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Critical Ancestral Computing: A Culturally Relevant Computer Science Education

Cueponcaxochitl Dianna Moreno Sandoval[1*]

[1]University of California, Los Angeles
Graduate School of Education and
Information Studies
(United States)

ABSTRACT

At first glance ancestral knowledge and computer science appear incompatible. Critical ancestral computing—socio-cultural and historical ecosystem approaches to solve complex problems—as an epistemological center for computer science education opens a pathway of critical consciousness, academic success and cultural relevance (Ladson-Billings, 2009). Weaving both disciplines to build a tapestry of critical ancestral computing in urban computer science education sets a stage for social transformation of present-day colonialism (Orelus, 2012). Critical ancestral computing feeds 1) a socio-historical learning context, 2) positive cultural academic identity formations, and 3) advocacy approaches that link engagement with society as individual and collective action by interrupting neocolonialism and prioritizing the health of social and environmental well-being.

Keywords: *critical ancestral computing, indigenous epistemology, critical theory, culturally relevant and responsive pedagogy, computer science education, Mesoamerica, urban education, decolonial scholarship.*

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1. Introduction

Centering ancestral knowledge systems as a primal focus in computer science (CS) education may promote social and physical sustainability where these do not exist. This paper illustrates a theoretical framework of critical ancestral computing (CAC), a culturally[1] relevant and ecologically responsible CS education that privileges

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[*]Corresponding Author:
Cueponcaxochitl Dianna Moreno Sandoval
University of California, Los Angeles
4442 Verdemour Avenue, El Sereno, CA 90032
E-mail: cueponca.xochitl@ucla.edu

[1] For purposes of this paper, I refer to culture as a fluid set of processes, that "create an artificial environment where young organisms could be provided with optimal conditions for growth. Such as tending required tools, perfected over generations and designed for specific tasks to which they were put. So close were the concepts of growing things and tools that the word for culture once referred to

indigenous[2] knowledge systems while critically examining socio-historical dynamics of power that impact underserved student populations. Critical ancestral computing engages generational knowledges and computer science learning as an approach to solving complex societal problems. The example of critical ancestral computing presented here is grounded in Mesoamerican (Kirchhoff, 1943)—ancient Mexican and Central American—epistemology and a Xicana Sacred Space (Díaz-Soto, Soon, Villarreal, and Campos, 2009), a method of reflexivity that relies on critical discourses, autoethnography and material practices through a focus on decolonial scholarship.[3] As a Xicana of Mesoamerican descent[4] trained in social science, my ancestral inquiry informs my engagement with computer science education. My position offers a unique perspective to the framing of this paper when considering the rapidly changing demographics of the United States.

Although the fastest growing population in the United States is of Mesoamerican-descent, positive cultural representations of Mesoamerica remain rare in public school education. Mesoamerican and other maize-based cultural knowledge systems native to the Americas[5] (Rodríguez, 2012) are superceded by a Eurocentric method of knowing. From this hegemonic perspective, we bear witness to present-day colonialism in a racially stratified society (Bonilla-Silva, 2001; Omi & Winant, 1994) that pushes Mesoamerican-descent peoples to the margins of what is considered institutional knowledge. Public schooling institutions were not designed to include a pluralistic epistemology that is built on the need to prepare students for their roles in an interdependent world. As a result, cultural groups at the margins of what is considered the canon of institutional knowledge are pushed out of schools. The Mesoamerican-

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ploughshares" (Cole, 1996, p. 143) In other words, culture points to behavioral practices that are fluid and dialectic. Culture is not to be seen as a categorical variable, but rather an always-changing process of making meaning.

[2] 'Indigenous' as an identity is not limited to a static concept. In this paper, it is not understood as an all-encompassing notion that spans the multiplicity of positions and experiences among indigenous peoples. The term *indigenous* is defined as "born or produced naturally in a land or region" (*Oxford English Dictionary*, 2010). In fact, indigenous comes from the Latin word—*indigena*—which means 'native.' And "Native peoples are communities or nations that have…governed themselves according to their own rules, and often have religious or creation stories that provide specific forms of [language], government, culture and territory" (Champagne & Abu-Saad, 2003) deriving from an ancient civilization. The current Mexica Movement calls this identity, *nican tlaca*, loosely translated to "we are here" as a term used to return to the ways in which we saw ourselves outside of the traditional notions of identity today (Berdan, Chance, Sandstrom, Stark, Taggart, and Umberger, 2008).

