Redefining Multicultural Science Education and Adopting Indigenous Science as "Classroom Science"

Jun Karren V. Caparoso
Mindanao State University

Bill Atweh
Philippine Normal University

Introduction

We have been fortunate to be involved in a project that aims to train teachers on the 'proper' use of inquiry approach in teaching science. In one of our region-wide trainings, one of the activities required teachers to revise the ready-made daily lesson log (as provided by the Department of Education) making it an inquiry-based one. During the presentation and critiquing of each other's work, we noticed that teachers from rural areas would comment that a lesson presented by a teacher from a more urbanized area is not applicable to their situation for the reason that their students could either not relate/connect with the examples and illustrations used or that they do not have the instructional resources needed to deliver the lesson as suggested. We realized, based on the teachers' arguments and discussions that the "one-size-fits-all" notion is false.

In one of our research projects, we had the chance to visit three "minority schools" in Occidental Mindoro, Philippines and be able to learn how they are operating as learning institutions to the *Iraya Mangyans* (the natives of Mindoro). In terms of curriculum, in science and other areas, they are following the national curriculum with English as the medium of instruction for Science. What situates them from the "regular schools" is the mere presence of an indigenous group of learners. Although, we observed that their pacing in learning Science is relatively slow and teachers find it impossible to cover all prescribed topics in the curriculum. From our interviews, the teachers would wish for a curriculum specifically designed for their culturally unique set of learners—one that takes into account the cultural aspect of the *Iraya Mangyans*.

These experiences with schools, teachers, and learners, have prompted me to revisit and problematize the ideals of good education, particularly putting into question the notion of universal science education. Although Biesta (2009, p.41) did not give a direct answer to what constitutes a "good" education, he posits that the purpose of education may be related to the quality of what he calls "subjectification". Good science education is judged based on how it promotes the development of a person and can be measured by the extent of change or impact such person has caused in the society where he/she lives.

In this paper, we discussed the problems of universal science education to argue that indigenous science education is way better and more relevant than the national science

curriculum. In doing so, we first explored the relationship between science and culture as well as the cultural perspective of science education. We then showed how universal science education and a national science curriculum devalue culture. From there, we proceeded with the proposition that other sciences shall be recognized as science and that mere integration to the popular science is insufficient. Lastly, we presented some implications of indigenous science education as alternative to popular science in culturally-unique educational systems and society.

Science in culture and the cultural perspective of science education

We find it necessary to start the discussion by establishing the interface between science and culture. For this purpose, we adopted a simple and common definition of culture such as the one provided by Phelan, Davidson & Cao (1991) which states that culture is a set of beliefs, expectations, values, and conventions shared by a group; it also includes language, traditions and practices unique to a group. But this definition of culture is quite limited as it fails to emphasize the place of science in the whole idea of culture. Culture also includes science. Any group or society defined by a unique culture has its science (Ogawa 1995; Snively & Corsiglia, 2000). There can be many sciences and Western modern science (WMS), the one taught in today's science classrooms and has its historic origin from Western culture is just one of the many sciences that need to be considered (Ogawa, 1995; Snively & Corsiglia, 2000; Eijck & Roth, 2007). Ogawa (1995) even identified two other sciences other than WMS. These are the personal and indigenous sciences which refer to the personal and cultural level sciences, respectively. The science practiced by a particular group or society is shaped by the expectations, values, traditions, language and beliefs shared by its members. Science is enriched by realities unique to each geographical subdivision. Indeed, culture informs science.

Now, viewing science as a mere part of culture is but too simplistic. A society practicing the same science may have shared beliefs, traditions, norms, values, and conventions. Using Phelan, Davidson, & Cao's (1991) definition of culture, science is indeed culture in itself. Thus, if science is culture, then learning science, which is the primary concern of science education, is learning of culture. As Aikenhead (1996, p. 219) puts it, "cultural perspective on science education views teaching as cultural transmission and learning as culture acquisition". Gramsci (in Balampekou & Floriotis, 2012) even affirms this when he encouraged teachers to facilitate the smooth acceptance of cultures (which are acceptable across societies) among students. Science education, therefore shares the task of enculturation, making sure that cherished beliefs of a group are transmitted from one generation to the next. Culture-sensitive science education helps save culture especially in communities where younger generations have become alienated to their own culture or in societies where elders fail to do their duty on cultural transmission. Science teaching, therefore is just one of the many avenues to promote appreciation of culture.

