TYPE Original Research
PUBLISHED 09 May 2025
DOI 10.3389/feduc.2025.1553001

OPEN ACCESS

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RECEIVED 29 December 2024
ACCEPTED 21 April 2025
PUBLISHED 09 May 2025

CITATION
Brage-del-Río M, Martin-Núñez JL and Pablo-Lerchundi I (2025) Educational strategies to reduce the gender gap in the self-efficacy of high school students in stem teaching.
Front. Educ. 10:1553001.
doi: 10.3389/feduc.2025.1553001

Educational strategies to reduce the gender gap in the self-efficacy of high school students in stem teaching

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In the current educational context, the equal participation of women and men in STEM fields remains a challenge. Despite the progress, there are still significant disparities between the number of men and women who study and dedicate their professional lives to scientific careers. The main objective of this study is to determine whether there is a gender difference in self-efficacy in Physics and Chemistry among pre-university students with the same academic performance. The participants of this study are a total of 525 Secondary Education students in Madrid (Spain). By relating the results of a self-efficacy survey to the students' academic grades and their gender, it was possible to analyze the impact of gender on the participants' self-efficacy. ANOVA analyses results show that there is a gender gap for the entire sample and that this is particularly notable in the crucial years when students are deciding on their academic careers. These findings emphasize the importance of early intervention to enhance the self-efficacy of female students in scientific disciplines. In response to this issue, three potential methodological approaches have been suggested: fostering cooperative learning, incorporating self-assessment and metacognitive activities, and introducing female role models. These approaches should be carefully implemented to prevent unintended negative effects. This strategy will not only foster equal opportunities but also enhance the innovative capacity and socio-economic growth of our society.

KEYWORDS

self-efficacy, STEM education, Physics and Chemistry education, pre-university students, STEM engagement strategies, STEM vocations

1 Introduction

In recent years, the issue of the underrepresentation of women in STEM fields, an acronym for Science, Technology, Engineering and Mathematics, has been brought to the forefront. In Spain, according to the statistics of the Sistema Integrado de Información Universitaria (2023), although the total number of female students enrolled in undergraduate degrees in the 2022–2023 academic year (56.8%) is higher than that of male students, the percentage of female students studying degrees in the fields of Physical, Chemical and Geological Sciences (42.8%), Computer Science (16.3%), Engineering (26.9%) and Mathematics and Statistics (37.1%) is lower. The same report shows that this trend seems to continue at higher levels such as Masters and PhD programs. The reasons why the disparity between men and women in science and engineering remains so significant are not yet fully understood. Recent research highlights that these differences may stem from persistent gaps in students' self-efficacy, especially in Physics and Chemistry contexts, even when performance is equal or favors female students (Cwik and Singh, 2022; Whitcomb et al., 2020).

Women pursuing careers in STEM face a complex set of challenges that can be broadly categorized into external and internal barriers. External barriers include societal stereotypes, workplace discrimination, and a lack of female role models, all of which contribute to the underrepresentation of women in STEM careers (O'Connell and McKinnon, 2021). Negative stereotypes about women's mathematical abilities may further discourage them from pursuing STEM careers (Wang and Degol, 2017). Additionally, systemic biases in hiring, promotion, and work-life balance policies create further obstacles for women seeking advancement in these fields (UNESCO, 2019). This disparity is not limited to STEM fields alone but extends to broader educational and entrepreneurial contexts, where gender gaps persist across different European countries (Gaweł and Krstić, 2021).

Likewise, UNESCO (2019) suggests that, in order to close the gender gap in STEM disciplines, it is necessary to implement policies that foster gender equality from early education to the professional environment.

Another study by Cheryan et al. (2017) concludes that the lack of female representation in STEM not only affects girls' perceptions of their own abilities but also perpetuates a cycle of exclusion and disinterest in these areas. Promoting an inclusive culture and providing resources and support for women in STEM are essential steps to reduce this gap.

Internal barriers, on the other hand, stem from psychological factors such as imposter syndrome and lower self-efficacy, which can diminish women's confidence in their ability to succeed in STEM environments (Swafford and Anderson, 2020). Research has shown that these internal doubts are often reinforced by the external biases they encounter, creating a feedback loop that discourages persistence in STEM careers (Oliveira-Silva and Lima, 2022).