[3] More on critical ancestral computing in section 3 of this paper.

[4] I use Mesoamerican-descent peoples in this document to refer to Mexican and Central American-descent groups, revealing ancient cultural knowledge systems of the Americas. By contrast, using terms such as Latino/a and Hispanic, although traditionally used to describe peoples of Latin America, point to only European-rooted historicities. My use of Mesoamerican-descent peoples offers an acknowledgement of the over 3000 years of documented cultural roots of what we now refer to Mexico and Central America.

[5] I use maize-based cultural knowledge systems to refer to all peoples of the Americas who were united by corn-based cultures as the common denominator (Rodriguez, 2012).

descent school-age population remains the most undereducated major population group in the country (Gándara and Contreras, 2009). Systematic exclusion is particularly salient in computer science, one of the most segregated fields in education (Goode, 2007; Margolis, Estrella and Goode, 2008). One of every ten students who graduated with a computer science degree in 2008–2009 was of African, Mesoamerican or Native descent (Goode, 2007). The computing workforce also reflects this dearth of diversity. The National Center for Women and Information Technology (2011) reports that only 25 percent of computing professions were occupied by females: 3 percent African-American, 4 percent Asian and 1 percent Mesoamerican-descent. Native Americans were not reported. As technological applications become more salient, we must question the ways in which computer science knowledge is framed in public schooling and how this monolithic framing systematically excludes underserved populations from engaging in the production and questioning of CS.[6]

In this paper, I address some of the complexities concentrated in urban schools as I explore the question, "How might ancestral knowledges and computer science education co-construct an inquiry-based approach to solving complex societal problems?" After laying out a basic description of indigenous epistemology and computer science as historically separate worlds, I focus on three areas that may provide insight into ways in which underserved students can benefit most when an indigenous epistemology engages computer science teaching and learning. First, I explore identity formation under colonialism and develop ways in which historicizing and building upon computing in line with students' ancestral cultural knowledge systems promotes a positive ethnic and academic identity (Martin, 2000). Second, I discuss how centering indigenous ways of knowing within a computer science curriculum situates students' generational knowledges and connects them to their communities and ecologies. Driven by self-inquiry and reflexive practice, students may explore solutions to everyday problems in ways that engage inquiry-based approaches to civic participation. Third, I explore how critical ancestral computing in CS classrooms contribute to decolonizing theory and ultimately, a social transformation in the last section of this paper.

[6] Section 3 contains a more extensive discussion of CS.

2. Identity formation in public schooling

The public schooling system as a social institution reflects a historical process of a hierarchical classification of peoples, which began with the formation of America and world capitalism as a Euro-centered colonial/modern global power (Grosfoguel, 2004; Quijano, 2000). The establishment of this world power entailed the imposition and reproduction of a socially structured idea of race, "a mental construct that expresses colonial experience and that pervades the most important dimensions of world power, including its specific rationality: Eurocentrism" (Quijano, 2000, p. 215). This is often enforced through racial projects—"an interpretation, representation, or explanation of racial dynamics, and an effort to reorganize and redistribute resources along particular racial lines" (Omi and Winant, 1994, p. 56). The idea of 'race' as biologically structured and hierarchical "was not meant to explain just the external or physiognomic differences between the dominant and the dominated, but also the mental and cultural differences" (Quijano, 2000, p. 216). In addition, the pervasive ideology around the "cultural representation" (Omi and Winant, 1994, p. 66) of race reproduces the hegemonic structure of the coloniality of power (Quijano, 2000) or *el patrón del poder colonial* (McLaren, personal communication, July 30, 2011), which continues a living legacy of colonialism via racial, sexual, spiritual, legal, political, economic, and social hierarchical orders imposed by European colonialism that pervades our current approaches to being in the world (Orelus, 2012).

This unequal distribution of world power is reflected in the public schooling system, particularly in urban schools. People of color experience a systematic denial of their own socio-cultural histories as academic rigor, excellence, and wellness in classrooms and schools. The coloniality of power is ever-present in legislation and through the lack of opportunities in both curricular projects and in the educational system based on legislative hegemonic actions, described by Omi & Winant as racial projects. These racial projects (Omi and Winant, 1994) perpetuate a legacy of group disparities. For example, in 2010, Arizona's SB 2281 banned Mexican American Studies and prohibited the teaching of ancestral knowledge systems using the rationale that these historical knowledge systems would 'advocate ethnic solidarity instead of the treatment of pupils as individuals', etc. This legislation is a clear example of a racial project that pushes for a systematic denial of access to the original history of these lands and the people that originated in the Americas.

