Using logistic regression to explain enhancing adolescent students' interest in Mathematics, Physics and Computer science through STEM workshops

Aleksandar Milenković, Dragutin Ostojić, Aleksandra Maksimović,

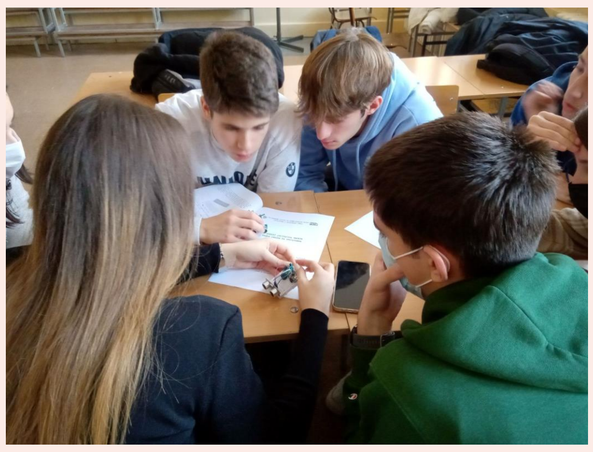
University of Kragujevac, Faculty of Science

INTRODUCTION

Numerous research papers point out the importance of identifying the moment when students' interest in mathematics and other sciences becomes more intense or weaker during the educational process (Hacieminglu, 2016, Nugent et al. 2023, Vidić & Đuranović, 2020). In addition, mathematical education is considered an important component of STEM literacy, and mathematical achievement in adolescence is a critical door opener for STEM college majors (John et al. 2022). Regarding the attitudes and views of elementary and secondary school students toward the school subjects of mathematics and physics, it is interesting to note that students begin to polarize as early as age 14 (or even earlier), i.e., they develop strong feelings toward these subjects quite early. As a result, these two subjects are at the top of the list of favorite subjects, but also at the bottom of the scale, representing both extremes. The peculiarities of these school subjects provide the background for students' unfavorable thoughts and feelings toward them. Indeed, relevant studies suggest that the majority of students begin their education with positive attitudes towards mathematics, and that the negative attitudes that appear later in their education are often the result of lower performance, failure in work, and emotional reaction to failure (Videnović & Radišić, 2011, Vidić & Đuranović, 2020). Research shows that students understand the value and usefulness of STEM subjects in daily life and consider them interesting and fun, but still too difficult (Nugent et al. 2023). It is vividly explained that the interest in learning STEM subjects and pursuing a career in these activities can be represented as an "ever-narrowing pipeline" in which the number of students interested in these subjects decreases from lower to higher grades (Burušić, 2018, Hacieminglu, 2016, Luo et al. 2021, Nugent et al. 2023).

METHODOLOGY

The purpose of this study is to attempt to stimulate interest in the above sciences among students who generally have not had similar experiences, through participation in the workshops of STEM, and to determine the factors that increase this interest. To this end, two different STEM workshops were conducted in Serbia during the 2021-2022 school year with students aged 14-17 (with several iterations of these workshops with a total of 208 students). These workshops were developed (through a multidisciplinary approach) in such a way that students could playfully see the connection between different contents of mathematics, physics and computer science. To solve the task in the provided game, students had to apply concrete knowledge and skills from the fields of light, cryptography, Arduino, and simple Python programming.



After the workshops were conducted, the students were surveyed. In the survey, students were asked to record their grades in mathematics, physics, and computer science, indicate whether they had had previous experience with similar workshops, and respond to fourteen statements on which students expressed their opinions on a five-point Likert scale (the statements related to the students' level of motivation, the extent to which they felt engaged in the work, the degree to which they cooperated with other participants in the group, whether they thought they had acquired new knowledge, and similar aspects).

RESULTS

The collected data were analyzed using a machine learning strategy, specifically the logistic regression method. With the help of the created model, it is shown in detail which variables have the greatest influence on the increase of students' interest in certain sciences, with a prediction accuracy of **82%** for the value of the dependent variable. Of all the variables included, four variables were found to be statistically significant in predicting the model, i.e., in determining the degree to which students agreed with the statement that their participation in the workshop contributed to an increased interest in mathematics, physics, and computer science. Here is the corresponding predictive model.

Increased interest towards Mathematics, Computer Science and Physics = 0.278145997∗ Math grade - 0.166297450 ∗ Physics grade + 0.612846041∗Motivation level + 0.644797729∗New adopted knowledges

CONCLUSION

Based on the obtained model, we can conclude that the higher the students' performance in mathematics, the higher the degree of agreement that their interest in the given sciences has increased. In contrast, students' performance in physics has a different influence on the dependent variable - STEM workshops have a greater effect on increasing students' interest in the given STEM subjects among those with lower performance in physics. A much stronger positive influence on the increase of this interest is the motivation level of the students during the implementation of the STEM workshops, as well as their perception that they have acquired new knowledge and skills through these workshops.

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