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Risk as a concept in science education and socio-scientific issues

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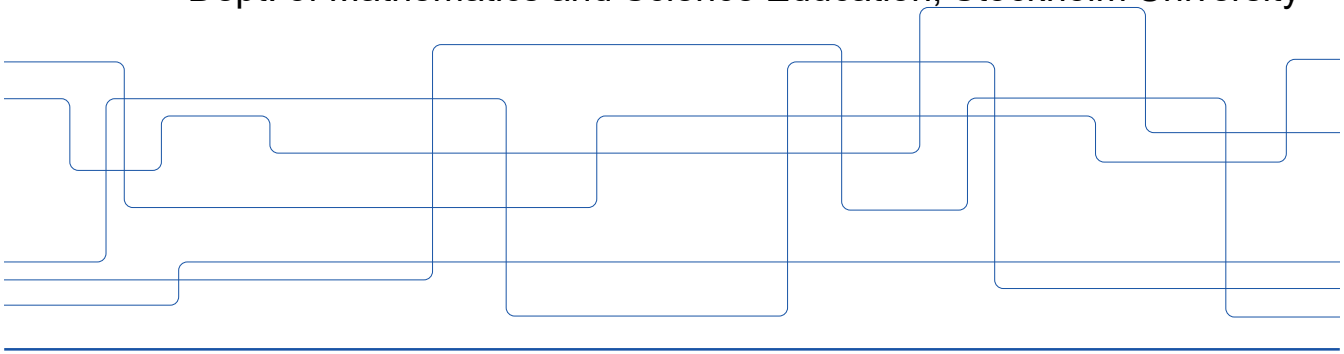
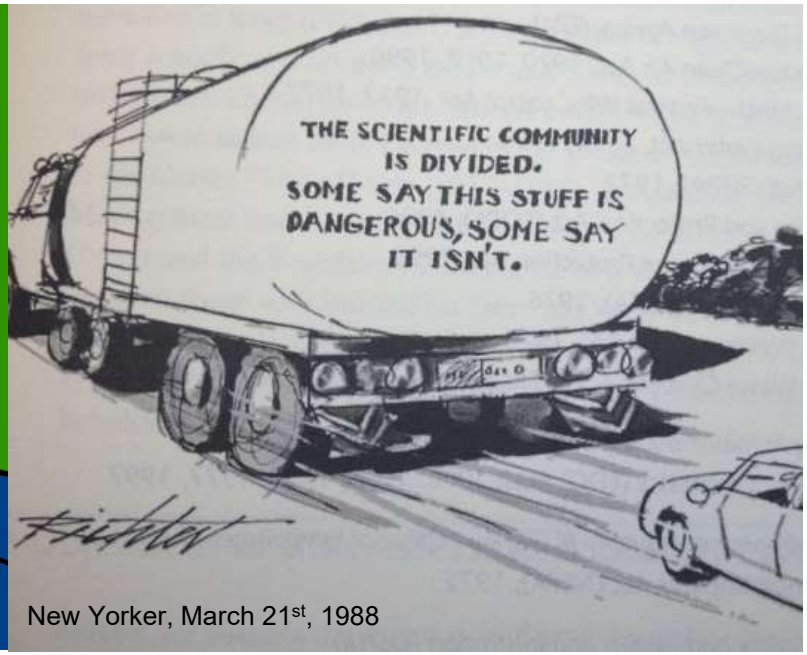


Knowledge is not static and often incomplete



New Yorker, March 21st, 1988

Ejikelhof, 1986; Ravetz, 1997, Kolso, 2006, Christensen 2009; Aven & van Kessenich, 2018; Schenk et al., 2018; 2019; Bouder, 2019

Scientific literacy & citizenship education

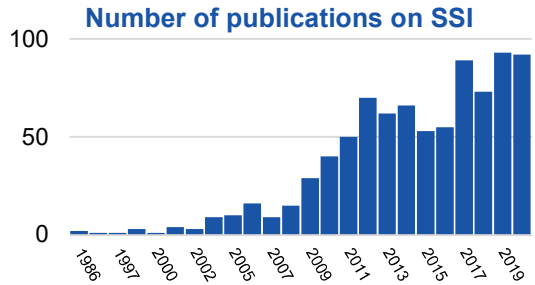
OECD Programme for International Student Assessment (PISA):
Scientific literacy refers to an individual's:

- scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about science-related issues
- understanding of the characteristic features of science as a form of human knowledge and enquiry, awareness of how science and technology shape our material, intellectual, and cultural environments, and
- willingness to engage in science-related issues, and with the issues of science, as a reflective citizen.
  (OECD, 2013).

