American Museum of Natural History

Center for Biodiversity and Conservation
Network of Conservation Educators and Practitioners

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Source: Lessons in Conservation, Vol. 14, Issue 1, pp. 5-12

Published by: Network of Conservation Educators and Practitioners, Center for Biodiversity and Conservation, American Museum of Natural History

DOI: https://doi.org/10.5531/cbc.linc.14.1.1

This article is featured in ***Lessons in Conservation***, the official journal of the Network of Conservation Educators and Practitioners (NCEP), a program of the American Museum of Natural History's Center for Biodiversity and Conservation.

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Climate Change and the Voice from the Classroom

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DOI: https://doi.org/10.5531/cbc.linc.14.1.1

"To build relationships among generations is to make a commitment to the life that will exist after us."
- Ailton Krenak, Indigenous leader, environmentalist, and author

I started writing this paper in June 2024, during a nightmare that began two months prior, when my home state of Rio Grande do Sul in Brazil suffered a dramatic and historic tragedy due to torrential rains and flooding (Figure 1).

Despite an outpouring of human solidarity to help local people and the Brazilian government's efforts to reduce damages, at least 180 people have died and more than 500,000 people have been displaced from their lands, creating a new wave of environmental refugees and a rural exodus to city borders. Unpredictable event or fate? Is it the result of climate change? Who are guilty and who will bear the brunt of the impacts? What is the role of education (and educators) at times like these?

Figure 1. (A) Streets of Porto Alegre (Rio Grande do Sul capital) during floods in May 2024. On the left, the Guaíba River at a historic record level. (B) Aerial view of Porto Alegre during the floods of May 2024. On the right, the flooded pier buildings. (C) President Lula's delegation visiting the Passo de Estrela neighborhood. Cruzeiro do Sul/RS in June 2024. Image credit: Ricardo Stuckert, CC 2.0.

INTRODUCTION

The motivation for writing this text comes from my experience of the tragedy and recent calls in this journal for "responsive education" (Porzecanski et al., 2023), which motivated me to explore, theoretically and empirically, how science literacy can respond to this emerging demand related to climate change. I propose that if we can improve scientific literacy and make education more relevant to the student then we are more likely to engage students in critical analysis of the current environmental risks, including climate change, environmental challenges, and paths to resilience. The arguments for this are developed based on recent education research I have conducted in the Brazilian context.

THE CASE OF RIO GRANDE DO SUL: CONTEXT AND OPPORTUNITY

Rio Grande do Sul (RS) is the southernmost state in Brazil, a territory once occupied by Atlantic Forest close to the sea and Pampas on the flat plains but continuously transformed into crops and pasture during the last three centuries. Large areas are concentrated in the hands of a few owners (3% of properties occupy 48.6% of the croplands/planted area in the state), making industrial agriculture and cattle farming the state's economic base and exerting a deep cultural influence. It is almost impossible to describe the *gaúcho* people (as those from RS are known) without linking them to the countryside, horse breeding, *churrasco e chimarrão* (barbecue and mate tea), and their traditional forms of music and dance.

A previous catastrophic flood occurred in the state in 1941, leaving a quarter of the population in the state capital of Porto Alegre homeless and causing a dozen deaths. Separated by 83 years, the tragedies have very distant outcomes and contexts in terms of land use. The 2024 rains happened in an area that now had larger and more populated urban areas, with less permeable and vegetated lands, and more bare hills. Additionally, there were now more populated areas on the banks of rivers and lagoons, which had become shallower and more silted as they had had their courses altered to serve industrial agriculture (Lenharo, 2024).

In my experience, this history and current context make environmental issues controversial topics in this society, often avoided and difficult to question in the classroom. In a state where everyone, in some way, is involved in these economic activities, it's not easy to question how the environmental impacts of large monoculture areas or the amount of water used in meat production have become major challenges. Do students engage with and want to learn about these questions? While science education research has provided valuable evidence on the quality of textbooks and impact of curriculum standards, this is something we don't know well. What do the students want to learn, what do they think about environmental issues, about the future, and about science classes and their teachers? With the aim of filling this gap, emerged the Relevance of Science Education (ROSE) project and its *gaúcho* sample (Bordin, 2023).

THE VIEW FROM THE CLASSROOM

The ROSE project is an assessment instrument developed through international cooperation effort to "shed light on the students' voice" (Jenkins, 2006) and bring theoretical and empirical perspectives to bear on how to improve the curriculum, science classes, and how to increase young people's interest in Science and Technology (S&T) (Schreiner & Sjøberg, 2004).

