Integration of robotics in front-of-class teaching

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***Abstract*— The integration of robotics into formal class periods has shown promising results in enhancing student engagement and learning. This paper presents a detailed analysis of Junior Botball Competition (JBC) workshops conducted over several years, focusing on middle school and elementary school students. The workshops aimed to introduce students to robotics, covering the basics of robot configuration and application. Pre- and post-workshop questionnaires were used to gauge students' initial knowledge and their responses to the workshop experience. The findings suggest that students not only enjoyed the hands-on activities, but also demonstrated a significant increase in their understanding and appreciation of robotics.**

I. Introduction

Robotics has become an essential component of modern education, fostering skills such as critical thinking, problem-solving, and collaboration. Integrating robotics into formal education can provide students with practical experience and an understanding of technology that is increasingly relevant in today's world. This paper explores the impact of robotics workshops conducted within the framework of the Junior Botball Competition (JBC) on elementary and middle school students. The objective is to assess the effectiveness of these workshops at enhancing students' knowledge, interest, and attitudes towards robotics.

II. State of the Art / Literature Review

Robotics in education is a growing field, with numerous studies highlighting its benefits. According to literature, robotics can enhance learning in STEM (Science, Technology, Engineering, and Mathematics) subjects by providing interactive and engaging experiences [1]. Studies have shown that students involved in robotics programs demonstrate improved problem-solving skills and increased motivation towards learning [2]. Furthermore, integrating robotics into the curriculum can help bridge the gap between theoretical knowledge and practical application [3]. This paper builds on existing research by providing empirical data from multiple JBC workshops, offering insights into a practical implementation and outcome of such programs.

III. Concept / Design

The JBC workshops were designed to introduce students to the fundamentals of robotics in an engaging and interactive manner. The workshops were structured as follows:

1. **Introduction to Robotics:** An overview of what robots are, their applications, and the importance of robotics in various fields.
2. **Interactive Discussion:** A question-and-answer session to encourage student participation and curiosity.
3. **Hands-on Tutorial:** A practical session on configuring motors and basic programming of robots.
4. **Project Work:** Students work in groups to apply what they have learned by building and programming their own robots.
5. **Assessment:** Pre- and post-workshop questionnaires to evaluate students' knowledge and attitudes towards robotics.

IV. Implementation

The workshops were conducted over several years, targeting middle school and elementary school students. Each

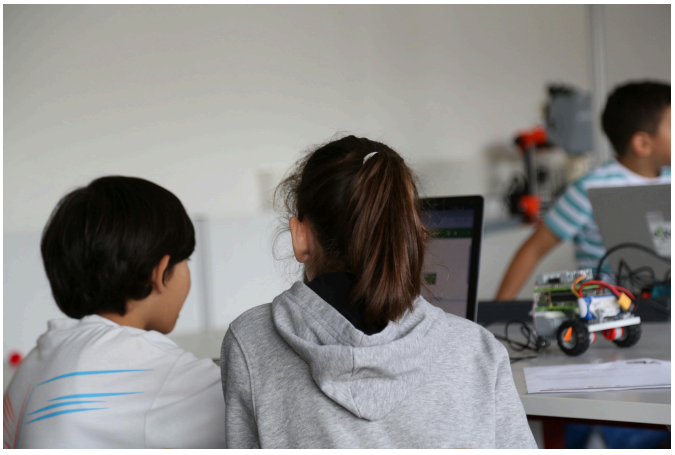

Figure 1: Children using a laptop to program a robot

session began with a pre-workshop questionnaire to assess students' initial knowledge and perceptions of robotics. The students were shown several images of robots, ranging from medical robots to robots used for the exploration of Mars. They were asked why these types of robots specifically were used in their respective fields in order to highlight the diverse areas of application, and the corresponding design challenges, in robotics. The main content of the workshops included interactive lectures and hands-on activities where students learned to configure and program robots. It may be of interest to note that during the JBC workshops, male and female students' interest in robotics was equally balanced. The workshops concluded with a post-workshop questionnaire to measure any changes in students' understanding and attitudes. The data collected from these questionnaires provided valuable insights into the effectiveness of the workshops.

V. Encouraging girls in STEM

While the immediate educational outcomes observed in JBC workshops provide ample incentive for the implementation of similar programmes in schools, the importance of these workshops extends further. Early exposure to robotics can lay the foundation for the development of interest and future achievement in STEM fields. This is particularly significant for female students, who may face societal and cultural barriers hindering them from pursuing STEM careers. By engaging students at a young age, these workshops help to build confidence and interest in STEM, contributing to long-term efforts in diversifying these fields.

VI. Results / Conclusion

The results from the pre- and post-workshop questionnaires indicated a significant increase in students' knowledge and positive attitudes towards robotics. Many students who initially had little to no experience with robotics reported a newfound interest and confidence in the subject [4]. The hands-on activities were particularly well-received, with students expressing excitement and enjoyment. These findings suggest that integrating robotics into formal class periods can be highly beneficial for engaging students and enhancing their learning experiences.

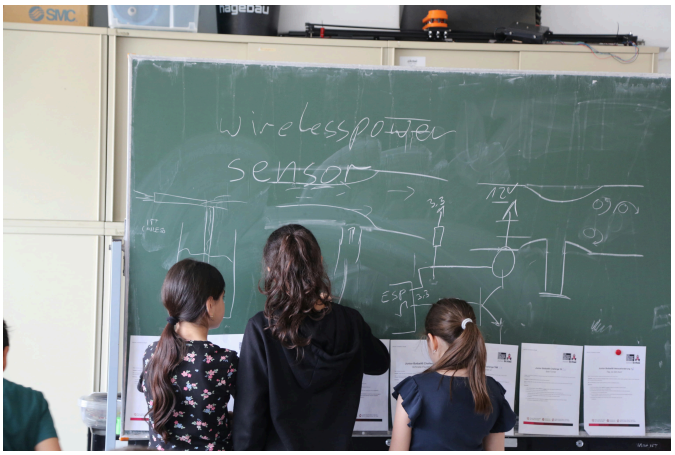

Figure 2: Children discussing technical difficulties

In conclusion, the JBC workshops have demonstrated the potential of robotics education to positively impact students' knowledge, interest, and attitudes towards technology. The success of these workshops highlights the importance of incorporating robotics into the educational curriculum to prepare students for a future where technological proficiency is increasingly crucial. Moreover, these early interventions are crucial in fostering a diverse and inclusive future workforce in STEM.

References

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