➡Content knowledge, Nature of science, and Engagement in deliberation and decision-making

Socio-Scientific Issues (SSIs)

- One approach to promote scientific literacy.
  - Current issues that may impact society and/or our lives
    > *Have a basis in scientific knowledge, often at the frontier.*
    > *Involve forming opinions & personal/societal decision-making*
  - Deal with incomplete or conflicting reporting or evidence base.
    > *May have media attention framed by conflicts of interest.*
  - May involve cost-benefit analysis in which **risk** interacts with values.
  - May connect to sustainable development
  - Involve values and ethical reasoning.

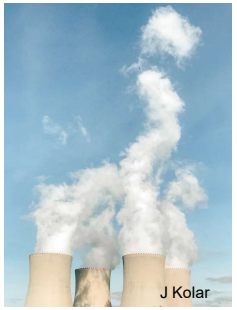


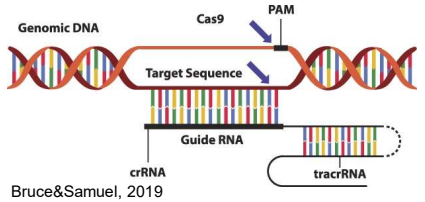
Ratcliffe & Grace *Science education for citizenship* 2003

How does risk come into play in SSIs?

- **Scoping review** of the literature on SSI and Science education
  - Web of Science Core Collection: "socioscientific issue" OR "socio-scientific issue" refined by "science education".
  - 422 hits in April 2020.
- Read and categorised according to:
  - **Empirical** (n=296), **theoretical/review** (n=91), or not relevant (n=35)
  - Which **SSI topics** in empirical publications
  - Treatment of "**risk***"