It was translated, adapted, and applied three times in Brazil (in 2007, 2011 and 2014). In 2021, public

financing was approved for the application of ROSE at K-12 levels in RS, led by IDEIA, the Science Education group of the Federal University of Santa Maria. A team made up of professors, researchers in training, and doctoral, master's, and undergraduate students led the adaptation and production of the questionnaire, sample definition (representative of the state), application logistics, data tabulation, and analysis. It was called ROSES-RS.

In light of this recent tragedy I wondered, could the lessons from the ROSES-RS project provide insights about the current moment? The results provide important insights about what young people think about environmental issues and the future and collaborate with educators in addressing these topics. The whole questionnaire has 152 items, many of them directly related to science and technology (S&T), climate change, pollution, and student perceptions of causes of climate change which I bring into this discussion.

In four months, the research team visited 44 public school across 4,000 miles, resulting in a record of the interests and attitudes of 1,892 young *gaúchos*, most of them in early high school. The executive report and some analyses are available, with some sections also in English, on IDEIA's website (www.ufsm.br/ideia).

STUDENTS, SCIENCE, TECHNOLOGY, AND ENVIRONMENTAL ISSUES

Students' Perceptions of Science and Technology and Environmental Problems

We found that the majority of these students view science and technology positively; they believe that science and technology (S&T) will help us find the cure for diseases like AIDS and COVID (~82% agree) and will make our lives better (~82%). Not surprisingly given that finding, most of them (~69%) do not consider that S&T is the cause of environmental problems. This aligns with previous research at the national scale (Massarani, 2021) that found that 70% of young people believe that the main causes of environmental problems are economic and political interests, not S&T.

Student Beliefs About Solutions and the Future

Student opinion is divided between those who agree (~47%) and those who disagree (~53%) that S&T has the potential to solve environmental problems. They also feel responsible for contributing to the threats against nature (~69% agree), and only ~43% of them are optimistic about the future of the planet. Previous studies (Gouw et al., 2016) show young students were previously more optimistic than the young *gaúchos* of 2022. Might the COVID-19 pandemic have influenced current students' projections for the future? These and other factors, such as a worsening planetary crisis, may be at play. While our data cannot speak to this, Franzolin, et al. (2020) have argued that "engagement with environmental issues requires not only knowledge about, interest in, and motivation but also confidence, in the sense that citizens believe that they can contribute to real change acting in individual and/or collective ways" (Franzolin, et al. 2020 p.9).

Student Beliefs About Specific Causes of Environmental Change

Overall, the students' perceptions and attitudes data reflect a belief that they play a role in environmental impacts, can influence their environment, and are even somewhat optimistic about the future of the planet (Figure 2).

When asked about the source of pollution (which was not strictly defined and left for students to interpret), ~74% of young students consider industries the main responsible for environmental

pollution and ~25% attribute these effects to agriculture and livestock (Figure 3).

In contrast, a data review published by Evans (2021) reveals that, in Brazil, deforestation and changes in land use (including agriculture and mining) were responsible for 86% of all greenhouse

Figure 2. Results of Agree/Disagree questions from the ROSES-RS study about students' beliefs on individual responsibilities and environmental impact.

