

## A Self-Reported Instrument to Measure and Foster Students' Science Connection to Life with the CARE-KNOW-DO Model and Open Schooling for Sustainability

Alexandra Okada

**OVERVIEW:** This cross-national study explores students' "science connection" through teaching and learning experiences involving 85 schoolteachers and 2,082 underserved students (ages 11–18) from Greece, Romania, the UK, Spain, and Brazil. Using Exploratory and Confirmatory Factor Analyses, the research identifies five key components of science connection: confidence and aspiration in science; fun participatory science with teachers, family, and experts; active learning approaches; involvement in and outside school activities; and valuing science's role in life and society.

**AUDIENCE:** Teacher educators, Teachers, Instructors, Curriculum designers, Project coordinators, Policymakers.

### KEY POINTS

- A critical challenge for governments, science professionals, and educators is the widening gap in green qualifications (sustainability competencies), with 20.6% of EU and 43.2% of Brazilian students lacking essential skills. This misalignment with the green job market highlights the need to strengthen students' science connections.
- Science disconnection undermines the development of scientifically literate societies and hinders sustainable well-being and a just, green economy.
- Strengthening science connections enhances scientific literacy and builds science capital — the knowledge and skills individuals gain over time. This study's validated instrument, combined with the CARE-KNOW-DO model, helps policymakers, educators, and learners identify factors influencing science connection for sustainability.
- This study demonstrates significant potential in addressing the green qualifications gap and fostering a deeper science connection among students, contributing to the development of scientifically literate, sustainable, and equitable societies, while also promoting the open schooling approach and declaration.

**INTRODUCTION** The open schooling initiative, launched in Europe alongside the UN's Agenda 2030, aims to strengthen students' science connections through real-world problem-solving with families and scientists. Its expansion and sustainability require solid evidence.

This study conceptualizes *science connection* as the integration of science into personal, social, and global actions, understanding its meaning and purpose in life and for the planet. Unlike short-term engagement, science connection fosters a deeper, long-lasting bond that integrates science into daily life, well-being, and sustainability. This comprehensive mixed-methods study examines students' perceptions of open schooling lessons guided by the CARE-KNOW-DO pedagogic model, which encourages them to: **care** about real-life issues that matter to them, inspired by scientists; **know** curriculum content with teachers; and **do** actions toward solutions within their communities. The study designs, implements, and validates a self-assessment instrument, drawing on qualitative insights from consensual analysis of textual and visual snapshots. These findings are refined through exploratory and confirmatory factor analyses and further assessed using descriptive, comparative, and analytical methods.

**FINDINGS** Comparative Analysis revealed that many students felt connected to science after completing their open schooling activities—Brazil: 80%, Spain: 79%, Romania: 73%, Greece: 70%, UK: 57%—with boys: 75%, girls: 73%, nonbinary students: 56%. Science connections weaken as students' progress from the primary to secondary education, but the CARE-KNOW-DO model may help re-engage older students. Overall findings revealed students more readily recognize science's importance conceptually than engage with it through practical activities; further studies with more frequent open schooling activities will be valuable to determine if increased practical engagement can bridge this gap between conceptual appreciation and active participation. Qualitative insights from teachers reinforced the value of integrating real-world contextual learning into curricula.

### TAKEAWAYS

**Teaching and Teacher Education:** Science through open schooling and the CARE-KNOW-DO model including self-assessment instrument empowers teachers to enhance and assess real-world learning, ensuring it is purposeful and meaningful. The study's self-assessment instrument enables research-based interventions that address equity in science education by gender, age, and region. Teachers can use this tool to better understand students' needs and interests. By integrating curriculum knowledge with fun, hands-on science linked to real-world issues, students can develop skills and experiences that prepare them for the future.

**Open Schooling for Authentic Learning:** The instrument encourages students to reflect on their experiences with science—how they feel, think, learn, and engage with scientific knowledge and support networks. These reflections foster discussions that expand students' awareness of real-world science applications, careers, and potential future pathways.

**Open Research:** The instrument advances open research in Science Education for Sustainability, supporting the development of practices, resources, tools, policies, and networks. Equipped with just-in-time feedback, open badges, and automated reports, it serves as a valuable resource for learners, educators, and policymakers. Validated with 2,082 students, the instrument has already driven further research involving 51,488 students.

**Sustainability Education Policy:** This research provides an analytical instrument and framework to inform science education policies, linking transversal skills to the five components of science connection. **Problem-solving** fosters critical thinking and confidence in tackling scientific challenges (confidence and aspiration in science); **Collaboration** enhances teamwork through science activities with teachers, family, and experts (fun participatory science); **Creativity** supports interactive learning approaches and effective communication of scientific ideas (active learning approaches); **Initiative** drives leadership in both school and extracurricular activities (involvement in and outside school activities); and **Civic Engagement** connects students to the broader societal impact of science, promoting global awareness and its role in sustainable development (valuing science's role in life and society).