Engaging students via activity-led learning with a social robot

Ginevra Castellano, TUFF-medel 2016 – final report

1. Pedagogical idea

Previous research has shown that interest and active participation are important factors in the learning process [1]. In the domain of educational robotics [2], techniques to engage students typically follow constructionist learning approaches [3] and learning by doing usually occurs by programming and manipulating real robotic platforms.

This project proposes a new activity-led learning (ALL) [4]-based approach using social robots to increase students' motivation and engagement in a Master level course on Intelligent Interactive Systems. The approach is novel as it goes beyond the traditional robot programming and aims to engage students by means of teacher-facilitated hands-on activities to learn how to develop computational capabilities for social robots in concrete human-robot interaction scenarios.

2. Relation to work of others

Several methods for activating students and increasing their motivation and engagement have been proposed in the literature [5]. Within the domain of educational robotics the most prevalent pedagogical theory has been the theory of constructivism as proposed by Piaget [6], according to which learnt knowledge is based on experience. Work by Papert [7] brings forward this idea suggesting that learning occurs when students build a physical artefact and reflect on their experience. As a consequence, most courses teaching robotics and intelligent interactive systems are based on constructivism-inspired hands-on activities that involve programming and manipulation of robotic platforms [8].

Due to an increased interest in robots that are built to interact socially with humans [9], researchers have suggested the need to go beyond the traditional approaches in educational robotics and to promote student motivation and engagement by means of activities that encourage the design of robots' meanings and roles in a specific social context [10].

This project aims to go beyond the traditional educational robotics approaches and to take to a further level the idea by [10]. It proposes a new approach based on ALL, which has previously successfully been used in other computing degree courses [11], where student motivation and engagement are promoted by means of activities involving the design and development of computational abilities for social robots in a concrete social human-robot interaction scenario (for example, imagine an educational scenario where a robot plays the role of an instructor of a human user and students need to build computational social capabilities of relevance for this specific context and robot's role).

3. Context

The project developed a new ALL-based approach using social robots to increase students' motivation and engagement in the Master level course on Intelligent Interactive Systems that was delivered for the first time at the Department of Information Technology of Uppsala University in Spring 2016. The courses attracted students from different Master Programmes at Uppsala University, including the Computer Science, Computer and Information Engineering, Embedded Systems, Computational Science, and Sociotechnical Systems Engineering programmes. Sixty-two students registered to the first year of the course and approximately forty of them have completed and passed the course.

4. Process

"Hands-on" activities were built around a real social robotic system (e.g., the NAO humanoid robot[1], see Figure 1), and involved the design of scenarios for the development of computational social abilities (for example, the ability to recognise humans, their behaviours and higher level social states and emotions) for application with robots.

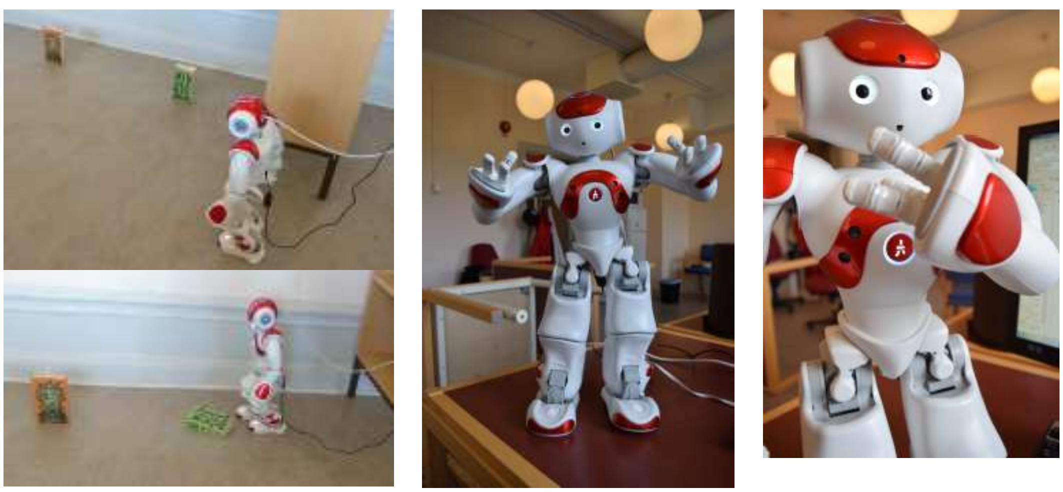

Figure 1: screenshots from implemented projects (NAO looking for objects in a room (top left and bottom left) and expressing emotions (center and right).

