

# Cultural pre-conceptions and their Implications on earth science education

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## *Introduction*

Over the last decades the public debate about climate change, sustainability, and other global environmental issues was focused solely on perspectives from the Earth sciences, on economic demands and societal challenges. Some scholars see the working programme for climate research of the EU as an example, which seems to be “characterized by its exclusion of human (cultural, ethical and spiritual) dimensions and is simply interested in monitoring and technical and socioeconomic engineering of solution policy” (Bergmann, 2010:17). Only recently cultural studies and theology have been introduced into relevant research, but a deeper understanding of “how human environmental attitudes get shaped and what causes those attitudes to change through time” (Kareiva; 2008: 2757) is still missing. While scientists agree, that there “... is also ample evidence that distinct cultural and religious values of individuals and whole societies influence their perception and tolerance of risk as well as their capacity to cope with environmental hazard” (Gerten, 2010:39f), education and communication research have not yet focused on how these risks and hazards are transported into the public in respect to various socio-political environments. Within this article, we want to discuss ways to gain a better understanding of how cultural preconceptions influence science education and science communication.

## *Theoretical setting*

Scholars have observed that individual concepts of human–environment interaction are shaped by socio-political and socio-cultural environments, and that education takes in a major part in developing such concepts. These observations were made for example in research about the role, function and impact of indigenous knowledge on environmental management strategies (see Weiss et all 2013, Gerhardinger et al 2009 or Dowsley & Wenzel 2007 as examples). Scholars showed – for example with a focus on indigenous people (see for example Hintjes 1997; Schmuck 2000; Cruikshank 2001) – that “disrespect for knowledge systems other than quantitative science and technocratic solutions, or by the characterization of local people’s religious viewpoints of environment degradation and natural hazards ...” might result in “fatalistic” outcomes (Gerten, 2010:42). To develop solid sustainable political concepts, one has to gain a strong understanding of the people’s worldview and their perception of nature (Gerhardinger at al 2009; Weiss et al 2013). But, “the scientific approach, with its imperative for precise categorization and abstract generalization, rapidly loses its ability to provide useful guidance to the general public when faced with increasingly complex situations typified by uncertainty, nonlinear dynamics, and conflicting perspectives.” (Mistry & Beradi, 2016:1275) Therefore, Brocchi argued, that since reality is highly complex, humans have to reduce complexity to deal with their environment (Brocchi, 2010:148).

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While our perception of reality is individual and selective, this selection process is highly influenced by the social, cultural, and spiritual environment we live in. As numerous social scientists state, this selection process is framed and steered by common codes and systems of meaning, that we as individuals adopt to a large degree by education (see or example Marten, 2010). Education again is strongly dependent of the socio-political and socio-cultural environment, or – as Brocchi in respect to Wittgenstein said: “The Limits of our world are the limits of our culture.” (Brocchi, 2010:149) Therefore, “... education and education research can provide very important contributions to the public and academic debates about sustainability and climate change, with significant potentials to increase citizen’s responsibility in learning about the ongoing environmental changes.” (Bergmann & Gerten, 2010:8) Thus, one has to come to the conclusion that analyzing educational and communication concepts will provide crucial insights into how concepts and preconceptions about the role and interdependencies of humans and their environment are shaped and about the way future political decision makers are trained to observe, perceive and experience the world. Furthermore, by looking at science communication and STEM education – especially natural science education in schools – it is important to recognize that “only few studies have investigated the influence that ... indigenous stakeholder’s understanding of Western scientific knowledge (WSK) has on their ability to effectively communicate with each other.” (Weiss et al, 2013:285-286). The concept of the term “indigenous knowledge” as defined by Berkes (2008) provides a starting point to understand socio-political differences in worldviews and nature perception. Nevertheless, we acknowledge, that there “is a risk of over-simplification when conceptualizing the essential concepts of traditional and western scientific knowledge and developing a dichotomy between the two knowledge systems.” (Gerhardinger et al.,2009:155) “Recognizing different perceptions can help to understand why individuals and different societies interact with the environment in such strikingly different ways.” (Marten, 2010)

### Culture

While talking about the processes which occur within communication at the boundary of diverse socio-political and socio-cultural systems, we have to shed light on the concept of *socio-political* and *socio-cultural*. Both terms describe contexts for cultures to prosper. Meanwhile, “Culture is a fuzzy set of basic assumptions and values, orientations to life, beliefs, policies, procedures and behavioral conventions that are shared by a group of people, and that influence (but do not determine) each member’s behavior and his/her interpretations of the ‘meaning’ of other people’s behavior” as per Spencer-Oatey (2008: 3). This said, observing communication processes at cultural boundaries can be focused on encoding and decoding procedures of communication. Encoding and decoding again are guided if not limited by socio-political and socio-cultural contexts. Thus, we have to understand these contexts first, if we want to create meaningful, memorable and moving communication.

