



EDUCATIONAL DIGITAL MEDIA TOOLS TO REFORMULATE ACTIVITY AND OBJECT IN INDIGENOUS SCIENCE AND ENVIRONMENTAL EDUCATION

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ABSTRACT

This paper examines the functioning of and underlying assumptions about digital media in collaborative curriculum design processes in public science and environmental education, and community-designed action research learning programs. The article discusses teaching practices in US rural Northeast Wisconsin among Native Youth learning processes, from the complementation and articulation of formal and informal education to meaningful engagement and participation in science. The focus on the transformative use of digital media in science community education is intended to serve two interrelated purposes: First, it helps to address cultural-historical relations around the production of knowledge and relevant curriculums and pedagogies for rural tribal youth. Second, it intersects with the opportunities for the transferability of activity systems and action research centered around the production of mediational artifacts designed for the collective negotiation between First Nations Tribal communities and western modeled schools, institutions, workplaces, and societal roles. The transferability of this model envisions the incorporation of local actors and institutions in a deep artifact-based dialogue around epistemologies of self-determination and sustainability for Peoples who are fighting for their survival. These propositions take a new level when the transformative power of digital media shifts representations of power in historically marginalized communities, serving a larger activity of reorganizing ecologies of learning in education for culturally distinctive communities of practice.

Introduction

The incorporation of inter-cultural funds of knowledge in science education curriculum (Barab & Plucker, 2002) demonstrated significance to the preservation of Indigenous Knowledge Systems and literacies, not as mere tools of cultural expression but as objects, actions, and artifacts that connect forms of activity in which students' and teachers develop the "power to act" to honor the "motives" and collective identities (Roth & Lee, 2007) that tribal communities endured to secure assurance of larger systems of educational and political self-determination. Associated notions of cultural continuity and activity theory developed in different contexts, argued that the appropriation of the means of "internalization" for cultural reproduction expanded the participant's "repertoires of practice" (Engeström, 1991), creating conditions for social transformation and social movement (Engestrom, 2004). This paper highlights the ability to produce and articulate mediational artifacts as keys to transforms isolated individuals and groups into "collectives and networks" (Engestrom, 2000) in the experience with digital media cohorts in Tribal reservations.

Collective actions involving researchers and practitioners constitute forms of social justice to expand the inquiry about policies and standardized curriculums that are part of the "social design experiment" (Engestrom, 2004). These expansive redefinitions within curriculum development from actions, such as producing artifacts, are precisely at the center of the meaning of local capacity as a central activity. Indigenous Peoples identities have been referred in their personal and social trajectories as "those who have witnessed, been excluded from, and have survived modernity and imperialism," and as members of "colonized and minority communities that still remember other ways of being, of knowing, and of relating to the world" (Tuhiwai Smith, 2005). Part of these trajectories have been articulated through a wide range of social artifacts and mediational tools, communication devices conveying messages and actions with human and social significance, in this case, communities facing untenable

participation in schools in the middle of external forces of settlement, urbanization, and modernity in their land.

Evidence of the untenable position in education has been the focus of a previous interdisciplinary study of 4 years around the same triangle of Indian Tribal communities in rural Northeast Wisconsin where our educational research practice was taking place (Menominee and Oneida Nations and Sotckbridge Munsee Band of Mohicans). The study was conducted by well-known researchers who worked with some members of our team, combining cognitive psychology, education, and anthropology methods (Bangs, Medin & Atran, 2007, 2010) that show that American Indian and European American children and parents living in the same geographical areas upheld significant differences in their overall knowledge or level of knowledge organization about ecological, holistic, spiritual, and moral approaches to nature for both school children and their parents (Bang, Medin & Atran, 2007). The study concluded that the imposition of western epistemological and ecological categorical orientations starting as 4th-grade curriculums affected Menominee Native students sharing classrooms with European American children, across classroom practices such as memory organization, ecological reasoning, and understanding of roles and references to the human learning activity. These findings found also that this issue had implications for the ongoing efforts for improving science education in the region (Bang, Medin & Atran, 2007). This study became a key reference in the design of remedial and meaningful actions that would match and potentiate our students' capacities through our educational collaborative interventions using digital media.

