AISOY Social Robot as a tool to learn how to code versus tangible and non-tangible approaches

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Abstract— In this paper we have conducted a study to validate the use of educational social robotics as an hybrid system between the traditional approach of using technology in the classroom based on computers and the pioneer approach about using tangible devices such as educational robots. In order to accomplish our goal we have organised a workshop with 36 participants, where students between 8 to 12 years old had to program a rock-paper-scissors player using scratch on a computer, a scratch on a computer (Enchanting) + LEGO NXT, and the educational social robot AISOY programmed with scratch.

Keywords— Education, Social Robots, Tangible Device

1. INTRODUCTION

Research involving technology in education has two trend topics, the first one is about technology being the base of the STEM or STEAM learning. The second one is about the computational or engineering thinking. The first one foresees that with the use of technology students are attracted and engaged with science and technology, while the second one believes that engineering skills are used in the everyday life, and in addition, through the engineering skills people develops a better human sensitivity [1].

So, the controversial about virtual and tangible devices is served. Some researchers claim that tangible devices increase the level of immersion because students are manipulating things in a real world [2]. However, we can find other studies that understands that non-tangible devices brings more flexibility and avoids limitation because of the physical body in the real space, furthermore, in [3] authors explain that exist a lack of evidence that tangible systems offer any benefits compared to onscreen counterparts. What seems logical is a hybrid approach as the one presented in [3], where a merge between physical and virtual world provides more flexibility to teachers and learners.

In this paper, we propose and studied the benefits of a tangible non-tangible combined system based on a social robot for education purpose named AISOY. We have structured this abstract as follows: in section II is presented the methodology used to study a tangible system vs non-tangible system vs a hybrid system, and in section III, indicators from the analysis of the data obtained are given and discussed.

2. METHODOLOGY

For doing this study we have selected a population of 36 students from a summer camp organized in Barcelona by ClauTIC [6] at la Salle BCN - Ramon Llull University facilities. They were students between 8 and 12 years old, and they are going to do this activity as a workshop organised aside a summer camp about robotics. The students were divided in three classrooms or groups of 12 each, and in each classroom there were 4 groups of 3 participants each.

The activity is a 2h long session where children are going to build and program a rock-paper-scissor player. As we can see in Fig.1, each classroom has different resources to accomplish the goal: the study group A have a computer with Scratch software, in the study group B the students have a commercial LEGO NXT 2.0 set + Scratch to program it, and finally, the group C use the AISOY robot + Scratch to program the game. The group A will interact with the computer, and the interaction system will be the Scratch window. In group B, the students will have the computer with the scratch linked to AISOY, an educational social robot platform. Finally, in group C students will have the LEGO NXT 2.0 sensors and motors to build the physical agent that will perform the game, also connected to the scratch software.

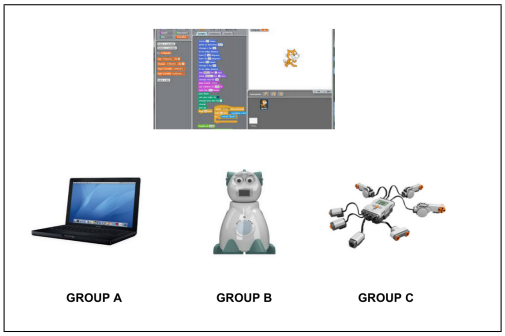

Fig. 1. These are the three platforms that students are going to use to implment the game rock-paper-scissors.

We are measuring not only the absolute data acquire from the sessions, but also the incremental gain based on a pre-test and a post-test conducted at the beggining of the session and at the end.

A. Setup of the Study

The sessions are recorded with two cameras that cover all the classroom, and one camera for each table covering the working space and the kids.

B. Evaluation Metrics

We are evaluating the following skills:

- Level of autonomy: How many times they ask for help. The capacity of divide a complex task in subtasks.
- The creativity: We are measuring the differences between the designs and solutions that the kids can find. These can be about the coding, or about the building.
- The coding performance: the items to be evaluated here are the understanding of the concept of the variable, loop, and conditional.
- The building performance: how robust are the system, the reliability, and the robustness of the implementation.
- Hardware knowledge: How a sensor and actuator works.
- Social skills: wining, losing, greeting, cheating, mercy.
- Application in the real goal: which solution allow the student to map applications in the real world.

3. RESULTS AND CONCLUSIONS

Not all kids that participated in the study where familiar with the Scratch software, the LEGO NXT 2.0, or also with the AISOY robot. However the number of times that they have been playing with LEGO or scratch is much higher than with the AISOY Robot. Novel effect could contribute to focus on the activity so students in group B paid more attention compared to group A or C.

While all children played nicely during the test phase, the group A plays a children computer interaction as it was a video game, the group B had more social-based game and they considered the robot as a human-like competitor. Finally, the group C who were using the LEGO NXT 2.0 created a children-machine interaction context.

When the implementation was forced to cheat with the result, groups A and C assigned an attribute of failure to the system, showing emotional states of angriness and frustration. In group B, the reaction was quite different, students enjoyed when the robot failed with the answer of the game. Implementation B helps to work issues like fair play, cheating, etc. creating a positive atmosphere at the same time.

The group using the LEGO NXT 2.0 (C) set asked for help higher number of times and it makes sense because this was the group with a wider diversity of elements. Group B needed to ask for help for the same issue a higher number of times than the other groups. We understand that missing a tangible context difficulties the understanding of the specific coding task. Group C had a better balance between solving the questions fast and the generated number of questions.

During the sessions, we asked in the pre and post test the applicability of the Scratch software. While group A 100% of answers, before and after the session, were to program or to program video games, the groups B and C include not only video games but also robots in the case of group C, and 2 students answered robots or other devices in group B. However we understand that better results can be obtained if we increase the number of participants, the diversity of activities, and the number of sessions.

If we focuse on two of the evaluation metrics that represents how well the students learnt about new concepts (what is a variable and what is a motor) we can see that the increment of percentatge of good answers is as follows:

- Coding performance: the percentatge of students that understood what is a variable is, in case A 10%, in case C 17%, and 50% in case B.
- Coding performance: the percentatge of students that understood what is a motor is, in case A 25%, in case C 59%, and 42% in case B.

AISOY got a better results understanding an intangible concept as a variable while LEGO NXT works better to understand a tangible and specific component as a motor. However, is interesting that in case B results about what is a motor was in most cases to make robot work in the environment while in case C was more like turning wheels on.

About how they like the activity, the score obtained by case A in a scale 1 to 5 was 4.25, in case B was 4, and in C was 4.25. So the conclusions is that all of them were good enough in terms of fun.

Finally, we observed that Group B had a better capacity to map what they learn to applications in the real world.

Other considerations to take into account for further research are: 1) Team teaching understood as how to organise the group roles, balancing of tasks, and make sure that everyone understands the concepts and processes, and 2) The ways of playing with the final implementation: child to system play, multiple children to system play, children are following turn taking to play.

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