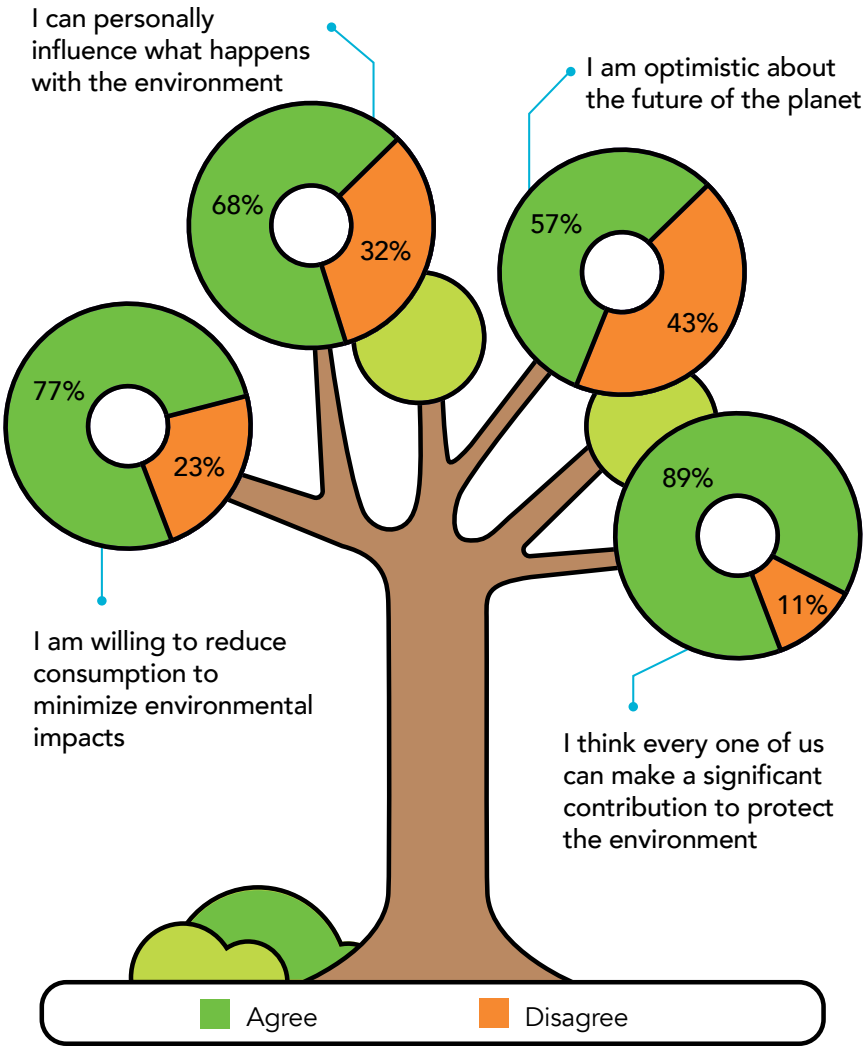
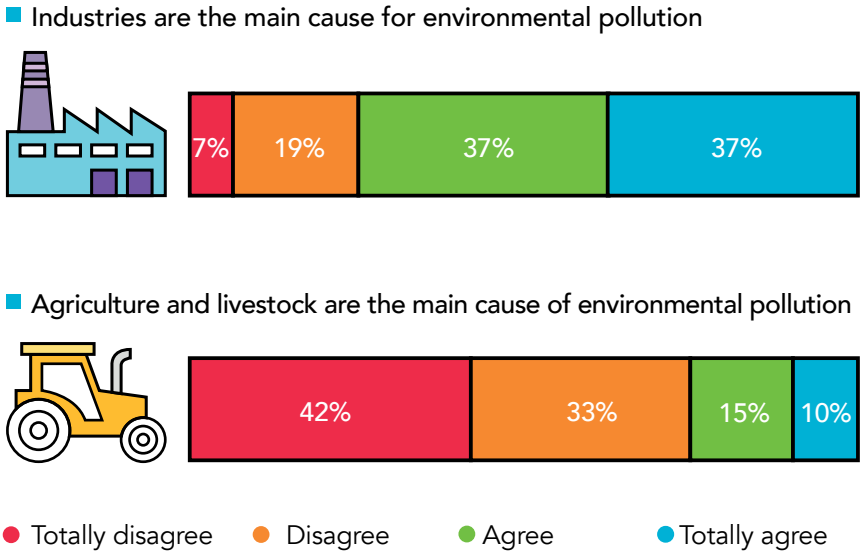


Figure 3. Students were asked to choose, on a scale from "Totally agree to Totally disagree" whether industry and agriculture are the main cause of environmental pollution.



gas emissions between 1850 and 2021. The burning of fossil fuels by industry, transport, and other activities contributes the other 14%. This points to a potentially skewed perception among students in terms of what is driving environmental change. Although we do not know for sure what Brazilian students are referring to when they think of 'environmental pollution', the data is concerning.

I hypothesize that in a state with an economy heavily based on industrial agriculture, it may be difficult, painful, or embarrassing for students to believe that those major economic activities are the main cause of environmental problems. It may also be difficult for teachers. In the context of such a dynamic, potentially also amplified by misinformation, the role of the school gains relevance: the school is the place where, by nature, controversial topics can be discussed with autonomy and respect. The intention should not be to create a clash or a dispute over reason but, through scientific data and sociological analyses, to understand natural phenomena.

What Students Report Wanting to Learn in Science Classes

Most students (~77%) think Science classes are interesting and ~67% considered it useful in daily life. Similar positions were found on a nationwide context (Gouw, 2013; Tonin et al., 2021). Most of the students (~71%) believe that their curiosity is stimulated during Science classes and ~81% of them would like to have more experiments and practical experiences. They affirm that they learn Science outside of school (~82%), when they visit zoos, museums, and planetaries (~67%) and even when they play video games (~48%). Understanding what kinds of topics students themselves wanted to learn about was also a goal of this survey; and considering our current focus on climate and the disaster, we wondered where climate ranked for students in terms of their interests in learning. The top topics they want to learn about are: how to perform first aid, the possibility of life outside Earth, how to protect endangered species, life and death and the human soul, and medicinal use of plants. Climate related topics, such as "changes in climate and how these can be influence by humans," are not among their top interests (it ranked in 47th place).

