game or app), and also to allow for and provide creative space for the "generation of digital content". At the same time, the YH workshops also aim to transmit and give pupils a positive attitude towards STEM (Science, Technology, Engineering, and Mathematics) subjects and towards coding while following a gender neutral didactic concept, strengthening the youngsters' self-confidence. Besides, the workshops also promote the idea of team-based learning where pupils solve tasks in teams across potential differences of opinion, explore personal strengths, e.g. design; analytic/mathematical thinking; storytelling; technical know-how, etc.

As regards the teaching and learning materials DaVinciLab offer in their hackathons, they are an Open Educational Resource (OER), including learning cards and access to game or app software, which after the workshop is free to access for teachers and pupils, and even online mentoring is available in case the class wishes to continue workshop on the topic after the hackathon.

Finally, the developed projects can be submitted to a competition with a final award ceremony which takes place each year, and is this year part of the 4GAMECHANGERS Festival. This event acts as an opportunity for social emotionalisation and the connection to the real world context of the business world for youngsters. This year, 2020, due to the prevailing COVID19 impacts, alternative, virtual events have been envisioned, such as the online congress for developers (WeAreDevelopers)<sup>3</sup>.

The strengths of the YH workshop format as highlighted by DaVinciLab thus are:

- a) no additional hardware/software investment for schools are necessary except of skills, mindset and curriculum development by teachers
- b) the format reflects research study results on new learning design methods - including constructivist learn design/ playful and project-based learning

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<sup>3</sup> <https://www.wearedevelopers.com/talents/> [last access: 18.08.2020]

- c) application of pedagogical methods where pupils learn in their everyday world - world of computer games and game apps

In addition, the YH is also a community of schools, business volunteers and stakeholders from education, politics, science and research. The YH ambassadors aim at spreading the vision of a digitally competent society of tomorrow in their networks.

In the current Austrian education system, the Youth Hackathon workshops aim to align with the “Digitale Kompetenzen Informatische Bildung” (*digital skills computer science education*) (<https://digikomp.at/>) of the Austrian Federal Ministry of Education, Science and Research (BMBWF).

To-date (04/2020), 179 schools, 2355 teachers and 11450 pupils have participated in the DaVinciLab related activities. In the year 2019/20 several school types were represented (see Figure 1) as well as CoderDojo groups<sup>4</sup>, which are voluntary communities offering free coding and programming workshops to youngsters.

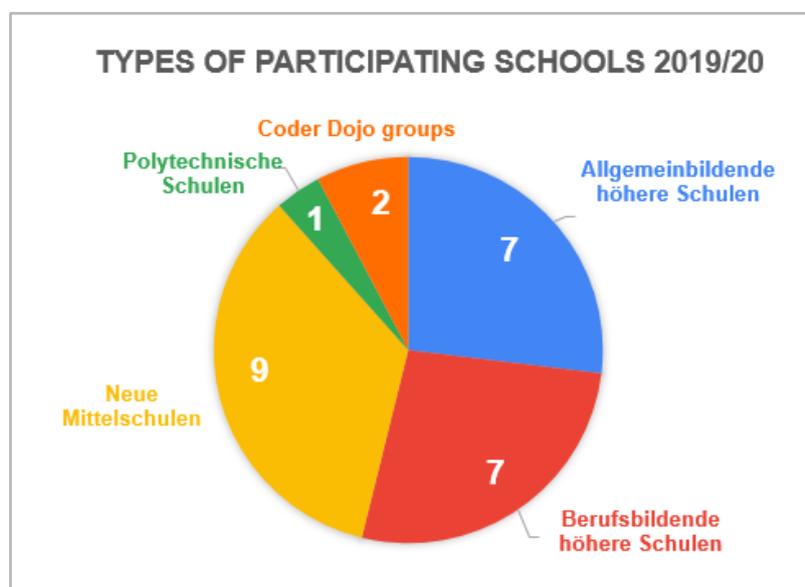


Figure 1: Schools and groups that participated in the YH workshops 2019/20, grouped according to types: Allgemeinbildende höhere Schulen (AHS) (blue); Berufsbildende höhere Schulen (BHS) (red), Neue Mittelschulen (NMS) (yellow), Polytechnische Schulen (PS) (green), CoderDojo groups (orange); numbers in white = absolute number of schools.

## 2.5 Objectives Of The Current Report & Research Context

As mentioned in the abstract above, this report is realised in the context of an Innovation voucher (Innovationsscheck) of the FFG. The Innovation Vouchers “[...] is a funding instrument designed to help small and medium-sized enterprises in Austria to start ongoing research and innovation activities. The Innovation Voucher enables enterprises to enlist the services of research institutions and to pay for these services [...]”<sup>5</sup> Both parties then agreed to a joint endeavour where, based on iterative interactions, the status quo was determined and

<sup>4</sup> <https://coderdojo.com/de-DE> [last access: 06.08.2020]

<sup>5</sup> <https://www.ffg.at/en/programme/innovation-voucher> [last access: 30.03.2020]

analysed, the teaching / learning materials tested and analysed, and recommendations for embedding the scientific analysis in the daily work of the DaVinciLab given.

In this context it was agreed that the exploration space @ ACDH-CH ÖAW would produce an analytic report on the effectiveness of the used learning and teaching approach the DaVinciLab implements in their Youth Hackathon workshops as part of “verbindliche Übung Digitale Grundbildung” (“*mandatory exercise basic digital education*”) and an innovative intervention to the regular classes to promote collaborative, project based learning focused on 21st century skills and future job profiles. The objectives of this report are thus to provide an analysis and evaluation of existing methods, with an emphasis on participation, democratization of learning processes, innovative learning from the specific perspective of game and app design for students, mapped to the goals of the basic digital education in Austria<sup>6</sup>.

As to the particular teaching and learning approach, DaVinciLab claims to practise a constructivist approach. Constructivism is a theory in education that is most typically associated with the work of Jean Piaget (1896–1980)<sup>7</sup>. It is an approach to learning that suggests that children must construct their own understanding of the world in which they live. The learners construct their own understanding and knowledge of the world through experiencing things and learning from them. Also, learning is seen as an active, contextualised process of constructing knowledge rather than acquiring it (Reinmann & Mandl 2001). Pupils are thus pushed to deal with complex challenges and work out solutions with the mediation of a teacher and discover essential learning skills they need in order to solve these challenges. Teachers guide through “hands-on” sessions, enable experimentation and support logical thinking and authentic learning.

In order to carry out scientific analyses on the effectiveness of the Youth Hackathon workshops, the following questions were addressed:

**Which problem does the product of DaVinciLab solve?**

- a) For teachers (overcome a lack of (digital) skills?)
- b) For pupils (learn to be prepared for future (digital) competences?)
- c) For the education ecosystem, e.g. ministries, schools, agendas etc. (to formally reach their goals?)