Groups with a long history of colonial relations with an imperial state are particularly vulnerable to negative representations of their identities (Grosfoguel, 2004). What is considered knowledge and what kind of knowledge is valid? The Eurocentric concept of "knowing" rests on an approach to logical knowledge that references a specific historical experience that considers all non-European peoples "objects" of knowledge, producing a hegemonic approach that dictates social institutional relations without questioning a pervasive ideology. A coloniality of power names the continuities in the "relationships of exploitation and domination between Westerners and non-Westerners that have been built during centuries of European colonial expansion, with an emphasis on cultural and social power relations" (Grosfoguel, 2004, p. 325). As Grosfoguel (2004) noted, "These ideas have configured a deep and persistent cultural formation that is reflected by a matrix of ideas, images, values, attitudes, and social practices, that do not cease to be implicated in relationships among people" (p. 326). National ideologies lead us to an unjust distribution of power. This creates dehumanizing practices that stifle creativity, particularly in K-12 science education (Barrow, 2010; Johnston, 2007; Rennera, Brown, Stiens, and Burton, 2010) and in urban centers, where power relations and practices are magnified (Anyon, 1997).

Overlaid with racial constructions, urban schools reflect a factory model that reproduces a division of labor designed to sustain economic imbalance (Bowles and Gintis, 1976; Tyack, 1974). Only an estimated 71.4 percent of Mesoamerican-descent students who enter the 9th grade in 2005 graduated from high school with a regular diploma in 2010. This is lower than the national average of 78 percent (Stillwell and Sable, 2013). Although high school graduation rates have increased over the years, especially after the creation and implementation of *El Plan de Santa Barbara*, college degree attainment remains a grave concern. Only 6.3 percent of Mesoamerican-descent groups received a Bachelor's degree in 2000 and 8.8 percent in 2010. Native Americans graduated with a Bachelor's at 0.7 and 0.8 percent respectively (U.S. Department of Education, 2012).

Moreover, urban students who attend public schools are often conditioned to "divorce ourselves from ourselves" (E. Morrell, personal communication, November 24, 2008) so that we "fit" into a dominant structure of knowing that follows the legacy of a coloniality of power. The effects are profound, and they have to do with the way we think of ourselves when we look at ourselves in the mirror. Non-dominant groups find ourselves operating within a colonizing framework and look at ourselves with a

distorted mirror in which our resistive agency and colonial forces—internal and external—clash:

> The tragedy is that we all have been led, knowingly or not, willingly or not, to see and to accept that image as our own reality. Because of it, for a very long time we have been what we are not, what we never should have been and what we never will be. And because of it we can never catch our real problems, much less solve them, except in only a partial or distorted way. (Quijano, 2000, p. 222)

At its core, this paper challenges the Eurocentric model of knowledge production. For these general reasons, we look towards unearthing our complex ancestral knowledges to develop positive cultural and academic identities. Coupled with the development of a critical awareness of the historical forces of colonization, especially in computer science, critical ancestral computing promises a sustainable approach to problem-solving engagement in schools.

Schooling practices reflect a systemic colonization process on a larger scale. Particularly, Kahn (2010) critically examines the uses of technology and mainstream media in the interest of the neoliberal marketplace as it promotes a hierarchy in labor production. Moreover, curriculum and instruction within STEM[7] and computing fields has historically been devoid of a multiplicity of knowledge systems (Eglash, 2001) while focusing on a consumerist approach to digital production, without regard to the environment and social inequity. Instead of rejecting technology in its totality, as Mander[8] (1991) suggested for the survival of indigenous nations, Eglash proposed that researchers look to the rich ancestral knowledge systems that live historically in the indigenous practices of students' everyday practices as "a potential source for changes in reconstructing identity, social position and access to power" (Eglash, 2001, p. 353). Ancestral knowledges pose complex systems through, for example, art, calendrics and archaeoastronomy (Carrasco and Sessions, 2011; Aveni, Ruggles and Urton, 2007). These systems are vulnerable to extinction within colonial forces that push for

