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FORUM

Indigenous knowledge and science in a globalized age

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Abstract This forum explores and expands on Ben-Zvi Assaraf, Eshach, Orion, and Alamour's article titled "Cultural Differences and Students' Spontaneous Models of the Water Cycle: A Case Study of Jewish and Bedouin Children in Israel" by examining how indigenous knowledge is appropriated in science classrooms; how students from indigenous students' experiences are more complex than many non-indigenous students; and how science and globalization complicates the preservation of indigenous knowledge. In this forum we suggest that research on indigenous knowledge be examined through the lens of the locally situated contexts and the extent to which globalization hinders this kind of knowledge in the name of value neutral scientific knowledge. We finally suggest that research in indigenous communities has to be more intentional and respectful, and teachers need to rethink how useful and meaningful science learning can be for indigenous students.

Keywords Indigenous knowledge · Globalization · Research

Indigenous knowledge framework and science content in school

Ben-Zvi Assaraf et al.'s (2012) article compares how elementary grade students from Bedouin and Jewish communities form their spontaneous and non-spontaneous mental models of the water cycle as a part of science learning in school classroom settings. In their

This review essay is a critique of Ben Zvi Assaraf, O., Eshach, H., Orion, N., & Alamour, Y. Cultural differences and students' spontaneous models of the water cycle: A case study of Jewish and Bedouin children in Israel. *Cultural Studies of Science Education*. doi:10.1007/s11422-012-9391-5.

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article the authors correlate religion and socio-cultural practices and beliefs with Western school science content on the water cycle. Ben-Zvi Assaraf et al. show that Bedouin students' mental models include humans as a part of the larger water cycle system which is informed by the students' direct experiences with water in their everyday lives. We believe that the Bedouin students experience water much more intimately as they have to cope with the issues of water access based on how much productive time is spent in getting to a water source. On the other hand Jewish students in the suburbs encounter water, but the access to water is easy and water arrives to them with very little effort. We believe this difference in experience is fundamental to Jewish students not seeing humans as a central part of the natural water cycle system unlike the Bedouin students. Furthermore, the question then arises as to why Jewish students could remember unrelated information in the water cycle system but Bedouin students were more apt to remember the relationships between concepts within the content of the water cycle system.

To explore this kind of knowledge organization further in the case of indigenous knowledge structure and school science, we draw from Rogoff (1981) and Scribner and Cole's (1981) work with the socio-cultural nature of learning and its relationship to indigenous ways of learning. Rogoff and Scribner and Cole have suggested that the institution of schooling is designed to aid students to learn and organize disparate sets of information and students over time become very skilled in using these disconnected sets of information in various school tasks. Similarly schooling trains students to solve problems based on the information that is imbedded in the problem itself. However students who are unschooled or students who are from communities that find schools as oppressive institutions tend to view learning and organization of that learning as connected sets of activities. These students do not find disconnected pieces of information useful or meaningful because information that does not contribute to the process of living everyday life is not worth remembering. Therefore the Bedouin students comprehended a much more complex process of the water cycle because they mentally processed and connected individual components within the water cycle system. Additionally connectedness between the components of the water cycle system was integral to Bedouin students' knowledge of survival in the desert. In this connection, the humans; i.e. themselves, always held an important part. Therefore Bedouin students' knowledge about the water cycle as a complex and dynamic system was much closer to the more scientific concept of this system. Bedouin students did not seem to show much influence of schooling in how they constructed their water cycle models. On the other hand Jewish students saw schooling and its ways of helping them learn disconnected information as a normal process of learning. Jewish students were very comfortable with learning about water cycle in chunks of somewhat disconnected items because they did not seem to view water cycle as a dynamic and complex system that would profoundly influence how they lived their everyday lives. What is very fascinating, which the article does not extensively discuss, is the importance of science learning in the context of everyday living.