Above all, it is suspected that self-efficacy in science may play a crucial role in the lack of women in STEM fields (Marshman et al., 2018a).

In this study we will try to analyze the influence of gender on self-efficacy in pre-university students according to their academic performance. This paper is organized as follows: Section II briefly describes Self-efficacy and its influence in STEM fields. Section III explains the material and methods used. Section IV reports the results obtained and the discussion and conclusions are presented in Sections V and VI.

2 Relevant literature: self-efficacy and its influence in STEM fields

The term self-efficacy, introduced by Bandura (1994), refers to confidence in one's ability to accomplish a task or achieve a goal. It is focused on perceived capability rather than self-esteem, assessing confidence in handling tasks of specific difficulty without comparison to others. It is future-oriented, gauging confidence prior to undertaking an activity. This characteristic makes self-efficacy a crucial factor in academic motivation and a reliable predictor of outcomes (Zimmerman, 2000; Pajares and Miller, 1994; Smith, 1989).

High self-efficacy impacts activity choices, effort, persistence, and emotional responses. Students with higher self-efficacy are more likely to engage in challenging tasks, persist in the face of difficulties, and maintain positive emotional responses (Bandura, 1997). In STEM fields, motivational factors like interest and self-efficacy strongly influence career choices and academic engagement (Betz and Hackett, 1986; Pajares and Schunk, 2001). This influence is particularly relevant in disciplines like Physics, where female students report consistently lower self-efficacy despite similar or better academic results (Stang et al., 2020; Ayoola, 2024). For instance, students with high STEM self-efficacy are more likely to persist in their goals and see challenges as opportunities (Zimmerman, 2000; Watt, 2006).

However, self-efficacy does not always align with actual ability. The Dunning-Kruger effect suggests that individuals with lower competence may overestimate their abilities, whereas highly competent individuals tend to underestimate theirs (Kruger and Dunning, 1999). This discrepancy raises important questions about whether men or women are more prone to overconfidence in STEM settings and how this affects persistence and career choices.

Self-efficacy creates feedback loops: positive outcomes boost self-efficacy, while low efficacy leads to diminished performance. This cycle is particularly impactful in STEM, where high self-efficacy fosters effective strategies like self-assessment and problem-solving (Zimmerman, 2000; Bouffard-Bouchard et al., 1991). Conversely, low self-efficacy can limit performance, reinforcing doubts.

Gender disparities in self-efficacy are significant in STEM, with female students consistently reporting lower self-efficacy than males, regardless of ability or teaching approaches (Vincent-Ruz and Schunn, 2017; Cavallo et al., 2004). This pattern is especially pronounced in Physics, where studies show that even in classrooms where women outnumber men, self-efficacy remains lower in female students (Kalender et al., 2019a; Moreno et al., 2021). This gap is influenced by societal stereotypes and internalized standards, as women often believe they must outperform men to succeed in STEM (Correll, 2004; Goodman, 2002). Given the Dunning-Kruger effect, it is worth considering whether men in STEM fields show higher self-efficacy despite lower actual performance, whereas women may underestimate their abilities even when their performance is high (Dunning, 2011; Ehrlinger and Dunning, 2003). Lower self-efficacy in mathematics particularly affects women's decisions to pursue STEM careers, highlighting the need to address this discrepancy (Correll, 2001).

Marshman et al. (2018a) explored these dynamics in introductory physics, investigating whether self-efficacy differences between genders persist when performance is equal. Their findings suggest that environmental factors and stereotypes contribute to the gender gap, which plays a role in the underrepresentation of women in STEM careers.

Understanding and addressing self-efficacy gaps is vital to fostering equity in STEM, supporting persistence, and reducing dropout rates among women in these fields.