**Where does DaVinciLab make a difference?**

- a) relative to the setting (school)
- b) relative to the taught knowledge (skills, content)

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<sup>6</sup> <https://digikomp.at/> [last access: 30.03.2020]

<sup>7</sup> [https://en.wikipedia.org/wiki/Piaget%27s\\_theory\\_of\\_cognitive\\_development#cite\\_note-1](https://en.wikipedia.org/wiki/Piaget%27s_theory_of_cognitive_development#cite_note-1) [last access: 30.03.2020]

### 3 PARTICIPATING SCHOOLS 2019/20

Since 2018, Youth Hackathon workshops have been held across five provinces (*Bundesländer*) in Austria (Vienna, Lower Austria, Upper Austria, Burgenland and Tyrol) (see Figure 2). The Youth Hackathon workshops 2019/20 were held in a total of 24 schools and 2 CoderDojo groups (see Figure 2 below). Eight schools participated in the App Design workshops, eighteen in the Game Design workshops. Secondary Schools, such as AHS (Figure 2, blue) and BHS (HAK, HAS, HTL) (Figure 2, red) participated as well as Neue Mittelschulen (NMS) (Figure 2, yellow) and one Polytechnic School (Figure 2, green), and also two CoderDojo groups (Figure 2, orange), one in Steyr<sup>8</sup> and the other in Neusiedl am See<sup>9</sup>. The Game Changer workshops were extracurricular activities not linked to any particular school and took place in Vienna. The spatial distribution of YH workshops 2019/20 reflects clear clusters of involved schools in and around Vienna and Linz.



Figure 2: Geographic distribution of participating schools 2019/20, according to participating school types 2019/20 (see section 3).

### 4 REVIEW OF DAVINCILAB PRODUCTS

This section provides an overview and a review of the different materials used in the Youth Hackathon workshops, grouped according to the different workshop topics (Game Design, App Design). The hackathon materials are made available as Open Educational Resources (OER) and can be accessed online under the following link:

<https://www.youthhackathon.com/youthhackathon-educational-resources/>. For participating classes, the materials as well as the tools are made freely available to work with them during the workshops, but also afterwards.

<sup>8</sup> <https://tic-steyr.at/coderdojo-steyr> [last access: 30.6.2020]

<sup>9</sup> <https://neusiedl.coderdojo.net/> [last access: 30.6.2020]

## 4.1 Game Design Worksheets

For the Game Design workshops different analog materials are used and distributed in the workshops, such as ideation canvases for noting team names, the type of avatars and actions that need to be programmed, as well as the story that pupils will implement in their game. These materials are typically distributed with one copy of each canvas per team during the workshops. These materials are very much in line with and follow the structure of typical design thinking canvases and can be downloaded from anyone interested online<sup>10</sup>.

Name für mein Spiel:	Designed von:
Das Spielziel:	Dein Avatar:
Die Challenge/Die Gegner:	Die Hintergrundgeschichte:

Was wird programmiert?	Was macht diese Figur?	Wie muss ich das programmieren?
Avatar		

Figure 3: Examples of ideation and story canvases for game design

To support the Game Design development, the learning cards are also available in both printed format or online<sup>11</sup>. They indicate very detailed the necessary steps or actions that need to be known in order to programme the game and work with the Scratch software.

<sup>10</sup> [https://www.youthhackathon.com/wp-content/uploads/2019/01/00\\_Youth-Hackathon\\_Spieldesign.pdf](https://www.youthhackathon.com/wp-content/uploads/2019/01/00_Youth-Hackathon_Spieldesign.pdf)

<sup>11</sup> <https://www.youthhackathon.com/youthhackathon-educational-resources/> [last access: 30.6.2020]

## 4.2 App Design Worksheets

For App Design, similar canvases are used in workshops as for Game Design (see section 4.1. above). Learning cards are also adapted to show a step-by-step instruction with an example for the OER (Open Educational Resources) software *Thinkable*<sup>12</sup> that is used for programming<sup>13</sup>.



Figure 4: Examples of App Design canvas and learning cards to work with thinkable

## 4.3 Game Changer Materials

For the Game Changer workshop which took place 1 week in summer 2019 slightly different materials were available due to the different duration of the formats. These included interactive whiteboards, flipcharts, a 3D printer and colour markers, Lego pieces, sticky notes and other stationery materials. These materials are then used for rapid prototyping sessions.



Figure 5: Examples of the Game Changer workshop materials

## 5 GAME DESIGN, APP DESIGN AND GAME CHANGER PROGRAMMING - THE PROCESS

This section provides an outline of the 5 observed Youth Hackathon workshops. Two dealt with Game Design, one with App Design and the remaining two with the Game Changer format.

<sup>12</sup> <https://thinkable.com/#/> [last access: 30.6.2020]

<sup>13</sup> [https://www.youthhackathon.com/wp-content/uploads/2020/01/2020.Thinkable.Game\\_Space\\_Traveler.Complete.pdf](https://www.youthhackathon.com/wp-content/uploads/2020/01/2020.Thinkable.Game_Space_Traveler.Complete.pdf) [last access: 30.6.2020]

## 5.1 Observation 1

The first observation took place on 31 January 2020 in the St. Ursula Schulen 1230 Wien, in a secondary school class (AHS, 1st year) with 28 pupils (13 girls, 15 boys). The workshop dealt with **Game Design** and was held in the regular classroom. With regard to the mentioned workshop outline in section 2, the workshop followed the given outline in terms of content. As regards the timing, however, it deviated with a total duration of five hours instead of the typical four (08:00am - 01:00pm). In addition, three instead of the usual two DaVinciLab instructors were present, as well as the class teacher. The DaVinciLab instructors were very competent and helpful and supported the students whenever they had questions by going over to the individual groups.

The **classroom setting** was a regular school class situation, with pupils sitting in pairs at a desk. For each desk one laptop was provided by DaVinciLab, where pupils could programme and work together in teams of two. Instructions were given by one DaVinciLab member in the front of the class, where videos and written instructions were displayed on a screen. The learning cards were provided in analog form and pinned to the class room walls at the back of the class where pupils could walk around to access them.



Figure 6: Class observation 1 (images © Amelie Dorn)

In terms of **content** the topic of collaboration was stressed, as well as the overall topic of the Youth Hackathon 2020 which deals with health and sports. The sustainable development goals (SDGs) were mentioned in this context too. None of the pupils had heard of the SDGs before.

