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Student Interest in STEM Subjects by Gender: Community Service

Nur Choiro Siregar [1*], Siti Nasiah [2], Hendra Irwandi Siregar [3], Warsito [4]
[1] Department of Informatic Engineering, Universitas Muhammadiyah Tangerang, Banten, Indonesia
[2] Department of Mathematics Education, UINSI Samarinda, Indonesia
[3] Department of Islamic Religious Education, UIN Syahada Padangsidimpuan, Indonesia
[4] Department of Mathematics Education, Universitas Muhammadiyah Tangerang, Banten, Indonesia

* Corresponding Author: **Nur Choiro Siregar**

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Abstract
The underrepresentation of women in Science, Technology, Engineering, and Mathematics (STEM) continues to pose challenges globally. This study investigates factors influencing interest and participation in STEM subjects, emphasizing the role of gender, age, learning methods, tutoring, and resource access. Using a descriptive research design, the study gathered data from 202 students (102 male and 100 female) in Darul Musyid boarding school, Medan. A stratified random sampling method ensured gender balance and representation across grades. The research utilized an open-ended questionnaire, complemented by demographic data, to explore students' STEM-related experiences, learning methods, access to resources, and the influence of tutoring. Responses were analyzed using data visualization techniques. The results show that gender disparities, rooted in societal norms and stereotypes, significantly affect female participation in STEM, highlighting the need for equitable interventions. Age impacts STEM engagement, with younger students exhibiting more flexibility in subject preferences, while older students face societal and peer influences on academic choices. Learning methods, particularly active and experiential approaches, enhance engagement and inclusivity, especially for underrepresented groups. Tutoring emerges as a critical factor in bridging self-efficacy gaps, disproportionately benefiting female students. Finally, access to STEM resources significantly influences academic outcomes, underscoring the importance of equitable resource distribution. These findings provide actionable insights for fostering equity and inclusivity in STEM education.

Keywords: STEM education, Gender, Learning method, Interest, Resource

Introduction

The underrepresentation of women in STEM fields remains a significant global issue. Despite various initiatives aimed at promoting gender equality, females continue to be underrepresented in STEM careers worldwide. This disparity is evident from early education through to professional levels, with fewer girls pursuing STEM subjects during their schooling years and even fewer entering STEM-related careers. Understanding the factors that influence students' interest in STEM subjects, particularly through a gendered lens, is crucial for developing effective interventions to bridge this gap.

Recent studies have explored various factors contributing to gender differences in STEM interest among high school students. Wang and Degol (2017) [7] examined the role of psychological, social, and cultural factors in shaping students' STEM aspirations. They found that self-efficacy, or a student's belief in their own abilities, significantly influences interest in STEM subjects, with girls often reporting lower self-efficacy in these areas compared to boys. Additionally, societal stereotypes and a lack of female role models in STEM fields can negatively impact girls' perceptions of their suitability for STEM careers.

Master *et al*. (2021) [4] highlighted the impact of early gender stereotypes on children's interest in computer science and engineering. Their research indicated that stereotypes associating these fields with males emerge early in childhood and contribute to the gender gap by discouraging girls from developing an interest in STEM subjects. Furthermore, the study emphasized the importance of creating inclusive educational environments that challenge these stereotypes to foster greater interest among girls in STEM.

In the context of high school education, a study by Wang and Eccles (2020) [8] examined how gendered experiences in mathematics and science courses influence students' decisions to pursue STEM careers. The researchers found that girls who perceived their math and science classes as less supportive or more competitive were less likely to develop an interest in STEM careers. This finding underscores the need for educational practices that create supportive and collaborative learning environments to encourage female students' participation in STEM. This study aims to contribute to the existing knowledge by providing a comprehensive analysis of the factors influencing students' interest in STEM subjects, with a particular focus on gender differences.

Methodology

This study employed a descriptive research design to explore gender differences in student interest in STEM subjects. The design focuses on providing a detailed understanding of the factors influencing students' preferences and engagement levels with STEM subjects based on their gender. The study utilized a stratified random sampling method to ensure representation across gender and grade levels. The sample consisted of 202 secondary school students (102 male and 100 female) boarding school in Darul Musyid, Medan. These schools were selected to reflect similar socio-economic and cultural backgrounds, ensuring there is family support for studying STEM subjects. An open-ended questionnaire was developed to gather insights into students' interest in STEM subjects. The questionnaire included questions such as: (1) Have you ever received special tutoring for science? (2) Do you have access to learning resources (books, internet, etc.) outside of school? (3) What is your preferred learning method? In addition, the demographic survey collected basic information, such as age and gender. Data were collected over a two-week period through face-to-face sessions at school. Students were given 30 minutes to complete the questionnaire in a supervised classroom. Prior to distribution, the purpose of the study was explained, and students were assured of confidentiality to encourage honest responses. The responses from the open questionnaire were analyzed using analysis by means of data visualization (diagrams). Ethical approval was obtained from the academic institutional review board. Participation was voluntary, and informed consent was obtained from the students. Confidentiality was maintained, and data were used solely for research purposes.