Documenting a Collaborative Framework

The "Place-based Opportunities for Sustainable Outcomes and High-hopes" (POSOH) project was a six-year project initiated in 2011, the second-largest grant by the United States Department of Agriculture (USDA) under the Agriculture and Food Research Initiative (AFRI) to integrate

Indigenous ways of knowing into teaching and learning about ecosystems and sustainability, and following a concept of decolonization (Wilson & Yellowbird, 2007) that valued and centered Indigenous Knowledge (LaFrance & Nichols, 2009) in community-based strategies (Cram, 2012). I entered the project as an instructional media designer, my work evolved from a 3-year process of participation in multicultural and inter-institutional capacities into a 9-year involvement that still continues in the present 2020 back to the media cohort program, still a meaningful action for Tribal youth years after the POSOH project ended in 2016.

The interest in Indigenous local capacity was the central concern during my participation in this first pilot project and program of its kind, as I was part of a multicultural and multidisciplinary academic and community network that studied educational issues in Indigenous contexts and discussed science learning from the understanding of learners' participation in cultural-historical situated systems apart from deficits discourses (Gutierrez & Rogoff, 2003). The process of documenting participant teachers' journey in the curriculum development process started in 2012 while POSOH initiated the development and testing of two curriculum units: Unit 7, "Interdependence of Biodiversity and Sustainability within the Menominee Indian Tribe of Wisconsin Forest," and Unit 8, "Local Land Use Practices in Agriculture (Past & Present)."

My first interaction with members of different curriculum development teams involved observing and video-recording collaborative sessions that were part of a consented dynamic. As an active participant-observer of the curriculum development and curriculum design processes, I conducted interviews with 18 participants of the POSOH Project that would be used as internal training artifact with a format of an educational documentary titled "Decolonizing Local Capacity in Tribal STEM Education in Northeast Wisconsin" that captured and visualize the context of discussions and interactions with members of an interdisciplinary group of scientists and educators. By Spring 2013, Unit 7 included 5 educational videos that I produced with the assistance of a Native undergraduate

and graduate student team from different tribes filling different technical roles. The program was shared and introduced to 7 schools in the CESA 8 and 9 regions, including two high schools on Tribal reservations (Menominee and Oneida).

My responsibilities expanded my work scope to interact with tribal historians, archivists, and digital curators to produce complementary instructional video programs for different units. In the process, I was in a unique vantage point to interview members of the community, teachers, managers, workers of tribal farms and tribal enterprises, government officers, culture teachers, environmental officers, tribal legislators, members of different religious and spiritual groups, family clans and youth "gangs." The process included long visits to other Indigenous sovereign territories where tribes lived away from mainstream society, in a long struggle for physical survival and the needs of cultural reconstruction to recover the memory of the instructions they needed to survive in a hostile environment. The process also included attending ceremonies, learning protocols and proper words, being part of the community at times of sorrow, celebrate achievement and success among the families of these survivors, walking together in scientific conferences with my students, seeing them talking in public sharing their story.

The value of using video as a method of inquiry was addressed through a collective discussion about the creation and implementation of local capacity in American Indian tribal communities around education. This inquiry included attention to the issues and challenges of the collaborative curriculum design process itself, troubled by the incorporation of diverse voices and knowledge systems to be formally incorporated especially in public schools located within or adjacent to tribal reservations, its implementation, and institutionalization, as well as the process of possible negotiated integration with Western-modeled science epistemologies to change the rules of engagement and interaction with Tribal communities with their own governance systems. The statements from the interviewed participants highlighted how it was "difficult to operationalize" (Engestrom & Suntuio, 2002) the

recommendations from a professional development team beyond the classroom context.

These interviews also showed the need to create innovative institutional practices addressing “systemic contradictions” and “double bind” dilemmas (Engestrom & Suntio, 2002). From these perspectives, our evolving understanding of “mediational” practices from teachers who developed a capacity in long-term collaborative activities was aimed to present evidence of transformative pedagogical practices that resulted from the incorporating American Indian “voices” from rural and semi-urban contexts. However, members of these communities were referring to a process addressed by the notion of “ontogenesis” (Tomasello, 1999), in which collective efforts at a group-level attempt to “modify an artifact of practice” (Engestrom & Suntio, 2002).