SSI topics: some examples

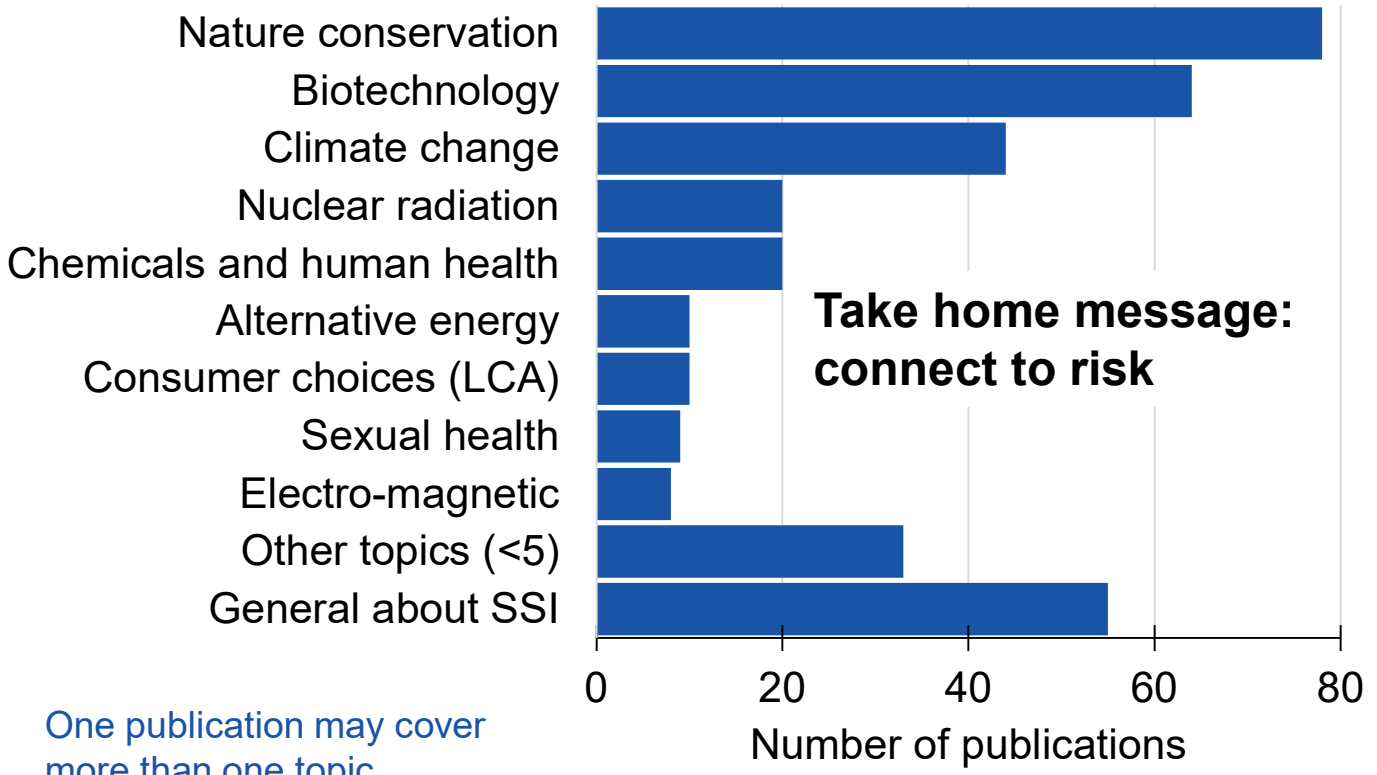




Bruce&Samuel, 2019

Photos: Unsplash.com

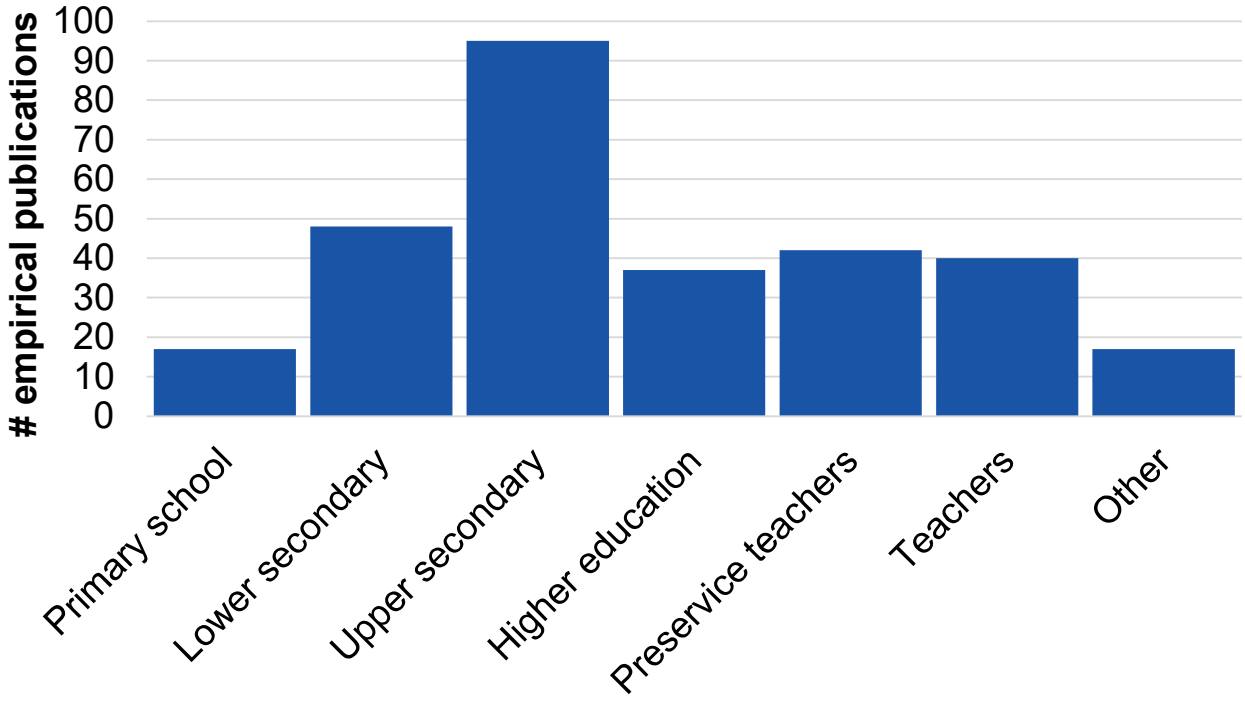
SSI topics in empirical publications



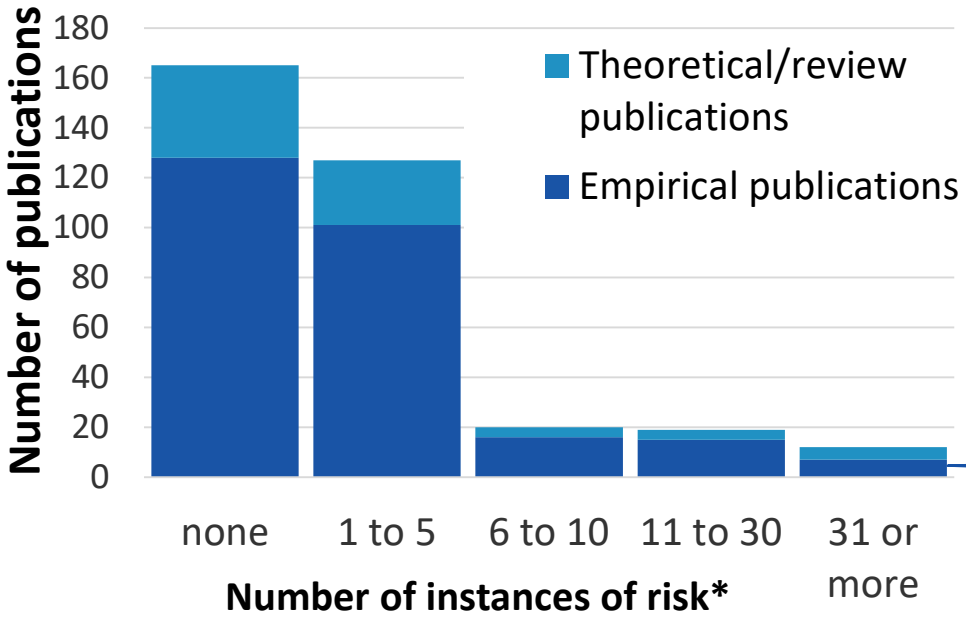
One publication may cover more than one topic.

