EDITORIAL

Trust in Science and Science Education — Part 1

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As I write this editorial about trust in science and science education, a news story broke out about Rishi Sunak's views about scientists' empowerment in the context of the COVID-19 pandemic. Sunak, the former Chancellor of the Exchequer and a candidate for Prime Minister in the UK has stated that it was a mistake to empower scientists and to allow them to have so much influence on decision-making about closing of schools and colleges during the onset of the pandemic (Badshah, 2022). The pandemic of course is a complex problem that demands input not only from scientists but also from a range of other stakeholders including politicians, economists, historians and educators. Societal decision-making necessitates consultation with a range of experts, not only scientists. This much is warranted in his claim. However, Sunak's stance is misplaced in discrediting the priority that scientific expertise had to take in dealing with a deadly disease for the protection of public health. After all, it is scientific understanding that has helped us mitigate the disease through investigations ranging from recognising how a virus is transmitted to producing vaccines in order to reduce mortality. What exactly does such broad stroke singling out of scientists in sound bites in media accomplish other than potentially breed mistrust in science?

Such public references to scientists are not new. Debates around issues such as climate change and vaccination have often put into question the public trust in scientists and science (Oreskes, 2019). Some science educators themselves have criticised science as being fundamentally shaped by ideology (Mackenzie et al., 2014). The emerging lines of research in science and science education have been based on claims that science suffers from a systematic bias through sexism, racism, capitalism, colonialism and other ideological interests. The methodological approaches such as ethnomethodology, deconstructionism and critical theory have mediated the propagation of such lines of research along with showcasing of historical case studies of misuse of and abuse by science in society. Of course, scientists and science educators are not immune to mistakes and unethical behaviour, and they need to be held accountable through critical appraisal. However, how are we to transcend such positions as vaccine hesitancy and climate change denial if not through some level of trust in science? Science has a history of not only contributing to society, for instance, through medical and technological innovations but also through rational and evidence-based debate on social issues. In the post-truth era where the legitimacy of expertise and evidence-based claims are increasingly eroded, the consequences of science denial can be

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fatal. For example, climate change denial is likely to lead to a planetary emergency where the natural world and the environment will suffer an irreversible destruction.

Despite the existence of anti-science attitudes in the public as well as the research community, public trust in science rose during the pandemic. During late 2020, the Wellcome Trust in collaboration with Gallup surveyed more than 119,000 members of the public in 113 countries and territories. The survey consisted of a range of questions including the public's trust in science. According to the findings of the report "globally, people were more likely to express a high degree of trust in science and scientists in 2020 than they were in 2018. There was a 10-percentage-point increase in people saying they trust science in general 'a lot', while the percentage who said they trust scientists in their country 'a lot' rose nine percentage points" (Wellcome Trust, 2020, p.3). However, there were regional variations. In Sub-Saharan Africa, where trust in science went down between 2018 and 2020, only 19% expressed a high level of trust in scientists, the lowest level in the world. This can be contrasted with 62% in Australia and New Zealand, where trust was the highest (Wellcome Trust, 2020, p.3). Although such statistics are encouraging, they still leave room for science educators in shaping trust in science in educational contexts, for example through the input of history, philosophy and sociology of science to understand how epistemic and cultural norms shape scientific communities.

In this first part of a two-part thematic issue of *Science & Education*, 13 articles tackle trust in science in various ways. Blancke and colleagues point to how some philosophers have provided ammunition to distrust and scepticism of science by portraying science as a force that has unrightfully seized political power. As philosophers of science, the authors believe that philosophers should help people to understand why science, even though it is far from perfect, deserves trust and its special standing in modern societies. On the other hand, Covitt and Anderson question the ways in which scientists recognize and analyse limits in their studies and conclusions. They distinguish uncertainty from untrustworthiness. The authors argue that a critical goal of science education should be to help students understand how science may be employed as an uncertain and limited, yet still useful tool for informing decisions about socio-scientific problems. Develaki focuses on scientific objectivity and reliability as matters of fundamental importance both to science and in the public sphere, where they tend to be regarded with scepticism due to reporting of faulty or biased information. The author examines the kinds of bias that can affect science, the mechanisms available for dealing with them, and the arguments against treating them as a basis for blanket scepticism.

