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Regional Differences in STEM Interest among Primary School Students in Croatia

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Abstract
The aim of this study was to examine the level of interest in STEM fields among primary school students across different Croatian counties and to determine whether significant regional and gender differences exist. The research included 289 students from 8 counties, and the data were analyzed using descriptive statistics, ANOVA, and cluster analysis.
The results revealed statistically significant differences in STEM interest between counties, with Karlovac County showing the highest average interest, while Sisak-Moslavina and Međimurje Counties recorded the lowest values. Gender differences were not statistically significant, although a tendency toward higher interest among girls was observed.
Cluster analysis enabled the grouping of counties based on STEM interest levels, providing a foundation for the development of targeted educational strategies. The findings were compared with relevant literature, which confirms the importance of local context, teacher support, and access to educational resources in shaping STEM motivation.
In conclusion, the study highlights the need for regionally tailored approaches to promoting STEM education, with an emphasis on inclusivity, accessibility, and the quality of teaching content.

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1. Introduction

Interest in STEM fields among students is not only an indicator of personal inclination toward science but also a reflection of educational quality and long-term societal development. According to the (10), countries that successfully motivate a greater number of young people to pursue STEM careers tend to experience higher economic growth and innovation potential.
Studies by (1) and (7) confirm that early exposure to high-quality STEM content—including hands-on experiments and project-based learning—significantly contributes to students' positive attitudes toward STEM. Additionally, access to extracurricular activities and the visibility of STEM professionals as role models further strengthen students' identification with these fields.
Regional differences in interest may stem from varying educational policies, social factors, economic opportunities, and cultural capital in specific communities (3). For example, local schools that partner with industry, participate in EU-funded projects, or host active STEM clubs often report higher levels of student interest.
Gender aspects in STEM education are increasingly explored in the context of inclusion and equal opportunity. Although girls in primary school often show strong curiosity toward science, their participation tends to decline in later educational stages (6). However, approaches that incorporate inclusive teaching methods and female STEM role models can significantly influence long-term motivation (8).
Within the Croatian educational system, quantitative analyses such as ANOVA, Tukey's test, and cluster analysis provide concrete data that support the development of targeted educational strategies. Regional trends in STEM interest can serve as a

Regional trends in STEM interest can serve as a foundation for implementing locally adapted intervention programs aimed at equitable STEM inclusion and development.

2. Method

This study utilized quantitative data collected from primary school students across nine Croatian counties. The sample included a total of 289 participants, with varying numbers of respondents per county. Data was gathered through a structured questionnaire that covered topics related to STEM interests, hobbies, and demographic characteristics.

A comprehensive statistical analysis was conducted to examine students' attitudes toward science and their demographic profiles. In the initial phase, descriptive statistics were applied to analyze hobby frequencies by gender and county, calculate average STEM interest scores for individual items, and present the age distribution of respondents.

To gain deeper insight into relationships between variables, inferential statistical methods were employed. A t-test was used to compare average STEM interest scores between girls and boys, while one-way analysis of variance (ANOVA) enabled comparison of interest levels across counties. The chi-square test was applied to examine the association between types of hobbies and interest in science.

Following the ANOVA, Tukey's post-hoc test was used to precisely identify county pairs with statistically significant differences in STEM interest. Finally, K-means cluster analysis was conducted to group counties into three clusters based on average STEM interest levels—high, medium, and low—thus allowing for the profiling of educational needs by region.

Visualizations include tables, bar charts of STEM interest by county, and boxplots illustrating gender differences.

3. Problem Formulation

Despite growing global emphasis on STEM education, interest in STEM fields among primary school students in Croatia remains unevenly distributed across regions. Previous studies have highlighted the importance of early exposure, teacher support, and local educational resources in shaping STEM motivation. However, there is limited empirical data on how these factors manifest regionally within Croatia, particularly at the primary school level.

This study addresses the gap by investigating regional and gender differences in STEM interest among students from eight Croatian counties. The aim is to identify whether statistically significant disparities exist and to explore the underlying factors contributing to these differences. Understanding these patterns is essential for developing targeted educational strategies that promote equitable access to STEM learning opportunities and foster long-term engagement among all students, regardless of geographic location or gender.

3. Results and Discussion

The study included a total of 298 primary school students from eight Croatian counties (Table 1). The sample consisted of students in lower primary grades (3rd–4th grade), aiming to assess their interest in STEM fields. Of the participants, 53% were girls and 47% boys. The average age was 10.8 years (SD = 1.1). The largest number of respondents came from Karlovac, Požega-Slavonia, and Zagreb Counties, while the smallest group was from Koprivnica-Križevci County.

