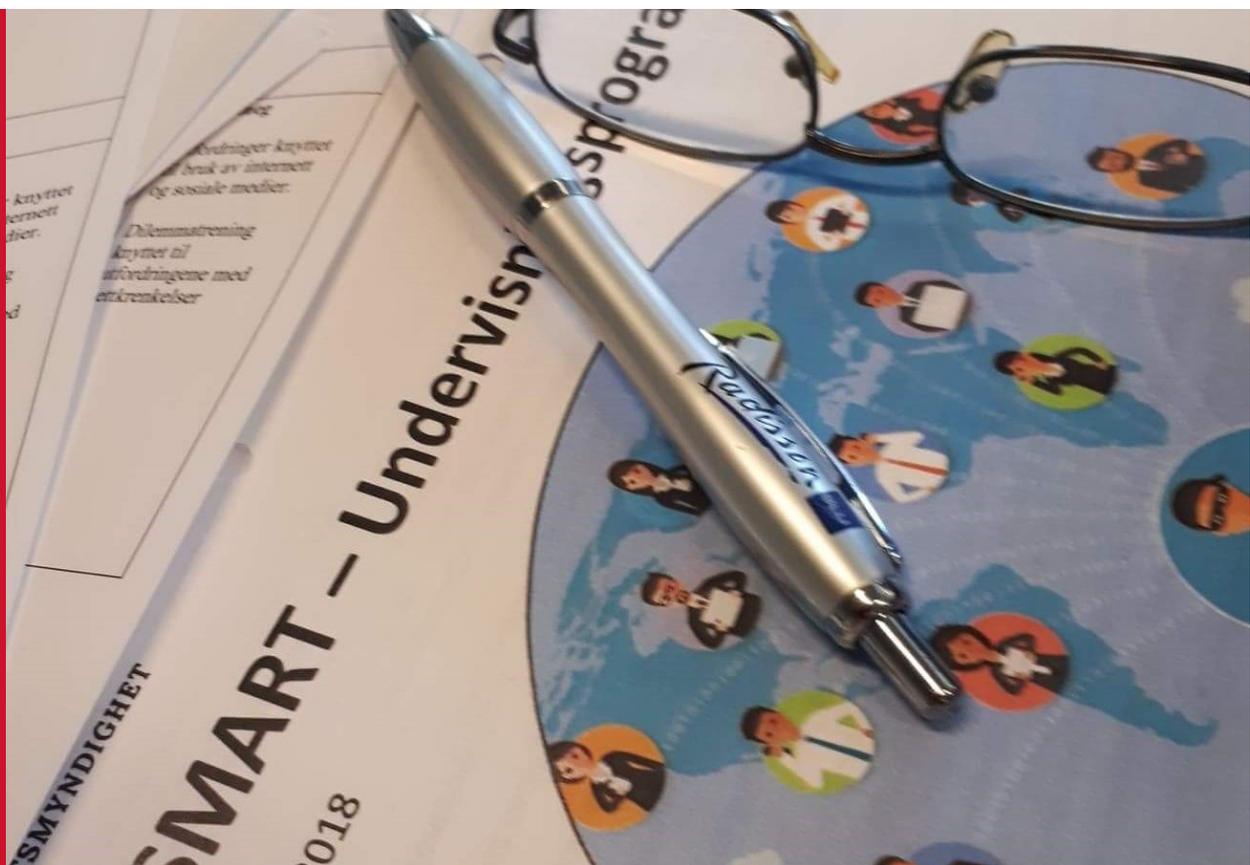


## CyberSmart - educating the future workforce

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Narrative and financial report

*Janne Hagen*



## Rapport nr 20-2019

### CyberSmart - educating the future workforce

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**Summary:** CyberSmart is a Norwegian project on cyber-security education of teachers and high school students. The project is inspired by the American GenCyber programme. This report covers the teachers' cyber-security seminar at UiO in February 2019, where visiting American educators from the University of Tulsa contributed.

**Keywords:** Cyber-security CyberSmart Teacher Camp

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# Contents

<b>Preface</b> .....	<b>4</b>
<b>Summary</b> .....	<b>5</b>
<b>1 Introduction</b> .....	<b>6</b>
<b>2 The CyberSmart project</b> .....	<b>6</b>
2.1 The very beginning .....	6
2.2 American visiting educators .....	8
<b>3 Financial report</b> .....	<b>10</b>
<b>4 Conclusion</b> .....	<b>10</b>
<b>5 Way forward</b> .....	<b>10</b>
<b>Acknowledgements</b> .....	<b>11</b>
<b>References</b> .....	<b>11</b>

# Preface

CyberSmart is a Norwegian project on cyber-security education of teachers and high school students. The idea of a Norwegian project was born at a cyber-security workshop arranged by the Norwegian Water Resources and Energy Directorate (NVE) 9. October 2017. The workshop addressed the question: *What can Norway learn from US's 20 years of building cyber-security capabilities?* American and Norwegian experts from academy, industry and public authorities participated and discussed what to do and how to increase the knowledge and security awareness of the Norwegian population.