The use of digital media in this regard qualitatively expanded a collaboratively produced and validated dialogue within the project channels, serving Indigenous teachers as well as high school, undergraduate, and graduate students from public and tribal schools and universities to have a voice, and be the evidence on this negotiated discussion and inquiry process. The practice of constructing an audiovisual format as a method of inquiry followed a careful consideration for the equitable treatment of diverse voices, thereby articulating transformative values in a relation of reciprocity, shared knowledge, and fostering social action (Angen, 2000). Capacity in these terms for Indigenous learners further relies upon learners’ abilities to become effective boundary-crossers between science and diverse Indigenous knowledge systems, and how skilled they are in “reading” and incorporating other pertinent funds of knowledge into environmental and sustainability action.

A second educational media component inquired instead about forms of local capacity at the student-level in science education. Participants from leadership cohort groups, community-based education, and after-school and service-learning programs were all incorporated. The instructional inquiry along this process appealed to inter-organizational

networks and instructional experiences around the production of digital storytelling pieces as part of action research projects conducted within tribal reservation settings and under the academic scope of science and sustainability. This second experience, from a practitioner’s perspective, took into consideration four main approaches: 1) Digital storytelling workshops using an organic educational video and technological literacy perspective that paired American Indian high school students from the Ojibwe Nation Bad River Band of Lake Superior with Health Science undergraduate and graduate students from the University of Wisconsin-Madison. 2) Exploring different formats of instructional digital and online media as visual evidence to be incorporated in a science inquiry process consistent with the National Science Standards, applied to the 7th, 8th and 9th science units produced by the POSOH Project from 2011-2014. 3) Developing teacher development programs for Tribal school educators that incorporated digital media pedagogies, and instruction of environmental filmmaking summer workshops since 2013 for Indigenous high school student participants of the Summer Cohort Program with the College of Menominee Nation and the Sustainable Development Institute that continues in 2020. 4) Serving as the lead instructor on additional educational media projects in the state with the Earth Partnership for Schools Project and urban American Indian high school students from central Chicago (Chi Nations Youth Council and American Indian Center of Chicago) on water conservation in Lake Superior and Ojibwe Tribes, and its significance for Indigenous Peoples, and with Escuela Verde Charter School of Milwaukee (attended also by Native and Latino immigrant descendants) on a community environmental health project about the restoration of the Kinnickinnic River on Milwaukee Southside.

These complementary approaches expanded the use of digital media through the production of a placed-based instructional design incorporating culture into science. This approach combined formal evidence by western scientific inquiry, incorporated the views from Native scientists, elders, teachers, and community members, as well as articulated Indigenous and

Western science epistemologies and methodologies into formal classroom experiences.

Digital Media and Strategies for Local Capacity and Self-representation

The first outcome of our summer workshop in 2014 and 2015 were two new collaborative documentary productions made by students interviewing teacher and tribal community mentors. A team composed by Menominee High School and Shawano High School students produced “Work Hard, Play Hard” (HD - 12:30 minutes), that looked critically at Menominee youth leadership, sports, and healthy lifestyles to redefine tribal youth’s inter-cultural visions of success; and “Namao: The Ancient Storyteller,” HD - 13:52 minutes, a creative story that included digital animation telling the story of the struggle for the sustainable and reciprocal relationship between the Menominee peoples and Namao (Sturgeon), who is a living ancestral fellow of the tribe. The experiences challenged students to understand action research projects as components of larger activities. Students were crafting digital media artifacts that summarized their research and increased their understanding and engagement in science education.