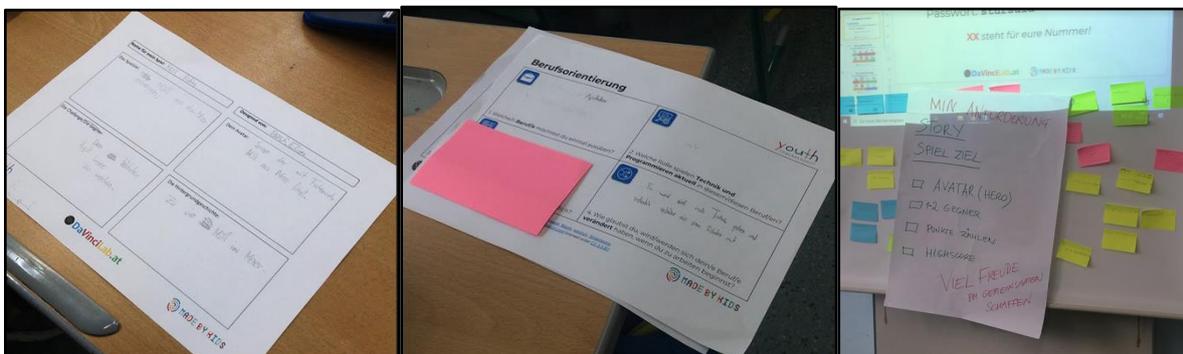


Figure 7: Examples of design canvas and instruction materials (images © Amelie Dorn)

## 5.2 Observation 2

The second observation took place on 21 February 2020 in the secondary school (AHS, 3rd year) Heustadlgasse, 1220 Wien. There were 27 pupils (girls n=16, boys n=11) and the workshop dealt with **Game Design**. The workshop took place in the informatics room. There was only one active instructor present from DaVinciLab (a second DaVinciLab instructor was present but only in an observing role, taking notes for their own research paper), and two teachers for the first half of the workshop and then another teacher for the second half of the workshop. Also in this class pupils were instructed to sit in couples at one computer each. The DaVinciLab instructor was very competent and helpful and helped the students whenever they had questions or needed support, by going to the individual groups. As regards the overall **workshop outline**, there were some deviations to the regular plan: first, the duration of the entire workshop was cut shorter than the intended four hours. The teacher explained that it was difficult to block the needed hours on the pupils' timetable, and that's why the workshop could just last three school hours (08:15 - 11:00am).

Given the reduced work time, the first part of the regular outline (professions of the future) was cut short to around 10 minutes. As regards the **content** of the workshop the regular sections were followed, but shorter to fit into the given timeframe.



Figure 8: Observation 2 - classroom setting and work with design canvas and scratch platform (images © Amelie Dorn)

As regards the **classroom setting**, also here instructions were given by the DaVinciLab instructor in the front of the classroom, using an overhead projector. No analog instruction cards were used, but pupils were directed to the respective website where they could look up any information they needed.

## 5.3 Observation 3

The third observation took place on 21 February 2020 in the secondary school (HLT, 3rd year) Bergheidengasse 1130 Vienna. The workshop dealt with **App Design** and there were 22 pupils (girls n=17, boys n=7) in the class. One instructor from DaVinciLab was present, and also two teachers, where one of them was present for the entire duration, the other not. The workshop lasted four teaching units (1:30pm - 05:00pm). The workshop was implemented in the informatics rooms, where the pupils were instructed to form groups of two or three around one PC and work together. The pupils could choose themselves who they wanted to form groups with. Most groups were all girls groups or all boys groups, and only a few mixed teams. The DaVinciLab instructor was very competent and helpful and helped the students whenever they had questions or needed support, by going to the individual groups.



Figure 9: Class observation 3 - App Design class setting, design canvas and app (images © Amelie Dorn)

As regards the **content** of the workshop, it followed largely the outline mentioned in section 2, with some deviations. For example, the video introducing the 4GameChanger Festival didn't play and was thus substituted by a verbal account from the DaVinciLab instructor. Most of the pupils had previously downloaded the thinkable App on their phones. They then worked in teams of two or three with PC and mobile phone to design the App. Design canvases were used to note the story or idea of the created app. Instead of learning cards, printouts of the App Design manual were distributed, which were collected again at the end of the workshop.

#### 5.4 External Observations

Related observations of DaVinciLab learning designs interactions were conducted by two other colleagues on the 15th and 19th July 2019 at the weXcelerate facilities in Vienna during one week long GameChanger bootcamp for teenagers aged 13-17. There were nine participants (eight boys and one girl) and they were thirteen years or more of age. The observations from July 15 note in terms of space, that the room for the session was a relatively small office, with glass walls and meeting atmosphere. The weXcelerate facilities as startup's hub are new, practical and modern, but to some extent contributed to a cold atmosphere. The room is equipped with an interactive whiteboard, a flipchart, a 3Dprinter and a table with colour markers, Lego pieces, sticky notes and other stationery materials. As opposed to the early age groups, there was a clear unbalance of gender among participants, with only one girl and eight boys. In the other groups, a tendency to more easy empathy and participation is observed when there's more gender balance. The key role of the facilitator was led by an empathetic and secure young person, who provided calm explanations, provided context to participants and managed time according to the process.

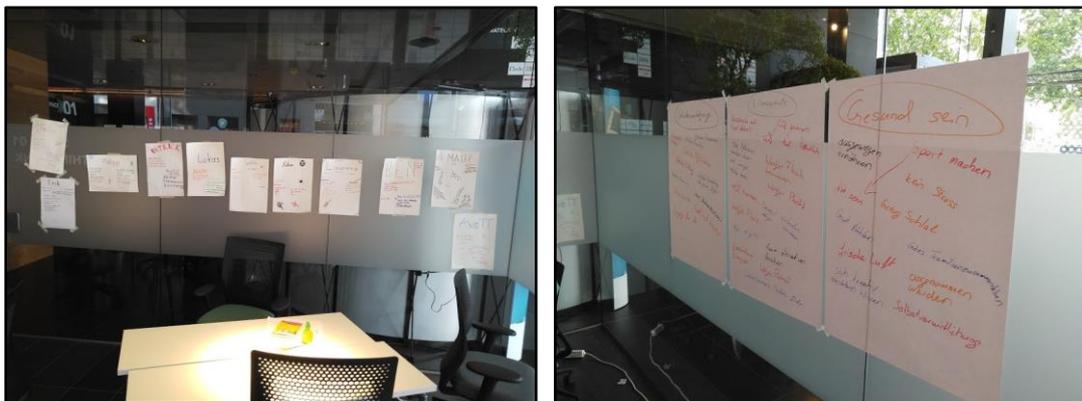


Figure 10: Location setting at one of the Game Changer workshops (images © Enric Senabre)

The introductory round from the facilitator led to a round of introductions that consists in each participant reflecting on a page their name and attributes, likes, dislikes, etc., following the example of the facilitator. This helped to “break the ice” and at the same time each youngster to bring their style by free use of colours and text. Like the rest of the session, this seems based on the notion of not immediately using technology, but instead a more conceptual and discussion-based approach.

The explanations in German from the facilitator included some English terms that probably reflect the idiosyncratic context of the workshop, with concepts like “Game Changers”, “Prototyping”, “Design Thinking” or “Brainstorming”.

