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Evolution Education in Europe

Evolution by natural selection is one of the most powerful and significant theories in the history of science (Dawkins, 2009), representing a unifying paradigm within which everything in biology makes sense (Dobzhansky, 1973). For this reason, research on the acceptance and understanding of evolution is a central topic in science education research (Sa Pinto et al., 2021). A wide range of variables impact the learning of evolution, including beliefs, religiosity, educational backgrounds, curricular emphasis on evolution, and knowledge and understanding of the nature of science (Kuschmierz et al., 2021). Without knowledge of evolution by natural selection, it is impossible for students to understand how or why organisms have come to exhibit their diversity and complexity, and for them to develop acceptance of evolution as valid within science.

Science classrooms remain one of the arenas where evolution education can take place. The question of how a teacher can effectively teach evolutionary ideas and deal with the controversial aspects of evolution is relevant to evolution education. There is an ongoing need to pursue this area of research in Europe, in order to properly address the diversity of Europe's socio-cultural contexts. The lack of understanding of evolution and the consequent deficit in the ability to effectively teach and learn the topic and address problems concerning the acceptance of evolution as the main unifying paradigm in biology, as well as the fact that many people believe evolution contradicts their beliefs, are the main triggers for this focus issue. The idea for the issue was inspired by the framework of the COST Action Euroscitizen (CA17127) project, which aimed to identify targeted strategies to raise the level of scientific literacy in Europe using evolution as a model (EuroScitizen building in Scientific Literacy in Evolution in Europe; euroscitizen.eu).

In the thematic part of this issue, six papers discuss the aforementioned challenges of evolution education in Europe. In the first article, entitled *Not by Design Alone! Modelling Practices to Identify Students' Frameworks of Evolution in Real-Life Contexts*, the authors focus on engaging students in modelling evolution in real-life contexts by modelling the resistance developed by a population of mosquitoes in a lagoon when an insecticide is introduced. After modelling the process of natural selection, the explanations appeared to improve (from Lamarckian to Neo-Darwinian views) and most of the groups of students provided accurate explanations regarding adaptation. In conclusion, the authors highlight the fact that the relationships between genetics and evolution in modelling experiences may help students to develop more accurate explanations of natural selection as a form of retroactive rather than linear causality.

In the second article, entitled *The Role of Wonder in Students' Conception of and Learning About Evolution*, the authors investigate the role of wonder in seventh-grade students' learning about evolution. Lessons and workshops were carried out to elicit a sense of wonder in relation to concepts that are known to impact the learning of evolution: aesthetic experiences, defiance of expectations, agency and awareness of a mystery within the ordinary. A qualitative analysis of the role of wonder in the students' meaning-making about, learning of and engagement in evolution showed that it is possible to design science teaching that triggers students' wonder in relation to an intended learning object. However, the authors also highlighted the fact that the students still struggled to make sense of the concept of evolution after six weeks of teaching, which once again emphasises the difficulty of teaching and learning about the theory.

In the third article, entitled *Relationships between Epistemological Beliefs and Conceptual Understanding of Evolution by Natural Selection*, the authors explore Cypriot twelfth-grade students' epistemological beliefs and conceptual understanding of evolution before and after an inquiry-based intervention on evolution. The intervention involved students' collaborative work in inquiry teaching and learning activities to investigate specific concepts and problems related to evolution. The aim of the intervention was to help the participants obtain a deep conceptual understanding of the related mechanisms and processes of evolution, as well as facilitating discussion, interaction and reflection on the tasks. In conclusion, the authors report that engagement in an inquiry-based intervention might be a promising way to acquire content knowledge and develop more sophisticated epistemological beliefs.

The following two articles focus on conceptions of prospective teachers and primary school students in Portugal. In the first article, entitled *Conceptions of Portuguese Prospective Teachers about Real-Life Evolution Situations*, the authors explore the ability of Portuguese prospective teachers to apply evolution to two real-life situations. Specifically, they examine the students' ability to identify evolution misconceptions in online newspaper articles, their misconceptions expressed when explaining real-life evolution situations, and the evolution key concepts they apply to make sense of real-life evolution situations. The findings show that half of the prospective teachers struggled to identify teleological misconceptions in the newspaper articles, and some of them revealed their own misconceptions in their explanations. The students also found it difficult to explain how evolution is related to the real-life situation described. The results remind us how important it is to devote particular attention to evolution education in teacher education.

In the second article from Portugal, entitled *The Impact of Exploring Sexual Selection on Primary School Students' Understanding of Evolution*, the authors explore primary school students' level of understanding of evolution by sexual selection and their ability to employ differential reproduction to propose and justify evolutionary predictions. To promote students' learning about evolution by sexual selection, the authors planned and implemented an educational programme that included four sessions, introducing different practical activities to explore the variation principle, the transmission and expression of these features, and sexual selection. The authors report a significant increase in the students' justifications employing the concept of differential reproduction, and therefore conclude that activities that model and simulate biological evolution through sexual selection can contribute to students' understanding of evolutionary processes.

The final article of the thematic part, entitled *Evolution in the Spanish Primary Education Autonomic Curricula and Textbooks. A Geographic Analysis*, brings a different but equally important methodological approach to the analysis of the quality of evolution education, which enriches this issue. The authors conducted a detailed analysis of selected evolution concepts in the autonomic curricula of Spain and in the activities of eighteen Spanish primary education textbooks, and concluded that curricula and textbooks have important gaps when addressing evolution. The article therefore has an important message and recommendation for curriculum developers and textbook authors.

The thematic part of the issue is completed by a review of a book entitled *Learning Evolution Through Socioscientific Issues*, which sheds light on the connections between the Socioscientific Issues (SSI) approach and evolution education, as described by the author Bento Cavadas. The book is useful reading for anyone interested in evolution education.

The Varia part of the issue offers three interesting articles and one additional book review, thus creating very rich issue of the CEPS Journal. We hope that the issue will resonate with those interested in evolution education.

References

Dawkins, R. (2009). *The greatest show on earth: The evidence for evolution*. Simon and Schuster.

Dobzhansky, T. (1973). Nothing in biology makes sense except in light of evolution. *The American Biology Teacher*, 35(3), 127–129.

Kuschmierz, P., Beniermann, A., & Bergmann, A., et al. (2021). European first-year university students accept evolution but lack substantial knowledge about it: A standardized European cross-country assessment. *Evolution Education Outreach*, 14(17). <https://doi.org/10.1186/s12052-021-00158-8>

Sá-Pinto, X., Realdon, G., & Torkar, G., et al. (2021). Development and validation of a framework for the assessment of school curricula on the presence of evolutionary concepts (FACE). *Evolution Education Outreach*, 14(3). <https://doi.org/10.1186/s12052-021-00142-2>

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