Schenk et al., 2021

When are SSIs taught?



“Risk” is not frequent in SSI publications



No thorough investigation of the students’ conception of risk or its connection to students’ attitudes/decision-making (n=7 emp.)

Schenk et al., 2021

Concluding thoughts on risk in SSI teaching

- Few SSI-publications engage with the concept of risk
  - Relatively few mention risk, fewer define
  - The role of risk understanding and risk judgement in SSI deliberation and decision-making is still unexplored
- ...despite the fact that the SSIs treated in them more often than not connect to risk.
- We argue that knowledge about risk analysis is valuable to SSI teaching;
  - as a tool to structure deliberation and decision-making,
  - fostering skills central to the education of our citizens.
  - Hence, risk should have a more central role in SSI-teaching.
  - An opportunity for risk researchers to engage with educators!

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Socioscientific Issues in Science Education: An opportunity to Incorporate Education about Risk and Risk Analysis?

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CONTROVERSIAL ISSUE

Educating about radiation risks in high schools: towards improved public understanding of the complexity of low-dose radiation health effects

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Abstract
The levels of stochastic health effects following exposure to low doses of ionising radiation are not well known. A consequence of the uncertainty is that any radiation exposure is met with deep concern—both by the public and by scientists who disagree about how the partly conflicting results from low-dose studies should be interpreted. The concern is not limited to ionising radiation but is inherent to other areas of modern technologies such as biotechnology or electromagnetic fields. The everyday presence of advanced technologies confronts people with the necessity to take decisions and there is an ongoing debate regarding both the nature and magnitude of potential risks and how education efforts may empower peoples´ decision-making. In the field of radiation research there are different opinions regarding the optimal education methods, spanning from the idea that peoples' fears will be eliminated by introducing dose thresholds below which the risk is assumed to be zero, to suggestions of concentrating research efforts in an attempt to eliminate all uncertainties regarding the effects of low doses. The aim of this paper was to present our approach which is based on developing an education program at the secondary school level where students learn to understand the role of science in society. Teaching about radiation risk as a socio-scientific issue is not based on presenting facts but on showing risks in a broader perspective aiming at developing students' competency in making decisions based on informed assessment. We hope to stimulate and encourage other researchers to pursue similar approaches.

Keywords Risk · Low doses · Education · Stochastic effect · Cancer

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Teaching and discussing about risk: seven elements of potential significance for science education

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ABSTRACT
The present paper takes its point of departure in risk being a relevant content for science education, and that there are many different approaches to how to incorporate it. By reviewing the academic literature on the use and definitions of risk from fields such as engineering, linguistics and philosophy, we identified key elements of the risk concept relevant for science education. Risk is a phenomenon of the future that may be conveyed by our activity, it is something that may or may not take place. Hence, at the core of risk we find uncertainty and consequence. Furthermore, the elements of probability and severity are relevant modifiers of the consequence, as well as both subject to uncertainty. Additionally, in framing, understanding and decision-making on risk, as individuals or society, we need to acknowledge that risk has both objective and subjective components, lying in the interface between knowledge and values. In this paper, we describe how these key elements were derived from the literature and derive a schematic model of the risk concept for the purpose of science education. We further discuss how this model may assist in planning, execution and evaluation of teaching activities explicitly or implicitly involving risk issues.

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KEYWORDS
Scientific literacy; science; technology; society; nature of science; models & modelling; philosophy of science

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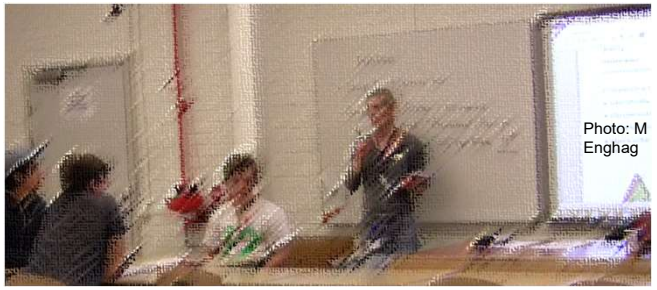

Photo: M Enghag

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