

## ■ Research Paper

# A Multi-cultural Science Education Model for Sustainability at the National University of Colombia, Medellin

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Modern societies all over the World are facing numerous challenges of *sustainability* owing to a growing human footprint. A materialistic view of nature has resulted in unchecked consumption that has been propagated through Western colonization. Examples include, water and food shortages, global warming, soil degradation owing to chemical agriculture, deforestation, loss of species and biodiversity leading to the sixth massive extinction of biological species and possibility of a civilizational collapse. Incorporating our ancient and indigenous heritage into an educational programme requires a paradigm shift in the current education model. Here, we present results from a unique collaboration among scholars with great interest in ancient and indigenous culture to develop and to implement a multi-cultural science education model of sustainability at the National University of Colombia, Medellin. Colombia has 87 different tribes comprising 3.4% of the country's population, which presents a unique opportunity for *in situ* model development and implementation. The proposed new education model can be shared as an illustrative example with other institutions in Colombia, and all over the world. Copyright © 2017 John Wiley & Sons, Ltd.

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## INTRODUCTION

The 60th Annual Conference and Meeting of the International Society for the Systems Sciences, held at the University of Colorado, Boulder, explored different dimensions of 'Realizing Sustainable Futures in Socio-Ecological Systems'. One of the authors co-organized a workshop and a plenary session at the conference on 'Multicultural world views on sustainability'. Both the events were focused on sharing knowledge of sustainability through the worldview of Ancient, Native, Indigenous and Tribal (ANIT) cultures. A 2-h documentary film "Force of Nature", on the basis of Suzuki (2010) contrasting the Western and the Indigenous worldviews for survival of all life on our planet was shown at the workshop. A group discussion was organized to compare responses to the film. The plenary session included both the Native American scholars (Cajate, 2000; Maryboy et al., 2006) and Western scholars (Milne, 2015) and Rudy Miick, a unique business entrepreneur (more information is given on his web page<sup>1</sup>). Gupta *et al.* (2016) served as a resource to help focus this collaboration. These resources and initial synergy among the participants highlighted an urgent need for individual transformation from a highly materialistic mindset and a paradigm shift in the current science, its education and research (Bhatt *et al.*, 2015). Here, we report the group's consensus on background issues and priorities for the future.

We generally agree that a *conscious worldview* may be used as a benchmark for assessing progress in sustainability (Gupta *et al.*, 2016). Contemplative inquiry by the ancient and modern sages from India led to the revelation that the five elements, all life and its environment come from one source, *the pure space or Brahman*. Modern science is currently returning to this view, and the ancient Indian concept of *Akashic field* has been revisited to develop a theory of everything that includes life and consciousness (Laszlo, 2007). Vethathiri (2004) defined Brahman in four axioms that are explained in Gupta *et al.* (2016). He went on to present a seamless,

consistent theoretical framework that explained how Brahman itself transformed into the entire universe, our solar system and all life on earth. This theory of Brahman resolves many societal and scientific dogmas. It unifies material and consciousness realities under one umbrella, and views *self*, *society* and *nature* as an integrated whole.

Evidence is here that modern societies all over the world are facing numerous challenges of *sustainability* owing to a growing human footprint. In November 1992, through the union of concerned scientists, some 1700 of the world's leading scientists, including most Nobel laureates in the sciences, issued an appeal, the "World Scientists' Warning to Humanity (1992)".<sup>2</sup> Their opening words were an urgent call to action:

Human beings and the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about.

They went on to say that

The developed nations are the largest polluters in the world today. They must greatly reduce their overconsumption, if we are to reduce pressures on resources and the global environment. Quoting Suzuki (2010, p. 35)

The failure of the media, politicians and corporations to respond to their warning means we are turning our backs on the survival strategy of our species- ...

A mechanical view of nature is at the root of a highly materialistic culture that originated in the West (industrially developed nations) and resulted in unchecked consumption. This trend has been and continues to be propagated all over the

<sup>1</sup> <http://www.miick.com/>

<sup>2</sup> <http://www.ucsusa.org/about/1992-world-scientists.html>

world through Western colonization. Examples include, water and food shortages, overfishing, water, air and soil pollution, global warming, soil degradation due to chemical and genetically modified agriculture, deforestation, loss of species and biodiversity leading to the sixth massive extinction of biological species (Kolbert, 2014), which has brought humanity to the brink of a cognitive threshold (Costa, 2012) and a civilizational collapse (Brown, 2009).

