

SHADES OF BLUE: NEED FOR TRANSFORMATIVE AND SOCIALLY JUST SCIENCE

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Vexation

The discussion below occurred in a middle science classroom of mostly Hmong students. Apart from Hmong students, there are six White and three African American students in the class. A White female teacher (Anna) is providing the demonstration and leading discussion as students are engaged in observing and responding to their teacher. In this day's class Anna is teaching the unit on "classification" that relates to understanding acidic and alkaline substances. The goal of this lesson is to address the goals of the Minnesota State Standards in science content and processes. Anna wants to help students understand and practice how science observations are recorded, analyzed, and presented in the mainstream science classrooms. In the demonstration students will observe how an indicator (purple) will *change color* based on the acidity or alkalinity of a substance. In addition, Anna's goal is to encourage Hmong students to actively participate in science discussions. What Anna did not expect is how the Hmong students will observe, interpret, and understand the results from the demonstration. Anna also did not expect that the students will have a different way of understanding a *simple* thing like color.

In the following exchange between the students and Anna, Hmong students are describing their observations of color changes as cabbage solution, used as an indicator, is put in different acidic and basic (alkaline) medium.

Anna: Xiu (pronounced as 'Shoo'), why do you think the liquids are same?

Xiu (Hmong male): All the colors are same.

Anna: What do you mean? What are the names of the colors?

Xiu: That, that, that (pointing to each one of the test-tubes) **blue** color.

Anna: Really? (pause) Sai.

Sai (Hmong female): Yes. Same color, blue. That (test-tube with cabbage solution) **dark blue**. That (test-tube with vinegar and cabbage solution) **light blue**. That (test-tube with soap solution and cabbage solution) **blue**...*The spirit lives in (shades) of blue.*

All Hmong students firmly believed that the color of the indicator changed to various shades of blue in different liquid mediums. Thus, the above excerpt from a middle school science classroom on acids and bases presents to many mainstream science teachers a challenging dilemma while teaching science. One of the major challenges to many mainstream teachers in a non-mainstream science classroom is how to positively and productively negotiate the impact of culture on pedagogy and how to teach science that is transformative and socially just to minority students.

The interactions between culture and pedagogy are important because students and teachers express both of these factors in everyday lessons. However, there are still questions raised as to if culturally responsive pedagogy and curricula alone are powerful enough to ameliorate the effects of social stratification, racism, unequal resource distribution, and historical discrimination. In many science classrooms of domestic minority and recent immigrant students, science instruction tends to discount rich and complex cultural, social, and linguistic knowledge that the students bring into these classrooms.

Another challenge for mainstream teachers is effectively utilizing students' funds of knowledge in science instruction. Students bring many funds of knowledge that are personally and spiritually meaningful to them because those funds of knowledge are manifestations of their social, cultural, historical, and linguistic experiences passed on over many millennia. Teachers need to respect and recognize these funds of knowledge in order to effectively teach science. In this case the goal of learning science can be an empowering and transformative experience to both the students and the teachers.

Yet, transformative and socially just science is hardly a part of everyday science teaching practices. In many classrooms science is generally taught to pass the test or to memorize content or to learn the scientific processes that sustain Western ways of doing science. Thus, the emphasis on the phenomenon of conscientization (i.e. understanding what is taught and the ability to act on that learning in such a way as to affect a change) is hardly stressed. As a result, students with vastly diverse experiences than those of the mainstream culture learn science that is unjust to their knowledge and their ways of learning.

In general schools uphold mainstream culture through the process of exclusion of experiences of underrepresented students and by deemphasizing their ways of learning science and many other subjects. Therefore, for many underrepresented students schools become "contradictory social sites" where their values, beliefs, cultures, and languages are contested and marginalized. Education does not simply reproduce the inequality existing outside itself; it plays an active part in reinforcing the differences and inequalities that

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already exist. Thus, schools function as agents of a larger system of oppression of underrepresented students. This is especially true in the case of recent immigrant students, whose science teachers, in many cases, find themselves unprepared to deal with entirely new cultures.

Looking back at the idea of “shades of blue” among Hmong students, I cannot stop wondering if a mainstream science teacher would value their ways of observing and explaining a natural phenomenon. How would a mainstream science teacher reconcile this kind of language discrepancy? Is it then wrong for a Hmong student to use the word ‘blue’ to describe his/her observations instead of ‘purple’? If the goal of science teaching and learning in schools is to develop students’ reasoning skills then how should one negotiate with the description that the Hmong student gave in the class. How can a science teacher present science as a subject that can transform their lives in different ways? How can a teacher be socially just where s/he has to disregard students’ knowledge? How can we, as teacher educators, prepare our science teachers to be socially just? Does science, in its basic level, support the notion of social justice? These are very important questions that teacher educators need to answer if we are to promote and sustain a democratic learning environment.

Venture

For the last six years I have been working with students, teachers, and parents that are at the margins of our society such as immigrants, low-income, and minority. My engagement with these individuals, in and outside the classrooms, has led me to understand how important the role of science can be in these people’s lives. In addition, many students in my work come from cultures where spirit is central to their being. Therefore, I try to understand and document how the idea and knowledge of spirit fits in the teaching and learning of science. For example, as one of my teacher participants put it:

I use the idea of *spirit* synonymous to scientific *theory* as both of them try to explain a natural phenomenon. As spirit is a cultural way of explaining why something happened and *theory* is science’s way of explaining why [something] happened... May be science teachers can help ethnic and cultural minority students understand an important aspect of the nature of science by juxtaposing *spirit and theory* in their science classes.

Furthermore, can science teachers build a bridge that supports and nurtures these students’ desire to excel in science and also help them view their spirituality, thus, providing a transformative experience?

Yet, in many science classrooms of minority students I sense that teachers are constantly negotiating between what the demands of the mainstream science are and the demands of the students who *genuinely* want to learn science. The successful teachers have always negotiated this tension between the *Western* science and the *Local* science. What I truly admire about the students and the teachers is their conviction to make science work for them personally for the better future goals.

My work with Hmong students and their teachers in the U.S. and my work with one of the indigenous ethnic groups in Nepal, the Tharus, is guided by my desire to understand how students and teachers of these communities relate science knowledge in transforming the self and the community. Science for students of these communities is not only about learning new knowledge and ways of practicing the art of doing Western science, but science can also be a tool to assist in the search for social transformation and social justice. Thus, for students of these communities my interest is how science learning can connect to transformation and justice. My hope is that through my work I will be able to engage teachers and students from these communities in doing and learning science so that teachers will simultaneously promote critical reasoning skills, social problem solving, socially transformative ideas, social justice, and also success in science.

Very recently I have started a project where I’m engaged in documenting and identifying immigrant students’ local funds of knowledge. The goal of the pilot project is to generate a list of funds of knowledge that students bring into the classroom and another list of funds of knowledge that they create in the classroom with their peers. In the second phase the teachers will utilize students’ funds of knowledge to teach science. In this phase my goal is to discover the impact of this method of teaching on the long term retention of the science knowledge and skills. For this project, I’m seeking funding from the NSF Early Career Award. I would be very grateful to receive any suggestions during the Crossroads conference.

Finally, I am wondering what would be an effective way to capture students evolving science knowledge and their search for social and self transformation through science education. How can teachers promote the idea of social justice through science education, especially since it may provide a unique opportunity to bridge cultures?