TOWARDS A NEW TEACHING APPROACH FOR SCIENTIFIC LITERACY: EXPLORING THROUGH A THREE-VISION FRAMEWORK FOR TEACHING SCIENCE

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Abstract

Through the three-visions framework, a science educator approaches her science lessons and her practice from a more purposeful and intentional place and building and understanding the relation to the subject of study beyond an objective view can potentially bring more meaningful learning for the students.

Keywords: science literacy, vision I, vision II, vision III, scientific literacy, relationality

Towards a New Teaching Approach for Scientific Literacy: Exploring through a Three-Vision Framework for Teaching Science

Research on science education is diverse and there are different perspectives and accepted classroom practices on teaching and learning science. The broadly accepted idea about science education is that it contributes to two main areas of development: social agency and agency in the material world. Social agency provides a sense of respect for knowledge and skills to allow an individual to do useful work (Anderson, 2007). Agency in the material world contributes to an individual's ability to effectively explain phenomena and to influence both natural and technological systems. Essentially, science has been taught through conceptual change theories, which presents scientific concepts with the intention to change a student's current conceptual framework about a topic to cultivate and create a critically thinking citizen (Anderson, 2007).

There are two terms to describe a scientifically inclined person: science literate and scientific*ally* literate; and each has its own sets of "criteria". These criteria are segregated into two visions, Visions I and II, which describe the difference between a science literate (Vision I) and a scientifically literate person (Vision II) (Roberts & Bybee, 2014) and reviewed in (Tan, 2016). Building on critical work by Roberts and Bybee, I will briefly describe Vision I and Vision II in the following sections. Briefly, Vision I's principles are about curriculum, knowledge built from pre-existing techniques and methods that are well tested with explanations for the events and objects of the natural world. Science literacy is said to be important to enable one to sift through the massive amount of information and to decipher fact from fiction. In part, the role of science literacy is to encourage critical reading related to one's welfare and democracy (Fischer, 2011). Vision II's principles were developed later (based on elements from Vision I) and encourage an understanding of science through a more holistic lens to consider human endeavour and life situations as part of the solution to creating a scientifically literate person (Roberts & Bybee, 2014). Specifically, Vision II points to a scientifically literate person as someone who "reflects critically on information and appreciates and understands the impact of science on everyday life" (p. 547). It is important to note that there are multiple interpretations of Vision I and Vision II of the science literate and scientifically literate person depending on the organization or group who defines it. According to Roberts, (2007) each Vision can be viewed as extremes of a scientific literacy spectrum. Within a classroom, an educator may teach using a science infused curriculum that adopts and integrates elements from each Vision to support the student's learning and not necessarily solely focused on Vision I or II at any time or in any given activity. Although Vision I and II have been widely accepted by most in the field of science education to attribute characteristics of a scientifically literate person, a standard definition of a "scientific literate" person is still debated. For complete in-depth reading, please refer to Roberts and Bybee's published piece in 2014 or for a review of their work, please refer to Tan, published in 2016.

In the past decade, scientific literacy has encompassed a STEAM (Science, Technology, Engineering, Arts, and Math) as an attempt to bridge Science and Art disciplines to address

Cartesian divides. In this brief communication, I am presenting a new Vision, one that melds instead of bridging the Science and Art disciplines. Aligning with specific post-humanist theories and Indigenous Hawaiian epistemology, Vision III presents theoretical concepts of relationality with 'others' that include the more-than-human.

Vision III presents attributes of a scientifically literate person who places equal importance to different understandings about science (e.g. Indigenous knowledge, philosophy and art). Vision III is based on theoretical concepts on relationality with/within 'others' by acknowledging that scientific understanding and thinking is a fluid process and recognizing that this process is continual and perpetual. We propose that the convergence of scientific knowledge (Vision I), and scientific application (Vision II) with an understanding about the relations between and within human and non-human entities will eliminate a dualistic and objectified worldview, and thus moving towards a deeper understanding of "science citizenship and global interdependence" (Bybee, 2018, p. 61).

Scientific citizenship is a notion that has been defined and redefined for many centuries. The idea of scientific citizenship implies citizens with scientific knowledge and understanding can make responsible choices for personal well being and for the well-being of others. "Citizenship is both the condition of being a citizen and the reciprocal obligation of duties, rights, and privileges" (Bybee, 2018, p. 57). The idea of citizenship carried through until the Enlightenment period in the late 18th century. The Enlightenment period closely associated with the scientific revolution era where René Descartes philosophy on reasoning was the focus for knowledge creation (Mills & Woods, 1996) and this redefined the meaning of citizenship to move responsibilities from a regional to a national level. As we progress through the 21st century, the idea of citizenship is evolving to include a global perspective. Bybee (2018), acknowledges and insists that scientific citizenship, must now include, a move towards global scientific citizenship where perspectives from other disciplines are considered to realize the "interrelatedness of individuals, environments and communities" (p. 61). The shift in scientific citizenship is further discussed in a concluding argument by Ward and Dubos (1972),