Developing a multi-cultural science education model for sustainability is long overdue. Incorporating our ancient and indigenous heritage into an educational programme requires a paradigm shift in the current education model. The first step in this challenging objective is to 'educate the current educators' (Kohli, 2014). We are exploring innovative approaches to develop a new multi-cultural foundation that is built on a conscious worldview that treats consciousness and matter as an integral whole (Walia, 2014).

This article discusses the initial stages of developing a multi-cultural science education model of sustainability that will be nurtured and matured at the National University of Colombia (NUC), Medellin, Colombia. It follows the work at the International Society for the Systems Sciences workshop and the plenary session as a guide. There were four main reasons for selecting this institution for the project. First, one of the authors has many years of academic interactions and collaborations with colleagues from NUC. Second, Colombia has an indigenous population. Our objective is to share this model as an illustrative example with academic and research institutions in Colombia and all over the world. Third, the Colombian colleagues are enthusiastic about participating in this project through the Fulbright US Specialist programme, which has been approved. Fourth, Colombia's 1991 Constitution stands out from the rest of the world as one of the few that recognizes the ethnic diversity within the territory and accepts the coexistence of multiple ancient ways of understanding the world.

Here, we outline the research objectives and *in situ* methodology, introducing the Indigenous People, Kogi, of Colombia. We describe the initial structure of our multi-cultural science education model, highlighting an exchange between

Western and the Indigenous knowledge. Finally, we outline the proposed multi-cultural science education programme at NUC and initial implementation activities. We view this process itself as research and development of holistic practice within the systems sciences, with an *in situ* component involving the indigenous people of Colombia.

#### KOGI, THE INDIGENOUS PEOPLE OF LA SIERRA NEVADA DE SANTA MARTA, COLOMBIA

La Sierra ranges in altitude from beaches on the Caribbean Sea to the highest of Colombia's peaks, at a staggering 5700m a.s.l. Its Hillslopes contain all existing tropical ecosystems. Thirty-five rivers emanate from its peaks and flow down an intricate compact group of deep valleys and steep slopes. Kogi, the ancient tribe of Colombia, are sufficiently isolated from the modern world to have retained their indigenous culture.

The Kogi, along with an astonishing diversity of other beings that live in La Sierra, are contemporary survivors of global and local socio-cultural destructive processes that we do not recount here. The Kogi are very much aware of this fact and dedicate their life to the constant observation, study, conservation and defence of their territory. They know they are the guardians of the *Mother*, which is under constant threat of being destroyed. The Kogi recognize the interconnectedness of the world, actively seeking to understand how one change induces many others throughout the territory. They take this concept further and believe that they carry the burden of responsibility for nature itself to follow the Law.

To be sure, avoiding un-critical romanticism and dogmatism are among the most important points we would like to make here. Traditional Kogi, for example, still refuse to use medicinal plants to heal their illnesses because of their belief that they are caused by external evil and not natural processes. Most Kogi instead resort to carrying small rock amulets and sell the medicinal plants to the *criollo* settlers. The Kogi have not discovered that their body is an ecosystem, their

gut a forest. Our understanding of the beautifully complex inner workings of the immune system is foreign to them, because that knowledge was revealed to us by tools that are not available to the Kogi.

The Kogi are a prime example of a surviving ancestral community with which a multi-cultural exchange of knowledge about water is urgent. They “know that water is the Mother of all life”, and they feel about their territory in ways that are difficult to frame within the context of water as a resource. Yet they manage, take care and live off a great variety of water sources, which are under a constant state of threat. Water from La Sierra is also important for non-Kogi Colombians as most of the water supply for the Departamentos of Magdalena, César, Atlántico and Guajira has its source in the snowy peaks of La Sierra. The Kogi recognize the rhythms, cycles and problems governing the current and future state of water availability and quality in their territory. It is necessary to integrate their knowledge and worldview in the design of any contingency and sustainability plans for water in La Sierra.

#### ESTABLISHING A MULTI-CULTURAL SCIENCE EDUCATION MODEL

*Three central questions* guide the development of our multi-cultural science education model of *sustainability* as a product of our collaboration: (i) What is the need for multi-cultural science education? (ii) How can sustainability be developed in a Systems Sciences framework? (iii) What are the components of a multi-cultural science education model of *sustainability*? Answers of the three questions are intertwined, as explained here.