2.1 Objectives of the study

As mentioned, the underrepresentation of women in higher education in STEM fields is believed to stem from the low self-efficacy perception in women. Studies like those by Pedersen and Nielsen (2023) confirm that gender-based self-efficacy differences begin even before university and may predict attrition in Physics and Chemistry disciplines. Therefore, this self-efficacy gap by gender can be expected to emerge at lower educational levels, such as pre-university education. An analysis of the self-efficacy gap by gender at pre-university levels could provide valuable information to propose methodological strategies to improve female students' self-efficacy and awaken STEM vocations. Early detection of this gap and the corresponding intervention to overcome it will help increase female participation in STEM careers. While previous research has extensively examined gender disparities in self-efficacy among university students (e.g., Marshman et al., 2018b), this study will provide novel insights by focusing on high school students. Unlike much of the existing research that examines self-efficacy broadly, this study will categorize students by performance levels (failing, passing, notable, and outstanding). By examining Secondary Education students from 2° ESO to 2° Bachillerato (13–17 years old), this study will provide a developmental perspective along four academic years on the self-efficacy gender gap.

Thus, the objectives of this study are:

- To analyze the self-efficacy gap in STEM subjects by gender and academic performance in pre-university students.
- To examine the relationship between self-efficacy, academic performance, and educational stage to identify critical moments where the gender gap is most pronounced and assess its evolution over time.
- To identify methodological strategies that favor the increase of female students' self-efficacy in science.

3 Materials and methods

3.1 Participants and procedure

To determine the gender gap in self-efficacy perception in science subjects among pre-university students, all of the students (a total of 525) of the IES El Burgo-Ignacio Echeverría, a public Secondary Education center in Madrid (Spain), taking the subjects Physics, Chemistry or Physics & Chemistry participated in this study. The students of this incidental sample belong to six different years taught by four teachers. In this respect, and given that the methodological decisions are taken jointly by the Physics and Chemistry Department, it is considered that there are no substantial differences between teachers' teaching style, methodological approaches and the like. Regarding academic performance, the students were classified into four categories according to their grades in the last quarterly evaluation and by the Spanish public grading system (form 0 – minimum to 10 – maximum): Suspenso (failed) for grades below 5 out of 10, Aprobado (passed) with grades of 5 and 6 out of 10, Notable (remarkable) with grades of 7 and 8 out of 10 and Sobresaliente (outstanding) with grades of 9 and 10 out of 10. The percentage of students in each performance category by gender and year is shown in Figure 1.

The sample is composed, by year, as follows: 2°Bach Physics ($N = 58$, 30 male and 28 female, age = 17), 2°Bach Chemistry ($N = 58$, 21 male and 37 female, age = 17), 1°Bach ($N = 61$, 38 male and 23 female, age = 16), 4°ESO ($N = 86$, 36 male and 50 female, age = 15), 3°ESO ($N = 121$, 63 male and 58 female, age = 14) and 2°ESO ($N = 141$, 82 male and 69 female, age = 13).

In April 2024, each teacher was given a printed copy of the self-efficacy survey for each of their students, divided by year and group, as well as instructions for answering the survey. The teachers handed the printed surveys out to their students at the beginning of the class and scheduled 10 min to answer it. Once the responses were collected, each teacher provided the results of the survey, the grades of the last quarterly assessment (which took place in March) and the gender of each of their students. Thanks to the enrollment number, year and group, all variables could be easily and anonymously linked.

3.2 Instruments

In order to test students' self-efficacy, a survey previously developed and validated by Glynn et al. (2011) and employed in subsequent research studies (Kalender et al., 2017; Marshman

