

PRE-SERVICE SCIENCE TEACHERS' EMOTIONAL PROFILE DESIGNING IBSE ACTIVITIES: THE GENDER PERSPECTIVE

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Abstract

In recent years, gender has been one of the demographic variables most often used to describe differences between groups. It results in particular interest regarding science education since there is a gender gap related not only to the students' future career expectations but also there is an important emotional difference between two genders in order to face and perceive science education. These gender differences could persist in posterior stages of education, reaching master levels after a science degree. As is the case when they are referring to pre-service teachers, these differences could be important in the way of selection, design, and application of active methodologies such as inquiry-based science education or integrated STE(A)M education, especially in the use of these methodologies to investigate and promote scientific attitudes and values towards science. Hence, this study aims to gain insight into the possible gender differences in the emotions experienced by pre-service science teachers (PSSTs) when designing and presenting an inquiry activity for Secondary Education students. To do so, we applied an *ad hoc* emotion questionnaire adapted from the work of Jiménez-Liso et al. (2019), referring to the emotions achievement and epistemic emotions associated with the stages of the design of the inquiry activities. The questionnaire was issued to 43 Physics and Chemistry PSSTs, and the analysis was performed in terms of the gender they explicit (20 males and 23 females), collecting the frequencies of emotions and their percentage representation per participant and stage. Results show that, in general, female PSSTs show more insecurity, altogether with a greater concentration level, compared to the male PSSTs, revealing that the differentiated emotions expressed by female or male PSSTs when designing IBSE activities might be taking into consideration into pre-service teaching.

Keywords: *Pre-service teachers, inquiry-based science education, gender, emotions.*

1. Introduction

Well into the 21st century, and despite STE(A)M skills ensuring a more innovative and prosperous economy (Bacovic et al., 2022), in Spain, there is still a low percentage of secondary education students (less than 20%) that choose a STE(A)M profession as a future career option. Looking closely into the gender gap related, the case of female students is particularly relevant, with only 4% of representation in STE(A)M-related careers. Unfortunately, the underrepresentation of women in scientific and technological careers seems to be a general tendency (Penner, 2015) since Spain is currently in the average of the OECD countries in the matter (López-Rupérez et al., 2021).

Analysing this gender gap, several authors claimed three main reasons women are underrepresented in STE(A)M careers. Hence, Cheryan et al. (2017) summarise them in a cultural background in favour of masculine stereotypes around STE(A)M areas, scarce contact with scientific and technological contexts and gender differences in terms of self-efficacy.

Self-efficacy, understood as the level of confidence in implementing scientific research, is closely related to the development of the scientific identity, which is the degree of considering oneself a scientist. Regarding the gender differences mentioned above, and as stated by Miles & Naumann (2021), both concepts are critical in science education and are not equally gender-managed, with women reporting a lower perception of both self-concepts than men.

According to Aurah (2017), these perceptions are essential since students with a good perception of self-efficacy exhibit a major level of ambition related to their future careers, also getting higher marks in scientific fields, being one of the main aspects in women's election of STE(A)M careers. Consequently, the gender stereotypes around science could be the key factor making women have more

negative feelings about their scientific self-efficacy. Therefore, the emotional profile is related to the self-efficacy concept, playing an essential role in the relation of women with science, functioning like a decisive factor when selecting STE(A)M professions (Benlloch-Pla et al. 2018; Udo et al., 2004).

1.1. Gender emotional profile in pre-service teachers

Such gender differences in emotions and perceptions are present as well in pre-service teachers, and they could affect their teacher identity in the way of selection, design, and application of active methodologies such as inquiry-based science education or integrated STE(A)M education, particularly relevant in promoting scientific attitudes and values towards science (García-Ruiz et al., 2020).

It is assumed that teacher identity is strongly related to the notion of oneself and is immensely affected by the context, being also generally described concerning emotions and previous experiences (Avraamidou, 2014). Thus, according to Snyder et al. (2013), when changing from a professional STE(A)M career to becoming a teacher, it is necessary to build up a new identity, and the emotions experienced in the process should be well-driven in order to get a good level of autonomy and confidence (Waters and Dietzman 2015).