The learning of science, which is the main concern of science education, is described by Aikenhead (2001) as a cross-cultural event. It brings students to undergo several cultural border crossings. That is, students are moving from one subculture to another. For instance, before learning classroom science, students may shift from their "already known science" in their homes and communities to a new perspective of science in school. In other words, in the process of learning science, a student has to cross from their everyday world to the world of school science.

Cultural border crossing is an important concern because it can be disruptive when not properly negotiated. When science is presented in a situation that is familiar or fit to students' beliefs and values, cultural transmission such as learning of science is supportive (Aikenhead, 1996; Hodson, 1993). On the contrary, science that is presented in a completely strange context is disruptive—it will either replace or devalue the existing beliefs and values and requires a lot more time and effort to happen.

What we are trying to convey here is that, culture and science must go hand-in-hand in the classroom. The cultural border crossing, which I find necessary in learning science, can only succeed if science is presented in a way that is congruent with students' beliefs and value systems.

The drawbacks of universal science education

Universalism as a philosophical concept is commonly applied to something that has a universal application or scope, and a universal concept or idea is regarded as "standard", "uniform" and independent of culture, ethnicity, class or race (Stanley & Brickhouse, 1994). It is the philosophy behind "universal education", "universal science" and "universal science education". In this section, we will focus on the universality of education as well as of science and its emerging field, science education. We will also lay down some criticisms on the three concepts mentioned above.

Countries which share the belief that education is a tool or instrument for national development offer free or state-sponsored schooling. They even regard it as constitutional right of its citizen. Universal education, which is an example of an educational system promoted by a state, upholds the idea that all children, irrespective of needs should be educated in mainstream schools (Cigman, 2007; Paquette, 1995). Despite its wide acceptance, universal education is never exempted from strong objections. One of its strong criticisms came from the philosopher Robert Lewis Dabney (1820-1898). As cited by Simpson (2006), Dabney believed that universal schooling does not necessarily educate people and that literacy, which most democracies consider as the primary aim of education, is not the only means of education. He also raised concern about the fact that universal education is given free. He fears that since it is provided for free, people may not find it valuable or children and parents alike may not take it as a serious

enterprise. He further argued that any kind of education which comes with some "universal" flavor is "*not a blessing but bane to the cultural norms of a nation*" (Simpson 2006, p. 52) and more likely results in cultural degradation, and to some extent, cultural disintegration.

Science or Western Modern Science (WMS) as it is "officially" called is charged with being universal. Stanley and Brickhouse (1994, p. 390) puts the universalist view of science this way: "the ontological physical world itself judges the validity of a scientific account of that world, and this account is unrelated to such things as human interest, culture, gender, race…". This view reflects the "exclusivity" of science. It appears that science exists in an independent world, completely devoid of any externalities. It is as if science will forever be free of cultural influences or contamination. Likewise, it considers "creation science" as non-science and indigenous knowledge as second-class knowledge. Behind this belief is also the regard of WMS as the "only" science (Ogawa, 1995; Hodson, 1993; Cobern & Loving, 2000) or "superior" science (Lewis & Aikenhead, 2000; Van Eijck & Roth, 2007).

The issue of the "exclusivity" of Western modern science revolves around the idea that science detaches itself from society which to us is impossible. As pointed out earlier, science is part of culture and culture in itself. Exclusivity also limits social participation. It makes science available only to a select few, contrary to Gramsci's (in Balampekou & Floriotis 2012, 291) call for the abolishment of social structures. To think that WMS is supreme over non-WMS is the same as accepting Western culture as more superior than the culture of the rest of the world. Cobern and Loving (2000, p. 52) even suspect that this view may promote "epistemological hegemony" and "cultural imperialism". We are worried on this because just like Gramsci (in Balampekou & Floriotis, 2012), we are convinced that the aim of science should not be the promotion of a single ideology. Science, by all means, must be geared towards meeting social needs. Another reason why separating science from culture is impossible is the mere fact that the label Western modern science itself signifies that it embodies Western (Ancient Greek and European) traditions and culture. WMS in itself is culture-laden. In the same fashion, people who do science (not limited to scientists) have their culture which would surely influence what they do. In fact, people who are bound by their respective cultures should not be detached from science for they are the ones who make science (Balampekou & Floriotis, 2012). Regarding WMS as superior is an admission that other sciences exist and thus, invalidates the claim that WMS is the only science. This suggests then that there are other sciences which at the moment we would like to temporarily label as non-Western modern science (as we have already mentioned, every culture may have its science).

