Cultural Constructionism: an Indigenous Computing Experience

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CULTURAL CONSTRUCTIONISM:
AN INDIGENOUS COMPUTING EXPERIENCE

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ABSTRACT

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Cultural Constructionism: An Indigenous Computing Experience

Directed by Professor Clayton H. Lewis

This dissertation is a semi-longitudinal investigation of the design, application and evaluation of a novel abstraction of two learning theories - William Demmert, Culture-Based Education and Seymour Papert, Constructionism, to form “Cultural Constructionism.” This study was driven by an interest to explore the linkage between cultural history and computing history and how they interplay in mind, culture, history and activity, in an effort to understand why there are so few Indigenous students in computing. This study investigates the potential of a learning theory that responds to Indigenous culture to support learning activities that can increase interest in the computing sciences.

The theory was used to guide the design of a computing workshop and to test the application of the theory in an intervention. The workshop provided the opportunity to observe and investigate its effects upon ten Indigenous high school students, who participated during the summer of 2010.

The students’ responses from discussion sessions that formed part of the workshop and during interviews at the end of the workshop were recorded. The ten
students were tracked between 2010 and 2015 to observe their choices for further education. During the passage of time, one student did choose computing as a subject of study.

In 2015 four of the students agreed to be interviewed, later one declined to allow his responses to be used in this research. These interviews contain the students’ reflections on the effects of workshop, and their views on the matters discussed during the workshop.

The results suggest that the Cultural Constructionism theory is useful in structuring educational activities in computing for Indigenous students. It shine a light on many challenges in the lives of Indigenous students, and suggest that the workshop had value for the participants in responding to these challenges beyond providing knowledge of computing.
DEDICATION

To My Father: for providing an education you never had

To My Mother: for providing a sense of adventure and exploration

Your lives ended too soon
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CHAPTER 1

INTRODUCTION

“Research into technology use by Native students may be a particularly rich field for evaluation and development studies … [however] … little research was available on the use of computers … with Native students.” (Demmert, 2001)

“There is a chronic underrepresentation of Indigenous people in STEM …” especially in the computing sciences (Bang, Medin, 2010),”.

This research investigates why Native Americans1 are underrepresented in computing, and how representation might be increased. The approach taken is to open a cultural space in learning theory, as applied to computing education. It explores how cultural history shapes identity and attitudes about education, as well as outlook on life more generally. Awareness of this cultural influence is badly needed in education in computing. Computing is a worldwide phenomenon adopted by many countries and cultures. However, Western production and education traditions are usually generalized for all people. To the contrary, this research finds production and education in computing to be a cultural activity influenced by its history.

Computing as the term used in this dissertation can be distinguished from related ideas of computer science and programming. Computer science is a body of theoretical ideas, often included in academic programs. Programming is the process

1 Native American, Native, Indian, American Indian, Indigenous, Alaskan Native, First Nations will be used interchangeable to indicate the original inhabitants on the northern continent prior to the accidental discovery.
preparing instructions for computers. Computing is the broader activity of applying the theoretical ideas of computer science and the skills of programming to the broader requirements of real work. Thus computing is an important human skill such as teamwork and communicating with clients.

It is said,

“... Culture shapes mind, that it provides us with the toolkit by which we construct not only our worlds but our very conceptions of ourselves and our powers ... you cannot understand mental activity unless you take into account the cultural setting and its resources, the very things that give mind its shape and scope. Learning, remembering, talking, imagining: all of them are made possible by participation in a culture” (Bruner, 1996).

With this in mind, should not culture be included in learning theory and in the computing education narrative with its association with human cognitive development? Constructivism, a dominant learning theory for computing (Ben-Ari, 1999), is based on the idea that learning is an active, situated and contextualized process of constructing knowledge. It brings past experiences into learning, and learning is linked to prior knowledge. Culture is a crucial part of prior knowledge. So, should not culture be included in the computing production and education narrative? Opening a space for culture in learning theory and the computing education narrative may be a requisite to increasing participation in the computing sciences. In this research, the inclusion of culture provides a more holistic understanding of the Indigenous experience, as “...
computing educational research is still emerging and searching for its shape” (Fincher, Petre, 2004).

Rogoff (2003) points out:

“Human development is a cultural process … to date; the study of human development has been based largely on research and theory coming from middle-class communities in Europe and North America. Such research and theory often have been assumed to generalize to all people. Indeed, many researchers make conclusions from work done in a single in overly general terms … For understanding cultural aspects of human development … people develop as participants in cultural communities. Their development can be understood only in light of the cultural practices and circumstances of their communities …” (Rogoff, 2003).