Let us discuss this further in the light of the indigenous knowledge framework. In Nepal Tharus, an indigenous ethnic population who lives in the southern plains, view their lives to revolve around water, forest, farming, and family. Many Tharus in Western Nepal live close to water and they view water as an integral part of their being. Some of them believe that constructing a home too far away from the water does not bring wealth to the family and the water is one commodity that has to be shared among all the community members. Therefore water is shared as a communal resource that should not be taxed, sold, or withheld so as to harm others. There is even a saying that the worst crime a person can commit is not giving water to the thirsty. Therefore in the Tharu indigenous knowledge

system water exists at a much higher level of human existence hierarchically. Furthermore this hierarchy is illustrated by the fact that many sources of water are revered and considered sacred; water purity is preserved. The primary source of pollution is humans and similarly to the Bedouin knowledge framework, the Tharus consider humans as part of the water cycle system. Water has always played a direct role in the survival of the Tharus. Therefore the Tharus have a complex view of the water cycle and how humans are connected to that system. Indigenous communities have to deal with water issues head-on because both flood and famine have threatened their existence. They have also learned to manage the water more appropriately. As their communities have become less mobile, the Tharus have also become more responsible in using water and they highly value their water resources. The article could have discussed further and pursued more in-depth to unearth why Bedouin students' models had humans in the water cycle system and what indigenous knowledge framework supported their ideas about the water cycle.

There are many distinct indigenous cultures in the world and they have distinctly different knowledge systems. In all indigenous groups the knowledge systems are based on local social, cultural, historical and environmental contexts. These knowledge systems have appropriated what kinds of knowledge count as useful and meaningful based on their specific contexts and history. However many of the perceptions and ideas that construct these knowledge systems have overlapping characteristics as well as non-overlapping ones too. Therefore Bedouin students' models of the water cycle would differ from Tharu students' water cycle models in some respects but would be similar in other respects. For example Bedouin students would depict water to be found mostly in deep underground systems, whereas Tharu students would depict water to be found in rivers, streams, and shallow wells. However both groups of students have humans as a part of the water cycle system. The difference and commonality are very local in nature but the knowledge system inhabits larger global ideas of water cycle system. The Western scientific knowledge system has diversity in depicting the water cycle system and similarly the indigenous knowledge system has diversity in it too. One profound difference is that the Western scientific system tries to oversimplify the water cycle system disregarding the local influences, while the indigenous water cycle system is a highly localized system and thus more adapt to local conditions.

Globalization and indigenous knowledge

The idea of globalization is Westernization both in the socio-cultural sense and also in the dominance of scientific knowledge sense. The economic and technological power of the west has transformed many cultures and practices around the world. The indigenous groups are not immune to it either. Globalization has gradually chipped away many of the indigenous knowledge, culture, and practices because indigenous people have not been able to rapidly adjust to the economic and technological changes that globalization has ushered into indigenous communities. In many instances scientific knowledge and science have been used to influence indigenous people as globalization has spread into these communities. For example many indigenous groups have lost the right to plants and their usage in everyday indigenous lives because globalization has allowed companies to patent these plants' products to the detriment of the local people. The neutrality of scientific knowledge gives many globalization advocates a cover to discredit indigenous knowledge. On the other hand some critics of indigenous knowledge argue that all knowledge indigenous or not should be shared and does not preclude non-indigenous people from using it

for non-indigenous peoples' benefit. This overly generalized argument takes power away from indigenous people, while Western scientific knowledge keeps others away from their knowledge through patenting laws (Whitt 2009).

One of the arguments constantly used against indigenous knowledge is its reliance on spiritual and cultural belief systems and that this knowledge does not pass a scientific test. This argument excludes indigenous knowledge as a useful and meaningful way of knowing, disregarding centuries of lived experiences that were the basis of indigenous knowledge. In most cases indigenous knowledge has to withstand the dynamic process of human development as well as the natural causes over long periods of time. Unlike Western scientific knowledge that is based on reduced and simplified structures, indigenous knowledge is based on more complex and interconnected systems. Therefore Bedouin students would have more complex models of the water cycle, while Jewish students would construct less complex models of the water cycle system. Jewish students are in a schooling context that values less complex models for understanding and very loosely connected ideas of a water cycle system. We agree with Ben-Zvi Assaraf et al.'s assertion that "… educators [need] to deal with such issues in a direct manner rather than try to ignore or circumvent such issues. We believe that joint and open discussions of such issues will help the indigenous students integrate the scientific view into their world view." However the question about how these discussions should take place in a classroom setting is missing from the article. Many researchers in science education have advocated that science should be taught based on the students' socio-cultural context because students then can easily find connections between their experiences and the science content taught at school. In many classrooms teachers of indigenous students struggle to connect indigenous students' world views with the science content that they are teaching. Teachers of many indigenous students need to recognize that the indigenous knowledge and the Western scientific knowledge systems can co-exist and be resources for each other. However we agree with Ben-Zvi Assaraf et al. that successful implementation of two distinctly different world views in a science classroom is a very challenging task, and the school administration and curriculum have to support this endeavor.