[7] Science, Technology, Engineering, and Mathematics

[8] Churchill (1994) focused our attention on the fact that Mander, although pushing for indigenous rights, chose to include very few indigenous peoples themselves in his analysis of technological dangers to Indian Nations and the environment. Although Churchill (1994) agreed that Mander brought up some important arguments against technology, Churchill contested the fact that he only cited or quotes three indigenous people as "props, orchestrated by and large to accompany Mander's own 'universal' themes" (Churchill, 1994, p. 150). The list of contemporary native "leaders and philosophers" Mander mentioned is a gross underrepresentation. He included three indigenous scholars as contributors to knowledge, while actually silencing their collective voices. This, Churchill contended, perpetuates disregard for indigenous intellectualism.

epistemicide. Although Eglash does not provide a critique of the context in which he presents ancestral knowledges and practices or inform us about his positionality in studying 'the other', he proposes a space to engage the intellectual contributions of indigenous peoples through his use of culturally situated design tools[9] in the classroom. His approach looks at historically situated practices of underserved minority groups and brings to light the intellectual contributions of ancient civilizations. However, Mander's position against digital technology addresses the vital need to consider the health of the planet. Therefore, critical ancestral computing foregrounds digital production within a sustainable approach of interdependence of cultural production.

Yosso (2005) called on stakeholders to develop schools that acknowledge the multiple strengths of communities of color, shifting away from deficit views that capitalize on a culture of poverty or considering culture as "disabilities" and that these disabilities are clear fabrications of the "power of culture [itself] to disable" (McDermott and Varenne, 1995, p. 327). Curricula can and should engage the array of cultural knowledge, skills, and abilities diverse students bring from their communities into the classroom. For example, Martin's (2000, 2007, 2009a, 2009b) work in mathematics education shows that African American students' identities and agencies are affected by their participation in mathematics education. He argues "life experience as an African American, often characterized by struggle and social devaluation, makes it difficult to maintain a positive identity in the pursuit of mathematics knowledge" (2007, p. 157). Furthermore, when students are presented with positive examples of identity as long-time scientists in society, participation in mathematics knowledge as *doers* of mathematics becomes more salient.

As a non-dominant cultural group facing the coloniality of power, Mesoamerican participants of a schooling community can act in solidarity with other oppressed groups to combat—both silently and vociferously, subliminally and forcefully—present-day colonialism. These subversive actions bring forth an "oppositional consciousness" (Sandoval, 2000) that serves to dismantle the structures of power that are imbedded in a daily struggle to survive. Critical ancestral computing as a decolonizing practice reclaims a collective agency while unearthing what Kahn (2010) calls an "ecopedagogical praxis" that is "shaped by the power of human emotions, the cultural rituals of diverse ways of being, a deep respect for universal rights, and the integration of planetary consciousness" (p. xvi). Imagination is used to create spaces that honor and hold dignity intact as an alterative revolutionary practice that Grace Lee Boggs and

[9] For more information on culturally situated design tools, visit http://csdt.rpi.edu/.

Angela Davis presented during the 27th Annual Empowering Women of Color Conference in Berkeley, California[10]. Imagining and creating a culturally relevant and ecologically responsible computer science classroom calls for a focused, critical and sustainable approach.

3. Critical Ancestral Computing in a Computer Science Classroom

The first recorded use of "computing" was in 1629 as "Neuerthelesse the number of the Lacedæmonians may be attained by computing thus" (Oxford English Dictionary, 2012). Today, the word is used primarily to describe the uses of an electronic computer yet the definition of computing does not limit itself to digital devices; it reads: "the action or an instance of calculating or counting". Critical ancestral computing refers to socio-historical approaches that address approaches to complex problems while engaging in issues of social and physical sustainability. Critical ancestral computing promotes a multiplicity of knowledges by engaging in the worldviews of ancient civilizations as an on-going process of survival.

For example, computing with digital technology entails an all-too-often unquestioned consumerist approach that does not give due consideration to the myriad costs of its production. What materials are used to build digital technologies? Where do these materials originate and how are they processed? What happens to digital devices when they become obsolete? For considerations of these and other issues, I propose we turn to critical ancestral computing as a process that engages issues of social and physical sustainability and the living historical experiences of underserved groups in computer science.