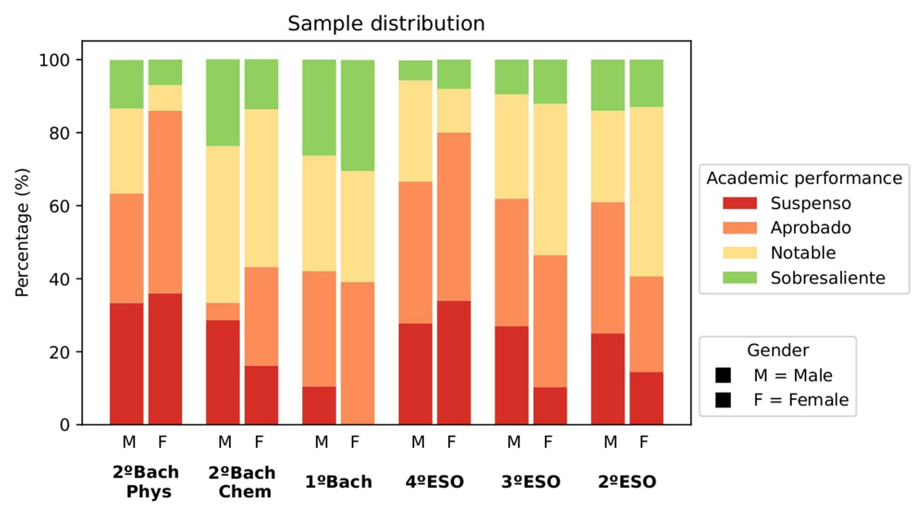

FIGURE 1
Description of study participants.

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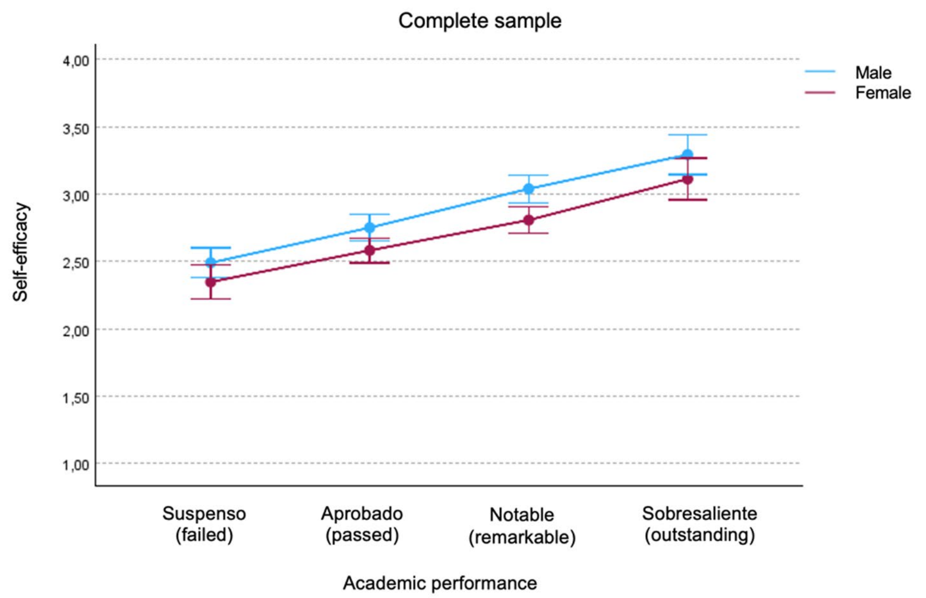

FIGURE 2
Self-efficacy by gender and academic performance for the full sample.

et al., 2018a; Nokes-Malach et al., 2017) was used. The instrument[1] was translated and slightly modified to adapt it to the sample's educational context. For instance, mentions of laboratory activities in the original survey were replaced by problem solving exercises, as the students in the sample do not attend the laboratory regularly. The instrument uses a particular 4-point Likert scale with the form "NO!, No, Yes, YES!." This scale has been extensively validated in previous studies, including studies on self-efficacy (Vincent-Ruz and Schunn, 2017). This response scale is used instead of "strongly disagree, disagree, agree, agree, strongly agree" because students interpret these response levels appropriately and because it reduces students' cognitive load, which is especially important for non-native speakers (Vincent-Ruz and Schunn, 2017). Vincent-Ruz and Schunn (2017) empirically tested the psychometric characteristics of the scale, ensuring discriminant, convergent, concurrent, and predictive validity. We obtained a Cronbach's alpha of 0.751, which is considered acceptable. Each item of the survey was translated into an integer numerical value from 1 to 4, 1 being related to a low self-efficacy and therefore corresponding to the first response option, and 4 representing high self-efficacy (last response option). Items worded in the negative have been reversed to preserve this in the analysis of the results. The final self-efficacy score was obtained by averaging the results of every item, providing a decimal number from 1 to 4.

3.3 Data analysis

First, to determine whether there are differences in self-efficacy between male and female students, mean plot with error bars was performed in which the dependent variable is the average score on the self-efficacy survey from 1 to 4, and the independent variables are gender and the students' academic performance category. This analysis was conducted separately for each grade, as well as overall for all participants in the study.

