



# Project Report **Digital Enlightenment**

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## Preface by the Tutors

Danilo Hackner and Andreas Heimfarth

The team Digital Enlightenment started with a bold and broad project goal: improving the way science is communicated. “Are scientific developments relevant to me?”, “Can I trust scientists to tell me the truth?”, “Is it even worth publicly funding science?”, were some interesting questions generated in this process. Highest social relevance had been a driving factor for the team to identify their topic, hence the fact that many people may have accordingly doubts was always an important prerequisite. The COVID-19 pandemic proved, how dangerous it can be if a part of society rejects scientific findings and ignores the corresponding recommendations.

Nevertheless, it was difficult to align on and formulate a concrete project idea and in the end the team developed new thematic ap-

proaches together. In this, probably one of the most challenging parts of the entire project, it was impressive to see how a new path was taken through constructive and focused cooperation – even under a certain time pressure. After extensive research the team identified a field both highly relevant and technically challenging to focus on: Educating high school students to manage their data privacy and security. Public discussions about face recognition on social media, large-scale data leaks in corporations and even surveillance by totalitarian countries highlight what can happen if your data gets in the wrong hands. Teenagers are among the most eager users of social media and cloud services, however many of them have little awareness about the risks, as the team’s results show. On the other hand, the topic is complicated and affected by lat-

est developments in science: An encryption technique that is safe today can be obsolete tomorrow due to advancements in math or computer science.

In very short time, the small team developed workshops for 8th to 10th graders and accompanying posters for schools. Simultaneously, they convinced several schools in and around Munich to participate and dedicate time to the teams' data privacy and security program. We as tutors were amazed by the determination and efficacy they showed in convincing school principals, creating great info material and delivering workshops in English and German without a single native speaker in the team. The team took the approach of fostering discussions and self-reflection with the high-school

students rather than lecturing about the “right way” of managing your digital life. The good feedback and observed changes in the teenagers' attitudes proved them right. The majority of participants reported that data privacy and security topics were not taught in school and that they enjoyed program.

We enjoyed supporting this diverse team in defining their project ambitions and later seeing them achieve their goals very independently. We are sure they have had an enduring influence on the way many of their participants will handle their data in the future. ■

## Decode your digital daily life

**Shape who you are by only four supermarket receipts.  
What more should we know about our digital daily life?**

*from Ho Huang, Munich*

“We often judge people by words they speak, clothes they wear, cars they drive, and their responses in different situations. However, have you ever thought of knowing a person by seeing things they bought from supermarkets on the receipts? How much personal information do you think you can get from them?”

These questions are asked to high school students in a guest workshop by the Junge Akademie project team “Digital Enlightenment” from the Technical University of Munich. Their goal is to convey knowledge and raise awareness of the topic “Data privacy and cybersecurity” to the digital generation.

“We not only want to inform the students about different risks on the Internet, but also how things work in the digital world. So that they would be more aware of their interaction with the digital world and have the ability to assess risks on their own and protect themselves.” Says one of the members from the team. After intensive research, interviews with experts from the university and local enterprises, the team Digital Enlightenment sorted out eight popular topics such as AI, hardware defect, data protection regulation, online sharing, activity tracking and so on. Each workshop contains two of the topics and is held either in English or German according to the choice of the school. For students, these workshops will be a special one and half hour in their regular English, German, computer or free elective classes.

### Data tracking

“I assume the person is very aware of eating healthy because he or she bought a lot of organic products.” A boy in the classroom raises his hand grasping a supermarket receipt and says. “and he

or she could also be a Muslim since there was no pork product on the list”, another girl also makes a guess. The whole class laugh out loud after a student says, “I think this person is a she, because she bought vegetables and fruits, men usually don’t do this.” What a stereotype! But, would this mean that we can tell the gender of the customers just by counting how much Irish ribeye-steaks they put in the basket?

In reality, by setting the right conditions, and correctly matching, shaping the customer by their purchasing behaviour or predicting their next purchase is not difficult at all using today’s technology. Imagine you got an unknown receipt and few things were on the receipt: a face cream, a hair conditioner, one bottle of soybean milk, a package of tofu, 10 organic eggs, 4 yogurts, 2 bottles of tomato sauce, 2 packs of spaghetti and frozen vegetables. Could you give me a guess about the customer’s gender, heritage, age range, if he or she is a student, live alone or with partners or family. Does this customer have lactose intolerance?

“She always went to the supermarket around 17:30 or 18:00, we assume she does grocery shopping after work. Oh, and we quickly checked the supermarkets she went to on Google Maps, and we think she either works or lives in the north-west part of Munich.” Say one group of students in the workshop at a local high school in Munich.

It is shocking, isn’t it? Just by looking at the supermarket receipts, you can already obtain so much information about the customers. Would it be possible to get even more precise information if you had more receipts saved from the same customer for three months, or even one year?

### Hardware-hacking and phishing

“Yes! This is a phishing email! We are the first!” A student jumps from the seat, raises his hand and shouts out loud. Here is another workshop with the topic “hardware-tracking and phishing”. Students are split up in groups and try to identify different phishing emails and websites by checking if there are obvious grammatical and spelling mistakes, if the names of the companies and institutions are fake, if there is any unusual combination of letters in the link, or any information regarding transferring money to a specific bank account.

We all have experiences where we receive some junk mails in our mailbox or accidentally click into some “weird-looking” website when we are browsing on the Internet. The listed check points above are vital information to prevent yourself falling into the phishing trap and eventually “voluntarily” giving out your personal information to hackers. It seems to be easy to avoid phishing, right? In fact, there

are almost 1,5 Million phishing websites created every month. And in 2018, scammers stole over 100 million US dollars from Facebook and Google.

“I know my camera is on when I see the green light. So, when somebody is using my camera to watch me, I should know right?” A student holds the camera cover he receives as a give-away from the team and asks. The answer is – not really. It is totally possible that someone turns on your laptop camera without the little green light next to it going on. Students then ask in surprise, “can I have one more camera cover?”

Is there anything else I can do to protect myself from being hacked? Here are some tips recommended by different cybersecurity experts:

Recommended actions	Something we do, but is not really helpful	Do not do
<ul style="list-style-type: none"> <li>■ Update your apps and operating system</li> <li>■ Download an anti-virus software on your computer and run the scan on the highest setting</li> <li>■ Long, strong and unique passwords</li> <li>■ Turn on the two-factor authentication function</li> <li>■ Cover your web-cam by using a web-cam sticker</li> <li>■ Use an ad-blocker</li> </ul>	<ul style="list-style-type: none"> <li>■ Change your password from time to time</li> <li>■ Use different anti-virus softwares on the same computer</li> <li>■ Deactivate the web-cam in the computer setting</li> </ul>	<ul style="list-style-type: none"> <li>■ Use same password across different platforms</li> <li>■ Use the “save your password” function on your browser</li> </ul>

“If I don’t use Internet and email, this problem will not exist anymore right?” A student sitting in the first row asked. Unfortunately, not exactly, phishing can also occur without using any specific technology, programming or computer skills. A video is played in the class, showing a woman who is playing the sound of a baby’s cry on YouTube to create a scenario of a busy and stressed mother with a newborn baby, trying to get her husband’s bank information. Guess what? She even managed to change “her husband’s” contact information with the bank in the end. This act of manipulating or tricking someone into divulging information or taking action is called “social engineering”.