> A strategy for planet Earth, undergirded by a sense of collective responsibility to discover more about man-environment relations, could well move, then, into operation on these three fronts: atmosphere, oceans, and climate. It is no small undertaking, but quite possibly the very minimum required in defense of the future of the human race.
>
> An acceptable strategy for planet Earth must, then explicitly take account of the fact that the natural resource most threatened with pollution, most exposed to degradation, most liable to irreversible damage is not this or that species, not this or that plant or biome or habitat, not even the free airs or the great oceans. *It is man himself.* (p. 217)

Therefore, through my research and this brief communication, I am proposing the three-visions framework (Tan, 2018), illustrated by Figure 1. Through this framework, a science educator approaches her science lessons and her practice from a more purposeful and intentional

place and building and understanding the relation to the subject of study beyond an objective view can potentially bring more meaningful learning for the students.

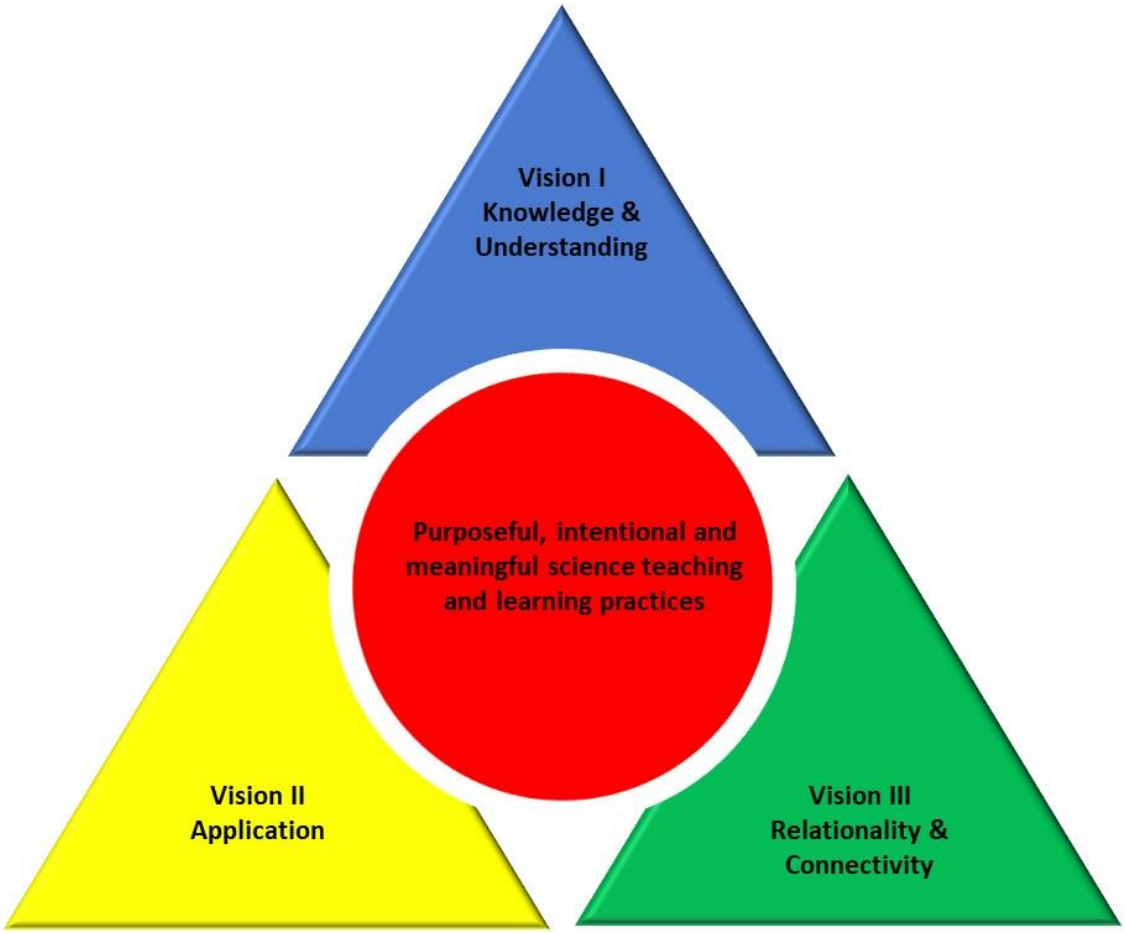

Figure 1 Three visions framework built upon accepted definitions of scientific and science literacy to include relationality and connectivity through different approaches of teaching science.

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