Once these differences were observed, a two-way ANOVA was considered to test whether there were statistically significant differences, using self-efficacy as the dependent variable and gender and the previously defined grade intervals as independent variables or factors.

4 Results

Figure 2 shows the self-efficacy results by grade and gender. As can be seen, self-efficacy increases with academic performance in a similar way for male and female students, however there is a gap between them when attending to their self-efficacy results.

Each year is analyzed separately in Figure 3. It can be seen that generally the self-efficacy of male students is above that of their female counterparts. Only in 3° ESO and partially in 2° Back Chemistry, there seems to be almost no difference, but the gender gap is evident in all the other years. Especially in 2° ESO and 4° ESO year a substantial gap may be observed.

Having observed that there seem to be differences between the self-efficacy of male and female students, the two-way ANOVA is performed to determine if these differences are significant. In order to ensure that the ANOVA is valid, three assumptions must be met: independence of observations, homogeneity of variance and normality of the data. Given the quantitative pre-experimental design, all observations may be considered independent. To test the homogeneity of variance, Levene's test was performed: $W = 1.525$, $p = 0.156$. Finally, normality was checked for each factorial cell with the Shapiro–Wilk test.

1 Raw data and the survey's questions are available in: osf.io/9rvcz.

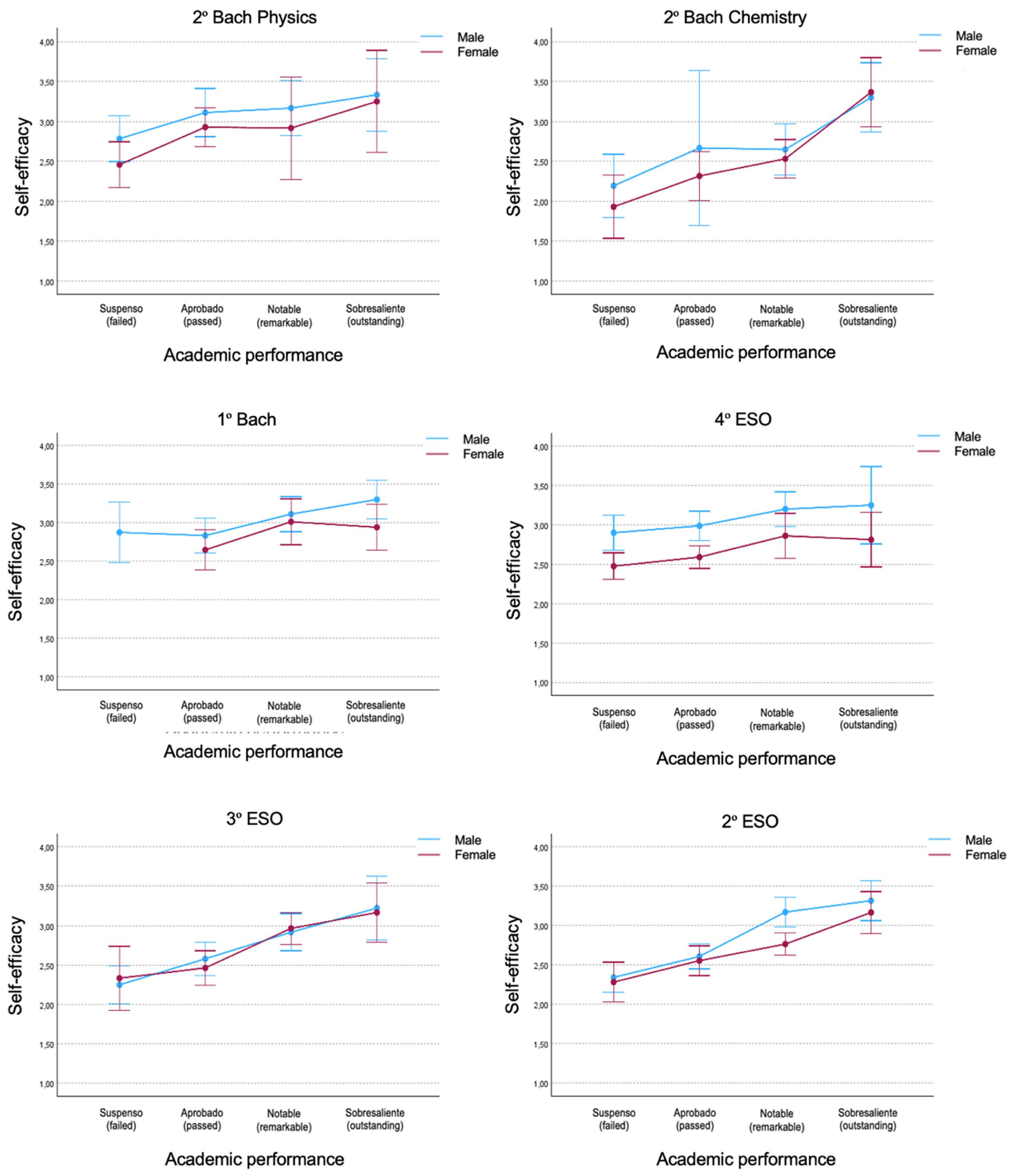

FIGURE 3
Self-efficacy by gender, academic performance and year.

The next subsections analyze self-efficacy in relation to the other variables considered in this study: academic performance, gender and the combination of both.

4.1 Differences in self-efficacy by academic performance

Table 1 shows the results of the first null hypothesis of the ANOVA: there are no significant differences in self-efficacy between students in the different performance categories. As can be seen, there is a statistically significant effect of academic performance on self-efficacy throughout every school year, so that the null hypothesis is rejected. Considering the data in detail, students with better grades also show higher self-efficacy scores: students with outstanding (sobresaliente) grades obtain higher self-efficacy scores ($\overline{x}$ = 3.2) than students with remarkable (notable) ($\overline{x}$ = 2.9) or pass (aprobado) ($\overline{x}$ = 2.6) grades and also in comparison with students who failed (suspenso) in the last quarterly assessment ($\overline{x}$ = 2.4).

TABLE 1 ANOVA results of self-efficacy by academic performance and year.

Year	F	p
Full sample	52.18	<0.001*
