

EMOTIONS ABOUT SOCIOSCIENTIFIC ISSUES TO DEVELOP CRITICAL THINKING IN SPANISH PRE-SERVICE SCIENCE TEACHERS

Abstract: Nowadays, science education should focus on the development of competences in students, and especially on the development of different skills that allow them to develop their critical thinking (CT), without forgetting the emotional aspects of students that can significantly influence the teaching-learning process. Argumentation and decision making are considered important skills to develop CT and can be developed through socioscientific issues in the classroom. A training programme for pre-service science teachers (PST) on CT was developed based on these ideas, focusing on socioscientific issues in different formats (text, video and opinions). This programme was implemented with 43 Spanish PSTs from the Master in Secondary Education at the University of xx during the academic course 2019-2020. The first phase analysed the emotions felt by the PSTs during the implementation of different issues included in the programme focused on energy, health, or technology. For data collection, the PSTs completed a questionnaire, including a list of emotions. The data were analysed qualitatively, comparing positive and negative emotions. It was found that, regardless of the dilemma format used, the emotions felt by the PSTs were positive, with particular emphasis on their interest and attentiveness. Insecurity appeared in the short opinions' format to solve the dilemma as a main negative emotion. These results show that the use of socioscientific issues in different formats can be very suitable for developing CT since the emotions detected favour learning.

Keywords: Emotion, socioscientific issues, critical thinking

INTRODUCTION

In recent years, there has been growing concern about students' declining interest in science learning, among other reasons, because it focused on the transmission of knowledge based on conceptual change and without considering the emotional side (Mellado et al. 2014). It is necessary to train competent teachers with critical thinking (CT) who know how to diagnose and self-regulate their emotions both in the cognitive and affective areas. In science education, critical thinking includes as fundamental aspects criticism and questioning in the practice of science since it seems impossible to think that without arguments and their evaluation it would be impossible to build reliable knowledge (Osborne, 2014). According to Vázquez and Manassero (2018), creativity, reasoning, argumentation, and complex processes are CT's outstanding skills, both in the cognitive and attitudinal fields. In short, science education faces the challenge of forming competent citizens who incorporate argumentation, criticism and decision making into their daily lives and, at the same time, self-regulating their emotions as they can act as facilitators or obstacles to teaching-learning.

Although the literature includes different teaching strategies to develop CT, there is no clear identification of a valid methodology for the classroom. An overall strategy is the use of educational issues or situations posed through socioscientific problems (Evagorou, Jiménez-Aleixandre & Osborne, 2012), in which the student must decide reasonably between apparently incompatible options (Authors, 2021) and where they also work on important skills such as argumentation and decision making (Fang, Hsu & Lin, 2019). This work presents the results of the emotions felt by Spanish pre-service science teachers (PSTs) who participated in a training programme on CT focused on the development of argumentation and decision making as important skills in science education and using socioscientific issues as a teaching strategy.

METHOD

This study was performed with 43 pre-service science teachers of the Master in Secondary Education of the University of xx (xx, xx). The 56.3% were women and 43.7% men, aged between 21 and 51 years. The PSTs studied innovation and educational research in Physics and Chemistry (N=16) and Biology and Geology (N=27) specialities during the academic year 2019-2020.

The PSTs participated in a programme with eight sessions of 90-minute in which argumentation and decision making were addressed as CT skills and different socioscientific issues related to energy, health and technology were analysed (Authors, 2021). Some examples of issues were the possible implantation of an artificial moon in China, the healthy or unhealthy nature of a vegan diet, or the use of autonomous cars (Authors, 2021). The issues were presented in different formats: text, video and opinions. The text format included two broad texts, one with arguments for and the other with arguments against the issue. Similarly, the video format included two short videos in favour of/against it. The opinion format provided short argued sentences from different roles involved in the problem. The PSTs also had the opportunity to design an issue to be implemented with secondary school students.

The emotions felt by the PSTs in the development of the different activities with issues were investigated using an adaptation of the KPSI questionnaire (Martínez, Jiménez-Liso & Evagorou, 2019), where they had to choose one or several positive emotions felt (confidence, attentiveness, satisfaction, interest) or negative ones (insecurity, rejection, dissatisfaction, boredom, shame) and justifying their elections. It is a qualitative and quantitative tool simultaneously since it allows, on the one hand, to measure emotions, but from the student's vision. A percentage analysis of emotions was carried out, and positive emotions were compared with negative ones for each issue format.