The attributes of durability and uncertainty of science are picked up by Cobern and colleagues who report the findings from initial and replication exploratory studies involving about 500 elementary and middle school teacher education students. The authors found that most students embrace noncontroversial science as correct, and that almost all embraced the tentative nature of science regardless of what they thought about controversial topics. However, when asked about the trustworthiness of science, many students were not willing to say that they trust scientific knowledge. Rosenberg and colleagues also tackle uncertainty in science. Drawing on research in statistics, child development and several studies in science education, the authors argue that a Bayesian approach can support science learners to make sense of uncertainty. They describe ways to make Bayesian reasoning practical in K-12 science education contexts. Herman and colleagues report on an investigation that determined how perceptions about COVID-19 science and sociocultural membership associate with 557 university biology students. Students' political orientation moderated the relationship between their trust in scientific models to guide COVID-19 decisions and their personal actions, with trust in scientific models to guide decision-making being

a significant positive predictor of moderate, conservative and very conservative student groups' mitigating actions. Conversely, there was no association between trust in scientific models to guide decision-making and very liberal and liberal students' conducting actions.

The pandemic context has fostered much debate about trust in science, for instance in relation to the uptake of vaccines. Reiss questions how science teaching addresses vaccines. He presents an argument to connect the phenomenon of vaccine hesitancy to the issue of trust and then argues for what education about vaccines in school science might look like in a way that takes seriously the notion of respect for students, including students who hold views about vaccination with which science teachers might disagree. The author concludes that good quality vaccine education should help students understand relevant biology and the nature of science, and it should also be respectful of all students, including those who come from families that reject vaccines or are hesitant about them. On the other hand, Mugaloglu and colleagues employ a mixed-method study to explore 1233 participants' trust in scientists about getting the COVID-19 vaccine. The authors explored the participants' health-related behaviours and justifications for their behaviours as a response to the pandemic in order to understand how trust in scientists and sources of information played a role in the fight against COVID-19. The findings illustrate that the participants justified their behaviour's mainly by referring to policies e.g. masks, distance and hygiene, developed and implemented with the collaboration of government, scientists and the World Health Organization.

Beyond the context of the pandemic, the authors interrogate further aspects of trust in science in relation to post-truth era and related concerns such as pseudoscience and post-modernism. Valladares cautions that post-truth is a social condition that threatens the trust in science and people's critical thinking. The author analyses some of the educational responses to post-truth, exploring the potential contributions of Science and Technology Studies (STS). Some of the responses based on traditional epistemology, characterized as 'epistemological vaccines', are contrasted with some more complex and interdisciplinary knowledge of science and technology. Mattos and colleagues reflect on public discourses about science and pseudoscience, proposing the same discursive structure for both—the Esperantist-Epideictic genre. The authors believe that this genre of discourse might bring together characteristics understood as constituents of the public discourse on science. The authors argue that the genre also enables us to depict the process by which to maintain cohesion on a group's values. Their findings indicate that some conceptions of validation of knowledge, scientific method, science bias, reality and truth compound a distinct part in the Flat Earth movement. Lima and Nascimento highlight how many authors blame post-modernism and studies on Sociology and Anthropology of Science (Science Studies) for the rise of relativism and anti-science movements. Despite such criticism, the authors indicate that Science Studies have always been concerned with the construction of the common world (a shared reality), while the anti-science movement goes in the opposite direction, denying science to defend economic and political interests of specific groups. In this sense, the post-truth movement is seen as part of a political agenda and science education will need to face the dilemmas of such scenarios by taking a clear political stance.

The last two papers provide suggestions including methodological considerations in addressing complex problems that impact trust in science. The food-energy-water (FEW) nexus framework is presented by Platts and colleagues who call for a systems perspective on addressing complex sustainability challenges. As a sustainability science field, nexus research is considered for its potential to bring together transdisciplinary approaches drawing from a range of stakeholder knowledge and experiences. The authors introduce a research project about the training of future researchers at the FEW nexus and explore how

these programmes train students in particular views such as technological solutions, stakeholder collaboration as well as equity and justice. Rowland and colleagues raise further methodological questions, cautioning that when public trust is analysed, it often simplifies a complex process of information retrieval and interpretation. Although questionnaire surveys help make sense of differences among actors and countries, the authors state that such tools fail to provide a comprehensive analysis of the reasons that lead citizens to trust a specific actor. Hence, the authors instead use a qualitative grounded approach to understand how citizens make sense of trust.

Overall, the papers in the special issue highlight trust in science ranging from the epistemic (e.g. uncertainty, objectivity) to the societal (e.g. political orientations) aspects, collectively pointing to some key tensions: tensions between uncertainty in scientific knowledge versus the capacity to build powerful explanatory and predictive models that help us navigate significant challenges such as the COVID-19 pandemic. The papers illustrate empirically how different stakeholders in education such as pre-service teachers and students view trust in science, and how post-truth and postmodern characterisations of science imply for trust in science. The December 2022 issue of *Science & Education* will continue with Part 2 of the special issue to further problematise such tensions with the aim of providing insight into how HPS may offer fruitful input to science education at a time when, though public confidence in science globally remains high, the political climate may breed scepticism and mistrust.

Declarations

Conflict of Interest The author declares that she has no conflict of interest.

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