

Evaluating the impact of RoboCupJunior on pupils' abilities

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Abstract. This paper presents an ongoing study investigating the impact of educational robotics, and RoboCupJunior in particular, on the technical and social skills of participating pupils and young students. The study will cover a period of approximately one year starting in winter term 2013. We plan to conduct the study in Austria and other European countries as well. The study is based on previous research collecting a qualitative assessment of RoboCupJunior in Austria. Data will be collected using pre, post and follow-up survey questionnaires. Results will be compared between pupils who participate in RoboCupJunior (treatment group) and pupils who do not participate in RoboCupJunior (control group).

Keywords: Educational robotics, RoboCupJunior, evaluation, technical and social skills

1 Introduction

Robotics in education has gained an increased attention over the last decades. Using robots as vehicle to interest pupils and young students in science and technology has become a widespread approach in various countries worldwide. Besides *RoboCupJunior (RCJ)* [1] a number of other educational projects and initiatives focus on improving pupils' technical and social skills. Although there is a subjective impression that those initiatives work well and are effective only a few studies exist which investigate the impact in an empirical way, applying quantitative and qualitative methods [2, 3]. One example would be the evaluation of the *FIRST Robotics Competition (FRC)* investigating the long-term impact of FRC on former participants [4]. A similar study, evaluating the *FIRST Lego League (FLL)*, was carried out by Melchior and colleagues [5]. The dissertation of Griffith [6] examines the relationship between pupils' participation in the FRC and their interests in science and technology. Data was gathered conducting pre and post tests (before and after the competition) using paper-and-pencil survey questionnaires. Results were compared between a treatment and a control group.

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Such an evaluation attempt focusing on RCJ was done by Sklar and colleagues [7] in 2004. The study did not conduct a comparison to a control group nor an explicit assessment of skills was done.

In this position paper we present our concept of conducting an empirical study evaluating the impact of the RoboCupJunior initiative on pupils' technical and social skills. In this context we plan to conduct a mid-term (one year) investigation, covering a broader region and several European countries. Similar studies have already been carried out in various other fields (e.g. medicine, sociology, psychology, economy, education [8–10]). Some of the methods and instruments used in those studies will be applied for our investigation as well.

2 Selected methods

Within this evaluation we aim to investigate whether or not pupils improve their technical (e.g. computer science, engineering, mathematics, and so forth) and social skills (e.g. teamwork, language skills, and so forth) through their involvement in RCJ. Therefore schools, which take part in annual national or international RCJ competitions on a regular basis will be contacted and asked for their participation in this study. Starting in winter term 2013 we will conduct an empirical study comprising both treatment and control groups (also see [6]). The treatment group will consist of pupils and young students who participate in RCJ for the very first time. The control group comprises students who actually attend the same school but do not participate in RCJ. Students in the control and treatment groups will be evenly distributed and share comparable demographic attributes (e.g. age). In order to determine improvements in terms of technical and social skills pre, post and follow-up tests will be conducted and results of the treatment group will be compared to the results of the control group. Pre tests will be conducted at the begin of the winter term 2013 when students start their preparation for RCJ. The post tests will be conducted right after the participation in a national or international RCJ competition in mid 2014. This results in a time-gap of at least eight months between pre and post tests. In order to consider also possible mid-term effects it is planned to conduct follow-up tests at the end of summer term 2014, at the begin of winter term 2014 respectively.

RCJ is well established in Austria. A number of schools have integrated robotics in their curriculum and participate in national and international RCJ competitions regularly. Therefore our basic plan is to conduct the study in cooperation with schools in different regions in Austria. We intend to carry out the same study simultaneously in other European countries as well. By applying this widespread, mid-term approach we aim to gather solid and valuable empirical results on the impact of RCJ on participating pupils on a larger geographical scale.

Data will be collected in two directions. First by using a standardized survey questionnaire assessing students' attitude on science and technology. Preliminary work on this topic has already been done in the Austrian context [2, 3]. Within this work we have conducted semi-structured qualitative interviews with former

RCJ participants from Austria. We analyzed the stories of their 'RCJ careers' and identified reoccurring motivational factors inherent to RCJ. Furthermore, we plan to reuse certain questions of the questionnaire used in the work of Griffith [6] investigating participants' attitudes and interests in science and technology. This questionnaire is divided into sub-areas focusing on different aspects like attitudes about teamwork, intentions to pursue a career in science and technology, self-perception, carrier field interests as well as educational plans after school.

Second we aim to assess the evolution of the students' technical and social skills using standard psychological tests [11, 12]. The data collection will be conducted using an on-line survey tool (e.g. SurveyMonkey) in order to allow a convenient collection of results from geographically distributed study participants. It has to be noted that in the case of the European-wide assessment we depend on the support of the RCJ national representatives and the RCJ community. Respecting legal and ethical requirements all collected information will be treated confidentially and personal information will be made anonymous.

3 Summary and Outlook

Currently we are in the detailed planning phase for the study evaluating the impact of RoboCupJunior on pupils' technical and social abilities. Therefore we are cooperating with experts in the field of psychology. We expect to have a draft version of the pre and post tests (comprising Likert type scales, multiple-choice and open-ended questions) by begin of summer 2013 which is already validated by the related experts. Utilizing this draft we will work on recruiting of potential participants for the study. This is done by contacting the RCJ national representatives as well as participating schools. By the begin of the winter term 2013/2014 we intend to conduct the first series of pre tests.

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