Having presented some problems attached to universalism in science, we just want to clarify that our intention here is not to devalue WMS. I believe that its methods and

products were able to advance society but what I have argued so far is that universal science is problematic because it ignores the role of culture in the discipline.

Insofar as science education is concerned, we do agree with Aikenhead (1996) that the main problem about "universality of science education" lies on the assumption that science is the same from one science classroom to another, that it addresses issues and problems of students irrespective of culture. Another problem is that it gives a standardized assessment to all students even if they were not taught the same way. At a closer look, universal science education is disrespectful of students' cultural backgrounds. It even violates students' right to getting meaningful and more relevant science instruction. This led us to conclude that universalism is not only an epistemological issue but a moral issue as well.

The problem of a national science education curriculum

In spite of the strong criticisms against universal science education, it still appears that countries across the globe thru their ministries of education, implement a national science curriculum. This national curriculum, as claimed by its framers, embody the "essentials of science education" which every student should learn. It imposes content standards and competencies which every student, regardless of interest and situations should master or demonstrate. This "universality" of a national curriculum is indeed problematic as shown in the concerns that we are laying down in the following discussion.

Consistent with the Universalist approach, a national science curriculum leads to compulsory education. This setup is problematic because it violates the primary requirements for schooling which Dabney identified as aspiration and desire. For him, an unwilling student is more likely to have less appetite for knowledge. A national curriculum is also viewed as a policy that every citizen has to comply. It compels students to learn its content even if they do not want to. What is even more tragic about this set-up, as Dabney has pointed out, is that uninterested children are forced to join those who have serious desires to acquire proper education. He fears that the setup will create an unhealthy, chaotic and miserable environment for children. Thus, Dabney warned against this type of schooling that promotes crime and encourages social rebellion. As we see it, Dabney is trying to point that compulsory education in the guise of a national curriculum suppresses freedom which when taken away from a person or group often leads to turmoil.

A one-size-fits-all curriculum which the national science curriculum is trying to assume is not the perfect answer to the students' unique learning needs and context. As early as seventh grade, students may already have a career choice. In a class of forty, we are pretty sure that at least ten different career choices would emerge. How can a uniform

or single science curriculum will then be able to prepare students for these different careers? Should a student who wishes to become an engineer be given the same science as the one who wants to become a sociologist? The curriculum developers may tell us that students irrespective of career choices must acquire the same, basic science content. But we don't think this answer addresses our questions head-on. Even if students with different interests need to be exposed to the same content, they always need a different approach. We are not sure if a student who is inclined in the social sciences will ever be interested to learn physics using a mathematical approach. In fairness to the national science curriculum, they now "encourage" the use of differentiated instruction or practices to address students with different needs (Tobin & McInnes, 2008; Tobin & Tippett, 2014). However, teachers do not implement this setup in the classroom for some obvious reasons. First, the word "encourage" is not compelling. Second, differentiating instruction is an added workload for teachers and requires more time for preparation and research. Third, due to time constraints, the teachers may not be able to cover all the prescribed topics in the curriculum and students may not be able to pass the national assessment. This shows that the implementation of the national science curriculum is less sensitive and adaptive to the actual learning needs of students and it continues to cling to its universal nature.

The fact that the national science education curriculum is crafted by a commissioned group of experts to determine what students should learn in Science also makes it problematic. To echo the concern of Gramsci (in Balampekou & Floriotis, 2012), these group of experts do not represent the society. Science must elaborate and use the realities of the society rather than just from a chosen few. Regardless of qualifications, these experts have personal interests to protect and are subject to their own biases. They may also be influenced by their institutional and political affiliations. More than anything else, they have a different set of values and ethics that will always dictate their decisions and actions. Moreover, Apple (1993) posits that any curriculum cannot be neutral. It is a collection of knowledge identified by a group as legit and official. Given this, a national curriculum can be dangerous. The danger, as Apple pointed out, is that by allowing the culture of the few to be incorporated into the national curriculum, it is like giving them the permission to become the moulders of people. It may also perpetuate superiority of some groups over others in society. For instance, some schools could emerge as class schools which are reflective of that particular social structure/s represented by the group of curriculum framers. What seems to be ideal according to Apple is a curriculum that responds to the culture and histories of the general populace.

In this section, we have just argued that universal science education or a national science curriculum is defective. A science education that has a cultural flavour is better (Aikenhead, 1996; Simpson, 2006; Apple, 1993) than a "universalist" curriculum.