The existing educational curricula are based on the mechanical scientific worldview that originated in the West nearly 500 years ago and took firm roots through organized institutional research (Sheldrake, 2012, p. 14). We propose to introduce ancient/native/indigenous/tribal (ANIT) worldview, and the related sciences and philosophies, to expand the conceptual science education framework currently in place. Respecting nature with its five basic elements, *Earth*,

*Water*, *Fire*, *Air*, *Akash* and their origin is the common thread among the ANIT people (Vethathiri, 1992). To contrast the dominant Western model with the indigenous perspective, Suzuki (2010) explained and illustrated the interconnectedness of the basic five elements for survival of all life on our planet. Below are some excerpts taken from Suzuki (2010, p. 71–76) as examples to illustrate the issue that a fundamental change in perspective is necessary to solve current environmental problems:

I realized that we had defined the problem incorrectly. I had pressed for laws and institutions to regulate our environment when, in fact, there is no environment out there, separate from us; I came to realize that we are the environment.

Leading science corroborates this ancient understanding that whatever we do to the environment or to anything else, we do directly to ourselves. The “environmental” crisis is a “human crisis”; we are at the center of it both as the cause and the victims.

Rather than being separate or apart from nature, we are deeply embedded in and utterly dependent on the generosity of the biosphere.

Air is more than just a physical component of Earth. It is a sacred element giving life to all terrestrial organisms, linking life in a single matrix, and joining past, present and future in a single flowing entity.

Our great boast is the possession of intelligence, but what intelligent creature, knowing the critical role of air for all life on earth, would then proceed to deliberately pour toxic materials into it? We are air, so whatever we do to air, we do to ourselves. This statement is true for the other sacred elements including water.

Suzuki’s comments strongly emphasize the need for an exchange between Western and the Indigenous knowledge. De Sousa (2010) clearly stated that the modern western thinking is ‘abysmal’: it concedes to modern western science a

monopoly over the universal distinction between true and false. On the other side of the abyss, there is no true knowledge, only beliefs, magic, folklore, myths, merely intuitive or subjective comprehension. Let us declare that this is a naive, useless, impoverishing and very likely, dangerous position. Davis (2009) gives many reasons. Knowledge and culture on the other side of the abyss are unique expressions of the human imagination and heart, unique answers to a fundamental question: what does it mean to be alive? The collective plural answer comprises our repertoire for dealing with all the challenges that confront us as a species.

One of the main features of the current worldview is that it fails to recognize as valuable any knowledge that is on the other side of the abyss. The hegemonic epistemic system is regarded as the pinnacle of human innovation and every exchange across the abyss is thus patriarchal. For life's sake, we need to motivate an exchange of knowledge that is horizontal recognizing the plurality of worldviews; perhaps a radical co-presence. The goal would be to maximize the probability of hope over that of despair (DeSousa, 2010, p. 26).

Davis (2009) defines the ethnosphere as the sum of all thoughts and intuitions, myths and beliefs, ideas and inspirations brought into being by the human imaginations: Humanity's greatest legacy. De Sousa (2010), in turn, proposes conceptualizing the co-presence of all contemporary worldviews within the ethnosphere as an *ecology of knowledge*. In this ecology, different worldviews interact, changing and evolving their respective knowledge and ignorance. It does not negate modern scientific knowledge, it simply implies its counter-hegemonic use.

Every ecologist agrees that biodiversity is of key importance for sustainability in the biosphere, coexistence of different traits being a marker of health of any ecosystem. In the ethnosphere as well, a monoculture is fragile, doomed to extinction. De Sousa (2010) claims that success in the ecology of knowledge should be measured with strict pragmatism as this ecology "does not conceive knowledge in abstraction". His sentence is that for the historically oppressed, vital experiences have turned their

epistemology into one of consequences, where ideas are to be judged only according to concrete interventions on society and the physical world. It ignores aesthetics as one major component in the success of ideas. Many memes are created, adopted and succeed simply because they yield more elegant explanations to abstract questions, even in the face of dire consequences to those who adopted them.

The value and legitimacy of ancestral/indigenous knowledge and worldviews, in the face post-modern environmental and social crisis, is therefore evident in this context. It is by nature local because of the deep connection between beings and the territory. It has long been understood, in most cases, that we live inexorably interwoven with all beings and Mother Earth, a concept to which Western traditional science has been slow to adopt as the key for our survival.