Implementation of the project's activities took place in two separate steps. First, students were instructed on how to program the NAO robot during laboratory sessions throughout the course. Second, students were asked to work in group on a given project, which could be chosen among a list of possible project specifications involving the design and development of computational abilities for application with robots in social scenarios. An example of project consisted in building a program to allow the NAO robot to express six different emotions for use in a social human-robot interaction scenario (for example, a scenario where a robot plays the role of an

[1] https://www.ald.softbankrobotics.com/en/cool-robots/nao

assistant, a companion or a tutor for human users). Another project involved programming the NAO robot so that it could find objects in a room, capability of relevance for socially assistive robots (e.g. robots as personal assistants for the elderly at home).

Following the tradition of ALL approaches, teachers acted as facilitators, guiding the students' learning and monitoring their progress. Presentation/feedback sessions were organized where students presented their latest work to the rest of the class. The core idea here is that the teachers play a less active role by simply facilitating student inquiry and the focus of work and problem solving is moved onto the students.

5. Evaluation, results and analysis

Evaluation of the effectiveness of the proposed activities was performed via assessment of the group projects at the end of the course against the correspondent learning outcomes. The projects, in fact, were one of the forms of student assessment during the course. Furthermore, evaluation was based on students' feedback, elicited by different means throughout the course, for example by using intermediate formative evaluations and surveys at the end of the course. The final evaluation included a projects-focused evaluation, which was carried out in the classroom in correspondence with the last feedback session where students had the opportunity to present their progress to the audience. Eighteen students took part in this evaluation, which aimed to find out whether this could be a viable form of assessment and teaching activity. Students, overall, reported that they liked to have been given a certain degree of freedom in how to carry out the projects, and that they think they learned more doing the projects compared to a more traditional examination methods (e.g. written exam). Figures 2, 3, 4, 5 and 6 provide an overview of the questions that were asked, as well as the students' responses.

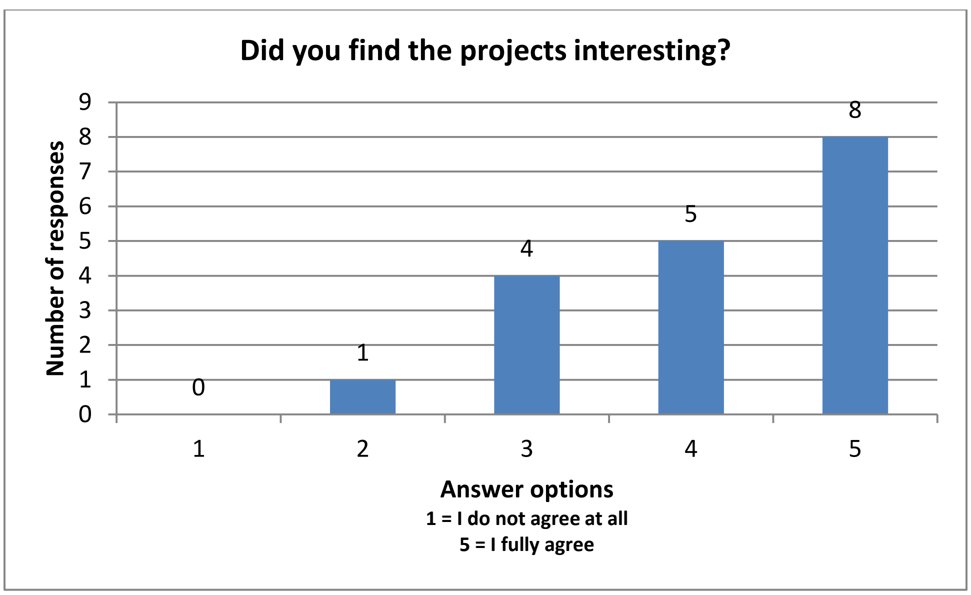

Figure 2.