Result and discussion

Gender plays a crucial role in determining interest and participation in STEM subjects. Research consistently highlights the underrepresentation of females in STEM fields, largely attributed to societal norms and gender stereotypes (Master *et al*., 2021) [4]. Figure 1 illustrates the gender distribution of participants in this study, providing foundational insights into how gender affects STEM interest. Previous studies (Wang & Eccles, 2020) [8] emphasize that gender imbalances often originate during formative education years, where females encounter fewer encouragements and opportunities compared to their male counterparts. These findings underline the need to analyze interventions that foster equity in STEM education.

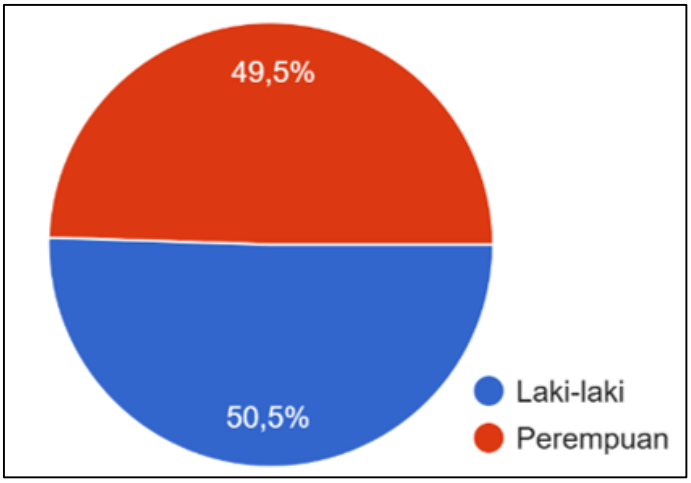

Fig 1: Gender of participants

Age influences STEM engagement, with older students often developing more defined academic preferences. Figure 2 presents the age distribution of participants, shedding light on how interest in STEM evolves with maturity. Younger students might show greater flexibility in subject interest due to less exposure to rigid societal expectations (Miller *et al*., 2022) [5]. However, as students approach higher grades, choices become more influenced by peer groups, career aspirations, and societal pressures. Analyzing data across age groups can inform strategies to nurture early STEM curiosity and sustain it into higher education.

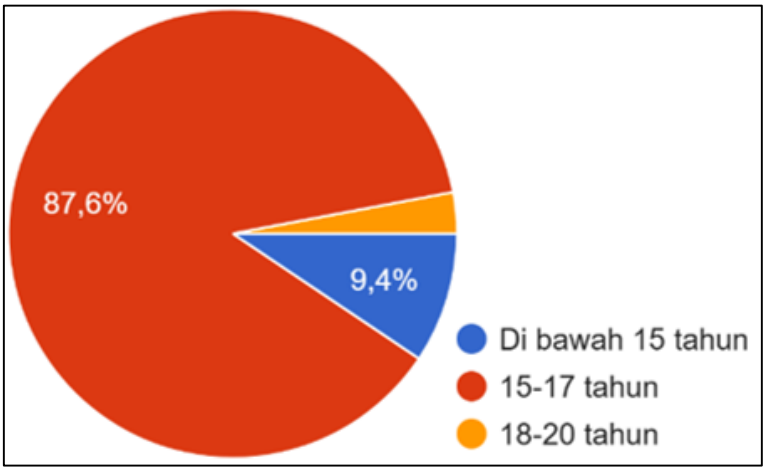

Fig 2: Age of participants

Figure 3 explores the learning methods preferred by students, which is pivotal for tailoring STEM instruction to meet diverse needs. Active and experiential learning methods, such as project-based activities and hands-on experiments, have been shown to significantly enhance STEM engagement, particularly for underrepresented groups (Freeman *et al.*, 2017) [2]. By understanding these preferences, educators can develop strategies to mitigate barriers and foster inclusivity in STEM learning environments.