An example of how to exchange fundamental knowledge within the context of the ecology of worldviews is ethnomathematics.<sup>3</sup> Blanco Álvarez et al. (2014) give a history of it. D'Ambrosio (2007) proposed adopting the following etymologic definition of what a programme in ethnomathematics should aim for: — 'ethno' as the natural, social and cultural habitat — 'matema' as explaining, understanding and dealing with — 'tics' as in modes, styles and techniques. Namely, ethnomathematics aims at comprehending the different ways of seeing, explaining and undressing of the World by different cultures in their struggle for survival and transcendence (Blanco Álvarez et al., 2014).

Three interwoven pillars constitute the bases for the ethnomathematics programme at the UdeA: cosmogony associated to the origin stories, cosmovision as the recognition of ancestral knowledge and spirituality that emerges from the relationships between all beings and the territory (Castaño et al., 2015). Our ancestral knowledge has given us beautiful and detailed origin stories that can and should be shared across cultures. Modern scientific tradition has used amazing tools of discovery, from microscopes to telescopes, mathematics and chemistry,

<sup>3</sup> The ethnomathematics program at the Universidad de Antioquia (UdeA), Medellín

DNA sequencing and archaeology. Our cosmovision has compiled a meticulous characterization of the tree of life, our place in it, the stuff that everything is made of and the forces that seem to dominate the universe throughout many scales. We do have a seat at the table of an ethnomathematics programme.

Important initial steps have been given to start incorporating the knowledge of diverse indigenous groups of Colombia into the educational curricula of primary and secondary education. The Sabiduría Ancestral Indígena, SAI, Project (Ancestral Indigenous Wisdom) is a private initiative led by Grupo Sura, a financial and insurance holding, that have funded and supported the dissemination of cultural values of diverse indigenous groups of Colombia<sup>4</sup> including the beautiful book 'Lenguaje Creativo de Etnias Indígenas de Colombia' (Creative Language of Indigenous Ethnic Groups of Colombia).<sup>5</sup>

The SAI Project has developed Learning Guides, led by a transdisciplinary team of social scientists, pedagogues, teachers, designers and has been validated with educational institutions in different socio-cultural contexts. The SAI Project has produced a series of videogames, books, apps for Android and IOS, and Learning Guides focused on children to support teaching activities about the traditional knowledge, cosmogonies, traditions and cultural values of some of the 87 indigenous groups of Colombia. The initiative acknowledges the pluri-ethnic and multi-cultural character of Colombia as defined by the 1991 Constitutional Reform and aims at valuing the indigenous ethics and aesthetics as fundamental components of socio-cultural development.

#### INITIAL OUTLINE OF A MULTI-CULTURAL SCIENCE EDUCATION PROGRAM AT THE NATIONAL UNIVERSITY OF COLOMBIA, MEDELLIN

The academic programme in the Geoscience and Environment Department, Facultad de Minas, Medellín, NUC is centred in Water. It is one of

the five basic elements, *Earth, Water, Fire, Air* and *Akash*, which are the common thread among the ANIT cultures (Gupta et al., 2016). Water is a fundamental part of the Cosmogony for the 87 different ancestral communities that live within the territory of Colombia, the Kogi being one of the most prominent. The section of Hydrology in the American Geophysical Union is devoted to water. Therefore, water is the natural starting point on which to build a Multicultural Science Education Program. NUC has an undergraduate programme in environmental engineering. Sustainability is its primary focus. The emerging project intends to provide guidance to expand the programme along the lines of a multi-cultural concept of sustainability.

The environmental engineering programme is designed within the framework of the newly developing nonlinear science of complex systems. Traditionally, Western science has been very successful in dealing with linear systems with a focus on studying a component of the system in isolation and concentrating on a few aspects of the problem. By contrast, society, culture, environment, human relations, biodiversity and organisms are composed of highly interconnected subsystems that cannot be ignored or simplified. A simple consequence is that curricula need to incorporate various basic sciences and disciplines that are usually beyond the traditional engineering programmes. But the challenge is not only in diversity of fields of knowledge but fundamentally in depth. How can one proceed in this ambitious undertaking? Wilson, (1998, p. 85) has stated the challenge accurately as illustrated in the quote thereafter:

The greatest challenge today, not just in cell biology and ecology, but in all of science, is the accurate and complete description of complex systems ..... Success in this enterprise will be measured by the power researchers acquire to predict emergent phenomena when passing from general to more specific levels of organization. That in simplest terms is the great challenge of scientific holism.