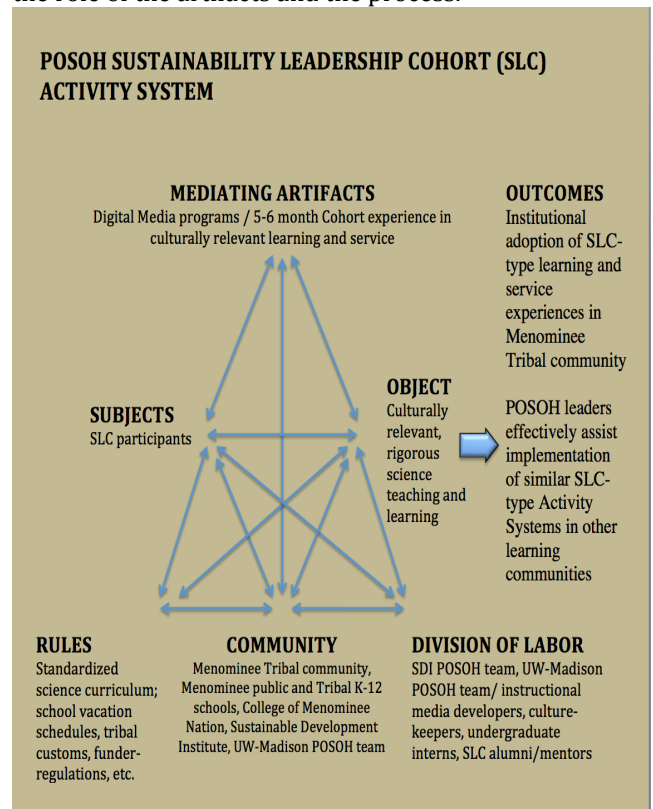
This experience served the inquiry about the notion of agency as a catalytic factor in students’ capacity and associated with teachers’ reflective performances and their ability to document their own “trajectories of practice” (Gutierrez & Vossoughi, 2010). Teachers gain competence on how knowledge is mutually “appropriated and indexed” (Gutierrez & Vossoughi, 2010) both in classrooms and after-school and community education programs using technology. These propositions were connected to the innovative approach of our teachers’ professional development workshop for Tribal educators that included digital media and digital storytelling. aimed to re-mediate teacher’s activity systems (Engestrom & Suntio, 2002) towards meaningful outcomes for the communities they serve.

The second edition of the student workshop coincided with a wave of interest on digital storytelling in the state, and momentum of significant achievement for students in the

quality of their work and their management of new technology platforms. Additionally, students learned along with technology new multicultural communicational code-meshing tools to actively shift terms of engagement in researching and drafting explanations and inferences for their science projects. It was clear that appropriating the tools for self-representation and the means of knowledge dissemination were important outcomes for our pedagogical and instructional options, as they were open to match the creative and research interests of students while ensuring academic science rigor, incorporating standard learning goals, and using of technology in formal and informal settings.

Figure 1.

Activity systems triangle model applied to the POSOH Sustainability Leadership Cohort (SLC) to visualize the relationship system between diverse stakeholders, institutions, and frameworks, as well as the role of the artifacts and the process.



The film workshop developed a three-week intensive collaboration between students, instructors, and members of the community in the processes of field research, film project,

scriptwriting, a television magazine production instruction and implementing process, and finally the last week of editing in the studio. The students wrote a final television magazine program about food and nutrition using a format consisting of independent reports articulated into a larger serial science news program. The increase in the level of confidence and self-representation from students agreeing to be the face of the program and segments was an important indicator of their increase in local capacity in the process of knowledge production. Two new young Native student anchors and seven reporters agreed to be the face of the program, thereby overcoming a historical muteness among American Indian youth (each group introduced the main presenter on-screen for each report). The topics also reflected an increase in their connection to their personal and collective science learning process. "Food for Thought," as the first television magazine pilot program made by Menominee youth, represented an important innovative contribution to community sustainable Indigenous education. It contributed to culturally relevant continuity as a source and channel for transformative pedagogies in the region that had a direct impact on school science learning engagement and academic achievement.