Table 1: Regional distribution of participants

County	Karlovac	Požega-Slavonia	Zagreb	Međimurje	Sisak-Moslavina	Primorje-Gorski Kotar	Istria	Koprivnica-Križevci
N	56	49	44	42	32	30	24	12

Most students attended schools participating in national STEM education projects, while a smaller number came from schools without structured STEM activities. This difference in school environments may influence students' expressed interest in STEM.

Analysis of the collected data revealed significant differences in STEM interest among students from different counties. The overall average STEM interest score was 3.72 (on a scale from 1 to 5), with students from Karlovac County showing the highest average interest (M = 4.01), while Sisak-Moslavina (M = 3.45) and Međimurje Counties (M = 3.48) recorded the lowest scores (Figure 1).

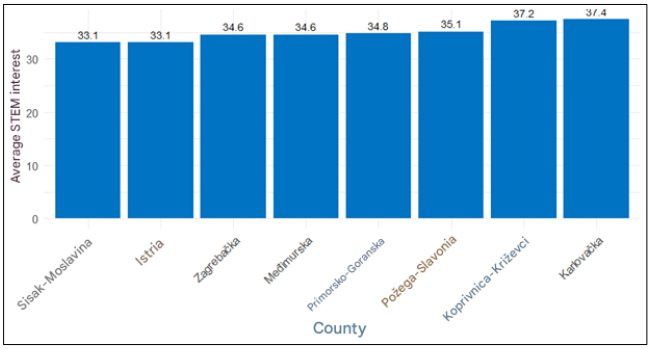

Fig 1: Average STEM interest by county based on ANOVA analysis

One-way analysis of variance (ANOVA) confirmed statistically significant differences between counties (F = 5.084, $p < 0.001$). Tukey's post-hoc test further identified specific county pairs with significant differences in STEM interest (Table 2).

Table 2: County pairs with statistically significant differences in STEM interest ($p < 0.05$)

Comparison	Difference	*p*-value	Conclusion
Karlovac – Istria	+4.35	0.0002	Karlovac significantly higher interest
Međimurje – Karlovac	−2.86	0.0109	Karlovac higher than Međimurje
Sisak-Moslavina – Karlovac	−4.37	0.00002	Karlovac significantly higher than Sisak-Moslavina
Zagreb – Karlovac	−2.86	0.0091	Karlovac higher than Zagreb

Other differences were not statistically significant, although some approached significance (e.g., Požega-Slavonia – Karlovac: $p \approx 0.06$).

Gender differences were not statistically significant ($p = 0.064$), but a trend of higher interest among girls ($M = 3.78$) compared to boys ($M = 3.65$) was observed, suggesting potential shifts in gender patterns of STEM motivation (Figure 2).

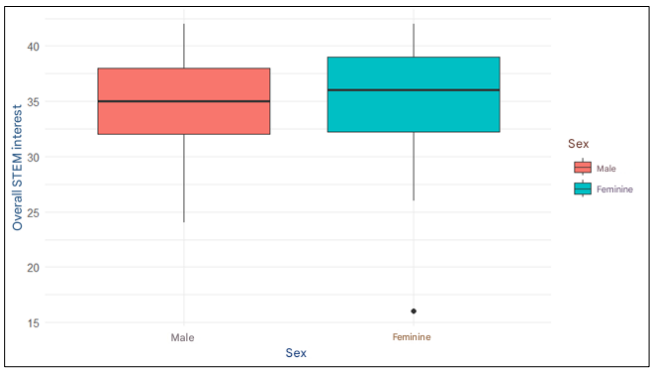

Fig 2: Boxplot of overall STEM interest by gender. Red indicates male respondents, turquoise indicates female.

Girls showed a slightly higher median interest in STEM, with one outlier in the lower range.

Cluster analysis based on STEM interest levels revealed that counties could be grouped into three distinct clusters (Figure 3). The first cluster, characterized by high interest, included Karlovac, Varaždin, and Zagreb Counties. The second cluster, with moderate interest, comprised Primorje-Gorski Kotar, Osijek-Baranja, and Dubrovnik-Neretva Counties. The third cluster, showing the lowest interest, included Sisak-Moslavina, Međimurje, and Virovitica-Podravina Counties.