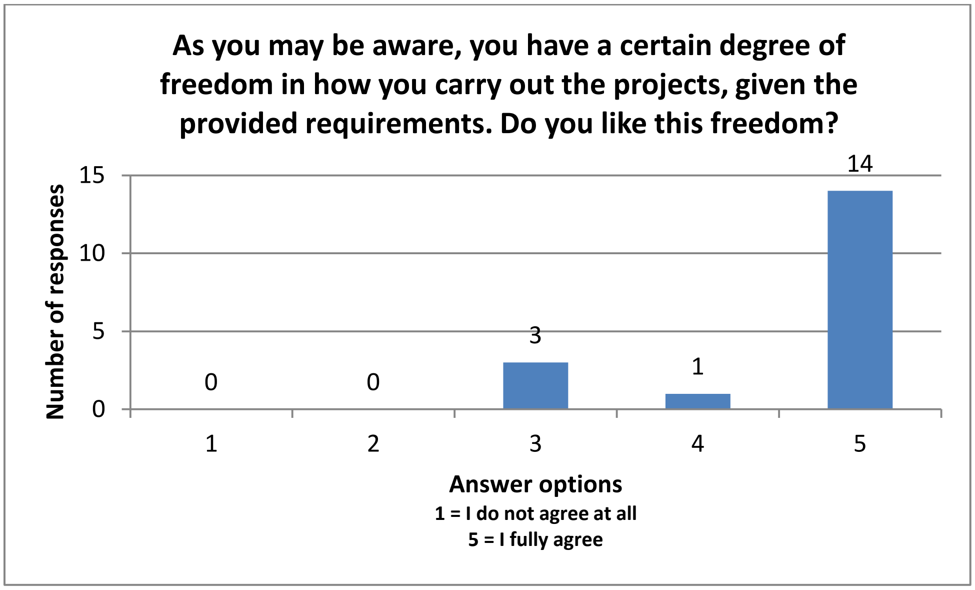

Figure 3.

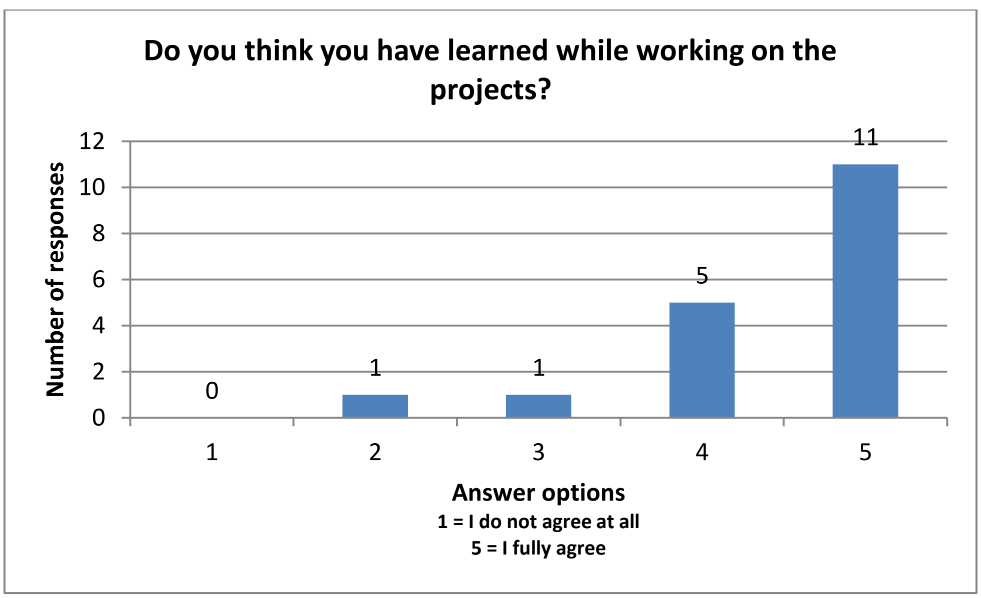

Figure 4.