2° Bach Physics	4.62	0.006*
2° Bach Chemistry	12.73	<0.001*
1° Bach	3.80	0.015*
4° ESO	3.76	0.014*
3° ESO	13.04	<0.001*
2° ESO	26.31	<0.001*

*$p \leq 0.05$.

4.2 Differences in self-efficacy by gender

Table 2 shows the results of the second null hypothesis of the ANOVA: there are no significant differences in self-efficacy between male and female students. Results show a statistically significant effect of gender on self-efficacy for the complete sample, 1° Bach, 4° ESO and 2° ESO. In these years, female students consistently show a lower self-efficacy (1° Bach $\bar{x}$ = 2.8; 4° ESO and 2° ESO $\bar{x}$ = 2.7) than their male counterparts ($\bar{x}$ = 3.1 for the 3 years). However, in 2° Bach Physics, 2° Bach Chemistry and 3° ESO there are no significant differences between the self-efficacy of male and female students, although the means for self-efficacy are also consistently higher in male students.

4.3 Interaction between academic performance and gender

Table 3 shows the results of the third null hypothesis of the ANOVA: there is no interaction between performance and gender, that is, the effect of one factor does not depend on the level of the other. These results show that male and female students have equivalent grades, so that the difference in self-efficacy between genders may not be attributed to differences in academic performance.

5 Discussion

Based on the results presented, pre-university students show a statistically significant gender disparity in self-efficacy, independent of their academic performance. Female students consistently perceive their abilities as lower than their male peers despite having similar academic results. This finding reinforces the idea that women tend to underestimate their abilities, as suggested by Correll (2001) and Dunning (2011). This disparity is particularly pronounced among 4° ESO students, where the effect is more significant. This is concerning because 4° ESO is a pivotal stage where students select educational pathways that influence their future university and career options. As self-efficacy strongly influences interest in STEM fields (Eccles, 1994), career choices (Correll, 2004), and persistence in professional goals (Betz and Hackett, 1986), low self-efficacy in a central year such as 4° ESO may lead to a rejection of STEM subjects and the abandonment of scientific aspirations. Significant differences were also identified between 1° Bach and 2° ESO students, while differences in 2° Bach groups were not statistically significant, possibly due to the small sample size. These findings align with the study by Marshman et al. (2018b), which identified a self-efficacy gap between male and female university students in introductory Physics courses, attributed mainly to students' perceptions of the subject.