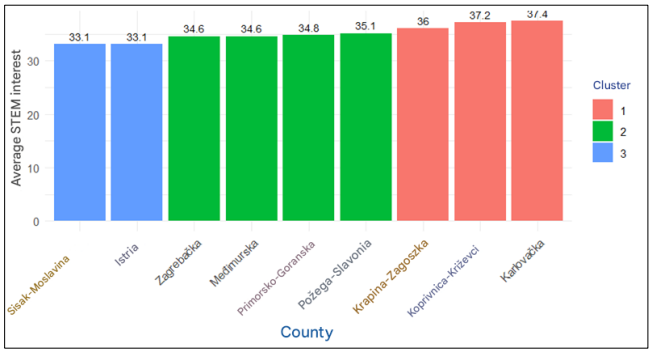

Fig 3: Average STEM interest by county grouped into three clusters: low (blue), medium (green), and high (red)

These results provide insight into the spatial distribution of STEM interest and open avenues for further research into the causes of regional disparities.

4. Discussion

The results of this study indicate significant regional differences in STEM interest among primary school students. Karlovac County emerged as the leading region in terms of average STEM interest, while Sisak-Moslavina and Međimurje Counties showed statistically lower values. These differences were confirmed through ANOVA analysis ($F = 5.084$, $p < 0.001$) and further elaborated using Tukey's post-hoc test, which identified specific county pairs with significant disparities.

The findings align with previous research emphasizing the importance of local context in the development of STEM interest. For instance, (4) highlights that the development of STEM competencies is closely linked to the availability of quality educational resources and teacher support. Similarly, (5) stress the role of students' expectations and the value they assign to STEM subjects, which can vary depending on social and cultural factors.

Although gender differences were only marginally significant ($p = 0.064$), a trend of higher interest among girls was observed. This phenomenon is consistent with recent literature (12) which suggests that gender gaps in STEM interest are narrowing, especially when girls are provided with positive role models and adequate support.

The cluster analysis based on average STEM interest enabled the categorization of counties into three levels: high, medium, and low interest. This classification offers a valuable foundation for designing targeted educational strategies tailored to the specific needs of each region. Counties identified as having lower STEM interest, such as Sisak-Moslavina and Međimurje, could benefit from additional educational programs, STEM workshops, and structured teacher mentoring.

Pedagogical implications derived from these findings point to the need for strengthening STEM activities in counties with lower interest levels. Moreover, teacher training and networking with scientific institutions can significantly enhance student motivation and teaching quality. Special emphasis should be placed on promoting gender balance in STEM education, where inclusive teaching methods and the presence of female role models can further empower girls' interest in scientific fields.

In conclusion, the results clearly demonstrate that STEM interest is not evenly distributed across Croatian counties. Therefore, educational policies should consider local specificities to ensure equal opportunities for all students. Comparison with relevant literature further confirms the importance of context, teacher support, and gender sensitivity in shaping STEM motivation.

Regional differences in STEM interest can be explained by a range of interconnected factors. First, educational policies and available resources play a crucial role. Counties with higher STEM interest often feature more active schools, a richer offer of extracurricular activities, and stronger connections with local STEM initiatives, providing students with more engaging and motivating experiences in scientific domains.

Second, socioeconomic conditions are a key factor. Access to modern technology, levels of cultural capital, and local support for education can significantly influence student motivation and participation in STEM activities. In

communities with better infrastructure and social conditions, students have more opportunities to develop interest and competencies in STEM.

Finally, the visibility of STEM professionals in the local community can have a strong impact. In environments where students are regularly exposed to STEM role models—through guest lectures, media, or family connections—interest in scientific careers tends to be more pronounced.

5. Conclusion

This study revealed that STEM interest among primary school students in Croatia is unevenly distributed, with clear regional differences indicating the need for targeted educational interventions. Karlovac County leads in terms of interest levels, while Sisak-Moslavina and Međimurje Counties were identified as areas with lower STEM motivation profiles.

Although gender differences were not statistically significant, the observed trend of higher interest among girls opens space for further research and the development of inclusive educational practices. Cluster analysis further confirmed the need for a differentiated approach in planning STEM activities, taking into account local specificities.

Comparison with relevant literature confirms that educational resources, teaching approaches, and cultural context are key factors in shaping STEM interest. Therefore, it is recommended to strengthen teacher competencies in STEM, increase the availability of extracurricular STEM activities, and promote gender balance and the visibility of STEM role models.

These findings can serve as a foundation for shaping educational policies that ensure equal opportunities for the development of STEM potential among all students, regardless of their geographic location.

6. Thank-You Note

The author would like to express sincere gratitude to all previous researchers whose work has contributed to the understanding and development of STEM education. Their findings provided a valuable foundation for this study and helped shape the research framework and interpretation of results.

Special thanks go to the participating schools and students across Croatian counties for their cooperation and openness, which made data collection possible. The insights gained from their responses are essential for identifying regional educational needs and shaping future strategies.

It is hoped that the findings of this article will contribute to a broader understanding of regional differences in STEM interest and support the development of inclusive and context-sensitive educational policies.

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