Findings

The initial POSOH project proposal to USDA made an inference that real measurable outcomes of capacity in the region triggered by our project, in the form of changes in teachers practice and rates of success from student's engagement in science and bioenergy related careers, could be determined 5 years after its implementation. A preliminary report completed in 2015 showed that as a result of our workshops initiated in 2013 and the emphasis on their leadership role, there was a significant change in the students' participation in service-learning programs. 70% of students participating in POSOH community education programs increased their interest and participation in bioenergy & sustainability-related experiences, along with interest in science related careers in sustainability. Yet, 31% of the students stated that they could not envision themselves in a

science job in the future, and 77% have not participated nor had the experience to participate in a science activity that was related to a job/industry specifically. Also, 69% of students reported they have not been engaged with an elder or community member in a science related activity or science career-related activity, while 35% did not have any awareness of science fair or science competitions that would be of interest to them. This is important considering that that year's Grade Point Average (GPA) from students participating in the Sustainability Leadership Cohorts increased during the course of the initial two years, which provides early evidence of potential long-term increases in student achievement and capacity for cross-cultural science knowledge construction.

The evaluation of qualitative data and observations about these students show also that more individual projects and higher levels of student participation in SLC activities were completed in the last year of the project. Additionally, these students "completed more assignments and have increased self-confidence in science content and instruction in classrooms, completing science experiments, completing science homework, and have increased interests in local applications of science and sustainability, and related career paths. One important conclusion is that outside of the SLC summer program for students, more connections between science, culture, and community are strongly needed in schools they attend. On average 77% of SLC students stated that in the classroom they hardly ever talk about science and culture connections, have community or family come to class to talk about science, or learn about science-related jobs they could find in their community. All these indicators make inferring that the SLC community education cohort's influence in finding evidence of student engagement in science and sustainability as an academic and professional path was possible.

By 2020, all my students without exception were success stories of achievement in different paths and careers. We walked together a path of presentations, conferences, visited schools, led community film screenings, and other related educational and community events, inspiring and talking in person to diverse communities. All of

them in college or graduated already and working in many fields, some of them now parents and researchers and practitioners, some leading projects in their reservations, universities, and across the state. As I have been appointed to lead the new summer immersion media workshop and new summer class of 2020, which is a formal component of a larger activity for sustainability and bio-cultural restoration in the three close and adjacent tribes in Northeast Wisconsin, the initial premises of students achievement and teachers adoption of collaborative frameworks that integrate diverse knowledge systems is today a reality.

Conclusions

Indigenous educational research has provided enough evidence to demonstrate that educational standardized content and pedagogies rooted in ethnocentric standards of western cultural epistemologies pose critical contradictions to current Indigenous sociocultural and historical processes of exercising political sovereignty. Sustainable coalitions, initiatives, and processes of local production of knowledge from community education and service-learning programs have an important opportunity to promote local capacity building in Indigenous cultural communities and should be important indicators for academic engagement and achievement in science and environmental education. Academic achievement for American Indian students and the resulting curriculum design and pedagogical strategies that are designed for them need to be redefined as part of the mutual negotiated learning processes that academic and cultural communities articulate through larger contexts outside of classrooms with clear outcomes that are in the best interest of the communities, the school and community education programs they

serve. These processes can incorporate respectful reflections on the sociopolitical and sociocultural conditions from placed-based sustainable and formal programmatic coalitions between reservation-based tribal educational institutions, public school administrations, research universities, community members, scientists, and educators.

Because of its multi-contextual and multi-directional uses, the digital media component is proving to be a strategic tool to assist in the reformulation, integration, and improvement of educational curriculum and instruction for historically disadvantaged Indigenous communities and survivors of European colonization. Indigenous de-globalized communities face constant threats to their geographical and socio-cultural boundaries around sovereign US Indian reservations and tribal communities. Educational digital media artifacts should not be considered activities themselves but parts of activity systems that incorporate learning and participation outcomes at larger contexts that will constitute local expressions of change. Contradictions within entire activity systems allow digital media artifacts to become powerful evidence that these dialogues are no longer confined to classrooms and schools. The use of educational media as a method of inquiry for local capacity building from informal community science education in Indigenous contexts also has the potential to preserve and promote sovereign forms of sustainable development. However, it is vital that this capacity emerges from expansive transformations of local placed-based curriculum and culturally relevant pedagogies (Ladson-Billings, 2003) that are consistent and respectful of Indigenous governance and educational self-determination.

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