The session’s visual support was mainly the flipchart during the morning, where the facilitator progressively reflects what participants say in each elicitation round. This follows the same described logic of “low-technology” first, which tries to focus on concepts, questions and shared concerns before the digital artifacts enter into consideration.

The progressive appropriation of the space reflected on the walls what the discussion was about, breaking the formality of the meeting room setting and reflecting conversations.

Convergence moments: The afternoon session focused on the Sustainable Development Goals, which require an introductory talk, followed by a discussion on the key problematics related to three of them according to participants. Once more, the role of the facilitator consists in eliciting and guiding the conversation while taking notes of the keywords on the flipchart.

Deciding on topics and forming groups: the second part of the first day session requires participants to express their opinion via “dotmocracy” votes, and afterwards forming three different groups to work on a first approach to problem solving together. For this, visual thinking comes into play again with the use of colour markers and other elements like Lego pieces. This allows to start to practice in a collaborative way how to work together in a small group sharing a goal.

Observations from the workshop on July 16th 2019, noted that as opposed to the first day, the session started directly with a “warm-up” activity where participants have to stand-up in a circle, passing juggling balls to each other while remembering each other’s names. This had the effect of breaking the ice again, gaining confidence and empathy among them.

Another interesting variation is the use of ambient music in the background, making the space more able to relax while working together.

After a reminder of the ongoing challenges and need of a problem-solving mindset, participants started to work on their laptops for creating a shared plan or routemap for their project. Previously, the facilitator has suggested possible tools, but the choice is open for them to select the best approach.

Before the first break, the facilitator had meanwhile started to activate the 3D printer, let some participants interact with the digital whiteboard and introduced in small groups the chips that can be used for the project.

## **6 QUANTITATIVE SURVEYS ON YOUTH HACKATHON WORKSHOPS**

In addition to in-class observations, also quantitative surveys were carried out to evaluate the short-term impact and sustainability of the Youth Hackathon workshops. Two surveys were designed, following recommendations on questionnaire and answer design from the literature (cf. Baur & Blasius, 2014). The surveys served to capture previous knowledge and expectations of the workshop participants, as well as post-workshop aspects. This is an additional important input for the research analysis, also to obtain insights on the effectiveness

of content and method. Section 6.1 provides an outline of the content and the results of the survey distributed to teachers. Section 6.2. outlines the questions and answers of the pupil's survey. The surveys were sent via email from members of the exploration space team @ ÖAW to each of the 26 participating schools main contact person, also with the request to distribute the second survey to the pupils which had participated in the Youth Hackathon workshop. Before the survey was sent out, the DaVinciLab instructors had informed the teachers that they would receive such a survey and had encouraged them to participate. Finally, the schools were requested to complete the survey within one week of receiving the notification.

## 6.1 Survey Teachers - Overview and Results

The teacher survey was sent to all the main contact persons of the schools that had participated in the YH workshops 2019/20. The survey contained 13 questions and could be answered in approximately 10 minutes (see Appendix 1a). The survey was completed by six out of twentyseven teachers. Due to the small number of respondents, we here present a concise summary of the main arguments of answers rather than a detailed report, noting that the information given by the respondents holds for this given small group.

Appendix 1a shows the detailed survey questions. The survey captured insights on general information (gender), information on the teacher's teaching subject, the possibility of integration into the school curriculum, reasoning for taking part in the workshop and questions regarding content topics. The survey was completed by a higher number of men (n=5, 83%) than women (n=1, 17%). Half of the teachers taking the survey taught the class which participated in the YH workshop in "Unterstufe" (n=3), two taught in "Oberstufe" and one in a NMS. Half of the teachers taught the class in the subject "Informatics" (n=3), and one in each *Digitale Grundbildung*, *Medienproduktion* and one non-matching response was given. The majority of teachers were not the form teacher (n=5) except for 1. As to the workshop content, four out of the six teachers had participated in the Game Design workshop and two in the App Design workshop

Summarising the main content of answers given by teachers as to why they integrated the YH workshop in their class, we can note that they emphasised the importance of having the possibilities for pupils to participate in extracurricular activities and competitions, such as the 4GAMECHANGERS Festival, and that they valued the workshop as an excellent addition to the regular curriculum where pupils have fun programming. As regards dealing with the thematic topics also covered in the Youth Hackathon workshops (e.g. SDGs, programming, sports & health, or gender & technology), answers from the teachers showed that programming and sports had previously been addressed in some school subject before, but the SDGs not at all, and the topic of gender and technology also less so.

After the workshop, half of the teachers were relatively certain that the acquired digital skills from the workshop will be put into future school lessons. Only one teacher thought it was absolutely certain, and others only partially or to a lesser degree. Finally, results from the survey indicated that the method and topics of the workshops would rather flow back into further lessons, than the class setting. This is little surprising, as the workshops were realised in the regular, day-to-day classroom setting without any changes.

## 6.2 Survey Pupils - Overview and Results

The survey for pupils who had participated in the YH workshops was sent out to their teachers together with the teacher survey, and teachers were asked to forward the survey to their students. The survey was answered by a total of 67 pupils of which 67% (n=45) were male, 28% (n=19) female, two didn't specify their gender and one selected the category "other". The majority of respondents (43%, n=29) were 14 years of age, followed by 13 (30%, n=20) and 12 (10%, n=7) years olds. A smaller number of respondents were between 15-17 years. (n=11). Most of them attended "Oberstufe" (79%, n=53), only 16% (n=11) "Unterstufe", and 5% (n=4) a different kind of school form. A total of 55 pupils (75%) had participated in the Game Design workshops, 11 (16%) in the App Design workshops and 6 (9%) in the Game Changer workshops. In the survey we also asked pupils to name the profession of their father and mother, as some previous interactions with youngsters have suggested, that they can get interested in technical and digital tools in case their parents work in related areas. Results from our survey showed no particular influence in this respect. Out of all respondents, 55% (n=37) claimed that they had already some programming knowledge before taking part in the workshop, and 45% (n=37) didn't.

As regards the topics addressed in the YH workshops, the highest number of respondents had already had a strong interest in the topic of sports, health and recreation, and a relatively strong interest in the topic of gender and technology before the workshops, less so for programming and hardly at all for the SDGs (see Figure 11).

