

# The Relationship Between High School Students' Sense of Belonging to Physics, Physics Identity, and Physics Achievement

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**Abstract.** This research explores how the sense of belonging and physics identity are associated with physics achievement in terms of grade level and gender. Five hundred sixty-six students from a science high school participated in the study. Data collection was done via an online survey. Spearman-Rank test was conducted to determine the relationship between these variables. Female high school students perceive themselves as less competent compared to males. In contrast, male students exhibit less hesitation in identifying themselves as physics persons and show higher scores in physics identity sub-dimensions, aligning with previous research indicating higher levels of belongingness among males.

## Introduction

The sense of belonging in physics (SoBP) refers to a student's perception of being valued and accepted within the class and academic community and confidence in their success [1]. Students with strong SoBP are more likely to receive higher grades and achieve better educational outcomes [2]. In contrast, students who do not feel a sense of belonging (SoB) may struggle to find meaning in their coursework, lack motivation and engagement, and have lower academic performance. According to Hazari et al.'s [3] study, physics identity (PI) relates to how much an individual identifies as a "physics person" including (a) identifying oneself as a physics person, (b) valuing recognition and encouragement from others, (c) believing in one's capacity and competence to fulfill specific scientific tasks, and (d) the individual's passion for learning science. The SoB influences students' views on science and their identification with scientific disciplines [4]. Meanwhile, the SoBP may vary by grade level, gender, or school type in high school physics courses [5]. Accordingly, this study explored how the SoBP and PI are associated with physics achievement (PA) in terms of grade level and gender. Within this scope, the research question for this study is as follows:

- What are the relationships between high school students' (a) PA and PI, (b) PA and SoBP, and (c) PI and SoBP regarding gender and grade level?

## Methods and Findings

This correlational study was conducted at a science high school in İstanbul. Of 750 students, 566 (271 females and 295 males) voluntarily participated. An online survey tool was formed for data collection in the study, consisting of a demographic data form, a scale, and a questionnaire. The demographic data form was used to collect information about the gender, grade level of students, and PA (*final physics exam scores last semester*). Students' PI was identified with the Physics Identity Scale (PIS) [6]. The PIS consists of four sub-dimensions: (a) interest, (b) self-efficacy, (c) recognition and (d) physics identity. Lastly, students' SoBP was assessed by four Likert-type items in the Students' Sense of Physics Belonging Survey [2].

The analysis revealed no significant correlation between PA and PI for female students in the 9th and 12th grades. In contrast, a low-level correlation was noted in the 10th and a high-level correlation in the 11th grades. A significant high-level correlation existed between PA and PI for

the 9th and 10th graders, with a moderate-level correlation for the 11th graders. No significant correlation was found for the 12th graders. Moderate-level correlations were observed between PA and the "interest" sub-dimension of PI for 9th and 10th-grade male students. Lastly, a low-level correlation between PA and PI's "recognition by others" sub-dimension was found for 12th-grade female and male students. When considering correlations regarding grade level and gender, significant low-level correlations between PA and SoBP were found for 10th-grade female and 11th-grade male students. However, the relationships between SoBP and PI sub-dimensions vary among female and male students. While statistically significant very low-level correlations were observed between SoBP and PI sub-dimensions for female high school students, only the "self-efficacy" sub-dimension showed a significant low-level correlation for males. For 10th-grade female students, a statistically significant high-level correlation was found between SoBP and the "Physics identity" sub-dimension. In contrast, 11th-grade male students showed a high-level correlation in the "self-efficacy" sub-dimension.

## Conclusion

Female high school students feel less competent than males, and males are more willing to identify themselves as physics persons. There could be several reasons females are negatively impacted by societal stereotypes [7]. A low-level correlation was found between the "interest" subdimension in PI and PA in males, aligning with previous research. Despite exhibiting less interest in physics than females, males demonstrate a more proactive orientation. Male students were found to have higher scores in the sub-dimensions of PI compared to female students. Kalender et al. also revealed that female students reported significantly lower physics identity scores than males [8]. Overall, differences were found in the SoBP between male and female students. Male students were found to have higher levels of belongingness than female students, which is consistent with previous studies in the literature.

## References

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