While computer science is defined as "the branch of knowledge concerned with the construction, programming and operation and use of computers" (*Oxford English Dictionary*, 2010) the field's "impact on society" (Deek, 2003, p. 6) is the specific focus for teaching and learning in this paper. Although there may be significant differences between the terms *computer science*, *digital media*, *technology*, and *Internet,* for purposes of this paper, the terms are used synonymously with a focus on their common characteristics as a tool. The underlying commonality of these digitally technical processes is descriptors of creations that are based in or rely on 'computer science'. Computer science is a discipline that serves as a tool that has applicable

[10] For more information on the conference visit http://crg.berkeley.edu/content/revolution-conversation.

properties for a range of disciplines from the sciences to the arts. In addition, CS is a field that is transforming the ways we interact with the world in our personal, professional, academic and political lives. While CS is seen by many as the panacea for many of society's challenges, it is deeply troubling that an undiversified "exclusive band of our population is learning the skills and techniques imparted by computer science" (Margolis, Estrella, and Goode 2008, p. 4). Computer science is manifested through an

> urban and First World bent, masculine and white nature, predisposition toward the English language, isolating nature (community is achieved only with a very individualized and lonely interaction with a machine), information overload and triviality of images, and the Internet's inherent visual bias. (Brook and Boal, 1995, cited in Froehling 1997, p. 293).

Computer science's development demonstrates narrow components neocolonialism, an approach to living that premises the privatization of public services, preys on a competitive economic market while abusing the consumption of natural resources and deregulation.

Computing is not new to today's context, it has existed in all ancient civilizations. In Mesoamerica, *Pohua* (in Classical Nahuatl[11]) is defined as "to count; to read; take note of in a census; to relate; to measure" (Wood and Sullivan, 2013). As an example of intricate computing, Mesoamerican calendrical systems remain one of the most complex processes of counting time recorded history. In addition, archaeastronomy, calendrics, horticulture and body knowledge are advanced complex systems of understanding the world (Aveni, Ruggles and Urton, 2007; Carrasco and Sessions, 2011; Lopez-Austin, 1984). It is with this understanding that Mesoamerican descent peoples can see ourselves as those who are now engaged with an approach to measuring the world using different tools, including digital technology.

Naturally, resistance builds where there is tension between hierarchical dynamics of power (Darder, 2012; Apple, 1999). Mander (1991) provided a series of claims with his publications on advocacy against digital technology by advocating for its abolishment for the survival of Indian Nations. He asserts that digital technology harms indigenous peoples, who traditionally have been left out of the developments of computer science. In this paper, I add complexity to Mander's argument within the context of indigenous peoples in present day urban schooling practices. I propose a reciprocal relationship

[11] Classical Nahuatl is an indigenous Mexican language that is not spoken today. However, Nahuatl continues to be spoken in areas of Central Mexico and beyond.

that urban indigenous peoples might have with computing as mutual informants and call this relationship between indigenous knowledges and modern day digital technology, critical ancestral computing. I use the term *ancestral* as synonymous with *indigenous* because it links a generational connection to a lineage of people. However, I use both terms *ancestral* and *computing* to discuss a temporal relationship between people and tools.

Although indigenous peoples use technology in their everyday lives, the recent phenomenon of computer science lacks a critical perspective. It lives in an unquestioned isolated world of zeroes and ones that purports to advance national competition with other nations through its use of military enforcement and spatial discovery. This paper proposes an interrelationship between an indigenous pedagogy and computer science curriculum. An indigenous pedagogy is centered in the ancient ways of teaching and learning promoting a pluralistic understanding of the world. At its heart, an indigenous pedagogy aims to place students' indigenous knowledges at the center of teaching and learning, thus acknowledging that students' knowledge is valued outside the standard dynamics of power that essentialize "other" types of knowing and/or push them to the periphery.

Electronic computing, or technological systems, are both socially constructed and society shaping (Hughes, 1987). Dominant modern computing has largely been informed by a globalized "white supremacist, capitalist patriarchy" (Hooks, 2000, p. 159) that is divorced from indigenous epistemologies. More notably, the Internet, a popular sector of computer science, began as a child of military expediency, and its "technological superiority provided justification for the mythology of genetic differences in intelligence, the means of domination, and the colonial" (Eglash, 2001, p. 356). In 1983, the Defense Advance Research Projects Agency, a division of the U.S. Department of Defense, issued a document that spearheaded a proposal of a thousand-fold increase in computing power over five years. The "Strategic Computing Plan" was a directed effort to develop a new generation of military applications for computers (Mander, 1991). As such, computer science, as a branch of science, has been pedagogically void of diverse perspectives of the world (Buckingham, 2008; Harding, 1998; Rosser, 1995).