NVE is, among others, responsible for securing hydroelectric power supply to the Norwegian society. The ongoing high-speed digitalization, which also penetrates the energy sector, provides better opportunities for more efficient operations, but comes at the same time with digital risk. The energy sector, like the rest of Norwegian industries, lacks security experts. In addition, the security awareness is weak, as pointed by The Norwegian Centre for Information Security (NorSIS) in their security-culture study back in 2016. This low skill – low awareness is a concern for future successful digitalization.

The Digital Vulnerability Committee, appointed by the Norwegian government, delivered its report in 2015. The Committee pointed towards the long digital value chain, never-ending digital risks and the need for education in broad. The report also pointed that the energy sector needs more cyber-security experts and strengthened cyber-security awareness. Based on the report, NVE and NTNU decided to initiate a pilot project inspired by the American GenCyber project. Several partners joined this initiative: The Norwegian National Security Authority (NSM), the University of Oslo, Rogaland County Council, Godalen high school, Ski high school, Abelia, Norsis, the Norwegian Defence Academy, the Ministry of Justice and Public Security and the US Embassy in Oslo.

The Oslo Grant, provided by the US Embassy in Oslo, funded two GenCyber “teach the teachers” educators from the University of Tulsa. In February, they spent four days in Oslo teaching Norwegian teachers how to teach cyber-security. The seminar was a success and the Norwegian teachers gave excellent feedback on the seminar.

We are thankful for economic support from the US embassy in Oslo, the Oslo Grant, and for the knowledge sharing and cooperation on cyber-security with the University of Tulsa, Oklahoma, USA. We are sure that the cooperation lifted the Norwegian CyberSmart project to a higher quality level compared with running all ourselves. It enables us to get inspired, to learn, to be creative and to build lectures for Norwegian teachers and students.

Oslo, 29. April 2019



Ingunn Åsgard Bendiksen  
Director



Eldri Naadland Holo  
Head of Section

# Summary

The Norwegian CyberSmart project is an initiative by the Norwegian Water Resources and Energy Directorate (NVE) and the Norwegian University of Technology and Science (NTNU). Director of communications Mona Strøm Arnøy at the Norwegian National Security Authority (NSM) is the chair of the CyberSmart steering committee, while Bodil Grødem, teacher at Godalen high school, holds the position as project manager. Several stakeholders run and fund the project: NSM, NVE, NorSIS, NTNU, UiO, and the Norwegian Cyber Defence Academy, the Ministry of Justice and Social Security and Rogaland County Council. The US Embassy's Oslo Grant has funded travel and accommodation expenditures for two American cyber-security educators from the University of Tulsa, Oklahoma, USA.

The Norwegian CyberSmart project targets teachers and high school students with cyber-security education and awareness training. The project is inspired by the American GenCyber program. GenCyber teaches teachers and students K12 cyber-security in the US. The GenCyber program is funded by the National Science Foundation (NSF) and the National Security Agency (NSA).

The first CyberSmart teacher camp happened at the campus of the University of Oslo (UiO) in May 2018. Cyber-security experts from the NSM, NVE, NTNU, NorSIS and the Norwegian Cyber Defence Academy developed curriculum and gave lectures. The curriculum covered privacy, cyber-security, social media and Internet hygiene, digital vulnerability, hacking methods and password security. After running three student weeklong seminars, a second teachers' cyber-security camp was organized at UiO in February 2019. Associate visiting professor Donna Farrior and lecturer in mathematics Kimberly Adams, both from the University of Tulsa, Oklahoma, USA, led the four-day teacher camp. Teachers from several schools participated.

Feedback from the participants show that CyberSmart manages to raise cyber-security awareness and build knowledge. The project will run another cyber-security student summer camp in June this year, in Oppegård.

The project will deliver a final project and evaluation report to the Ministry of Education and the Ministry of Justice and Social Security during the fall 2019. The report will evaluate and eventually suggest a way forward strategy on how to roll out more cyber-security camps and seminars.

# 1 Introduction

The first time we heard about GenCyber was at a workshop at NVE 9. October 2017. GenCyber was one of the topics covered at the workshop that discussed “What can Norway learn from US’s 20 years work of building cyber capabilities?”