Taking into consideration the existing gender gap in STE(A)M professions, assuming the role that the experienced emotions play in it and knowing it is also shaped by pre-service teaching, our study explores the possible gender emotion differences in pre-service science teachers (PSSTs) when designing and presenting an inquiry-based activity for Secondary Education students. By doing so, we hope to gain insight into the gender gap and contribute to improving future teacher training programs with an exceptional view of the role of women in science teaching.

2. Methods

A total of 43 PSSTs participated in this study held at the University of Málaga during the academic years 19/20 (11), 20/21 (15) and 21/22 (17). All of them were enrolled in the master's degree in secondary education (MEd), in the specialty of Physics and Chemistry, a prerequisite for teaching in secondary schools in Spain, and held a bachelor's or a master's degree in either science or engineering.

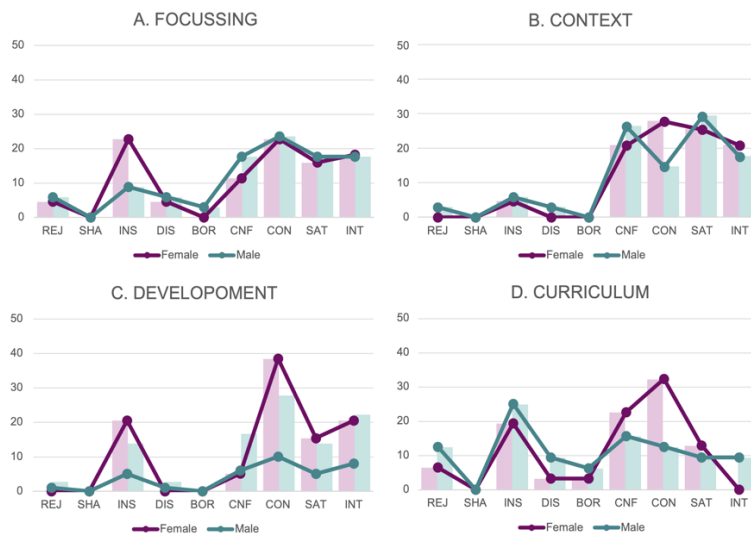
As research instrument, we applied an emotion questionnaire designed *ad hoc* and based on the work of Jiménez-Liso et al. (2019), which referred the emotions associated with the stages of the design of the inquiry activities (A: focusing; B: context, C: development, D: curriculum, E: management, F: assessment, G: presentation, and H: transfer into the practice). The questionnaire included achievement (confidence, satisfaction, shame, and dissatisfaction) and epistemic emotions (interest, concentration, boredom, rejection, and insecurity), and PSSTs could choose more than one emotion per stage. For its analysis, performed in terms of the gender PSSTs explicit (20 males and 23 females), a quantitative descriptive study was carried out with the RStudio program (version 1.3.1093), collecting the frequencies of emotions and their percentage representation per participant and stage.

Data were recorded after completing an IBSE training program, designed to promote PSSTs' understanding and implementation of inquiry-based teaching practice, integrate instruction in pedagogical content knowledge about IBSE, support the design and implementation of IBSE activities and encourage their transfer into practice (García-Ruiz et al., 2022).

