Increasing the motivation of high school students to pursue engineering careers through an application-oriented active learning boot-camp

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ABSTRACT (poster)
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The main objective of this work is to increase the motivation of high school students to pursue a career in engineering. This is achieved through a 3-day university boot camp with a high focus on applying theoretical knowledge to real world problems, technology development and working in teams. The learning outcomes are therefore both related to academic/technical topics and to career decisions.

The boot-camp is planned for second and third year high school students and has been developed for and co-funded by a project named “The Maritime House”. The students are presented to a problem concerning oil spills floating on the water surface at sea. Working in teams of 4-5 students they develop a solution for detecting oil spills using a drone carrying a video camera. The project work is divided into exercises that are spread across the three days. The exercises support the key challenges of the solution: Developing a drone capable of flying; developing a camera which can be remote controlled by the drone pilot; developing image processing algorithms capable of detecting artificial oil spills; flying the drone outdoor recording videos of artificial oil spills; Post processing of the recorded videos to validate the detection of artificial oil spills.

The exercises are closely related to key elements from the high school curriculum in mathematics and physics, and are designed to let the students experience the satisfaction of being able to apply theoretical knowledge previously learned in high school to develop a solution. A description of each exercise are handed out to the students and introduced by the teacher. Most of these introductions include a recap of the related theory and a few quick calculation exercises to emphasize the relationship with the problem at hand. Materials used for the drone and video camera are low-cost, and the software used is open source. This enables the students to continue working with this after the boot-camp.

The boot-camp has so far been conducted 5 times for third year students from technical high schools. At each boot-camp the students have worked with a high level of enthusiasm, planned free time in the evenings has been used voluntarily by the students to complete the exercises. It quickly became clear, that an important prerequisite for keeping the students attention and activity level is that they to a large degree are capable of completing the exercises including getting the drone flying. To this end most exercises have been designed to enable the teacher to support the teams by providing additional elements of the solution as time progresses.

At 2 out of the 5 boot-camps the students answered a questionnaire. Among other questions they were asked to rate on a scale of 1-5 how *learning*, how *exciting* and how *fun* the boot-camp has been. The average ratings of all answers are 4.3, 4.6 and 4.7 respectively. One high school teacher has reported that out of two boot-camps where he and in total 25 students participated, 6 students (24%) has subsequently applied for a bachelor in robotics at SDU.

Based on this limited data it is concluded that the boot-camps appear to be a succesful outreach activity. Further analysis is needed to evaluate to what extent the main objective and learning outcomes have been achieved. The authors would like to thank Mathias Neerup, Martin Skriver, Miichael Nielsen and Rasmus Stagsted for their contributions to developing and testing teaching materials, and UAS Test Center Denmark for providing access to their test facilities at HCA Airport for the flight experiments.