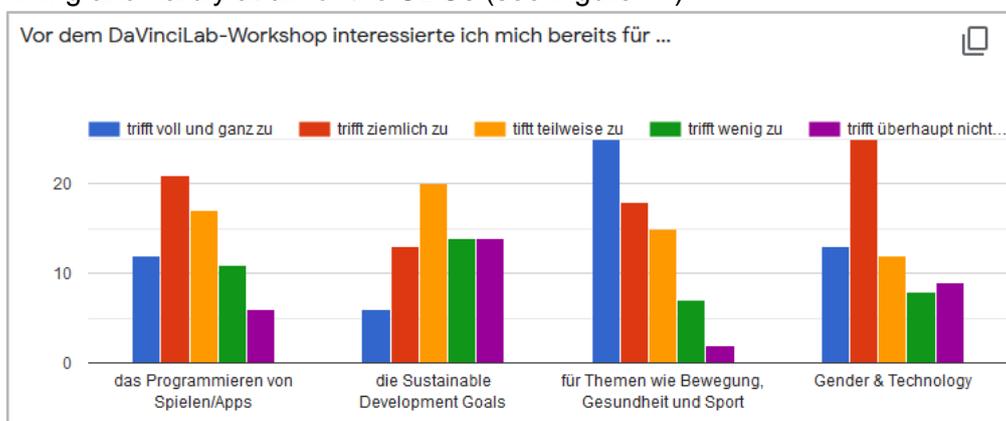


Figure 11: Result of the pupil survey (n=67) on the questions "Vor dem DaVinciLab-Workshop interessierte ich mich bereits für [...]."

After the workshops the majority of respondents claimed to have a relatively good command of the programming tool, a higher interest in programming and will engage more with the topic of health and sports. This holds true to a lesser degree for an interest in the SDGs (see Figure 12).

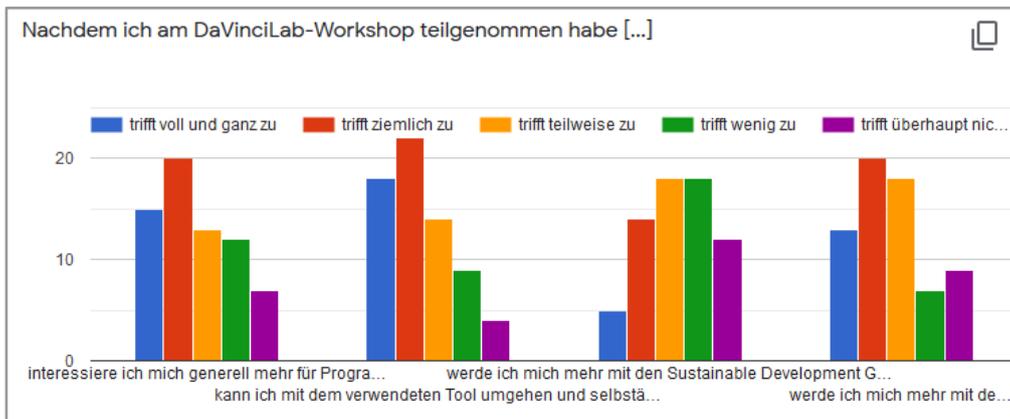


Figure 12: Result of the pupil survey (n=67) on the questions “Nachdem ich am DaVinciLab-Workshop teilgenommen habe [...]”

Looking at the same results from the angle of boys (n=45) and girls (n=19) separately we could observe that before the workshop a higher percentage of boys had an interest in programming than girls (Figure 13, left panel), whereas after the workshop an increase in interest can be noted for both boys and girls (Figure 13, right panel).

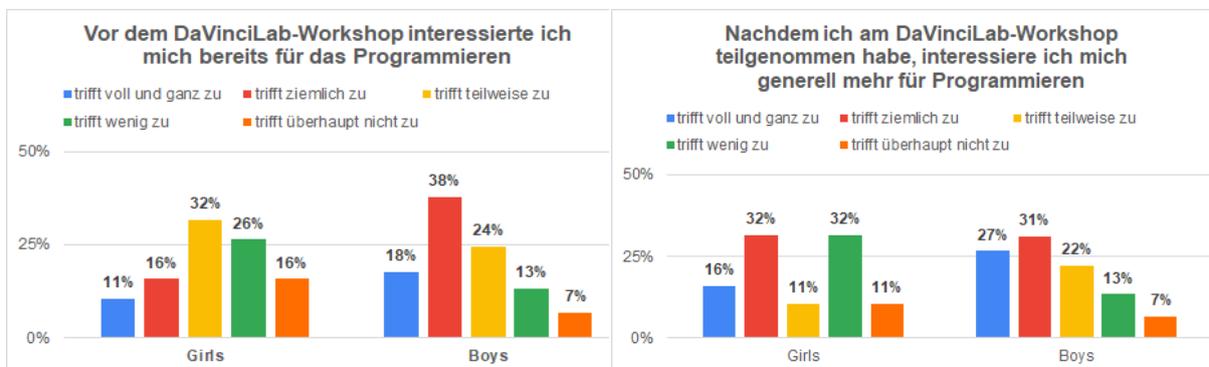


Figure 13: Result of the pupil survey (n=67) on the questions “Vor dem DaVinciLab-Workshop interessierte ich mich bereits für [...]” (left panel) and “Nachdem ich am DaVinciLab-Workshop teilgenommen habe [...]” (right panel) split into boys (n=45) and girls (n=19).

In addition, the majority of both girls and boys feel confident in using the tool themselves after the workshop (see Figure 14), which is indicative of a successful transmission of knowledge and attitude towards the used technology and command of the digital tools.

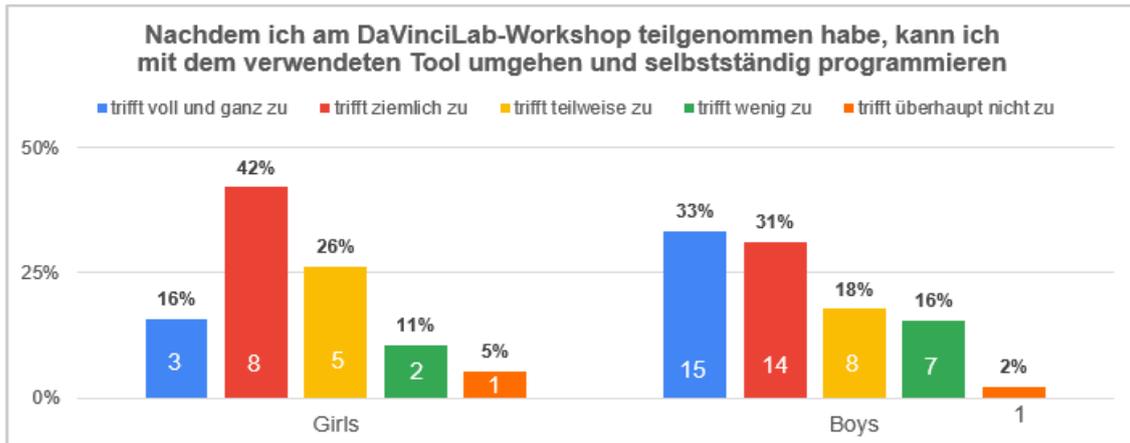


Figure 14: Result of the pupil survey (n=67) on the questions “Nachdem ich am DaVinciLab-Workshop teilgenommen habe, kann ich mit dem verwendeten Tool umgehen und selbstständig programmieren.” split into boys (n=45) and girls (n=19); numbers in white indicate absolute numbers.