In academia, culture is brought to the forefront in human development (Rogoff, 2003), Cultural Psychology (Cole, 1996) and socio-history (Vygotsky, 1978). This current research brings culture to the forefront for local and global inclusion by opening a space for culture in learning theory especially for computing.

This research introduces a novel abstraction of two existing learning theories to form Cultural Constructionism. Cultural Constructionism builds on Constructionism (Papert, 1991) which “is both a theory of learning and a strategy for education” (Kafai, Resnick, 1996). It integrates Constructionism with William Demmert’s Culture-Based Education (2003). Cultural Constructionism is a theory aimed at a better understanding of cognitive factors producing low participation by Indigenous students in computing,
and a better understanding of how to create interventions in a cultural context to increase interest in the computing sciences.

As described above, Cultural Constructionism was formed from the prior theories by *abstraction* and *inheritance*, two computational paradigms (Resnick, 1996) used in this research to create a “mashup” of the two theories and their respective functions. The main claim of the combined theory is, “Historic cultural activity influences current learning activity in making public cultural artifacts.” Exploration of this idea provides insights into the problem of underrepresentation, as well as suggesting a solution. As Papert says, “the surrounding cultures [provide] a source of … materials … [and] all builders need material to build with … [however] culture may provide materials but [may] block their use” (Papert, 1991) Understanding how this blockage happens may point the way forward.

Two investigations were intertwined in the research. First was a historic investigation of computing initiatives, or its lack of, associated with the Indigenous experience. Second was a semi-longitudinal investigation of a computing workshop for young people conducted in 2010. The workshop was designed following the emerging principles of Cultural Constructionism, as the author was forming them.

The goal of the workshop was to provide a computing experience in a cultural context, for Native American students. As mentioned earlier, computing here refers to
the broad mix of activity of applying computer science concepts and programming skills to requirements of practical work. The workshop was led by the author, a computing professional. The students created a proposal and a working model of an interactive museum exhibit on Native American life. The exhibit was to provide a more comprehensive view of Native American life than the museum’s existing depiction of Native American life in a still diorama².

The investigation includes interviews with three students from the workshop conducted five years later, when the students were ages 21 and 22, in 2015. Why five years later? Because there is need for, “... time to build personal connections is an essential ingredient strikingly absent from most school learning situations” (Kafai, Resnick, 1996). Two Native American teachers from the workshop were also interviewed in the follow up, with the same questions as the former students. However, they were not used in this study but indicate similar responses as the students.

1.1 Hypotheses and Research Questions

This study of Cultural Constructionism explores the hypotheses that integrating culture-based education and constructionism in a learning experience for Indigenous students, 1) may increase interest in the Computing Sciences, 2) may have positive

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² Taking this approach can be seen as opening new opportunities for the Native American community to provide a corrective digital voice of actual Indigenous life, rather than an outdated narrative.
effect on students’ identity, attitude, and outlook on self and computing, and 3) may clarify how cultural history and computing history contribute to underrepresentation.

More specifically, the questions addressed in the research are:

1. What effect does Cultural Constructionism in a learning activity have on the educational plans of Native American students?
2. What effect does Cultural Constructionism in a learning activity have upon Native American students’ identity, attitude and outlook, on self and on computing?
3. How do Native American history and computing history contribute to the Indigenous computing experience?
4. Can Cultural Constructionism be used to improve the Native American computing experience and increase interest in the computing sciences?

1.2 Overview of the Dissertation

Chapter 2 provides a historical backdrop of literature related to Native American history and Native computing history. Chapter 3 develops Cultural Constructionism from its theoretical roots. Chapter 4 describes how Cultural Constructionism was used to design the workshop of study, and the methods used to record data from the workshop. Chapter 5 describes the interviews conducted five years after the workshop. Chapter 6 presents the students’ responses, as collected before, during, and after the workshop. Chapter 7 interprets the students’ responses, so as to place their experiences in the workshop in cultural context. Chapter 8 summarizes the main findings, and their implications for future work.
CHAPTER 2

HISTORICAL BACKGROUND

“The history of the development of the higher psychological functions is impossible without study of their prehistory...” (Vygotsky, 1978).

“... to understand why minority groups differ among themselves in school performance we have to know two things: the first is their own responses to their history of incorporation into U.S. society and their subsequent treatment or mistreatment by white Americans. The second is how their responses to that history and treatment affect their perceptions of and responses to schooling” (Ogbu, Simons 1998).

2.1. Underrepresentation

The National Science Foundation (NSF) and the Computing Research Association (CRA) Taulbee Survey for decades continue to report low participation for some groups in the computing sciences, especially for the Native American/Alaskan Native population. Their reporting continues to find that recent and past initiatives have failed to increase participation at all degree levels – Bachelor, Masters and PhDs (NSF, 2014, 2017).

