Computer Science for Everyone: Interdisciplinary Online Courses of RockStartIT

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ABSTRACT

The RockStartIT initiative was explicitly designed to increase the representation of girls in STEM-related subjects, particularly the field of computer science (CS), by providing interdisciplinary courses that connect the subject matter to their interests and passions. The program has been successful in engaging a diverse group of high school students, encouraging them to explore CS through problem-solving in the areas of their choice. The program's structure and approach have been instrumental in promoting interest in CS and increasing the understanding of the importance of using CS to solve real-world, interdisciplinary problems. The IDEA (Interdisciplinary, Diverse, Exploratory, and Active) approach of RockStartIT provides alternative pathways into the field of CS by building on the individual interests of diverse students, which would not have been possible without the interdisciplinary approach.

KEYWORDS

datasets, neural networks, gaze detection, text tagging

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1 INTRODUCTION

An opinion piece by Dr Klawe and Dr Shneiderman [5] called for computer scientists to collaborate with other disciplines in order to attract the brightest students, inspire public interest, and expand resources. This call for collaboration is even more important today, as society relies heavily on interdisciplinarity and transdisciplinarity for research and technological progress [1]. Interdisciplinary courses are not only thriving, but vital for the growth and continued survival of computer science (CS).

One reason why interdisciplinary courses can be beneficial for motivating girls to study computing is that they provide context for the material being taught, making it more relatable and meaningful. Interdisciplinary courses can also break down stereotypes about who can succeed in the field, showing that anyone can use and understand computing in many different ways. This can help to make the field more accessible and inclusive, opening up a wide range of career opportunities for girls in fields such as game design, virtual reality, and digital art.

CS education needs to pay special attention to the opportunities offered by interdisciplinary learning and teaching. The traditional CS curriculum is ineffective in promoting female interest in CS because girls find it challenging to identify with CS as such. By tapping into their personal interests and creating interdisciplinary subcultures that resonate, all students can learn CS without feeling trapped by the dominant culture associated with the field today. It is essential that CS education keep pace with the ubiquitous computing-driven progress and innovation in the real world by offering students experiences that mirror this progress and innovation.

2 IDEA CONCEPT OF ROCKSTARTIT

RockStartIT is an initiative that seeks to provide innovative and engaging online courses. To ensure that our courses are effective, we have defined the IDEA (Interdisciplinary, Diverse, Exploratory, Active) concept based on previous research [3, 4]. This concept consists of four key elements that form the basis for all their courses. The first element is that all courses are interdisciplinary, which means that they connect topics from different domains to provide students with authentic and meaningful learning contexts. The second element is that they use a variety of didactic principles to target diverse personal needs and learning preferences. The third element is that all courses have an exploratory character, allowing students to discover different topics and techniques to solve big problems. Finally, the fourth element is that their courses are interactive, using various activating concepts ranging from simple multiple choice questions to open programming or designing tasks. By adhering to the IDEA concept, RockStartIT can provide students with courses that are both effective and engaging.

The content of RockStartIT is structured in different domain-connecting courses, so-called "expeditions". They are called expeditions, because students are not just learning the content; it is much more about starting an immersive journey, getting involved in a problem statement, and exploring new knowledge and techniques to make a change. We aim to lead students through learning experiences in which an exciting setting, question or challenge inspires curiosity. Students naturally experience exploration by asking and answering questions using CS methods, technologies and data. This means that we form together a motivating question or hypothesis that triggers the need, for example, to collect or analyse data by student, where the student should apply CS methods and technologies to reason, make observations, evaluate, and draw conclusions about the inquiry question. Thus our goal is to learn CS by doing science that engages scientific investigation. This is a means to provide a better illustration of what is and what to expect from CS than traditional siloed introductory CS courses.

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3 SELECTED EXPEDITIONS

All of our expeditions are inspired by topics that, at first glance, are often rooted in other domains but offer the potential to illustrate the strengths of CS and its applicability to achieve more extraordinary things. Our vision is to provide a comprehensive variety so that every student can choose a suitable start in CS connected to their personal interests.