Mander's position against digital technology offers us insight into the complicated ecologies of "modernization." It is true that technological advancements for the sake of "modernizing" society have harmed the earth in a variety of ways—from their toxic production of material use and abusive waste sites to the ways in which they have

excluded groups of people from participating as civically engaged participants. Nonetheless, it is more complex than this. In the hands of a privileged few, computer science contributions have augmented the globalization process, which has pulled individuals away from their immediate environments. In other words, technological advancements have given us the tools to obtain information in seconds from across the globe, and, thus, are moving us away from localized forms of knowledge. At the same time, computer science is a powerful tool that has transformed a society, and the urban city in particular. Teenagers are using digital technology at higher rates than ever before. A study conducted by the Pew Research Center showed that 75 percent of 12-17 year olds own mobile phones and use text messaging as a main form of communication, with 50 percent sending 50 or more text messages a day in 2004 (Lenhart, 2010). It is unrealistic to advocate for the abolishment of digital technology for young people. Instead, we can explore how we may rely on our immediate environments for survival without relying so much on a petroleum-based economy and transition into more sustainable ways that protect social and environmental health. Mother Earth has rights[12], too!

We must find a common ground in which we can use and create socially responsible technologies that will place indigenous epistemologies at the center of teaching and learning. In the classroom, there are some practical approaches that one can make as an educator to be conscious of maximizing student participation. As educators, we can become thinking partners with students. We can teach 'systems thinking' to help students question simple explanations while looking for patterns in how things happen to understand how problems arise, and figure out a way to solve them (Booth Sweeney, 2001). Critical ancestral computing promotes a solution-oriented approach and considers the impact of computers on society, as part of a larger fabric that connects to a responsible use of technology, with a long-term vision. Table 1 details a few examples of critical ancestral computing within the computer science classroom.

[12] On November 2010 Bolivia's Plurinational Legislative Assembly released a Law of the Rights of Mother Earth which includes her rights to live free of contaminated water, soil and air as well as preserving the diversity of life. The extensive law acknowledges the way in which Indigenous nations worldwide preserve ancestral knowledge systems that nurture the health of Mother Earth. The law stipulates an alternative to a capitalist economy from a study of complex and critical theories.

STUDENTS	TEACHERS
Co-construct classroom norms	Model curiosity
Socio-cultural curiosity	Plan inquiry-based projects
Creativity	Engage in critical consciousness
Collective agency	Decolonial scholarship
Critical reflection	Promote interdependence
Ancestral inquiry	Scaffold learning
Consider environmental impacts	De-center pedagogy
Form critical inquiry	Promote peer accountability
Community of learners	Inspire life-long learning
Solution-oriented processes	Promote positive identities

Table 1. Elements of Critical Ancestral Computing Inquiry and Action

Teachers become thinking partners with students as students play a central role in co-constructing classroom norms. Educators can be thinking partners who guide students to discovery, experiments and explorations through questions that open our minds (Booth Sweeney, 2001). At the beginning of the year, for example, a teacher could offer an activity that asks students to work in cooperative groups to explore what they expect from the school year in a computer science class: “What are your goals for this class? What do you hope to learn? What might be the purpose of learning to create digital technology? How do you hope to work with others? What do you expect from the teacher? What do you expect from yourself?” Students can reflect on these questions on their own and then share with each other in a larger classroom discussion. The process may take a long time to arrive at a consensus when the students and teacher agree to a set of classroom norms, but over time, as teacher and students hold each other accountable to these norms, the classroom behaviors may create a sense of ownership from all participants to set up a community of practice (Wenger, 2010).

Table 2 shows Hollie’s (2012) commonly accepted cultural behaviors within a culturally relevant and responsive teaching and learning. I have adapted her chart to include a decolonial approach to presenting CAC in CS classrooms.