Since the workshop had taken place, 69% (n=46) had not used the tool in their free time or in their school class again, but 31% (n=21) had. Finally, 52% (n=35) claimed that the work procedure used in the Youth Hackathon workshops was completely different than their normal classes, and 31% (n=21) claimed it was relatively different. Only 5% (n=3) thought it wasn't different at all. The majority of respondents completely (40%, n=27) and relatively well (30%, n=20) liked that they could acquire the programming knowledge themselves. Only 6% (n=4) didn't like it at all.

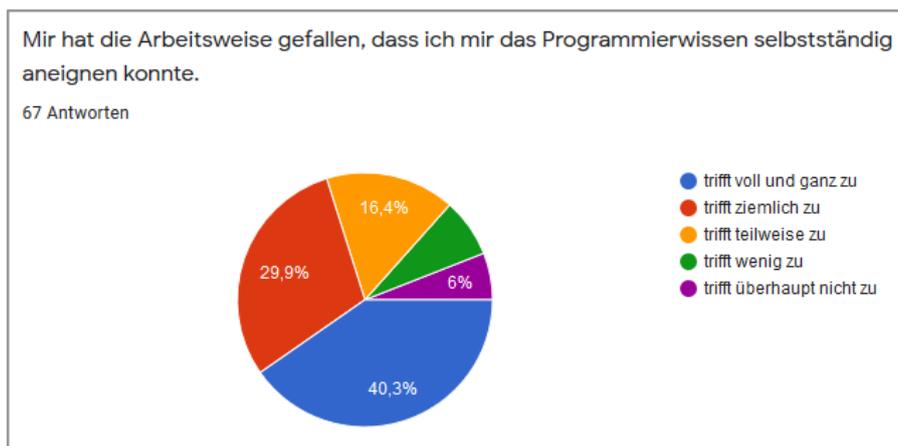


Figure 15: Result of the pupil survey (n=67) on the questions “Mir hat die Arbeitsweise gefallen, dass ich mir das Programmierwissen selbstständig aneignen konnte”

### 6.3 Summary

Summarising the results from both surveys we can state that both teachers and students were enthusiastic and positive towards the Youth Hackathon workshops as well as towards the project-based learning approach in general. Answers from the teacher's survey indicate that the workshops offer a valuable addition and different learning setting to the regular curriculum *Digitale Grundbildung*. In addition, pupils are given the possibility to take part in competitions and extra-curricular activities as well as making their often first experiences with programming in a fun and team-based way. Answers from the pupils' survey indicate that they enjoyed the

workshop experience, and that the workshop impact appears to lie in the fields of programming and the YH 2019/20 topic health and sports, rather than a greater awareness about the SDGs. In addition, a greater number of boys than girls had answered the survey. Based on the workshop observations we can summarise that the workshops follow the overall outline with some minor adjustments regarding content and duration, and that both teachers and pupils had a positive attitude towards the workshop experience as a whole.

## 7 CRITICAL REFLECTION UPON THE PROJECT

In this section we reflect on the materials and methods of the workshops with respect to the questions and dimensions mentioned in section 2.3.

### 7.1 Reflection on the materials

The materials used in the workshops cover several formats and speak to a range of different working styles. As could be concluded from the three workshop observations, the use of paper ideation and story canvases work well for both App and Game Design in both higher and lower school levels. It was also observed, however, that students often did not make use of them as extensively as they could. Rather, they dived straight into the programming part on the PC, noting only some elements on paper, or only filling partially the sections of the papers during the process.

Given that all materials are also freely accessible online (OER), it is in principle possible for anyone to make use of them on their own, even without the trainers. Nevertheless, an initial training session for teachers is advisable in order to make optimal use. The materials could be an additional resource to consider for schools and the subject *Digitale Grundbildung*, that teachers could draw on. At a closer look many of the online materials for *Digitale Grundbildung* do not conform to either critical and creative expectations of subject curricula<sup>14</sup>. Finally, Austrian curricula, especially those for pupils aged 10-14 so far consistently miss space for pupils' innovation (see Stuppacher, Golser & Vogler, 2020 forthcoming), especially in terms of creativity and implementation.

The set of materials is well documented and easily accessible through the Youth Hackathon webpage as OER materials. They fulfill the role of guiding and supporting the process in terms of content. The learning cards function as an easy learning guide for Scratch or the Thinkable App with their detailed explanations and images. They could also easily be used by informatics teachers in the basic digital education class, or in fact the teachers of any other subject in case *Digitale Grundbildung* is realised in the context of a different school subject. At the beginning of September, in addition to the learning cards, a set of interactive learn videos will also be provided on the website thanks to a grant financed by the OeAD (Österreichischer Austauschdienst)<sup>15</sup>.

### 7.2 Reflection on the methods

At the beginning (section 2.3) we posed some questions as to the effectiveness of the Youth Hackathon workshops, which we repeat here as a brief reminder for the reader together with our critical reflections based on the workshop observations and the surveys. After reviewing

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<sup>14</sup> see for example <https://digikomp.at/index.php?id=565&L=0> [last access: 06.08.2020]

<sup>15</sup> <https://oead.at/> [last access: 30.06.2020]

the materials and the surveys, we can conclude that the product the DaVinciLab offers in the form of the Youth Hackathon workshops, supports as well as complements the regular basic digital education curriculum *Digitale Grundbildung* of the Austrian lower and higher secondary school levels, both in terms of content and teaching/learning methods. It introduces pupils to programming through team-based learning or “playful learning” (constructivist learning approach), an approach that was well received by both pupils and teachers, as answers from the surveys have indicated. In what follows, we specifically look at the questions posed initially and reflect upon them.

### ***Which problem does the product of DaVinciLab solve?***

#### *a) For teachers (overcome a lack of (digital) skills?)*

Answers from teachers’ survey as well as impressions from the observations indicate that the workshops are effective in offering valuable support and additional input to the teachers’ already given curriculum of the subject *Digitale Grundbildung* while at the same time providing expertise in terms of content and digital skills that have not been and are not yet part of the more general teach education.

From the three class observations, it could be deduced that the workshops offer digital skills through possibly less widely practised teaching approach (constructivist/ “playful” learning). Note, however, that this observation holds just for the specifically observed interactions. When considering the wider context of school classes, however, often the subject *Digitale Grundbildung* is taught as part of different subjects with teachers managing the subject more or less successfully, depending on their own experience and training with digital content. Integrating “invited expertise” into the class has been widely practiced across different school levels and subjects, and is a beneficial asset for both teachers and pupils to experience different teaching methods, styles and topics. In order for teachers to take on the role of the facilitator, however, the product of DaVinciLab would need to be offered and integrated in teacher training programmes, for example, as train-the-trainer programmes.