3.1 Beyond Biology - Save the Bees

In this series of expeditions, students explore the application of technology to solve significant challenges such as colony collapse disorder. The program combines STEM and biological phenomena with computer science, enabling students to understand complex issues and create new knowledge. By participating in six expeditions, students experience scientific ways of working and inquiry-based learning. The first expedition introduces the biological background and the problem statement of "How can we help the bees?" In the second expedition, students learn the basics of web development and build a website to inform people about the problem. The third expedition focuses on data science, teaching students about suitable data storage strategies and how to use SQL to search for answers. The fourth expedition investigates if all bees that leave the hive also return and how AI can help count the bees. In the fifth expedition, students become project managers and learn about the benefits of building a team to approach big problems. Finally, students create their team with applications from different fictive people, utilizing skills they have learned throughout the program. Through these expeditions, students experience the joy of exploration, equipping themselves with STEM work methods and tools and applying them to solve real-world problems.

3.2 Beyond Physics - In Search of Other Life

In the physics-related expeditions series, students go on expeditions to search for extraterrestrial life. They start by learning the basics of rocket science to get their rocket into space. They write a program for their rocket using scratch projects, learning about control structures and variables. Next, they learn about camera sensors and signal processing using time-lapse photography. Then they learn how to digitize and store images as pixels before exploring error correction mechanisms to send the images back to Earth without interference. With their newfound knowledge, they can securely transfer their images and set the stage for future expeditions.

3.3 Beyond Geography - Save the Climate

In this course, students explore computational thinking concepts through the lens of climate change. The course is designed to be integrated into various subjects, with a focus on motivating students to make a real-life impact on the environment. Through a fictional character named Ida, students learn how to live a climate-friendly and sustainable lifestyle.

The first expedition introduces fundamental principles of computational thinking, and how they can be used to solve big problems such as the greenhouse effect. In the second expedition, students learn about sustainable nutrition by sorting legumes using decomposition and bucket sorting. In the third expedition, students explore information coding, such as supermarket bar codes, to label fruits and vegetables seasonally for sustainability.

4 EVALUATION

For evaluation, we use in most of the programs a pre-test-post-test design [2] to measure the impact of our project and to collect feedback. The instrument we use is a self-developed questionnaire that consists of 28 items extracted from a comprehensive literature review [7]. The results of surveys conducted with program participants have shown that the program has been successful in providing girls with an alternative pathway into the field of computer science by building on their individual interests, which would not have been possible without the interdisciplinary approach [6, 7].

5 CONCLUSION

REFERENCES

[1] Cristina-Maria Dabu. 2017. Computer Science Education and Interdisciplinarity. In *Science Education-Research and New Technologies*. IntechOpen, 137–151.

[2] Dimiter M Dimitrov and Phillip D Rumrill Jr. 2003. Pretest-posttest designs and measurement of change. *Work* 20, 2 (2003), 159–165.

[3] Lucia Happe and Barbora Buhnova. 2022. Frustrations Steering Women Away From Software Engineering. *IEEE Software* 39, 4 (2022), 63–69. https://doi.org/10.1109/MS.2021.3099077

[4] Lucia Happe, Barbora Buhnova, Anne Koziolek, and Ingo Wagner. 2021. Effective measures to foster girls' interest in secondary computer science education. *Education and Information Technologies* 26, 3 (2021), 2811–2829.

[5] Maria Klawe and Ben Shneiderman. 2005. Crisis and opportunity in computer science. *Commun. ACM* 48, 11 (2005), 27–28.

[6] Kai Marquardt and Lucia Happe. 2023. Saving Bees with Computer Science: a Way to Spark Enthusiasm and Interest through Interdisciplinary Online Courses. In *Proceedings of the 28th ACM Conference on Innovation and Technology in Computer Science Education.*

[7] Kai Marquardt, Ingo Wagner, and Lucia Happe. 2023. Engaging Girls in Computer Science: Do Single-Gender Interdisciplinary Classes Help?. In *ICSE '23: Proceedings of the 45th International Conference on Software Engineering Association for Computing Machinery, New York, NY, United States.* accepted.