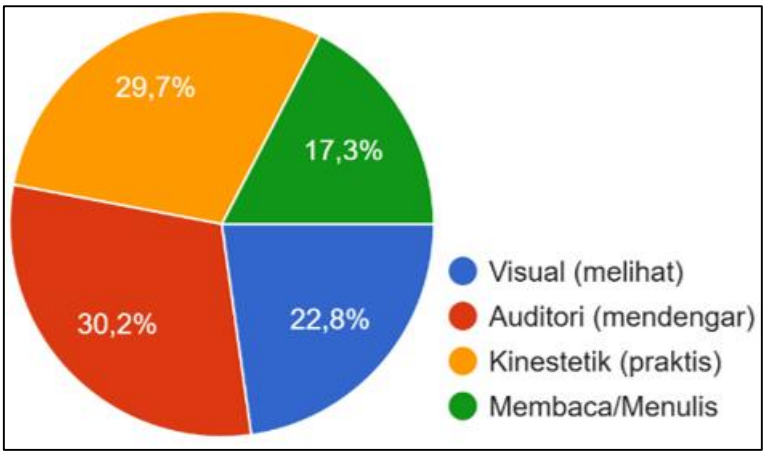

Fig 3: Learning methods preferred by students

Figure 4 examines the role of tutoring in influencing STEM interest. Tutoring provides personalized attention, enabling students to overcome challenges and develop confidence in STEM subjects. Recent research (Alghamdi & Hassan, 2020) [1] suggests that tutoring benefits female students disproportionately, helping them bridge self-efficacy gaps often seen in STEM disciplines. This data supports the integration of tutoring programs as a means to address gender disparities in STEM education outcomes.

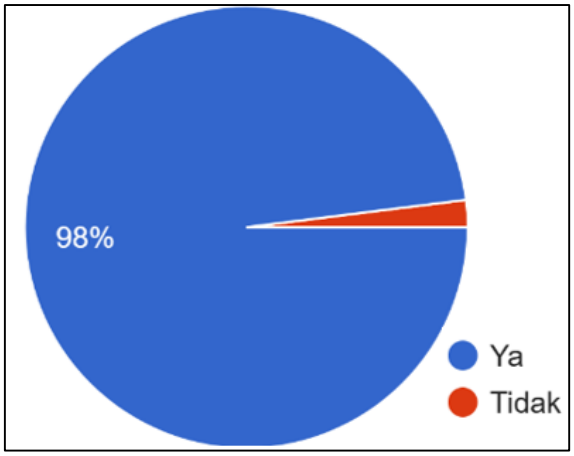

Fig 4: Receive STEM course tutoring

Access to resources is a critical determinant of STEM engagement, as depicted in Figure 5. Disparities in resource availability, such as laboratory equipment, technological tools, and reference materials, create unequal opportunities for students. Equitable resource distribution can significantly impact students' academic performance and interest in STEM. This highlights the necessity of ensuring that all students, regardless of gender, socioeconomic status, or geographical location, have access to adequate STEM learning resources (Johnson *et al*., 2021; Siregar *et al*., 2023) [3, 6].

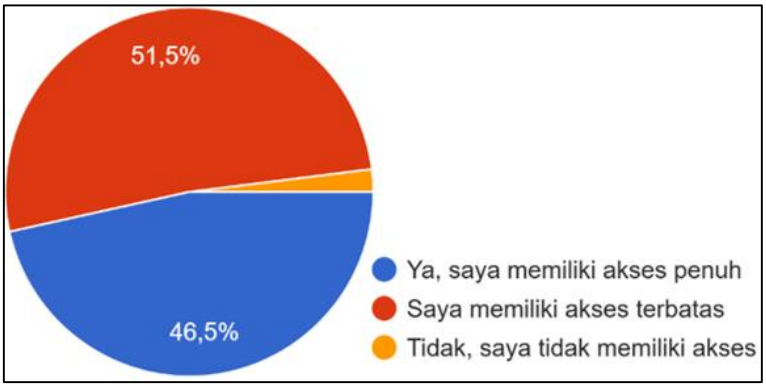

Fig 5: Student access to learning resources

Conclusion

This study provides valuable insights into the factors influencing students' interest in STEM subjects, with a particular focus on gender differences. The findings emphasize the pervasive impact of gender stereotypes, access to resources, and the role of personalized educational support on shaping students' academic preferences and future aspirations. Firstly, gender disparities remain a critical barrier in STEM education. As highlighted in this study, societal norms and stereotypes significantly shape students' perceptions of their abilities in STEM, discouraging female participation. Secondly, the data underscore the importance of resource availability in promoting STEM engagement. Figure 5 from the study illustrates significant disparities in access to laboratory equipment, technological tools, and supplementary learning materials. Thirdly, tutoring and mentorship programs play a pivotal role in bridging the self-efficacy gap often experienced by female students in STEM disciplines. As shown in Figure 4, access to STEM-specific tutoring significantly boosts confidence and engagement among students. Moreover, preferred learning methods highlight the need for active and experiential learning approaches. By understanding and incorporating students' preferred learning styles, educators can design more inclusive and engaging STEM curriculums. Lastly, the study demonstrates that age and developmental stages influence students' academic preferences and interest in STEM subjects. Younger students, as shown in Figure 2, often exhibit greater flexibility in their subject interests, while older students' choices are more influenced by societal pressures and career aspirations.

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