Following Schein (1984), to analyses culture means to conduct research and observations on three dimensions. At the first dimension, we have to look at observable artifacts. These include everything from the physical layout, the dress code, the manner in which people address each other, as well as more permanent archival manifestations such as company records, products, statements of philosophy. At the second level, we have to learn about basic values. Values govern behavior: they are hard to observe directly; can be derived by interview and interaction; are stated reasons for behavior; and only sometimes are written down and communicated directly. At the third dimension, we have to make an attempt to understand underlying assumptions. Those are typically unconscious within the individuals we want to learn more about. But nevertheless, they actually determine how group members perceive, think and feel and are less debatable and confrontable

than values. As a result, as communication researchers, we have to use a methodological set of tools that originates from psychology.

Driven by marketing and advertising strategies, communication science already started to take encoding/decoding into account when developing communication strategies. Workshops on intercultural behavior and intercultural communication are well established – at least in the realm of global industry. But if we look at these measures in detail, we can observe, that within the guise of interculturality these workshops address only multicultural, at best cross-cultural issues.

Multicultural refers to a society that contains several cultural or ethnic groups – as seen for example in classrooms. While people with different cultural roots live, learn, or work alongside one another, their cultural groups do not seem self-contained. They do not necessarily have engaging interactions with individuals of whole groups from other cultures.



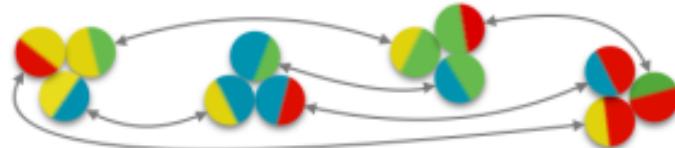
**Fig. 1:** Visualization of the concept of a multicultural system (Schriefer, undated)

Cross-cultural addresses observed differences of cultures. Cross-cultural communication respects differences and tries to understand and acknowledge these. It might even be possible to bring about individual change, but will not lead to collective transformations. Characteristic for cross-cultural societies is, that “one culture is often considered “the norm” and all other cultures are compared or contrasted to the dominant culture” (Schriefer, undated).



**Fig. 2:** Visualization of the concept of a cross-cultural system (Schriefer, undated)

Intercultural communities are characterized by a deep understanding and respect for all cultures. Intercultural communication therefore seeks mutual exchange of ideas and in-depth discourse about cultural norms. It aims towards the development of deep relationships between cultures. As a result, within intercultural societies, no one is left unchanged. There is a constant dynamic re-building of social norms, values, need, and demands.



**Fig. 3:** Visualization of the concept of an intercultural system (Schriefer, undated)

Furthermore, intercultural training reverse most often to communication strategies from academia to other cultural communities (most of the time indigenous communities). We understand and train scientists and industry partners to understand the impact of socio-economic, socio-political and

socio-cultural pressures on communication routines. We understand from the socio-economic perspective the pressure on science communication, e.g. how market prices dictate the resources for science communication in mass media and how media representation turns out as valuable benefits for science within the competition for funding and excellence. (e.g. Weingart, 2003) The socio-political perspective teaches us how political decision-makers shape science and how science can and should be communicated to policy. Ongoing research about how science shapes the decision making process is still quite juvenile and far from an accepted theory. (e.g. Pielke, 2007, or Wall et al, 2017) Open questions about how political decision influence the perception and acceptance of science within the diverse public spheres are still to address. Finally, the socio-cultural dimension is approached only from the science perspective. How science can be communicated into diverse socio-cultural communities is quite well understood. (Reyes-Galindo et al, 2017) But, how socio-cultural contexts influence science communication and the scientific sphere has not been addressed yet.

### *Result*

Science Communication research has to look at cultural pre-conceptions (underlying assumptions) and their implications on science communication. To better understand encoding/decoding processes within science communication, we have to understand the intereffication (see Bentele. 1997) of science, socio-cultural communities and other stakeholders within the decision making process. While this observation has to deal with a smorgasbord of side effects and disturbances, communication research has to identify *natural laboratories*, were the number and variety of such disturbances can be minimized. One such natural laboratory can be found in Israel, were four distinct socio-cultural communities are active communicators within well-defined socio-political boundaries. Secular Israeli, Jewish orthodox Jewish ultra-orthodox as well as Arab and Druze communities are involved in science communities. Nevertheless, within the boundaries of the Israeli political environment, all four communities deal with science communication in very different ways – from utilizing a scientific tradition that goes back several millennia (Arab and Druze) to communication routines that are strictly framed by religious beliefs and traditions. Another example of such a natural laboratory can be found in New Zealand and Australia, were indigenous communities are well integrated into decision making routines (NZ), respectively where only marginally integrated, if at all (AUS). While we can identify other such natural laboratories all over the world, communication research has yet to start to analyze critical intercultural communication processes.

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