Cultural Behavior of Underserved Students	School Culture Behavioral Expectations and the Coloniality of Power
Sociocentric	Individualistic
Cooperative	Competitive
Ambiguous gender roles	Defined gender roles
Subjective	Objective
Circular learning	Sink or swim mentality
Relational	Linear
Dynamic attention span	Static attention span
Sense of immediacy	Standardized
Spontaneous	Prompted

Table 2. Elements of Cultural Behaviors and the Coloniality of Power in the Classroom

Although it is highly problematic to present information in a false binary fashion, Table 2 helps us generally theorize the dynamic cultural behaviors of underserved students and schools. This table should not be taken as a static approach for making sense of cultural behaviors, but rather a starting point for critical dialogue. Each context will vary. Critical ancestral computing encourages us to think about classroom norms in nuanced ways, or learning as movement (Gutierrez, 2008) that does not remain static. When underrepresented youth are given the opportunity to shape their learning in a field that has historically denied their presence, we move toward a decolonizing practice in public schooling.

4. Critical Ancestral Computing as Decolonizing Theory

Eglash continued to contest the dynamics of power by explaining that the traditional purview of technophilia often supposes that minority groups wait for information technology for salvation, rather than acknowledging and examining the long-seated traditions of computation and coding from indigenous peoples. Critical ancestral computing turns the aforementioned approach on its head by re-membering, or returning to a sense of interdependence with others and the environment. “Through *Tezcatlipoca*, a Chicano Indigenous epistemology/concept/principle that speaks to a critical reflection of self, family, and community that calls for the liberation of the mind and spirit, we help our students create their [stories]” (Romero, Arce and Cammarota,

2009, p. 218). In the longrun, a re-introduction of this philosophy may position young generations to consider the ultimate health of our environment while producing tools that will be useful to solve complex problems as they engage in critical ancestral computing.

An example of CAC creating web-design, video production, and radio communication as technologies for increasing awareness of social transformation revealed itself on the first days of effect of the North American Free Trade Agreement (NAFTA). On January 1, 1994, the Ejército Zapatista de la Liberación Nacional (EZLN, or the Zapatistas) occupied seven towns in the Mexican state of Chiapas (Froehling, 1997). Their unexpected presence directed the focus from a globalized policy to the localized resistance of indigenous peoples. The Zapatistas' demands created a network of supporters and launched worldwide dissemination of the ways in which NAFTA impacted their communities. In this case, a group of indigenous peoples used web design and video production to spread the news of their subversive acts. Through this medium, the Zapatistas incorporated critical ancestral computing for a specific purpose that challenged neocolonialist practices. Instead of complying with government policy that did not reflect a fair representation of their needs, the Zapatistas engaged in digital and non-digital production to create autonomous spaces of living. Currently, other communities in Mexico are creating radio transmitters to provide meaningful information to community members while maintaining their cultural heritage.

Similarly, another example that preserves ancestral knowledge as decolonizing theory is *Ventana A Mi Comunidad*,[13] a project of the Secretaría de Educación Pública (SEP). This project produced by the Intercultural and Bilingual Coordination Office of Mexico created a series of short videos narrated by members of communities that illustrate their indigenous practices of language, medicine, games, and song to preserve cultural knowledges. The videos include elders' and children's ancestral knowledges as it is pertinent to their roles in the community. The creators of the video series provided a narration that engaged the audience about indigenous knowledge systems as practiced today through animation, video, and music. In this case, indigenous communities used critical ancestral computing to share their teachings and learning ways of knowing through an interdisciplinary approach to health sciences and oral histories, for example. This is an example of how a community is using computer

[13] *Ventana A Mi Comunidad* is a series of YouTube videos that are produced by the Secretaría de Educación Pública in Mexico. "Serie de videos Ventana a mi Comunidad. Una producción de Videoservicios Profesionales SA de CV para la Coordinación General de Educación Intercultural y Bilingüe de la Secretaría de Educación Pública, México."

science to preserve its culture and reinforce a positive self-image that incorporates knowledge that has been preserved subversively for a very long time. In this way, indigenous communities become the producers of knowledge.