GenCyber's mission is to stimulate and improve cyber-security education in the United States. The program sponsors summer camps across the nation. The camps are designed for elementary, middle and high school students and teachers that focus on engaging the attendees with sound cybersecurity principles and teaching techniques. GenCyber is a jointly funded effort sponsored by the National Security Agency (NSA) and the National Science Foundation (NSF).<sup>1</sup> The objectives are to:

- Increase interest in cybersecurity careers and diversity in the cybersecurity workforce of the nation
- Help all students understand correct and safe on-line behavior, and how they can be good digital citizens
- Improve teaching methods for delivery of cybersecurity content in K-12 curricula

The GenCyber started in 2014 with 6 summer camps, 2 teacher camps and 4 student camps. Today there are GenCyber camps in many states. In 2017, the number of camps had risen to 130.<sup>2</sup> Today, even more camps have appeared. Camps like these is a measure to increase interest and recruitment to university studies in cyber-security.

Norway needs more security experts and the need for cyber-security inn all professions is apparent. The workshop 9 October 2017 represented the starting point for a Norwegian initiative to educate the future workforce in cyber-security.

## 2 The CyberSmart project

### 2.1 The very beginning

Following the workshop of 9.October 2017 at NVE, NVE and NTNU arranged a phone conference with GenCyber experts in the US. This phone conference contributed to a deeper understanding of the GenCyber programme. Among the lessons learned was how to start building a programme on teaching young students cyber-security. The following spring in 2018, one NVE representative and four Norwegian teachers travelled to Tulsa to meet GenCyber educators, and observe in real-time how teachers teach cyber-security to young students. This was a kick-off for building a project organisation and planning a teacher camp in Oslo, May 2018, and student seminars in Ski, June 2018, Stavanger, September 2018 and Haugesund, February 2019.

Lecturer Bodil Grødem from Godalen high school was engaged as project manager. Director Mona Strøm Arnøy, NSM, was appointed chair of the steering committee. The

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<sup>1</sup> Text from: <https://www.nsa.gov/resources/students/summer-camps/gencyber/>

<sup>2</sup> From the telephone conference 14 November 2017.

following were appointed as members of a steering committee: Head of Section Eldri Holo, NVE, Director Nils Kallstad Svendsen, NTNU, Professor Kirsi Helkala, Norwegian Cyber Defence Academy, Professor Audun Jøsang, UiO, Director Peggy Heie, Lecturer Bodil Grødem and Anne-Helen Dale, both from Godalen high school.

The first teacher camp took place at the University of Oslo (UiO) with cyber-security educators from the Norwegian National Security Authority (NSM), the Norwegian Water Resources and Energy Directorate (NVE), NorSIS, the Norwegian University for Technology and Science (NTNU) and the Norwegian Cyber Defence Academy. Topics taught were privacy, cyber-security, social media and Internet hygiene, digital vulnerability, hacking methods and password security.. The feedback from the camp was good. The teachers that joined the seminar felt they had acquired new knowledge, and that they had been inspired. During the camp, the teachers designed a cyber-security week for 10th graders at Ski high school.



**Figure 2.1** From the teacher camp May 2018 (Photo: Omid Mirmotahri)

The student seminar in Ski was carried out in June 2018 with guest lecturer professor Sujeet Shenoj from the University of Tulsa. The feedback from the students was good.

In September, Godalen high school ran the second cyber-security student seminar, now for 11th to 12th graders. Evaluation showed positive feedback. On a scale from 1-5, where 1 is very poor and 5 is excellent, the average score was 4. Teachers from Godalen high school and educators from NSM and NVE together with instructors from the Police gave lectures. The seminar also offered practical tasks with coding. An additional student camp took place in Haugesund, week 6, February 2019. The 11th graders in Haugesund were a mix of two student groups studying service and security, and computer science. These students seemed to learn quicker than the previous high school students that joined the cyber security training offered by CyberSmart.

The Norwegian CyberSmart evaluation report (2018) summarized the results one year after the very beginning – the workshop 9.October 2017 at NVE, and concluded: Both teachers and students welcomed the initiative; the vast majority of participants was

satisfied with the learning opportunities given. The seminars contributed to raise cyber-security awareness, and lifted everyone to a higher level of cyber-security understanding.

## 2.2 American visiting educators

Having some practical experience with cyber-security education; it was time to invite US educators to visit Norway and teach Norwegian teachers the way they do in the US. The project became a reality with economic support from the US Embassy, by the Oslo Grant. Associate visiting professor Donna Farrior and lecturer in mathematics Kimberly Adams from the University of Tulsa, Oklahoma, USA, visited Oslo week 8, 2019. They brought with them their expertise and some educational tools, and led a four-day teacher camp. The focus of the program was to introduce the cyber-security concepts through "hands-on" activities that might be used in the classrooms. The activities included programming challenges, games, and competitions in addition to content lessons in a classroom setting. During four intensive days in the Norwegian winter recess, February 2019, 14 teachers from high schools in Ski, Oppedgård, Stavanger, Haugaland and Vågen learned crypto analysis and cyber-security essentials. UiO hosted the teacher camp. The teachers paid a small fee covering lunch and hardware. The curriculum was:

### 1. Cybersecurity First Principles & CIA Triad

- (a) Abstraction
- (b) Domain Separation
- (c) Information Hiding
- (d) Layering
- (e) Least Privilege
- (f) Minimization
- (g) Modularization
- (h) Process Isolation
- (i) Resource Encapsulation
- (j) Simplicity

And the CIA Triad: Confidentiality, Integrity, and Availability.