In addition, a personal communication with one of the founders of DaVinciLab gave insights, that many teachers lack confidence and don’t dare to teach the kind of programming as offered in the YH workshops or more generally, the digital content as needed for *Digitale Grundbildung*. According to DaVinciLab, around 5% of teachers having participated in the YH workshops across the three years would dare to teach it themselves, around 40% with support, and more than half (55%) would not dare to hold similar workshops themselves (A. Gawin, personal communication, 30 July 2020).

As the class and workshop observations have shown, it was possible to run the workshops successfully with just one trainer, however, it was apparent that more than one trainer or facilitator were needed when it came to assisting pupils during programming or answering their questions, particularly in larger classes with, for example, 20 or more pupils. In order to enable the YH workshops to become a self-paced learning course with teachers in coaching roles rather than experts, an online course is currently in preparation by DaVinciLab / MadebyKids.

b) *For pupils (learn to be prepared for future (digital) competences?)*

For pupils the workshops are effective in offering them the possibility to acquire additional knowledge in or make use of already existing programming knowledge through “playful learning”, taking part in extracurricular activities or competitions, and also strengthen social and project based learning skills. They are given the opportunity to follow the whole process of creating an app or game from idea generation to the final product, including a presentation to a jury and awards (on a voluntary basis). Further, they are also introduced to the Award gala at Austria’s biggest innovation festival, the 4GAMECHANGERS Festival, which was established for young people as a tangible bridge to real life. and delivers the important and tangible WHY for learning.

The content of the workshops, e.g. programming, is certainly a valuable asset for pupils to acquire, as future professions are more and more in demand of digital competences. This holds true for both girls and boys, for whom a playful introduction to programming and other digital content can be a fruitful experience, also beyond the school context. In terms of content, the YH workshop seems effective for raising awareness among youngsters on topics such as digital skills or health and sports, but less so on the SDGs, as answers in the pupils’ survey have shown. According to the survey results, pupils overall enjoyed the “playful learning” approach. As regards survey answers distributed across boys and girls, it was overall male students who responded; also in the observed workshops no particular effect or awareness among the pupils with regard to gender related or social aspects could be observed. These findings are congruent with other studies (see Steinmann et al 2013; Stephens 2012, Hargittai & Shaw 2015) that show that collaborative and *reviewed* development of digital content is a predominantly male domain that needs to be addressed urgently. This may be done through compulsory instead of elective workshops, as well as through gender-sensitive pedagogies, and probably a combination of both. Although it was mostly male pupils who answered the survey, answers showed that the YH workshop experience also positively contributed to strengthening their interests in further development of digital skills including coding. For girls, although the number of respondents was much smaller, a similar effect was observed from their answers.

Due to the scaffolding methods as well as due to the well prepared learning cards which act as building blocks, all pupils had functioning projects at the end of the workshop with different levels of complexity depending on self-motivation as well as individual competencies (some had already some programming experience, some not). The majority of pupils liked the format (70%) and 95% confirmed it is (very) different to the way they are used to learning in their day-to-day classes.

It was surprising to see that the majority had not used the tool either in class nor in their free time again after the workshops. One could interpret and attribute the missing further usage in the class to various aspects: on the one hand, restrictions by the given curriculum could place a need to advance with other topics; on the other hand, one could also wonder if a lack of confidence of the teachers to develop such technical content further without support could be the case. Here, teacher training would be beneficial to enable this kind of interaction.

As to the Game Changer workshops that were not specific to a particular class, the size and the structure of the group, with just one girl attending, varied greatly in terms of gender distribution compared to school settings. The size and the structure of the group shows that the better way to reach the broad population of young people of both girls and boys with innovative formats like the YH, is to run workshops in the school context as they enable a

more inclusive setting. However, here the issue of financing external tutors or increasing knowledge and training of teachers needs to be addressed in order to ensure it.

c) *For the education ecosystem, e.g. ministries, schools, agendas etc. (to formally reach their goals?)*

As regards the workshop content, it is effective in supporting and being in line with the general aims of the Austrian education ecosystem for the curriculum *Digitale Grundbildung*. The curriculum *Digitale Grundbildung* for secondary level I, which can to-date be implemented in a variety of forms (both stand-alone and integrated in other subjects (BMBWF 2018)), teachers trained to teach this subject are still not readily available, the workshops close a distinctive gap to fulfill the formal goals. In this respect it may be recommended to offer the workshops depending on the autonomous school curricula as prior knowledge may be vastly different. Care should be taken to provide a format largely addressing schools who implement *Digitale Grundbildung* across subjects instead of standalone. The workshops are a valuable addition to the regular lessons, particularly with their skills and practice driven (hands-on project based learning) approach, with a strong focus on collaborative learning in connection to modern job profiles (job orientation).

In this environment, the DaVinciLab YH workshops explicitly and implicitly address the shortcomings presented by current implementations of *Digitale Grundbildung*, as well as a wider set of problems of the Austrian education system regarding innovativeness and empowerment of pupils regarding learning processes. The hackathons do so by providing a) a learner-driven, problem based learning environment, b) a full project cycle including implementation, c) extracurricular incentives and activities and d) anchors for the experience of individual competence and success. It therefore positively conforms with current ideas of innovation education (Weis et al 2017; Shavinina 2013).

In addition, the workshops also serve as a successful example for strengthening Public Private Partnerships (PPPs).

### ***Where does DaVinciLab make a difference?***

a) *relative to the setting (school)*

The product of DaVinciLab was specifically designed to fit in the given school and classroom setting, without the need for further investment of time or equipment to change room settings. In this respect, the YH workshop works well in the standard classroom, and can equally be implemented in other settings, if we consider the Game Changer workshops. On the one hand, one could thus argue that the YH workshops do not require a setting different to the regular classes, as was noted during the three observations, and that no systemic investment is being necessary. On the other hand, class dynamics during such interactions could also benefit from a different classroom organisation, supporting the playful learning also in terms of the environment or arrangement of tables and groups.

In order to implement new strategies in secondary education, a few preconditions include minimal deviations from traditional classroom structures in a few ways to make the initiative attractive to teachers. In the case of the YH, this includes the use of the classroom instead of

specialised labs, and the use of free software (e.g., Scratch 3.0 and Thinkable) as schools are distinctly underfunded in this respect.

The major difference the DaVinciLab YH makes in this respect is the constructivist and problem-based way of teaching and learning, which in Austria is less common in STEM subjects and needs to be emphasized in order to address the innovativeness of learners, as well as their self-esteem.

#### *b) relative to the taught knowledge (skills, content)*

Our reflections and also the results from the surveys have shown that the YH workshops are effective with regard to emphasising the importance of digital (programming) skills and content such as health, sports or movement. As to digital knowledge, the content covered by DaVinciLab fits entirely with the curriculum *Digitale Grundbildung*.

As regards the transmitted knowledge and digital skills when it comes to gender, both girls and boys performed equally well in the programming of the games or apps and there were no differences in quality between the games produced by one or the other.