### Oversharing

While in the break between the workshops, I saw a new post from a friend of mine saying that she just found one hundred Euro in one of the pockets of her winter jacket. It does not really matter to me and to be honest, I am not really interested in every detail of her life. Sometimes, I really think people share way too much information on social media. But does this also have something to do with our digital world?

“Oversharing” refers to when a person gives out more information online about a topic than they would in person. It could be any kind of information, but especially personal information. Nowadays, it is also very common to see companies or celebrities use different online platforms or social media to advertise themselves. But maybe just because of the convenience, people sometimes forget to take the risks into account before they post things on the Internet. Tom Daley, who is an British diver and also the 2012 Olympic bronze medallist, once posted a YouTube video, in which he forgot to cover the phone number while calling his friend Nile Wilson, who is also an Olympic bronze medal artistic gymnast. And guess what, Nile got a lot of unknown messages and phone calls the next day. You might think “not so many people want to get my phone numbers, it shouldn’t be a big deal for us.” But you did post some

photos when you were on vacation last year, when you went to Mallorca with your family right? That could be also a risky action because you were basically letting people with certain intentions know that the whole family would not be at home for days.

“Some people share their negative emotion on social media all the time or even suicidal thoughts.” A girl responds when being asked what could be considered as oversharing. The teacher takes the chance and tells the students “if you ever feel depressed or have suicidal thinking, please reach out, no matter if you call somebody or post your thoughts on the internet. In the other case, if you ever see people posting something like this, please show your care, because you might save a life.”

Sharing information is part of our human natures, thanks to the technology and Internet, people can share different information, anytime, anywhere and to anyone. If you want to prevent yourself oversharing, think twice before you hit the “post” button and double check if you accidentally reveal personal information online. Set your social media accounts to private, that means only people you know can see your posts, is also an effective way to avoid sharing too much information to strangers.

### Conclusion

New information and development of technology are emerging every day at an incredible speed, at the same time, myths and misinformation are everywhere. Our daily living is surrounded by Internet and technology, whereas the knowledge regarding data privacy and cybersecurity is still not commonly covered in our basic education at schools. In an effort to translate scientific information into information and actions which everyone can easily understand and apply, the team Digital Enlightenment from the scholarship program: the TUM Junge Akademie is putting their ideas into action and trying to bridge the gap between science and our daily lives. ■





The posters are displayed around the campus and in the cooperated high school before the workshop



## Digital Enlightenment

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### Abstract

Though the Internet is already indispensable in our daily lives, knowledge regarding data protection and cybersecurity is still not commonly covered in schools. To translate scientific information into easily comprehensible information, our team Digital Enlightenment conducted twelve interactive workshops with almost one hundred and seventy students in four different Munich schools. The topics covered included artificial intelligence, hardware hacking, online sharing and tracked activities. By analyzing pre- and post-survey results, we can conclude that our workshop had a positive impact on students regardless of whether they had had previous training on the topic or not. Besides, more than 60% of students exhibited their willingness to reconsider their online behavior. Based on students' behavior in the workshops, we may also conclude that creating a competitive environment in class has a great potential to boost the students' motivation regarding science communication.

### Background

Ever since the inception of the Internet, distance communication and resource sharing have brought people much comfort and convenience. However, in recent years, data scandals of giant companies such as Facebook and Google have cast doubts on personal data protection and cybersecurity. Though the press and governments have exhibited rising concerns about cybersecurity and data protection, the public at large remains either unaware of or complacently indifferent to the potential hazards they may be exposed to. Pew Research Center designed an interactive quiz to answer the question: "What the Public Knows About Cybersecurity." They found out that many key concepts and topics in terms of cybersecurity are only known by a minority, while most people cannot even correctly answer more than half of the questions (Smith 2017). Responding to the call (2019) "Multimodal Science Communication," our team Digital Enlightenment decided to empower high school students with the necessary knowledge regarding artificial intelligence, hardware hacking, online sharing and tracked activities. To design successful workshops in each topic, we took interactivity as the most relevant factor, which includes the interaction between student and teacher, the interaction between students themselves, and the interaction between students and workshop materials (Moore 1989). To motivate the students so that they could participate actively in the workshops, we focused on engag-

ing the curiosity of students, explaining the challenge of each topic appropriately, avoiding more work than necessary, and introducing competitive games. These critical factors about intrinsic and extrinsic motivation are mentioned in (Williams-Pierce 2011).

### Goals and Methods

As smart gadgets have become indispensable in our daily life, we decided to conduct interactive workshops with incumbent high school students, who are most influenced by digitalization. Surveys were distributed to the students before and after the workshops for effectiveness analysis.

The selected topics include:

1. Artificial Intelligence
2. Hardware Hacking
3. Online Sharing
4. Tracked Activities

Through different workshops, we aim to:

- introduce the topics mentioned above in scientific but understandable terms to the targeted audience;
- raise awareness about cybersecurity among young people;
- determine factors influencing the efficiency of science communication in the field of cybersecurity through the analysis of the outcomes of the implemented actions.

In the following sections, the workshop overviews will be introduced.

### Artificial Intelligence (AI)

Though artificial intelligence seems to be a popular topic in our daily conversations, its influence can sometimes be underestimated due to its ubiquity. The workshop aims to motivate students to reconsider their online behavior such as preference settings and the usage of online tools, including Youtube and Instagram, through educating them on how AI works to influence our minds. By incorporating videos and online games into the traditional PowerPoint presentation, the workshop tried to convey the following messages:

1. AI is the codes written by humans. It is intangible. Alexa, Siri or robots should be considered as the carriers of AI.
2. AI works in two ways: follow the rules or learn with data.

3. AI can interpret what we are thinking by evaluating our past data.
4. AI can influence our behavior since it can calculate our interests.

### Hardware Hacking

Gadget security is of the utmost importance today since smartphones, tablets and personal computers can be seen in almost every household. This workshop was organized as a competition between different teams. After short introductions about phishing, social engineering and other fun facts, different games and quizzes would follow up to deepen the students' understanding. The token-winning processes worked to encourage a competitive and highly interactive environment in the class. After the workshop, students should have understood:

1. How much (private) data our devices can store;
2. The dangerous consequences that could result if this data falls into the wrong hands;
3. A brief idea about hacking and how it works;
4. Some advice and tips to help protect their gadgets.

Instead of building an intimidating atmosphere, the workshop encouraged the students to reconsider the protection of their devices based on the knowledge they have acquired.

### Online Sharing

As online sharing apps such as Instagram, Snapchat and TikTok become viral, the importance of information protection is brought to the stage. This workshop wants students to reconsider their current behavior on social media by providing information on the risks and benefits of sharing personal information on these platforms. The combination of online quizzes and presentations allowed the presenter to clarify students' doubts on the spot while maintaining an intermediate level of interactivity throughout the workshop. The main take-aways of the workshop are:

1. What oversharing is;
2. The risks, benefits and limits of sharing private information on social media.

### Tracked Activities

It is a typical phenomenon when a freshly downloaded app asks us for permission to track our voices, locations and photos. How would these tracked activities affect our daily life? This workshop

aims to share what data tracking is and how this relates to our everyday experiences.