New samples will show us whether there have been changes in the priorities of these young people, whether environmental issues have gained importance. And looking further ahead, and at teacher preparation, how do those subjects appear in curricula and, more importantly, in classrooms, and how fostering climate change awareness might be connected to these problem-solving interests of the students.

Most public policies ignore students' voices, experienced scholars and teachers have their perceptions, and media and policy makers speak on behalf of young students, often without concrete evidence. Since formal education is an intentional process that involves emotions and affect, it becomes necessary to consider the interests and attitudes of students in balance with the desires and influence of other social groups. One of the paths to narrow the gap between what we need to discuss and what we would like to, is understanding what students wish to learn—and what they currently don't. I am not defending the thesis that schools should only teach what students want to learn, which would be neglecting the role of educators. But ignoring what they want to learn at school is also a form of omission.

AFTER THE TRAGEDY

The unregulated urban growth, the expansion of industrial agricultural borders, the monoculture approach, poor infrastructure, the lack of environmental protections, and misinformation are likely

to have made the damages from the storm more serious, and to potentially make these events more frequent and destructive in the future. It's a complex issue and it deserves a complex analysis but we, educators, must ask and explore what role climate change played within this.

When we consider school as a universal institution—one which the majority of people attend—it is its responsibility to show that this extreme rain event was not an isolated and unpredictable phenomenon, and that Science can be an ally in reducing damage and in the search for solutions. It is tragic that a lack of scientific literacy in Brazil appears not to be a momentary problem or a contemporary crisis, but a deliberate "national project" (Brum & Train, Rob (Translator), 2021; Pereira & De Oliveira, 2024).

At the same time, we must be careful not to advocate a technocracy, in which all decisions are taken exclusively by technicians, scientists, and specialists, naively believing in their neutrality or good and noble intentions. But we should aim to move towards a democratic system that guarantees a voice for scientific evidence in discussions and decision-making about, for instance, how we can deal with future risks and climate-driven migration. In this context, listening to the "voice of the student" is important both in classroom decisions and for public policies.

The ROSES project gives us specific data to guide our decision-making related to curricula and topics and empower us to argue that knowing students' interests and attitudes towards environmental challenges can lead us to an education more relevant to the students. These types of data can contribute to engaging students in critical analysis of the current environmental risks, including climate change challenges and paths to resilience. Given that these data were collected before the extreme rain of 2024, there is potential for longitudinal research to be informative. As research continues, any analysis must be careful and sensitive to the fact that some of these students (and their teachers) probably suffered from the rains and floods, lost their homes, schools, crops, and perhaps relatives and friends.

Yet with the power of evidence, educators can embrace education as a protagonist and active agent of societal transformation, and the school as a democratic space for change. The same logic applies to textbooks and other resources that, fundamental as they are for Brazilian schools, have to encourage and support environmental discussions, informed by science. These textbooks, oftentimes, are teaching materials the teachers need for their own learning: teachers lacking access to professional development resources or courses often update their own knowledge by reading the same books as their students. Hence teacher preparation, pre and in-service, have to consider the study of complex, contemporary phenomena and linked social impacts, such as the relationship between deforestation and extreme weather/climate events.

There is a really complex social-scientific issue here: how can we engage with the cultural value of livestock and meat as a traditional food and their impact on climate change and local landscapes? In the public policy arena of curricula, teaching resources (textbooks), and large scale assessments, changes depend on coordination between conflicting and complex interests. Engaging with these questions within the classroom is more possible.

The university as a teacher training center, as a noble place for innovations and discussions and as a space for political and social organization, plays a fundamental role both in the recovery of history and social relations (Figure 4), as well as in mitigating damage, in the search for alternatives and in overcoming environmental problems.

Figure 4. Team of volunteers working to recover historical archives at the Federal University of Santa Maria, after record flooding in May 2024.

Ailton Krenak says that telling the stories of the abandoned, the excluded, and those diminished by hegemonic history is a way of keeping them alive and "postponing the end of the world," of centering our capacity for resilience, and of sustaining our ability to not give up. The same goes for reflecting on the ideas, interests and attitudes of students, voices silenced by the educational industry. My hope is that science education and scientific literacy can help us engage with this tragedy as a springboard to act on predicting changes (not only natural but also social); to engage with questions of inclusion, accessibility, equity, education for peace, and social justice; and to be responsive to these climate phenomena in terms of education policy by developing support resources for schools, creating teacher preparation courses, analyzing textbooks, and improving.

ACKNOWLEDGMENTS

This study was financed by FAPERGS, CAPES PrInt and National Council for Scientific and Technological Development (CNPq), Brazil

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