We could thus note that for both girls and boys, a playful introduction to programming can spark interest in acquiring or deepening such digital skills beyond the workshop or class setting. Thematic content, such as sports, health or programming that the students were already familiar with before, seemed to have had more sustainable impact and effectiveness from the workshop, than topics the pupils had not been familiar with before, such as the SDGs.

## **8 CONCLUSION AND RECOMMENDATIONS**

### **8.1 Conclusion**

Concluding we can summarise that the developed materials and used methods of the YH workshops are effective in transmitting a positive attitude towards programming, digital skills and STEM related activities for both male and female youngsters through a constructivist and team-based learning approach. In addition, the YH format is very much in line with and supports the curriculum *Digitale Grundbildung* of the Austrian lower secondary level (Sekundarstufe I), giving youngsters a playful introduction to digital skills and knowledge as well as an opportunity for reflection on future job profiles in a digital world. As one result of the workshops, all pupils were able to finish their projects in the given timeframe of the workshops and there were no differences in quality of the games or apps between boys or girls. As to social aspects such as gender awareness and equality, anchoring the YH workshops in school contexts rather than extra-curricular activities results beneficial for inclusive approaches, reaching both boys and girls more equally. Overall, the workshops were well received by both teachers and pupils of the different classes observed and this was also reflected in the two surveys. The workshops as offered by DaVinciLab can serve as a fruitful addition and support for schools to fill current gaps in the basic digital education curriculum, to engage pupils in extracurricular activities, offering opportunities for team-based learning and discovery of personal strengths and interests. In order to have the format more firmly integrated in the Austrian education ecosystem, longer-term funding from ministries or regional bodies would result beneficial, as well as integration into teacher-training programmes.

## 8.2 Recommendations For Increasing Effectiveness

Finally, after critically reflecting on the different aspects the product of DaVinciLab offers in the form of the YH workshops, we here present a number of recommendations for further development.

The following recommendations aim at further and potentially more sustainable development with different target groups and stakeholders in the Austrian education ecosystem. Not all may be implemented at DaVinciLab level, but may also be seen as incentives on political and administrative levels:

### a) Inclusiveness

To-date, the YHs are spatially exclusive (mainly available in the eastern regions of Austria); as a second thought there seems to be a minor exclusiveness in terms of gender, especially for activities beyond school, which was to be expected from relevant literature.

**Recommendations in terms of spatial spread:** in order to have a wider reach, either similar workshops could be provided with a stronger focus on western, southern and rural areas in Austria. Relevant funds would need to be provided by the respective ministry / *Bildungsdirektion* and may be supported by local government agencies. Further spread may also be achieved by in-service teacher training (see below). In addition, the increase and current development of DaVinciLab materials for entirely digital interaction formats, i.e. learning videos, etc., a more equally distributed geographical reach could be achieved.

**Recommendations in terms of gender equality:** while the quality of developed games seems to have been similar in the game development, there seems to be a lack of female interest in the extracurricular Game Changer workshops, which typically take place during the summer time and are paid for by the youngsters' parents. Possible solutions to this issue may include:

- a stronger focus on in-class development;
- the provision of specific Game Changer workshops for girls only under the girls in STEM initiatives;
- an explicit girls/boys division in classrooms to foster awareness of different approaches and expectation on interfaces
- “female” game development (“pinkification” of learning environments)
- stronger emphasis on female DaVinciLab instructors in schools and extra-curricular workshops that could function as a role models for girls and young females in general

### b) Teacher Training & in-service teacher training

For wider roll-out, the inclusion of the model in compulsory teacher training and teacher-in-service training would be necessary. This would probably need additional funding, and also the will on a policy level at pedagogical universities across the country would be relevant. Depending on the theme of the workshop, a widening of the subject base beyond the obvious subject of informatics may be thought of, i.e. into mathematics, geography & economics, or history, social science & civic education.

- inclusion in courses of subject pedagogies in initial teacher training in the above subjects at universities and pedagogical universities. This can be done through the cluster structures in teacher training, as well as the “Österreichische Gesellschaft für Fachdidaktik” (ÖGFD) to find cooperation partners. Both partial as well as full courses are possible and are provided for in teacher training curricula in BEd (Bachelor of Education) and MEd (Master of Education) teacher training.
- preparation of offers for in-service teacher training seminars for the 14 pedagogical universities across Austria, with the option to adapt for specific audiences. These plan for their programmes in advance, but later implementation as a partial seminar is often possible.

### c) Marketing during the actual implementation of *Digitale Grundbildung*

The implementation of *Digitale Grundbildung* is in its infancy in Austria, and little data is openly available about its success and/or shortcomings. As schools need to provide a specific number of lessons, and most have opted for integrative implementation of the curriculum, the DaVinciLab YH may fill a gap at many schools. To do so effectively, the following suggestions can support such development:

- Review current materials in *Digitale Grundbildung* in terms of pedagogies and content
- Review the ongoing implementation at lower secondary schools
- Develop ‘subject-specific themes’ to fit into the subject curricula (the subject curricula of *Sekundarstufe I* are currently revised and have to have parts of *Digitale Grundbildung* that may provide anchors for the YH workshops).
- Provide a basic structure for grading the students’ efforts within the workshop - teachers are required to grade along the “Leistungsbeurteilungsverordnung” (LBVO) although the concept of grading is counterintuitive to the project idea.

**Recommendations in terms of growing digitisation:** in the light of current developments including that of a COVID19 environment, digitisation is likely to increase across all areas of our daily lives even further. That’s why the workshop formats, which are to-date mostly implemented in an analogue way requiring physical presence of the participants, could benefit from adjusting their interactions to digital spaces. A first step in this direction has already been made with the DaVinciLab learning videos that will be implemented in a learn management system, where pupils can also take quizzes to test their learned knowledge and which they can use from home via online conferencing & collaboration platforms such as Microsoft 365<sup>16</sup>, Google G Suite<sup>17</sup> or similar. In addition, online coding sessions have also been implemented by DaVinciLab since spring.

**Recommendations in terms of partnerships:** similar to this short term report and observations with exploration space at the Austrian Academy of Sciences, DaVinciLab has partnered before with educational institutions such as pedagogical academies (*Pädagogische Hochschulen (PH)*) and other research or education related institutions who have produced short reports on their formats and interactions.

<sup>16</sup> <https://www.microsoft.com/de-at/microsoft-365> [last accessed: 18.08.2020]

<sup>17</sup> <https://gsuite.google.com/intl/de/> [last accessed: 18.08.2020]



Weis, S., C. Scharf, L. Greifzu & I. Gryl (2017): „Stimulating by Simulating. Fostering Innovativeness in Education”. In: International Conference on Education: IACB, ICE & ICTE Conference Proceedings, 386/1–386/11.

### Online resources:

<https://arbeitsblaetter.stangl-taller.at/LERNEN/LerntheorienKonstruktive.shtml> [last access: 30.06.2020]

## APPENDICES

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