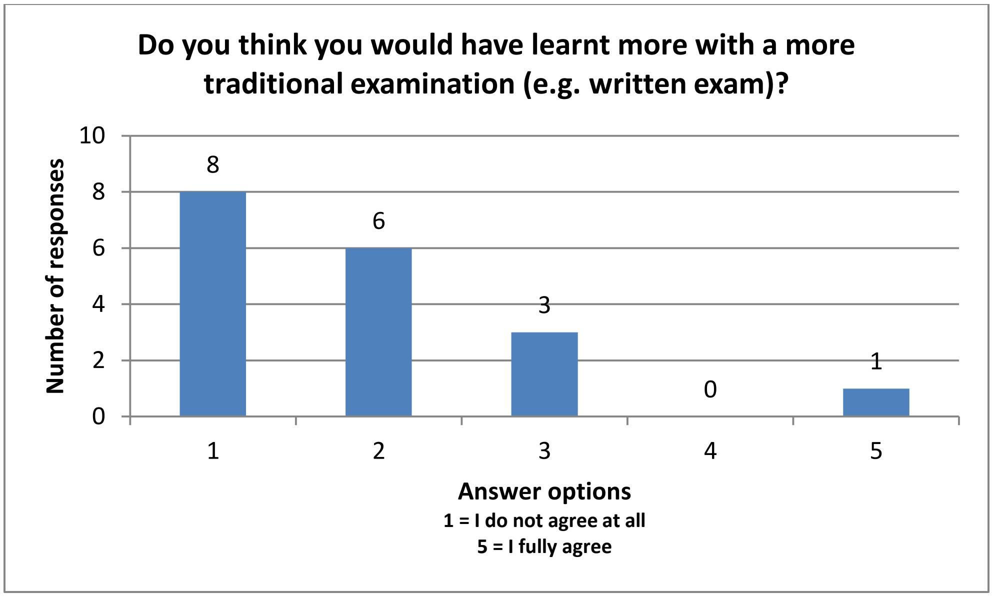

Figure 5.

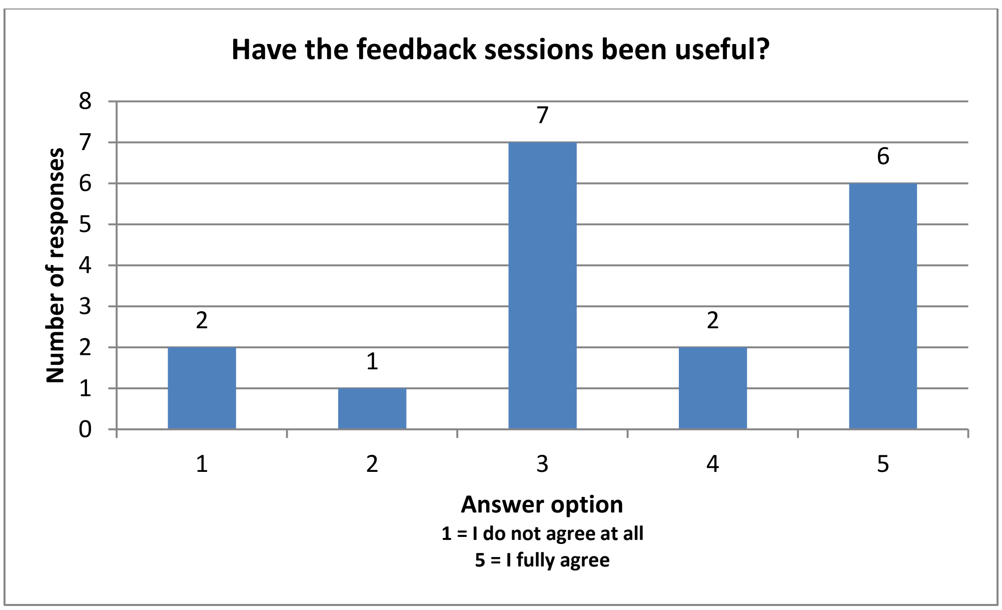

Figure 6.

6. Discussion

In terms of lessons learnt during the project, it should be mentioned that making the robot available to students was, at times, challenging, due to the high number of groups working in parallel on projects directly involving the physical version of the NAO robot (using a simulator was, at times, not sufficient). Supervision by teachers was also required, given that the robot is quite expensive and that is used primarily for research. We will try to find a good balance in the future so that students can have access as needed to the robot, while at the same time setting a limit for the required supervision by the teaching team, an issue of relevance to the finances of the course (i.e., teachers' time).

Another observation is that students showed that they liked the idea of attending feedback sessions. These are especially important given the degree of freedom given to the students to carry out the project and the consequent need of feedback. We received some comments that more ad hoc feedback sessions, tailored to each specific group, would be desirable. Again, the objective is to find a good balance between offering a good number of individualized feedback sessions and teacher time.

7. Continuation and conclusions

The activities designed as part of this project will be subsequently delivered on an annual basis as an integral part of the course in Intelligent Interactive Systems, ensuring a long-term pedagogical benefit of the project for students at the Department of Information Technology.

The Intelligent Interactive Systems course was, in general, rated quite high in terms of students' satisfaction. Particularly, students' positive feedback on the group projects as a way of "learning by doing" points in the direction of adopting this rather than more traditional assessment methods (e.g. written exam). Plans for the 2017 edition of the course include the design of projects that offer students the opportunity to develop a larger range of different computational social abilities to allow social robots such as NAO to engage in natural interaction with humans.

References

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