After grouping the students into different teams, different datasets from our daily life were given to them. Students were allowed to discuss within their teams to interpret what these datasets could tell them about the data owner. With careful moderation and result-sharing discussion, the students should have been able to learn:

1. Data tracking can make life easier, but at the same time expose us to the danger of data misuse;
2. How data can be used;
3. Data tracking describes how people retrieve data, but its usage depends on the owners of data.

### Outcome and discussion

After carrying out twelve workshops with almost a hundred and seventy students in four schools around Munich, our team obtained both pre- and post-survey results regarding the respective

workshop topics. The pre-surveys aimed to collect the students' demographic data and their previous knowledge regarding cybersecurity, and the post-surveys allowed the students to rate the overall quality of the workshop. Even though it was not possible to ask all the students in every school to answer the questionnaires – due to school regulations – at the end of the project, forty-four students filled out our surveys. Most of the students who participated in the workshop were between 15 and 16 years old (see Fig. 1).

Thanks to the surveys, it was possible to understand the students' overall Internet behavior. Most students (72.7%) own either two or three devices with which they access the Internet; however, a few have four or even more than four devices (18.2%) (see Fig. 2). Most of them spend two to three hours daily online (see Fig. 3). Both Figures 1 and 2 show that high school students are indeed subject to frequent data exchange, proving the necessity to empower them with a deeper understanding of cybersecurity. Figure 4 shows that they usually access the Internet at their home. This phenomenon could be caused by the restriction of Internet usage in some schools.

**Age of students in workshops**

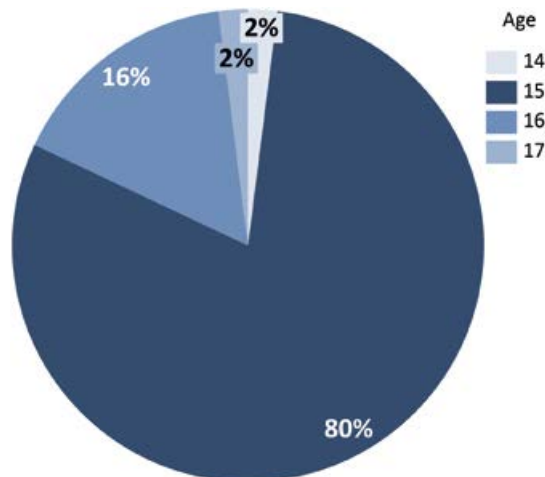


Fig. 1. Percentage of students by age

**Number of devices owned per student**

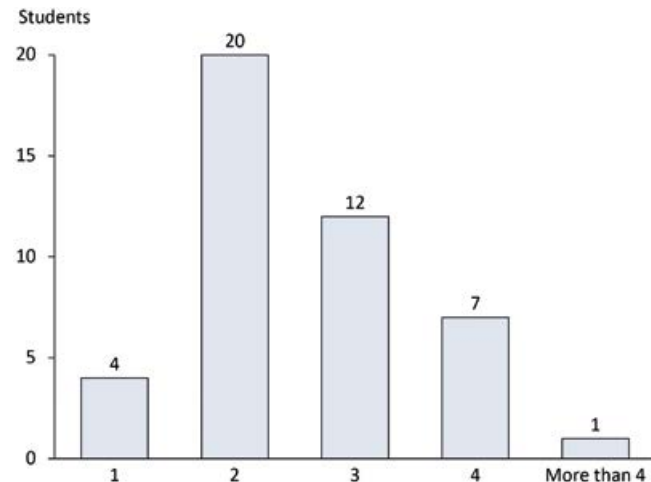


Fig. 2. Number of devices owned per student

When asking students about their main activities online, watching videos, listening to music and social media are the most common answers (see Fig. 5). Studying and browsing for information are also common, but not as much as the previously mentioned activities. Hence, it is essential to provide high-quality information to students on what kind of consequences their online behavior could have.

In general, good feedback was received from students regarding the workshop. 97% of them rated the workshop as good or very good (see Fig. 6).

Students were also asked whether the workshop satisfied their expectations on a Likert scale from 1 to 5 (1 = "Completely," 5 = "Not at all"). On average, the workshop scored 1.92, meaning that the expectations of students were mostly satisfied. The students also evaluated whether the workshop was interesting, fun, important and clear. On a scale from 1 to 5 (1 = "Very Much," 5 = "Not at all"), the workshop performed better on the categories of importance

( $M=1.34$ ) and clearness ( $M=1.52$ ). The category fun was also positively evaluated ( $M=1.63$ ). However, the category of newness was the least highly rated ( $M=2.45$ ).

One of the main goals of the project was to find out whether giving an interactive workshop on a new topic could increase students' knowledge. Within the sample, 50% of the students asserted they had previously participated in cybersecurity or data training, while 50% had no previous experience (see Fig. 7). The knowledge of some cybersecurity concepts was evaluated through questions (within the topics of Online Sharing, Hardware Hacking, Data Tracking and AI). It was hypothesized that students with previous knowledge would perform better than students who were being exposed to such training for the first time.

To examine the validity of this hypothesis, the percentage of correctly answered questions for both groups was assessed. On average, students with previous training answered correctly to 68% of the questions, while students with no previous training answered

### Number of hours per day spent online

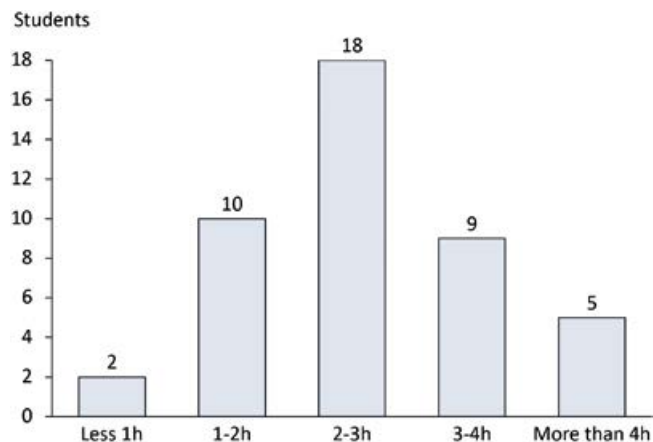


Fig. 3. Average amount of hours spent online per day

### Main place to use the Internet

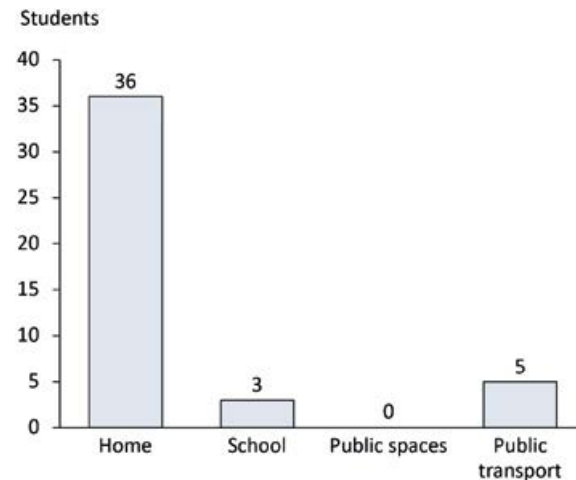


Fig. 4. Main places where students use the Internet

correctly to 73% of the questions. Even though students with no previous training had a higher proportion of correct answers, this difference was not significant between the groups,  $z=-0.364$ ,  $p=.719$ .