TABLE 2 ANOVA results of self-efficacy by gender and year.

Year	F	p
Full sample	17.95	<0.001*
2° Bach Physics	1.96	0.17
2° Bach Chemistry	0.94	0.34
1° Bach	4.10	0.048*
4° ESO	16.24	<0.001*
3° ESO	0.008	0.92
2° ESO	5.00	0.027*

*$p \leq 0.05$.

TABLE 3 ANOVA results of interaction between academic performance and gender.

Year	F	p
Full sample	0.24	0.87
2° Bach Physics	0.14	0.93
2° Bach Chemistry	0.28	0.84
1° Bach	0.49	0.62
4° ESO	0.05	0.98
3° ESO	0.26	0.85
2° ESO	1.74	0.16

Marshman et al. (2018a) suggest that stereotypes and cultural beliefs about gender and STEM performance may bias students' self-assessments. These stereotypes, particularly negative ones about women in Physics, may lead female students to perceive success differently from male students, believing they must work harder to achieve the same outcomes. Women may also face added stress to prove their abilities in underrepresented environments, reinforcing thoughts like "there are not many people like me," which can further erode their self-efficacy. In contrast, men often exhibit greater confidence in their abilities regardless of actual performance due to biases favoring their gender. For example, Correll (2001) found that male students rate their mathematical competence higher than females, even with similar performance levels, leading them to choose math-related careers more frequently. Tobias and Piercey (2012) noted that female students often attribute success in mathematics to luck and failure to a lack of ability, whereas male students credit their success to ability and failure to lack of effort. Such internalized beliefs contribute to the lower self-efficacy of women in Physics, even among high-performing students.

These environmental and sociocultural biases in Physics significantly influence students' judgments about their abilities, rather than reflecting their actual performance. Recent findings confirm that these biases persist even in female-majority Physics classes, and are not explained by performance alone (Cwik and Singh, 2022; Whitcomb et al., 2020), while Chemistry students show similar self-efficacy patterns that remain even after instructional improvement (Moreno et al., 2021), especially among underrepresented groups (Pedersen and Nielsen, 2023). As self-efficacy is a critical determinant of performance, enhancing female students' self-efficacy in STEM subjects could improve their academic outcomes and learning experiences in the field.

5.1 Educational strategies to reduce the gender gap

Given this problem, the need to introduce methodological strategies that favor the increase of self-efficacy in science of female students at each educational stage is highlighted. Specifically, to reduce the gender gap in self-efficacy in secondary education, the following is proposed:

- Promote cooperative learning. This methodology seeks to have students work in small groups to achieve common goals. By promoting mutual support, positive interaction and the development of social skills, it can improve self-efficacy (Gillies, 2004). However, it is important to keep in mind that, although cooperative learning can be beneficial for both genders in terms of performance results, the nature of these interactions in class can result in a decrease in the self-efficacy of female students. Felder et al. (1995) point out that women generally adopt less active roles than men in cooperative learning groups in the STEM field. Furthermore, women report that group work is beneficial to them because there are opportunities for the material to be explained to them (i.e., stereotypes of relative weakness are reinforced and low self-efficacy is contributed to). Furthermore, women also report that their contributions in group work are not valued and their input in cooperative learning situations may be ignored or belittled by other men in their group. Therefore, it is important for teachers to think carefully about how cooperative learning is implemented in order to help all students benefit from it and, most importantly, to enhance the self-efficacy of female students. For example, cooperative learning groups could be structured so that female students outnumber male students in any group that contains women; in this way, female students will feel less intimidated by male members of the group (Marshman et al., 2018a). When proposing these activities, it is also essential to consider how to formulate the objectives to be achieved. Setting clear and achievable goals can provide a sense of direction and purpose, which improves students' self-efficacy as they achieve these objectives (Schunk, 1990).
- Implement self-assessment and metacognition activities. Self-assessment can be useful to improve students' self-efficacy for two reasons. On the one hand, activities in which students must self-assess can provide very valuable information to teachers about the state of their students' self-efficacy. In this way, if a student repeatedly shows a self-assessment that does not correspond to their performance, the teacher can act accordingly and in a personalized way. It should be noted that self-assessment activities may not provide complete information about self-efficacy, but they are a good indicator of this variable. On the other hand, if students are required to self-assess frequently, they will practice their metacognitive skills and, with the help of feedback from their teacher, improve their accuracy when doing so. In addition, encouraging reflection on their own learning and self-knowledge can help female students identify their strengths and weaknesses, which contributes to greater self-efficacy (Zimmerman, 2002).
- Provide female role models. Female role models can help reduce the gender gap in self-efficacy for several reasons. First, as mentioned, stereotypes and the underrepresentation of women in scientific fields can harm students' perception of their own abilities. By introducing examples of women who have been or are currently engaged in the same discipline that they are studying, these stereotypes can be gradually dismantled. This will also help female students identify with scientific disciplines, which is closely related to motivational factors such as self-efficacy (Kalender et al., 2019b). It is important for both male and female students to be familiar with the findings of female scientists throughout history so that they understand that women have been involved in scientific development for a long time. It is also advisable to organize talks, workshops and activities with female professionals in science and technology to serve as inspiration and tangible proof of the success of women in STEM areas.