Producing technology in the CS classroom within the framework of a decolonizing theory may point to long-term efforts to social and physical sustainability of the environment. Before engaging with technological tools such as web design or 2-D animation, students can begin to deconstruct the impact of computer science uses on the environment through inquiry-based explorations. Building on a set of problem-solving skills, students could identify an issue that they wish to research in their communities. For example, students could focus on access to healthy foods in their communities while deconstructing food politics or food deserts and their relationship to health from a decolonial perspective[14]. This approach would include questioning food practices over time and studying ancestral foodways. After developing their research questions, they could use mobile phones to collect images (with the option of including mapping and time stamps) of examples of foods available in their neighborhoods: produce, fast food, grandmothers' fruit trees, etc., and categorize them accordingly. They could also record oral histories of their grandparents and create a living document online with their stories in order to preserve knowledge. After analyzing their own data, they could statistically and qualitatively narrate a powerful story. Their story could advocate for awareness within their communities about, for example, decolonizing diets using ancestral and native foods as a possible solution-oriented process for the onslaught of illnesses facing their communities. This is but one example that could be used to integrate bicultural understanding of self-knowledge and Western knowledge.

After a national survey of Mesoamerican descent peoples regarding information technology, the Tomas Rivera Policy Institute issued a report entitled *Latinos and Information Technology: The promise and the challenge* (Tornatzky, Macias, and Jones, 2002). Sponsored by the IBM Corporation, the report's goal was to focus national attention on how Mesoamericans can more "successfully engage and prosper by the expansion of Information Technology into their every aspect of modern life" (Tornatzy et al., 2002, p. i). This would be achieved through higher educational proficiencies and adaptation of "their cultural norms and behaviors to an entrepreneurial, fast-moving and global approach to business and life" (Tornatzky et al., 2002, p. i). It called for initiatives that would make digital technology more "culturally relevant" to Mesoamericans. But it is not enough to call for greater access to these

[14] See Decolonial Food for Thought at http://www.decolonialfoodforthought.com/

learning tools. Educators must also engage in the very ways that CS has been denied to specific cultural groups. The social context of CS production is imperative for innovation and subversive action. Operating with the preexisting cultural capital that exists within local communities is key for students to claim ownership of their learning and application, so that the community at large will support their efforts to maintain a relationship to schooling practices.

Eglash (2001) broadened "the category of 'information technology' to show how traditions of coding and computation from indigenous African practices […] have supported, resisted, and fused with the cybernetic histories of the West" (p. 353). He concludes that access to such information could potentially reconstruct identity, social positions, and access to power for underrepresented communities in computer science.

Faye (2001) described his experiences teaching Native science to students of Western science. In this case, we discuss the opposite of our previous examples, in that Native science is at the center of knowledge for students who are non-indigenous. Similar to the Pew Study (2009) on Mesoamerican-descent students living between two worlds, Faye (2001) found that teaching bilingually was the best approach. He would succeed in demonstrating the efficacy of Native science while validating Western science. In the meantime, he would include connections between both languages, thereby advancing the pluralism of the classroom setting. Similarly, the Pew Study (2009) found that Mesoamerican-descent youth who identified as bicultural and bilingual on a national survey that measured identity were more likely to succeed in school.

Returning to the term *indigenous*, native to the land, the focus of computer science through an indigenous pedagogy presupposes the use of the collective historical experiences of the community as the context for all learning in the school. As Deloria and Wildcat (2001) stated, indigenous peoples who historically and culturally connect to places can and do draw on power located in these places. Similarly, indigenous peoples may draw power from producing technology that has a larger purpose and give meaning to their everyday experiences. When educators are asked to incorporate students' background knowledge, despite standardized curricula, it becomes nearly impossible to *centralize* (rather than merely incorporate when appropriate) learning within students' locations and histories. Like Paulo Freire (1970) advocated the process of learning to be connected to the reading of a world through literacy practices, students, too, must own their learning experiences through their socio-historical locations. Educating indigenous peoples means that educators, as people who openly

admit to being learners who value and practice continual critical self-reflection, must become participants and observers in the community in a way that communicates genuine care (Valenzuela, 1999) and concern.

Cultivating a critical ancestral computing interrupts a neoliberal agenda to produce technology that values profit over people. A critical ancestral computing has the potential to spawn a social transformation of dignity for all by returning to "the voice of time and Mother Earth" (Huanacuni, 2010). Ancestral knowledges from all ancient civilizations hold a deep wisdom that can set the stage for critical consciousness, academic success and cultural relevance. Applying these knowledges when strategizing for present-day solutions to complex problems, with and/or without digital technology, may set the stage for social and physical sustainability of our future generations.

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