Methodological issue in indigenous research

Researching in an indigenous context is always challenging when the researchers are from a dominant group and possess power over the indigenous group. In the case of the Bedouin students the researchers Ben Zvi Assaraf, Eshach, Orion, and Alamour seem to be from the dominant group and I wonder how the students from Bedouin community viewed them. In many instances indigenous community members, including the students in schools from these groups, are reluctant to participate and share their stories to the outside researchers. Historically indigenous communities have felt that the outsiders have benefitted from their stories at their expense. We wonder if the researchers, Ben Zvi Assaraf et al., had any experiences that might have influenced their work with the Bedouin students. Furthermore indigenous communities are built on the idea of relationships rather than on efficiency or financial benefits. Building relationships with the community elders are very important part of doing research in these communities. We wonder if the researchers built these relationships and how these relationships helped or challenged the researchers in their work. We did not find enough discussions about the tensions between the researchers and the indigenous people. As we studied the long list

of semi-structured interview questions, we were struck by the breadth of the questions rather than the depth. The analyzed interview data seemed to suggest that there was very little depth in the responses from the Bedouin students. We wished the authors had discussed more about the methodological issues as they worked with Bedouin students and in particular the socio-cultural and historical issues related to this community and the relationship of that with their research.

Indigenous knowledge and teacher education

Ben Zvi Assaraf et al. argue that students from Bedouin communities import their socio-cultural experiences into school settings but these experiences are ignored in science classes because Bedouin experiences are categorized as value laden rather than value neutral. Many science teachers believe that indigenous students' world views are mostly based on scientifically unproven values because many of these students invoke the idea of God or spirit to explain natural phenomenon, particularly natural disasters. Therefore many teachers of science justifiably ignore indigenous students' ideas and knowledge because they are not based on "scientific methods". Scientific methods give many science teachers a cover to discount indigenous knowledge and expertise. The argument of methods is not that strong because many scientific discoveries and advances have been or are being made through accidental and abnormal outcomes. As Thomas Kuhn (1962) suggests normal science would not support the advancement of science because normal science lets scientists do the same old science based on the same old scientific methods. Therefore school teachers need to teach and view science as a dynamic and subjective enterprise that incorporates diverse ideas, views, and experiences that could be used as resources to teach science.

Sometimes teachers tend to view indigenous knowledge to be too contextual or narrow. Many indigenous groups are located in a specific geographical space for centuries. The knowledge used and gained based on these locations is very specific to these spaces. Thus the indigenous knowledge is locally situated and locally connected to other indigenous knowledge to produce a larger and cohesive connected knowledge. This narrower functional value of the indigenous knowledge makes many science teachers nervous because they believe that science is a universally applicable knowledge. Even in science many scientific concepts are very contextual or conditional. For example Newton's Laws of gravity are for objects that have very large mass and these laws are not applicable to microscopic objects. Thus the universality concept is broken and the laws of the quantum mechanics are applied to explain microscopic phenomenon. Therefore our teachers need to have a much broader view of science and empower students from indigenous groups to learn and engage in science.

Indigenous knowledge and Western scientific knowledge frameworks should not be pitted as traditional versus scientific. Rather these two knowledge frameworks should be viewed as connected and contributing to each other's progress and development. Science teachers need to focus on the merits of indigenous knowledge rather than as the obstacle to learning and teaching science. Merging indigenous knowledge and scientific knowledge of the water cycle system allows teachers and educators to rethink how knowledge is meaningfully constructed over time and through real life experiences, as well as through experiments and verifications of experimental results.

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