The following steps are suggested to reform the existing undergraduate curriculum in environmental engineering.

<sup>4</sup> <https://www.sura.com/artecultura/investigaciones.aspx>

<sup>5</sup> <http://etnias.las2orillas.co/>

1. The first and foremost recommendation is to transform individuals through education. Bhatt *et al.* (2015) defined a road map.
2. The division-of-labour model of separate departments is obsolete and must be replaced with a curriculum structured like a web or complex adaptive network. Responsible teaching and scholarship must become cross-disciplinary and cross-cultural. A set of core course offerings can be broadened by developing a syllabus for a multi-cultural science programme.
3. The undergraduate programme has curriculum flexibility. Not all the courses are required, and students have options to choose from and define areas of major emphasis within the programme. This flexibility is also essential from a pedagogical point of view. Learning to exercise freedom is a fundamental component in the formation of responsible Earth citizens. A course in multi-cultural science can be required.
4. Another major strategy has been problem or project-based learning. There are at least four courses based on this approach. During the course, working in teams, they need to design solutions to real problems and to present the project both written, oral and graphically. It can be expanded by developing projects that include indigenous knowledge. A team can visit the indigenous people of La Sierra Nevada de Santa Marta and include their ideas to solving problems of sustainability. Interactions with the Universidad de Antioquia must be developed as they already have a programme in place on indigenous knowledge. Another example is the work at the Environmental Research Center (Las Gaviotas) in Eastern Colombia (Pauli, 1998).
5. NUC will strengthen linkages within diverse in-house departments and faculties, and with other institutions in Medellin, for example, Universidad de Antioquia, where an education programme is already in place that is very complimentary to the proposed project. Colleagues from Universidad de Antioquia have been contacted about this initiative. A faculty member is serving as a co-author here.
6. A programme centred in Water would bring together people in the humanities, arts, social and natural sciences with representatives from all schools. Through the intersection of multiple disciplines and multi-cultural perspectives and approaches, new theoretical insights will develop and unexpected practical solutions will emerge.
7. To develop a series of 2-day workshops in the next months to gather researchers from different disciplines and sciences that include natural, social, humanities and economics and start thinking about the best way to go forward. Colleagues who have been working *in situ* with the indigenous communities as part of Universidad de Antioquia's Mother Earth Program will be invited to this workshop.
8. State environmental policies around water will be discussed and debated. The POT (territorial ordering plan) and POMCA (watershed management plan), which are being implemented on the territories by State authorities, will receive special attention. One of the co-authors would be requested to facilitate interactions between NUC and the state authorities.
9. The programme will be aimed at local leaders and 'sabedores' (knowing persons) from different ancestral communities in the Colombian territory with the following goals:
  - i. An exchange of fundamental knowledge about Water, its role in our cosmogony, cosmovision and spirituality. Western knowledge will be presented as one more of many approaches.
  - ii. The Mother and life would play a central role in the origin stories around water cycle and in discussions. They will be shared, compiled and studied as an object of reflection.
  - iii. The programme will include gatherings at the NUC campus, as well as visits to the different territories by all the participants. Local problems will be identified and debated among all participants.
  - iv. With permission of the local elders, each territory and the water running through it will be mapped according to the local understanding of the territory, and these maps will be

contrasted with the usual cartography. If physical measurements (quality and quantity) are approved, they will be carried out by the community.

- v. The ultimate goal is the conception of local manifestos around water, describing what it means, practically and spiritually for the community to live alongside the Mother and Water in equilibrium.

## CONCLUSION

We briefly contrasted the ANIT and the Western worldviews regarding water and other elements. To again quote Suzuki (2010)), "... there is no environment out there, separate from us; I came to realize that we are the environment." The ancient science of self-healing or Ayurveda is based in the five elements (Lad, 1985), By contrast, the premier journal of American Geophysical Union dealing with water is called 'Water Resources Research'. It views water as a resource. The Western view is that each of the five elements is a resource that is disconnected from human life. As briefly explained here, the ANIT worldview and the related sciences and philosophies offer a unique approach to expand the conceptual modern science education framework currently in place and build an all-inclusive systems sciences model of sustainability. We outlined the initial multi-cultural science education programme at NUC and implementation activities.

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