5.2 Limitations and further research

The study has faced several limitations. Firstly, by separating the sample by year, the size of the performance interval subsamples has been reduced, which has limited the ability to detect significant differences in some cases. This suggests that the sample size may have influenced the complete verification of the hypothesis, especially in years where no significant differences were found, such as in the two subjects in the second year of Bachillerato, which had the smallest subsample of all. Moreover, the fact that the study has been carried out in a single Secondary Education center may have introduced biases in the sample, such as those due to the socio-cultural context of the school.

A possible extension of this research could consider the study of a larger and more varied sample, covering more schools. This would not only mitigate the doubt that arises from the small sample size, but would also dissipate the effect of possible biases introduced by the choice of school and facilitate the introduction of new variables to quantify the impact of the socio-cultural context on differences in self-efficacy by gender. Ideally, this extension would be accompanied by the design of a standardized conceptual test in Physics and Chemistry appropriate to the students' educational stage that would allow their performance to be assessed under the same metric. Finally, it would be interesting to see how the gap evolves as the academic years progress, which would be possible with a larger sample.

6 Conclusion

This study has focused on analyzing the influence of gender on self-efficacy in pre-university students according to their academic performance. The results confirm that gender differences in self-efficacy are already present at pre-university levels and are not limited to higher education, independently of students' academic performance. More importantly, this gap becomes particularly pronounced at key academic transition points, such as 4° ESO, when students choose their future study paths. The fact that this disparity is aggravated at such a decisive stage suggests that low self-efficacy may be a determining factor in discouraging female students from pursuing STEM-related studies.

Faced with this issue, three possible methodological approaches have been proposed: promoting cooperative learning, incorporating self-assessment and metacognitive activities, and introducing female role models. However, these strategies must be implemented with specific considerations to avoid unintended negative effects, such as reinforcing gender stereotypes or creating environments where female students feel undervalued.

Beyond these proposed strategies, this study underscores the need for educators to reflect on their teaching practices and actively work to foster a learning environment that promotes confidence and equal participation for both male and female students. Encouraging self-efficacy in female students from an early stage is essential, not only to promote equal opportunities but also to enhance the innovative potential and socio-economic development of our society by increasing female participation in STEM fields.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: osf.io/9rvcz.

Author contributions

MB-d-R: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. JM-N: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. IP-L: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. The authors acknowledge the technical and the financial support of the Institute of Educational Sciences at the Universidad Politécnica de Madrid, Spain, e-Madrid-CM Project under grant S2018/TCS-4307 and TRANSIT Project—TRANSITion to sustainable future through training and education. (101075747—HORIZON-CL5-2021-D3-02) in the production of this work.

Acknowledgments

The authors also thank all students from the IES El Burgo-Ignacio Echeverría who became part of our online survey.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that Gen AI was used in the creation of this manuscript. Translate and summarize some texts.

Publisher's note

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