RESULTS

Figure 1 shows the percentages of emotions felt by the PSTs after implementing the issue-based activities in the classroom in different formats (text, video and opinions). In general, positive emotions prevail in all formats (confidence, attentiveness, satisfaction and interest), especially in the text format (73.4%) compared to video (67.8%) and opinions (57.8%), which shows the good reception of this type of activities by the PSTs.

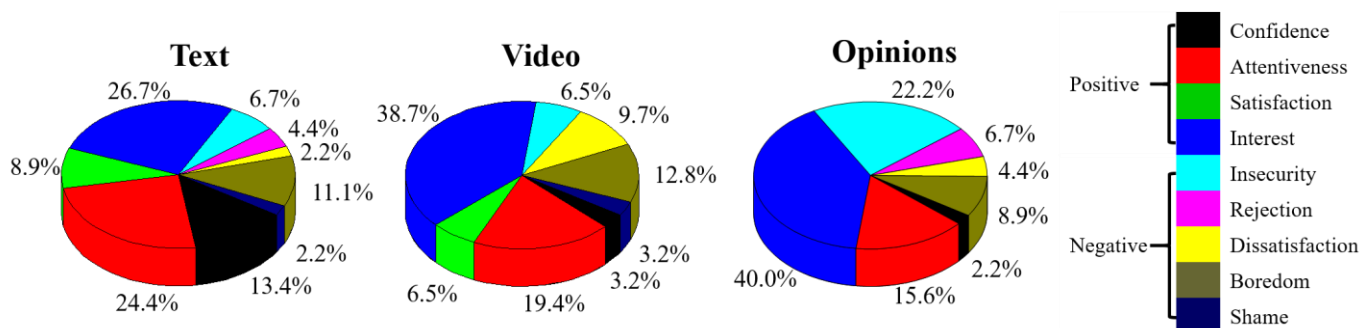


Figure 1. Emotions felt by PSTs in activities with issues in different formats.

If we focus on positive emotions, we see that interest is the main emotion, with values between 26% (text) and 40% (opinions). Some of the comments collected for the dilemma in text format: “*I thought it was an efficient activity aimed at making students see that science is part of their daily lives*”. Concentration was the second most considered positive emotion, with values above 15% in all formats. Regarding this emotion, the

PSTs commented that “*high concentration [text format] was necessary to locate the arguments for and against the issue*” or “*analysing every minute of the video brings high attention [video format]*”.

On the other hand, every negative emotion (insecurity, rejection, dissatisfaction, boredom and shame) remains below 13%, except for insecurity in the opinion format, which reaches 22.2%. This value can be attributed to the lesser amount of information provided in that format. As an example of the contribution of this emotion: “*I think it can give many faults from a technical point of view that can make the activity fail.*”

FINAL CONSIDERATIONS

This work has shown the emotions felt by PSTs when involved in the resolution of socioscientific issues in different formats (text, video or opinions) that aim to develop their CT. Regardless of the issue's format, the PSTs showed positive emotions, mostly interest and attentiveness. These results show the good reception of this kind of activities by the PSTs and show their usefulness to favour the teaching-learning process. In this sense, as a future line, we intend to investigate if the positive emotions of the PSTs influence the development of different CT skills, especially in argumentation and decision making through the issues and the possible effect of each format.

ACKNOWLEDGEMENTS

R&D project of the National Plan, reference PID2019-105765GA-I00, entitled “*Citizens with Critical thinking: A challenge for teachers in science education*”, financed by the Ministry of Science and Innovation in the 2019 call.

REFERENCES

- Authors (2021).
- Evagorou, M., Jiménez-Aleixandre, M.P. & Osborne, J. (2012). Should we kill the grey squirrels? A study exploring students' justifications and decision making. *International Journal of Science Education*, 34(3), 401-428.
- Fang, S.C., Hsu, Y.S. & Lin, S.S. (2019). Conceptualising Socioscientific Decision Making from a Review of Research in Science Education. *International Journal of Science and Mathematics Education*, 17, 427-448.
- Martínez, M., Jiménez-Liso, R. M., & Evagorou, M. (2019). Design of a pre-service teacher training unit to promote scientific practices. Is a chickpea a living being? *International Journal of Designs for Learning*, 11(1), 21-30.
- Mellado, V., Borrachero, A. B., Brígido, M. , Melo, L. V., Dávila, M. A. & Cañada, F. (2014). Emotions in the teaching of science. *Emotions in Science Education. Science Education*, 32(3), 11-36.
- OCDE (2017). *PISA Assessment and Analysis Framework for Development: Reading, Mathematics and Science*. Paris: OECD Publishing.
- Osborne, J. (2014). Teaching critical thinking. *New directions in science education? School Science Review*, 352, 53-62.