Giving other sciences a chance

In criticizing the Universalist view of science education, cultural relativists consider multicultural science education as the saving grace. All through these years, we consider multicultural science education as science teaching that integrates culture. However, after a thorough reading of its literature, our initial impressions were proven wrong. We have also found out that even cultural relativists do not articulate the same understanding of multicultural education (as expressed by Hodson, 1993). Given the various views towards the idea, we find the analysis of Ogawa (1995) useful in forwarding our intention for this paper. He argues that "multicultural" simply means "many cultures" (p.584). Since every single culture has its science (as mentioned in the previous sections), then, "many cultures", means "many sciences". Based on this logic, he equates "multicultural" with "multiscience". He also identified three types of sciences, namely: indigenous, personal, and Western modern science, and asserted that multiscience perspective science education is more sensible than the highly embraced multicultural education.

Multiscience perspective science education is but a promising and worth elaborating discourse, which we will try to partially tackle here. To begin with, multiscience perspective science education does not consider itself a "panacea" to solving science education problems. It does not even push for the merging of all kinds of sciences into just one science nor it subsumes or devalues other sciences as mere superstitions which the WMS tends to imply. The WMS's recognizes the existence of other sciences and their contribution to the society, but it does not consider them as its equal. Multiscience perspective science education removes the "exclusiveness" and "superiority" labels of science believing that they are impossible, unrealistic, hegemonic and disrespectful of cultural diversity. Simply, it accepts other sciences as "science". In essence, multiscience perspective science education gives other sciences a chance to be recognized or treated as "science" which to us is a significant step in advancing the ongoing universalist-relativist debate on how science education should support cultural diversity. It should also be clarified that multiscience perspective science education does not devalue WMS. It does not even say that WMS is bad or wrong nor intend to replace or displace it. It simply addresses the basic issues of universal science education as reflected in WMS.

While we agree with Ogawa (1995) on the acceptance other sciences, we can only move for the acceptance of indigenous science which includes a subset called Traditional Ecological Knowledge or TEK (Snively and Corsiglia, 2000). Personal science, to us, is not necessarily another science contrary to Ogawa's (1995) claim, but is just part and parcel of indigenous science. As mentioned earlier, indigenous science is unique to a certain culture and is derived from local or community-based knowledge that helps

communities thrive. TEK, on the other hand, is "the science of long resident oral people and a biological sciences label for the growing literature which records and explores that knowledge" (Snively & Corsiglia, 2000). The *Mangyans* of Mindoro, Philippines, for instance, have their indigenous science and their "kaingin" system is just one of their many TEKs.

What is clear at the moment is the recognition of the two sciences: Western modern science and indigenous science. WMS has already a well-established methods but indigenous science still needs systematic organization as a discipline.

Implications of Indigenous Science to Science Education

With the recognition of indigenous science as "official" or "legitimate" science, and as equal to WMS, science teachers, especially those who want to present science education in a cultural perspective, will be encouraged to use indigenous science as a "pedagogical stepping stone" (Snively & Corsiglia, 2000). It will help facilitate cultural border crossings (Aikenhead 1996; Aikenhead, 2001) that anthropologists consider important in the learning of science. It will make the learning of science better as it requires less cultural border crossing compared to WMS. Learning science is no longer a cross-cultural event but it is an avenue for learning one's own culture.

Adoption of indigenous science in the classroom creates in mind an interactive, informal, and reality-driven learning atmosphere. Students would talk about science in their own language and discuss the science behind the things around them and in the different phenomena observed in their community. It uses the community as the context of learning, in every lesson. It does not pressure students to perform experiments that verify some laws and theories. Rather, it encourages students to conduct research on how to solve basic community problems and issues.

While implementing indigenous science preserves the function of school as a social institution, it also introduces a radical change in the structure of the educational system. It promotes cultural transmission and helps in preserving diminishing cultures. Under this setup, the community should be tapped as a learning resource and a venue for experimentation. Community people may serve as resource persons, teachers, para teachers and collaborators. With indigenous science, science education becomes a collaborative enterprise. Nevertheless, it will make national curriculum, national testing/assessment, standardized criteria for hiring teachers and many other national standardization mandates irrelevant.