For our project, it was also critical to assess whether students had learned something at the end of the workshop. The surveyed students were asked to indicate whether they felt they had learned “a lot,” “a little” or “nothing.” The difference between the group with previous training and the one without was very slight. Although 5% of the students with previous training said they did not learn anything new, the majority of students asserted that they had learned a little or a lot (see Fig. 8).

To further rate the success of the workshop, students’ future willingness to change their behavior was measured. It was hypothesized that to consider the workshop successful at least 40% of the students should state their willingness to re-evaluate their behavior. At the end of the test, 61.36% of the surveyed students said they would like to reconsider their online behavior. This percentage was significantly greater than the 50% hypothesized,  $z=-2.90$ ,  $p<.05$ . In conclusion, the workshops were successful in motivating students to reconsider their daily online behavior.

From surveying the students, our team learned that students between 14 and 17 years spend a considerable amount of time online through several devices and that they mostly use the Internet at

#### Popularity of internet activities

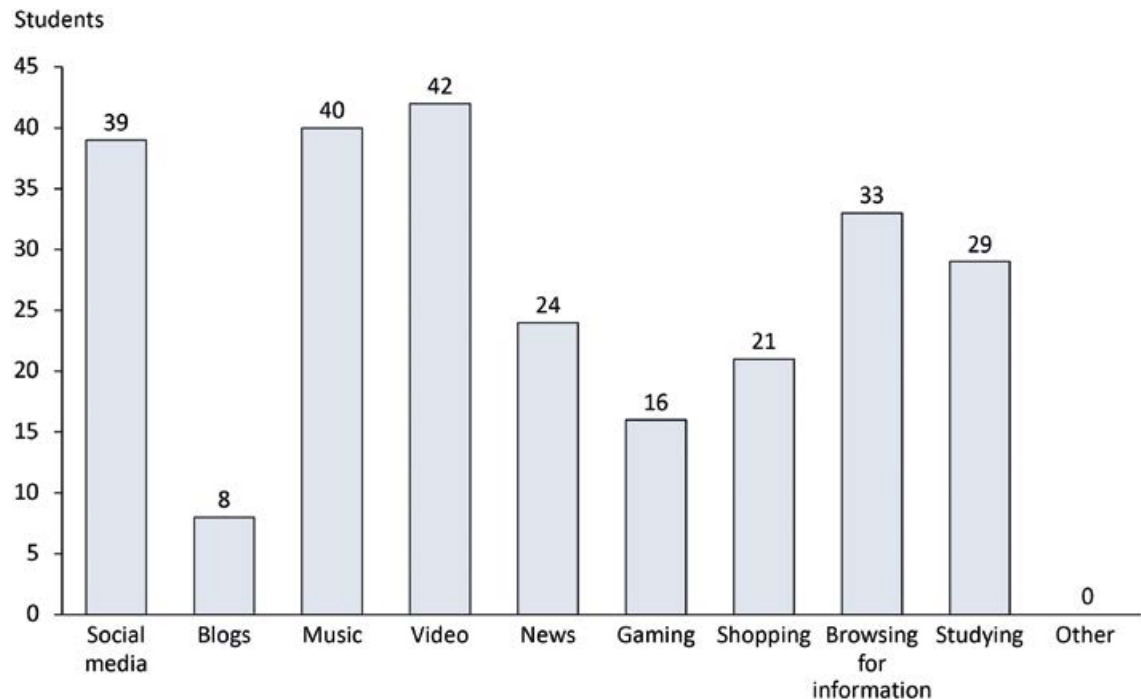


Fig. 5. Main activities on which students spend time online

Rating of the workshops

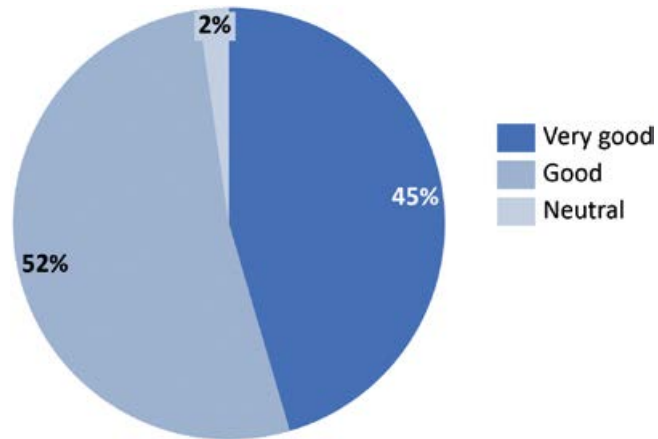


Fig. 6. Rating of the workshops

Students previous knowledge/training

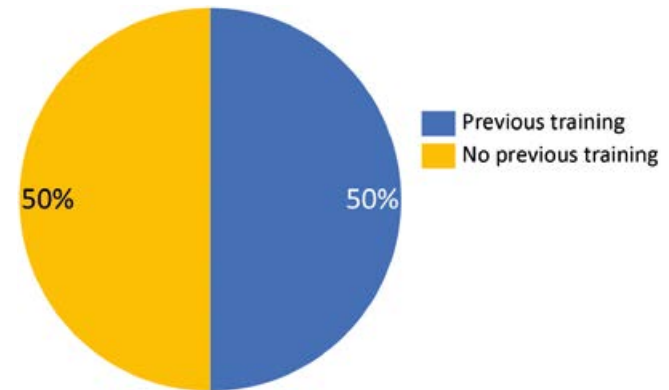


Fig. 7. Previous training on cybersecurity/data privacy topics

Students assessment of workshops: Do you consider you learned something today?