3. Results

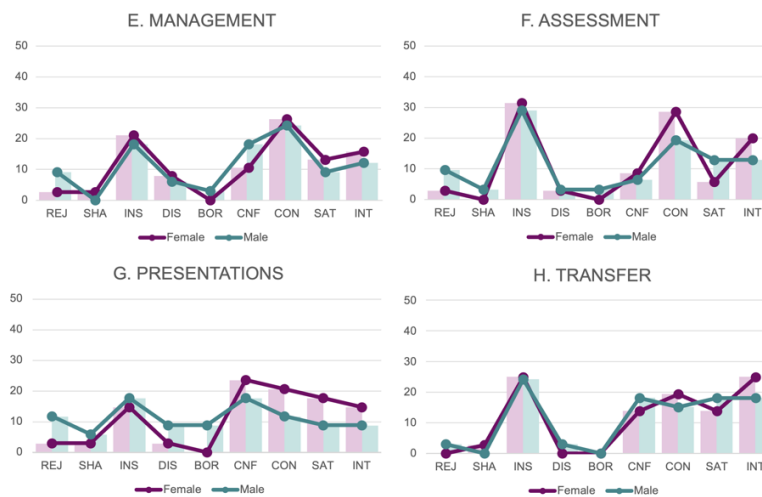
On designing IBSE activities and following the taxonomy of Pekrun and Linnenbrink-García (2014), that considers as positive emotions those associated with success and challenges (interest [INT], satisfaction [SAT], concentration [CON] and confidence [CNF]) and as negative those related to failure and abandonment (boredom [BOR], dissatisfaction [DIS], insecurity [INS], shame [SHA] and rejection [REJ]), figure 1 shows the emotional gender differences for stages A to D. Despite female and male PSSTs profiles looks quite alike, we would like to highlight several differences. While in stage A (focussing), there is a major selection of insecurity by female PSSTs, a tendency that is also observed in stage C (development), concentration is the other emotion more expressed by females in stages B (context), C (development) and D (curriculum).

Figure 1. Gender emotional profile for stages A-D.



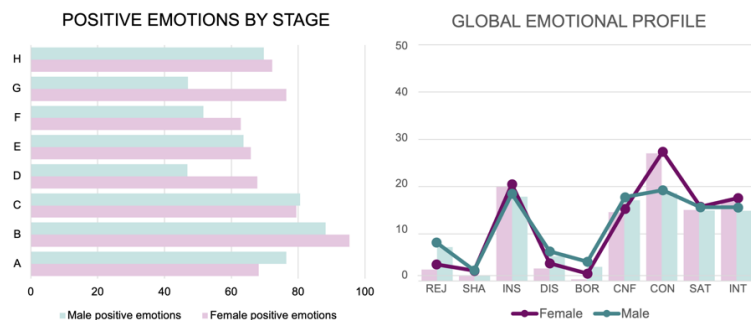
Regarding stages E-H, represented in figure 2, both female and male profiles are similar, with minor differences at stages F (assessment) and G (presentations), with female PSSTs greater expressing positive emotions than male PSSTs.

Figure 2. Gender emotional profile for stages E-H.



Considering the general profiles, figure 3 shows a more outstanding balance of positive emotions expressed by female PSSTs, particularly in stages B, D, and G. In terms of the type of emotion manifest, concentration is the one with major female representation.

Figure 3. General gender emotional profile.



4. Discussion

Results show that female PSSTs show more insecurity when designing IBSE activities, altogether with a greater concentration level, compared to the male PSSTs. This result is particularly interesting when analysing each of the stages independently, with female PSSTs expressing more than double the level of insecurity in the stage of focussing, revealing that this first step might result in some difficulty for them. These results might be in accordance with those documented by Miles & Naumann (2021), who reported lower levels of self-efficacy and science identity in female university students. Hence, in the particular case of female PSSTs who experience a career change when moving into teaching from a professional STE(A)M background, as described by Snyder et al. (2013), they required the construction of a new self-conception through a process filled with both positive and negative emotions which arose as significant when becoming a science teacher (Waters and Dietzman 2015).

5. Conclusions

One of the factors to diminish the gender gap associated with the STE(A)M careers depends directly on teacher training. Since PSSTs experience tensions that may become problematic, related to their teacher identity development and, ultimately, to the emotions they encounter when becoming a science teacher, it urges research into their emotional teaching profile. Consequently, the differentiated emotions expressed by female or male PSSTs when designing IBSE activities might be relevant when scheduling training programs aimed to provide emotional teacher support.

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