### 2. Cybersecurity Online Safety

Best practices for protecting ones privacy and information web browser settings, social media settings, password protection, and encryption. Online resources were identified that can be used to teach their students safe practices.

### 3. Cyber Ethics

A discussion of cyber ethics and various ethical dilemmas. Online resources were identified that can be used to teach ethical online behaviour at the appropriate grade level.

#### 4. Cryptography and Coding with Python

Teachers learned a variety of ciphers, from basic Caesar shifts to advanced back-pack algorithms. Teachers, with or without experience in programming, were introduced to Python programming and had lesson plans in-hand for studying a variety of ciphers in a classroom or as the basis of extra-curricular activities.

#### 5. Block Coding and Programming Sphero Minis

A strong emphasis was placed on introducing coding activities to inexperienced teachers and expanding programming options for the experienced teacher. Teachers programmed Sphero Minis using Block Programming. These robots are easy to assemble and may be used across the K-12 curriculum. Sphero Minis were used to form the bridge between Block coding and the use of Java Script.

#### 6. Learning Materials

A Google Drive was created that serves as a repository of materials from the seminar. Digital versions of all the handouts were shared in the repository along with various handouts utilized in the programs at the Tulsa University.

The Norwegian teachers that participated were very satisfied with the camp, and they learned during the few days to analyse, encrypt and decrypt using several algorithms. The US educators were impressed by how the Norwegian teachers worked, how they collaborated to solve problems and how they were even willing to work outside normal hours, just to get through. Most of the teachers had already gained some experience through the first teacher camp in Oslo the year before. They had a basic understanding of the context. A few participants were newcomers. According to feedback from Adams and Farrison, teachers are best off if they can join two camps. It builds maturity and a deeper understanding.



Figur 2.2 Kimberly Adams teaching at UiO February 2019 (Photo: Janne Hagen NVE)

In their evaluation report sent to NVE, Adam and Farrior states: *“CyberSmart 2019 was an incredible experience. The teacher participants were inquisitive and fully engaged each day of the workshop. The collegiality of the teacher participants was a major strength of the camp. Teachers were able to discuss the concepts, work together on finding solutions and determining methods for using the materials in their various classrooms. They embraced the challenges of hands-on”, project-based learning and worked together to accomplish the tasks. It was an honor to work with the teacher cohort and we look forward to collaborating with you in the future.”*

CyberSmart was later on presented by the project manager Bodil Grødem and lecturer Anne-Helen Dale at the Rogaland conference; here 300 principals and representatives from schools in Norway met. The project gained a lot of interest at that conference.

### **3 Financial report**

The US Embassy’s Oslo Grant provided 6500 USD to cover travel and accommodation expenditures for the American educators from Tulsa.

The CyberSmart project’s total budget is about 1.3 mill NOK. The project is funded by The Ministry of Justice and Social Security (400 000 NOK), The Norwegian National Security Agency (400 000 NOK), The Norwegian Water Resources and Energy Directorate (300 000 NOK) and Rogaland County Council (100 000 NOK).

### **4 Conclusion**

Some temporary experiences gained so far: The quality of the programme is high according to feedback from both teachers and students. The initiative raises cyber-security awareness and build knowledge among teachers and students. The main challenge for further dissemination is national funding and national resources. If we want to educate teachers in cyber-security, we need funding to cover teachers’ salaries and other expenditures. It seems to be a strength to invite external speakers and educators to the student camps.

The use of US educators was with no doubt a huge success, and is something we should do again. The idea of teaching the teachers is a great concept to reach out to the Norwegian population. Sharing knowledge across national borders is also very useful. Cyber-security is a after all borderless challenge.

### **5 Way forward**

In June this year, Oppedgård kommune will arrange a cyber-security student summer camp. This student camp ends the project. The project will deliver a final project and evaluation report to the Ministry of Education and the Ministry of Justice and Social

Security during the fall 2019. The report will suggest a way forward strategy on how to roll out more cyber-security camps and seminars.

## Acknowledgements

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We are grateful for the good cooperation with Professor Sujeet Shenoj at the University of Tulsa, Associate Professor Donna Fariior and Lecturer in Mathematics Kimberly Adams, all from the University of Tulsa. We would also like to thank Victor Piotrowski and Ralph Watcher at the National Science Foundation (NSF), who in the beginning of this project guided us and facilitated contacts.

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