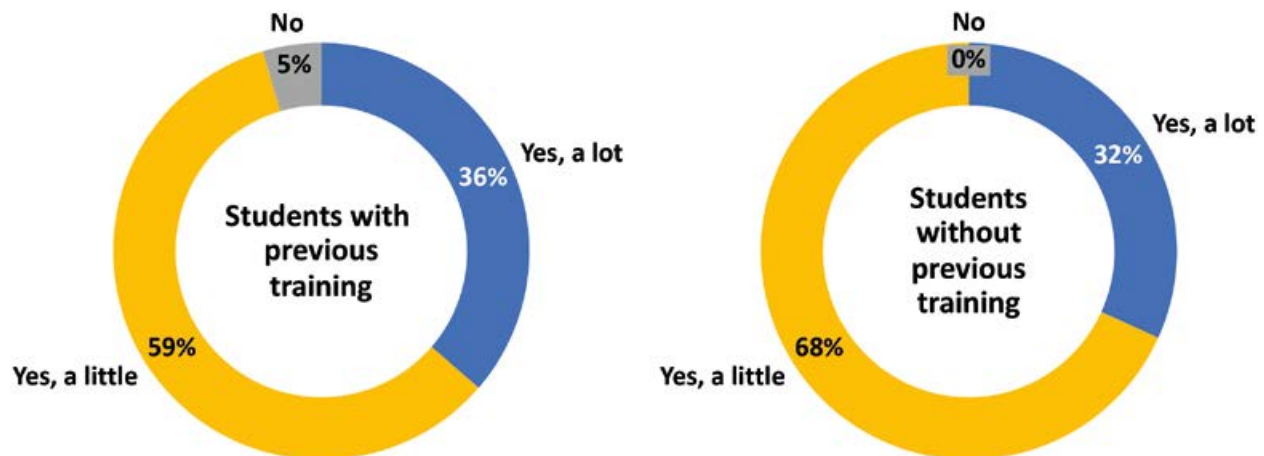


Fig. 8. Learning assessment after workshop: students with previous training vs. students without previous training



home, but seldom in schools and public spaces. In addition, they spend most of their online time on leisure activities; studying and learning new information are secondary activities. These findings reinforce the need to provide students with useful information on how to navigate safely and protect themselves and their personal information on the Internet. Even though some students claimed to have previous training on the topics of cybersecurity and data privacy, the survey results show that their knowledge was not superior to that of untrained students. This phenomenon could mean that the previous training they received was not impactful enough for them to learn basic concepts on the topic.

According to our survey results, very few students considered that they did not learn anything at all during our interactive workshop. The positive evaluation of our workshops could be related to the high willingness of students to reconsider their online behavior, implying that the high degree of interactivity could have had a positive impact on the workshop evaluation. Therefore, we consider that creating these interactive workshops and visiting the schools had a positive impact on the students in their daily lives. Even though it is not possible to assert that there will be a long-term impact on their behavior, motivating students to reconsider their habits is already a significant accomplishment. In the future, providing a permanent source of information directed to young students which takes into account the factor of interactivity could be an excellent opportunity to influence more students and produce a long-term behavioral change.

### Summary and Outlook

After conducting twelve workshops in four different Munich schools regarding AI, hardware hacking, online sharing and tracked activities, team Digital Enlightenment tried to motivate students to reconsider their online behavior. Through forty-four survey results, it

is clear that students are greatly affected by their online behavior. Whether they are studying online or listening to music, they are constantly in touch with all kinds of information and people during their daily lives. From our survey evaluation, we can conclude that our workshop had a positive impact on students regardless of whether they had previous training on the topic or not. Students with previous knowledge did not perform better than those without pre-knowledge. This phenomenon signals that current training carried out in school or other organizations are not always impactful enough to create long-term learning. In our perception, the environment during the workshops was always very energetic and positive. Using interactive strategies to communicate scientific knowledge about cybersecurity and data privacy, for example, through games and competitions, proved to be a successful method to motivate students. Moreover, even though our team's goal was to convince at least 40% of students to reconsider their behavior, more than 60% asserted that they would be willing to do so.

To ensure a long-term effect and expand the target audience to young people more generally, it might be possible to create a platform which comprises both on- and off-line activities. On such a platform, we could share exciting videos, print materials in the workshops and organize other offline events (see Fig. 9). Not only could the students with workshop experiences revise what they had learned in class, but other internet users could also register to participate in offline activities.

According to our survey results, we would also like to suggest the inclusion of cybersecurity topics in the school curriculum, since the younger generation is subject to vast data exchange every day. Neglecting cybersecurity knowledge in school education could have left the young generation vulnerable to vicious online attacks. ■

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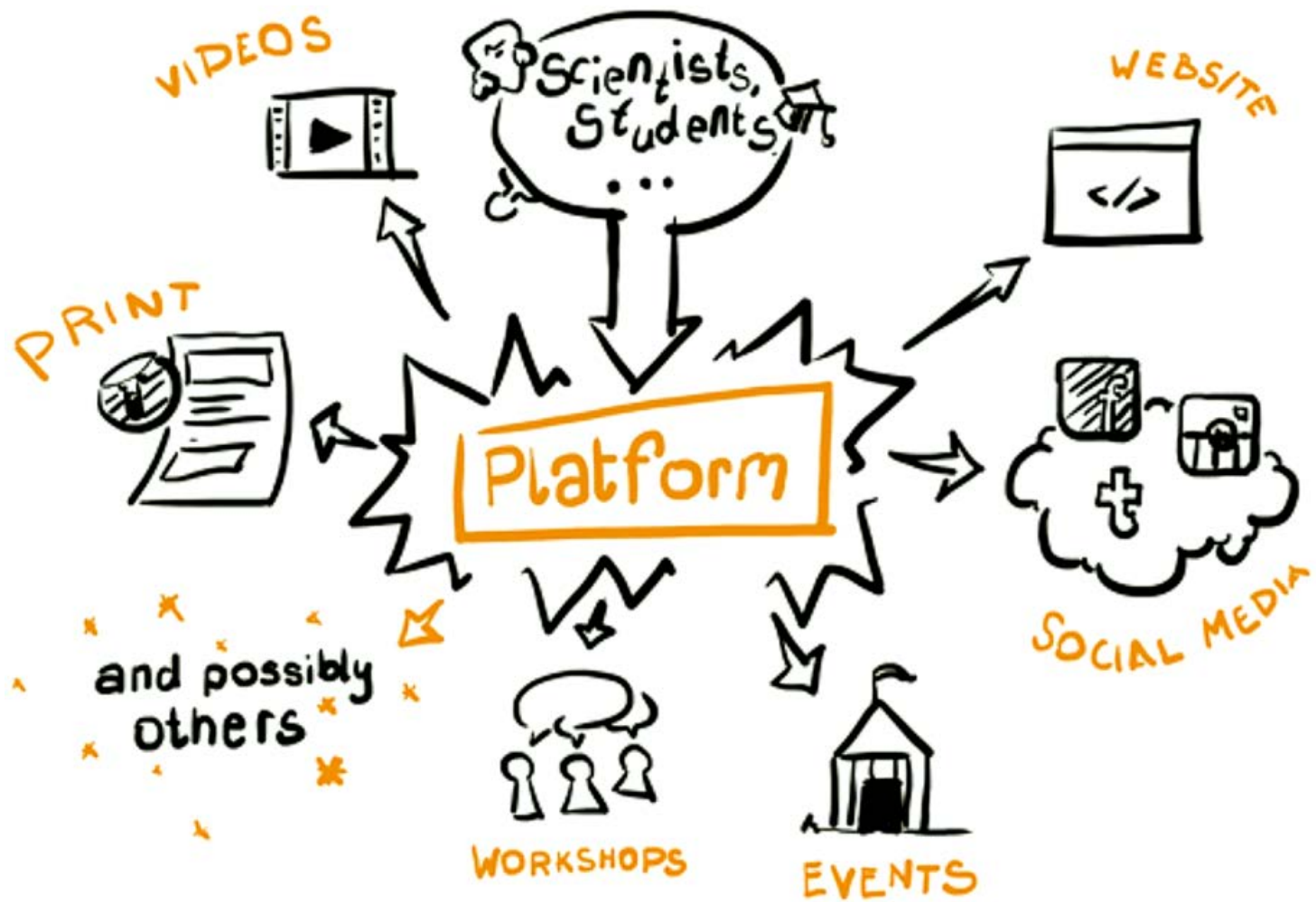


Fig. 9. A multi-media platform for cybersecurity online knowledge sharing and offline activity organisation

## Self Reflection

“The beginning is always the hardest” – our experience in Digital Enlightenment was no exception. Determining the theme of our project was exciting yet challenging. We started from a fundamental observation: scientific knowledge in many fields did not adequately reach out to the general public. Therefore, we decided to bridge the gap between science and society. This thought has brought to the birth of our project, “Digital Enlightenment.”