Conclusion

We wrote this paper in the light of some personal experiences that reflect the

deficiencies of a universal or national curriculum. To trace where the problems lie, we explored the relationship between science and culture and cultural perspective of science education, universality of education, science and science education, national science education curriculum and identified some ways to address glaring gaps. We also revisited some discourse on multicultural education which enlightened me about some possible reasons for the failure of the implementation of a certain curriculum that tries to integrate indigenous knowledge (multiculturalism). We went on and realized that to advance the discussion about the universality of science and the issues associated with it, coming up with a more liberal definition of science makes sense. For instance, describing science as "a rational perceiving of reality" (Snively & Corsiglia, 2000) invites other forms of knowledge to qualify as science. We appreciate the multiscience perspective science education of Ogawa (1995) and elaborated it. Eventually, we came up with the suggestion of looking at indigenous science and the popular Western modern science as equal sciences which are not mutually exclusive and may be used simultaneously in a science class.

Thus, the main contribution of this paper is to lay down significant rationalizations on the adoption of indigenous science education as a classroom science. Compared to Western modern science, indigenous science education requires less cultural border crossings and hence, facilitates better learning of science. It likewise gives teachers an alternative form of classroom science. It also respects students' right to be educated in the context of their own culture and helps society in its cultural transmission function. Most importantly, it debunks superiority and hegemonic labels of science which I think is necessary in the attainment of a just and peaceful society. Indeed, proper and systematic implementation of indigenous science education has a lot to offer for the improvement of teaching science.

References

Aikenhead, G. S. (1996). Science Education: Border Crossing into the Subculture of Science. *Studies In Science Education, 27* (1). 1-52. DOI: 10.1080/03057269608560077.

Apple, M. W. (1993).The Politics of Official Knowledge: Does a National Curriculum Make Sense? *Discourse: Studies in the Cultural Politics of Education, 14* (1), 1-16.

Aikenhead, G. (1997). Toward a First Nations cross-cultural science and technology curriculum. *Science Education, 81*(2), 217-237.

Aikenhead, G. (2001). Integrating Western and Aboriginal Sciences: Cross-Cultural Science Teaching. *Research in Science Education, 31*(3), 337-55.

Balampekou, M. & Floriotis, G. (2012). Antonio Gramsci, Education and Science. *Journal For Critical Education Policy Studies, 10*(1), 285-297.

Biesta, G. (2009). Good Education in an Age of Measurement: On the Need to Reconnect with the Question of Purpose in Education. *Educational Assessment, Evaluation and Accountability, 21*(1), 33-46.

Cigman, R. (2007). A Question of Universality: Inclusive Education and the Principle of Respect. *Journal of Philosophy of Education, 41*(4), 775-793. doi:10.1111/j.1467-9752.2007.00577.x

Cobern, W. W. & Loving, C. C. (2000). Defining 'Science' in a Multicultural World: Implications for Science Education. *Science Education, 85*(1), 50-67.

Eijck, M. V. & Roth, W. (2007)., Keeping the local local: Recalibrating the status of science and traditional ecological knowledge (TEK) in education. *Science Education, 91*(6), 926-947.

Hodson, D. (1993). In search of a rationale for multicultural science education. *Science Education, 77*(6), 685-711.

Lewis, B. F. & Aikenhead, G. S. (2000). Introduction: Shifting Perspectives from Universalism to Cross-Culturalism. *Science Education, 85*(1), 3-5.

Ogawa, M. (1995). Science education in a multiscience perspective. *Science Education, 79*(5), 583.

Paquette, J. (1995). Universal education: Meanings, challenges, and options into the third millennium. *Curriculum Inquiry, 25*(1), 23.

Phelan, P., Davidson, A. & Cao, H. (1991). Students' multiple words: Negotiating the boundaries of family, peer, and school cultures. *Anthropology and Education Quarterly, 22*(2), 224-250.

Simpson, B. D. (2006). Cultural degradation of universal education: The educational views of Robert Lewis Dabney. *Journal of Libertarian Studies, 20*(3), 47-60.

Snively, G. & Corsiglia, J. (2000). Discovering Indigenous Science: Implications for Science Education. *Science Education, 85*(1), 6.

Stanley, W. B. & Brickhouse, N. W. (1994). Multiculturalism, Universalism, and Science Education. *Science Education, 78*(4), 387-98.

Tobin, R. & McInnes, A. (2008). Accommodating differences: Variations in differentiated literacy instruction in Grade 2/3 classrooms. *Literacy, 42*(1), 3–9.

Tobin, R. & Tippett, C. D. (2014). Possibilities and Potential Barriers: Learning to Plan for Differentiated Instruction in Elementary Science. *International Journal of Science and Mathematics Education, 12*(2), 423-443.