To which extent do people need to know about science? Which kind of information is vital to be communicated? Who is the target audience? These are some of the questions frequently appearing in our initial discussions and debates. Science can be inspiring and exciting, but people do have different interests and capacities. Our job was to figure out the topics which the public should but yet have a basic understanding. Initially, we had some other candidates, such as nutrition and climate change, but we ended up choosing cybersecurity and data privacy due to their prevalence in our daily life.

Regarding the target group, the most comfortable choice would have been university students. However, the high school students, who were born and raised in the digitalized era, should be more relevant to cybersecurity. The decision-making process was not as smooth as it might look. We spent a very long time going through possible topics; we hesitated to make decisions because of our high expectations; we started to lose motivation over time. In the end, one of our team members, Markus, decided to leave the project. We were all saddened by his quit. Nevertheless, all the obstacles and hesitations also pushed us forward and let us learn from our mistakes.

After we finally decided to communicate cybersecurity and data privacy to the public, we collected the ten most intriguing questions regarding this topic and conducted a series of interviews, since we wanted to hear from the experts in this field besides the literature research by ourselves. We initially planned to have talks with experts in universities, companies, and organizations, for the diverse background knowledge could help us understand cybersecurity from dif-

ferent perspectives. However, it was tough to get in touch with the company and organization officials. We did not receive any response from them. Fortunately, four professors at TUM accepted our invitation, and we learned a lot from these interviews. They have given us many suggestions and insights. One professor we have interviewed is specialized in the area of science communication. Through that interview, we learned how to present the scientific background of cybersecurity to others more effectively. After extracting the essence from all interviews and research, we decided to focus on eight sub-topics from cybersecurity: (1) hardware hacking, (2) tracked activities, (3) is anonymous data secure? (4) how can data protection be secure? (5) why self-initiated data protection measures, (6) sharing online, (7) how AI affects our life, and (8) 5G.

Thanks for the help from Peter and SchaschLEAK, we obtained a list of contact information from high schools around Munich. After careful construction of an invitation letter, we sent them e-mails and asked them to choose the most relevant and intriguing topics for their students. To help the schools decide, individual workshop plans were drafted and sent to them, indicating the workshop's format, duration, and content. We included teaching methods, teaching aids, workshop language (given that our group is only made up of international students), and detailed workshop plans. Each workshop was planned to last around 30 min. Interestingly, most schools chose topics 1, 2, 6, and 7. All of the schools also decided to book more than one workshop, implying that the workshop plans and information we have presented were considered relevant and essential.

One team member was responsible for the workshop design of a topic. We agreed to deliver exciting and pertinent information through different teaching methods and aids to make the workshop interactive. In our plans, not only did we include audiovisual material, but also interactive forms of teaching such as role-play games, real-time digital interactive games, quizzes, and team competitions. Through several follow-up phone calls and skype discussions, four schools accepted our offer and fixed workshop dates and student numbers with us. However, one of them required german workshops, and no school selected the seminar that one of our team-



mates had designed. Since the teammate is better as German, we decided to have her hosting the workshop at that school.

In the planning phase, we wanted to have a diffusion campaign distributing posters about our workshops among the participating schools, but many problems arose. Regarding schools, in some cases, it was not possible to get permission to paste our posters ahead of time, or the communication with the schools was not fast enough to make sure we could paste them ahead of the workshop. In terms of the poster design, it was outsourced to a designer. However, the collaboration with him was not optimal: the posters did not meet our initial expectations and had to be redesigned. Besides, our team's busy schedule impeded the posters' collection and mailing. In the end, we tried to make the best out of the situation and decided to bring the final posters to the school and show them during the workshop to draw students' attention towards our workshop.

Fortunately, the workshops were rated as "extremely satisfied" by most students. And we all felt relieved when the workshops were over. However, there was still some room for improvement regarding our team collaboration. Firstly, as a very diverse international team, we were occasionally scattered all over the world. Physical

absence in the meeting has impeded the project's advance at the initial stage. Secondly, we started with an ambitious plan but ended up with a relatively small but concrete project. It is a life-long lesson for all of us since it is always necessary to balance our time and interest. Thirdly, like all teams may have encountered, we started to lose our passion in the middle of the project. Therefore, it is worth knowing that resilience sometimes matters the most for a successful project. Fourthly, we stopped our regular meeting since March 2020, when the postpone was announced. This interruption was detrimental to our momentum. It would be better to organize meetings at least once per month (our usual meeting was once per week). Thanks to TUM: Junge Akademie, we as a team have learned how to appreciate every team member's effort and accept imperfections in project's advance; we learned to challenge our limits such as conducting German workshops; we learned that written progress should be as substantial as (or even more important than) simply pushing the project forward. It is an honor for all our members to be a part of TUM: Junge Akademie.

### Acknowledgement

Our work would not have been possible without extraordinary support and guidance throughout the whole process from Peter Finger, Maria Hannecker, our supervisors Prof. Dr. Lisa Herzog, Prof. Dr. Maximilian Schiffer, Prof. Dr. Maria Bannert, and our tutors Danilo Hackner and Andreas Heimfarth. We would like to thank Dr.-Ing. Alexander Lang, Dr. Matthias Lehner, and Stefan Röhl for passing on their experiences and providing suggestions and advice in the project management workshops. We are also grateful for the valuable interview inputs from Prof. Dr. Thomas Neumann, Prof. Georg Sigl, Prof. Dr.-Ing. Klaus Diepold, PD Dr. Marc-Denis Weitze. We would also like to thank the teachers and students at the Kirchseeon Gymnasium, Humboldt-Gymnasium, Gymnasium Phorms Campus München, and Otto-von-Taube Gymnasium for their cooperation and active participation in our workshops. We thank Markus Schmidmaier for his ideas and efforts at the beginning of our project. ■



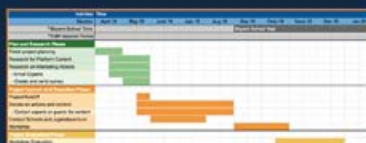
# Digital Enlightenment

## IDEA OF THE PROJECT

Communicate scientific knowledge about Cyber security (Data privacy) to young people (university or high-school students) using diverse mediums and actions. More concretely, we will create a "Digital-Enlightenment" online platform. This structure will be the framework for our on- and off-online actions. It will be as well our communication tool to reach our target group and gain more visibility. The online actions will be the basis to generate awareness, build a community and launch events to raise awareness about the topic.

The general topic is already decided but the specifics of the content will be discussed in the next month as shown in the Project Plan. The Project will include an event conducted in either a High School or a Center for Young People (Jugendzentrum).

## PROJECT PLAN



## RESEARCH QUESTION

The main goal of our project is to increase the share of students and other members of TUM until 30th of May 2019 which is aware of how high the portion of sponsored posts in the NewsFeed in big social media is. Furthermore, we want to give them the knowledge on how they can recognize such kinds of posts.

## GOALS OF THE PROJECT

Within the framework of our project and the planned actions we aim to:

- Introduce the topic of Cyber security in scientific terms to the general audience
- Raise awareness about Cyber security (Data privacy) among young people – by explaining its scientific and technological background and exposing them to a basic scientific knowledge related to the topic
- Determine factors that have an impact on the efficiency of science communication in the field of Data privacy through the analysis of the outcomes of the implemented actions.



MAY 2019

### MEMBERS TUTORS MENTORS

Ho Huang, Xinyi Huang, Rebecca Marichalar Quezada,  
Markus Schmidmaier, Youssef Walha, Yushu Yang  
Danilo Hackner, Andreas Heimfarth  
Prof. Dr. Maximilian Schiffer, Prof. Dr. Lisa Herzog

inspired by  
TUM Junge Akademie

The initial phase of our project was focused on finding a topic that we all found interesting and where we could profit from the interdisciplinary focus of our group. All members contributed to do initial research, identifying topics where major gaps between the scientific community and the public existed. To do this, we consulted Pan-European sources such as public surveys and publications from the European Commission, like the recent reports of the Standard Eurobarometer. We identified several interesting topics where a gap between the public opinion and the academic world exists, such as Food Safety and GM, Population Growth Problems, Energy Resources related to nuclear energy, gas and oil drilling and bioengineered fuels, etc. Finally, the topic of "Cybersecurity and Data Privacy" was the one that called our attention the most, and we chose it as the focus of our project. After that, the project planning began...

POSTER 1: Our first poster reflects the general idea, rough timeline, our scientific research question, and general goals of our project. At this point, we have not fixed our target audience and actions, yet we have already decided on the topic. We were too ambitious at the time and wanted to build an informational platform where both on- and offline actions could be taken to improve the diffusion of our topic from different angles. Our first goals ended up becoming impossible due to the limited duration of the project. In this light, our project plan was modified accordingly and proved to be feasible with minimal delays. The plan and research phase was expected to end by June 2019; the project launch and execution phases were planned to end by November 2019; while the evaluation phase should be finished by early 2020. Though we had to abandon the Evaluation phase due to unexpected issues to distribute post-evaluation surveys among our School Partners during the Coronavirus Crisis, we met all the deadlines for the former stages. In the first poster, our project focused on helping students identify sponsored posts on different social media platforms. That is an entirely different focus from what our real project ended up being. Still, the general goal remained coherent: "to raise awareness about cybersecurity among young people through effective scientific communication." ■



# Digital Enlightenment

## PROJECT GOALS

During the Intermediate Evaluation I, our team re-discussed and narrowed the goals for the project after the workshop.

## CURRENT STATE

- In order to obtain high quality information, we are currently interviewing experts from the Science Communication and the Cybersecurity fields.
- We are contacting external institutions – organizations and schools – with which we would like to cooperate.
- We are also working on a survey to have an initial idea of the expectations and current knowledge among teenagers.
- We are in contact with the team Schaschleak from 2017/II. During the Intermediate Evaluation I, we found out we share a common vision with this team and that being in contact with them would bring more insights to our project.
- On May 29th, we held a special meeting with our tutors and supervisors to present our current concept and plans for the project.

## FIRST RESULTS

### Expert Interviews:

- Data mining and data privacy talk with Prof. Dr. Thomas Neumann (Chair Database Systems/ Informatics, TUM)
- Quote: "The main issue with data privacy is that big corporations gather a lot of information on people, that could be misused. Everyone leaves a visible trace while traveling through the internet."
- Data Privacy in the Era of Digitalization talk with Prof. Georg Sigl (Chair of Security in the Information Technology, TUM)
- How to conduct Cybersecurity Workshops talk with Tobias Schöps – Information Security Manager at Celonis (upcoming)
- First Steps for an Effective Science Communication Strategy talk with Marc Weitzedenis (Head of Department Communication Technology, TUM School of Education), (upcoming)

## NEXT STEPS

- Derive key insights from the expert interviews to integrate learning into the project and the workshop.
- Focus on the workshop design taking into account the input from the Science Communication and Cybersecurity and Data Privacy experts, as well as the results from the survey.
- Establish contact and negotiate with the schools to make a more concrete plan of the workshop.
- Redistribute tasks among the team to cope with the upcoming challenges.

JUNE 2019

### MEMBERS

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### TUTORS

Danilo Hackner, Andreas Heilmann

### MENTORS

Prof. Dr. Maximilian Schiffer, Prof. Dr. Lisa Herzog



POSTER 2: At the time of the preparation for the second poster, we were focusing our efforts on becoming experts in "Cybersecurity and Data Privacy." To acquire this expertise, we interviewed several professors at the university and other institutes. By the second poster, we had already talked to three professors at TUM, who inspired us with ideas to narrow the focus of our topic and encouraged us to explore new aspects of it to incorporate it into our project. During the Project Management Training Session in the Intermediate Evaluation I, we managed to narrow our project focus after a long discussion. We decided to choose high school students as our target audience to improve their knowledge of Cybersecurity and Data Privacy, as they are one of the main internet and social media users and usually a vulnerable group target of cyberattacks and Internet malpractice. The plan was to create workshops that we would carry out in different schools in the Munich region. We started by contacting schools during the following weeks to ask for permission to give our workshop. It is worth mentioning that the team Schaschleak from the previous TUMJA batch was of great help. Their research had some common points with ours, and they were very interested in our project and open to collaborating with us. They especially shared valuable learnings on how to create an effective project plan and organizational tips such as how to approach schools. Another important issue at this stage was to design the first concept of our workshop content. The goal of each workshop was to "raise awareness of high school students about cybersecurity and motivate them to more actively protect their online data after the workshop". To this end, we also contacted experts who had previous science communication experiences and learned how to conduct workshops successfully, especially for young people. ■



# Digital Enlightenment

## WHAT IS OUR RESEARCH ALL ABOUT?

Based on the results from the workshops we organized, our research will investigate the impact of using different interactive activities (interactivity) on knowledge communication.

In fact, during the workshops we tried to diversify the methods and techniques used to communicate the content and as a result we had different levels of "interactivity".

In some workshops we opted for a "vertical science communication" based on the conventional model where a first person has the knowledge and present it to other people whereas in other workshops, we picked a different model in which the students reach the knowledge by themselves based on an interactive activity/game.

N.B. it was argued during the last workshop that since we have not presented the same workshop with different levels of interactivity, the research might be biased. We think that this could be valid if the topics of the different workshops had been considerably different, in this case they would have influenced the interest of the students and as a result on the knowledge communication experience. However, in our case, all the topics were related to one theme "Cybersecurity and Data privacy" that's why we esteem that we could consider them as a constant and this will not tarnish the validity of the results. Moreover, although we went to different schools, in some of them we did organize more than one workshop (in some cases with the same class) with different levels of interactivity, based on this we can consider the students as a constant in our research and the unique variable will be the level on interactivity.

## UPDATE: WHAT HAPPENED SO FAR

The call of our year 2019 is "Multimodal science communication". In order to find a better and concrete approach to this call, we focused on the sub-topic "Interface to society". Our mission is to bridge the gap between science and people's daily life. After a lot of discussions, research and interviews with experts, we found that even though Internet, social medias and technologies have already become a necessity in our lives, there is still a lot of unknown and underestimated in this whole new digitalized world. In addition, these important topics are mostly not yet enough covered in the compulsory education. Therefore, our goal was to raise awareness about these and specifically regarding data privacy and cybersecurity by holding workshops at local high schools in Munich, Germany. So far, we have already finished all the workshops we planned to do by the end of this year.

## PROCESS AND MILESTONES

- **Literature research & existing resources**  
Scientific paper, podcast, online platform, company
- **Interview experts**  
Interviews with experts and companies, sort out useful information
- **Preparing workshop content**  
Write teaching plan, design activities, different languages
- **Develop questionnaires**  
Questions design, also go through get permission from school and government
- **Contact and send mails to high schools**  
Letters, emails, phone call, personal visit
- **Poster design and discuss with designers**  
Poster ideas, contact designers, send them, Workshops rehearsal, improve ... and then go on the stage!



## MOST IMPORTANT RESULTS

Although we still did not go through all the results in the questionnaires, based on our experience during the workshops we can mention our first impressions, some of them are directly related to the research others less but still interesting.

- interactivity has a remarkable impact on knowledge communication for high-school students
- based on the four high-schools we visited, a general impression is that a certain level of awareness concerning cybersecurity already exists although we chose different high-schools (city/rural, private/public)
- creating a competitive environment in class has a great potential to boost the students' motivation about science communication.

## WHAT ARE THE NEXT STEPS?

The next steps:

- send follow-up surveys after possible modification.
- conduct some interviews with the teachers that were present during the workshops or ask them to fill questionnaires

POSTER 3: After intensive research and more interviews with professors and experts from the university and other companies, we started to work on the structure and content of each workshop. We also had already contacted numerous high schools around Munich and proposed our workshop ideas. Eventually, we cooperated with four local high schools – Kirchseeon Gymnasium, Humboldt-Gymnasium, Gymnasium Phorms Campus München, and Otto-von-Taube Gymnasium. We prepared a list of eight sub-topics around our main topic, and the high schools could choose by themselves which of them was the most interesting and appropriate for their students. The most chosen topics were AI, Activity Tracking, Hardware Hacking and Cybersecurity, and Oversharing on Social Media. We prepared all topics with a comprehensive workshop plan template, which were pre-approved by the schools and rehearsed several times before. Our goal was not only to inform the students about different risks on the internet and raise their awareness but also to show how these topics are relevant in real-life. The major goal behind this was to make students more aware of the consequences of their interaction in the digital world and provide them with basic abilities to assess risks on their own and protect themselves. Simultaneously, we wanted to investigate how much did the students know about the topics before the workshops and assess whether an interactive workshop would increase their knowledge on the topic and ultimately result in a change in their online behavior (measured as a willingness to change the behavior). For this, we designed pre and post-workshop questionnaires especially tailored for each topic, and asked the students to fill them out. Although it was not possible to carry out these surveys in all schools for regulatory reasons, we obtained enough data to assess the impact of our workshops. In the end, we received a lot of positive feedback from the teachers and students. This experience also became one of the highlights of our project.

## MEMBERS

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## TUTORS

Danilo Hackner, Andreas Heimfarth

## SUPERVISORS

Prof. Dr. Maria Bannert, Prof. Dr. Lisa Herzog, Prof. Dr. Maximilian Schiffer



JANUARY 2020

# Digital Enlightenment

- DECODE OUR DIGITAL WORLD -

## WORKSHOPS WITH HIGH SCHOOL STUDENTS ABOUT TOPICS RELATED TO CYBERSECURITY AND DATA PRIVACY // SUMMARY

Ever since its inception in the late 1960s Internet has changed our societies drastically in many aspects. It has also raised concerns regarding privacy and data protection in this new interconnected world. Recent Data scandals of giant companies made us realize a lack of awareness among the major public about topics like Cybersecurity and data protection which was also confirmed by several studies (Smith, 2017). Based on this observation and Responding to the call (2019) "Multimodal Science Communication", our team "Digital Enlightenment" decided to conduct a science communication experience to empower high school students with the necessary knowledge regarding relevant topics related to Cybersecurity while researching the keys to an effective science communication. For this sake a series of workshops were organized at local high schools in Munich about Artificial Intelligence, hardware hacking, online sharing and tracked activities in which various communication strategies were implemented.

Our research confirmed the lack of knowledge among students concerning these topics. It has also revealed that Using interactive strategies to communicate scientific knowledge, for example through games and competitions, leads to a more successful learning experience.

## RESEARCH LIFE CYCLE



## CONCRETE RESULTS, IMPACT AND SUSTAINABILITY:

Within this project we have reached more than 150 students from 4 high schools in Munich.

- 92% thought the workshops were good to very good.
- most students asserted to have learned something
- more than 60% asserted that they would be willing to reconsider their online behavior.

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Even Though these students represent only a small proportion and this impact is as a result not sustainable we think that some of the outcomes of this project can build the foundation for a more sustainable approach, we can summarize the outcomes in these points:

- Topics related to Cybersecurity are not covered enough in school curricula.
- Students are greatly affected by their online behavior.
- Interactivity has a remarkable impact on knowledge communication for high-school students and creating a competitive environment in class has a great potential to boost the students' motivation.



## STAKEHOLDERS

Tum Junge Akademie • Team Digital Enlightenment  
All schools involved in this project

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POSTER 4: Our project concluded on time at the beginning of 2020. Our final poster summarizes all the work we have done in the last two years. We intended to tell the story of "Digital Enlightenment" by presenting the milestones and the phases of this project. It also gives an insight into the most important results from the evaluation phase. In fact, after conducting the workshops in high schools, we took some time to analyze the data we collected from the surveys. We discussed our impressions and our observations about the outcomes of the workshops and the interaction of the students. That allowed us to draw further conclusions regarding the knowledge of high school students on Cybersecurity topics and the effectiveness of the different science communication strategies we implemented in our workshops (e.g. games, lectures, digital activities, etc.). Certainly, we had to adapt our plans for the Evaluation phase. With the outbreak of the Coronavirus Crisis, it was not possible to send follow-up surveys to schools or to return there for interviews and discussions with the teachers to understand the long-term impact of our workshops as we had planned. Nevertheless, we all were very satisfied with the work done. This last part of the journey was also an occasion to remember how it all started, the challenges, the hardships, the laughs, and especially the people who stood by us and without whom all of this would have never been possible.