In reviewing degree data from NSF statistical tables (NSF, 2014, 2017), below, for Native Americans in the computing sciences, it shows low levels of all degrees awarded to the Native American populations in comparison to other underrepresented populations and the White population.
The statistics of degrees awarded from 2000 to 2014 showed very low Native American degree attainment in the computing sciences. The table does show increase participation from 172 bachelor degrees awarded in 2000 to 278 degrees award in 2014. However, degrees awarded to Native Americans are strikingly low, in the single digits in comparison to African Americans and Hispanics.

Degree attainment at the Master’s degree level also indicates an increasing trend from 32 Master’s degrees awarded in 2000 to 56 degrees awarded in 2014. Again,
degrees awarded to Native Americans are strikingly low in comparison to African Americans and Hispanics in the hundreds.

Degree attainment at the Doctoral degree level also indicates an increasing trend from 0 Doctoral degrees awarded in 2000 to 7 degrees awarded in 2014. However the 7 degrees awarded is deceptive and an anomaly in degree attainment. On average for Doctoral degree attainment by Native Americans from 2000 to 2014, is about 1.5 per year and in several years no degrees were awarded.


The Taulbee Survey differs from NSF statistics in that it includes a section on the ethnicity of current faculty across institutions. The Taulbee Survey indicates there are only nine (9) American Indian/Alaska Natives who are on current tenured and tenure-tracks across 266 institutional departments in which 178 out of the 266 responded. The breakdowns of these positions are: One male as Full Professor; Two males and two females as Associate Professors; and two males and two females as Assistant Professors.

Two other Native Americans, one male and one female were reported as teaching faculty. There were no Native Americans as Non-Tenure-Track Research and
in Postdoc positions (Taulbee, 2016). Thus total Native American faculty reported by the Taulbee Survey is currently 11 across the 178 departments.

2.2 The Computing Education Pipeline

In general, computing education is concerned with human production. The pipeline, imagery or metaphor, refers to a feeding system that is not producing expected outcomes, with an implied need to fix areas to improve expected outputs. In computing, the pipeline refers to the collection of programs for exposure, learning and experiences in the educational institutions, which extends to the computing field. There is a wide acceptance of a growing requirement to create more human intellectual capital (people with the right skills and knowledge) in computing to support a country or countries’ initiatives to fill computing jobs. Filling jobs is necessary to stay competitive in today’s growing technology economy and communications sector. This growing requirement is driven by the continuing advances in computing. Simultaneously, there is a continuing call for inclusion of underrepresented minorities and women in the pipeline.

In the United States there are several complex issues related to computing and a need to address underlying dynamics that contribute to the problem in the pipeline scenario, especially for the underrepresented. In many cases in the underrepresented community there is no pipe, no opening, too many holes, thus only a dribble at the end.
Looking at the statistics, African-Americans comprise of 13.2% of the U.S. population (Dillion, et al., 2015), Hispanic women “increased from 7.2 in 2002 to 9.9% in 2012” (Gates, Hug, Thiry, 2013). Native Americans represent 1% to 2% of U.S. population. But these groups are not represented proportionally in computing. (Natalie, Simmonds, 2016). Further, compounding the issue, it is observed, “hiring of underrepresented minorities seems to be ‘stuck in neutral” (Gates, Hug, Thiry, 2013).

As far back as 1982, IEEE and ACM worked to establish standards and evaluation for academic programs with the Accreditation Board for Engineering and Technology (ABET) in the post-secondary educational sector. Post-secondary institutions saw computing as a science, related to mathematics and electrical engineering. However, at secondary institutions, computing was seen as teaching to a vocation rather than a science. Secondary institutions were not seeing and understanding the need to learn computing (Becker, 2001). This led to limited, or no computing courses in secondary institutions. Schools saw computers as word processors, and tools for presentations and web searches, and provided little if any experiences in computing itself. Thus students who did enter post-secondary institutions and chose computing as their major were ill prepared. This scenario indicated a need for uniform classes and certifications in secondary schools. Later, in creation of the Computer Science Teachers Association (CSTA) in 2004 out of Association for Computing Machinery (ACM), in conjunction with computer science
departments at colleges and universities, they developed curriculum and offered teacher certification to provide computing experiences.

Unfortunately there was little uptake of these resources in minority serving secondary schools. The underrepresented continued unprepared to enter the computing sciences (Gilbert-Valencia, 2014). “It is believed that if sufficient minorities are encouraged to enter the CS field [the pipeline], the racial disparities will disappear. Though important, such a focus tends to neglect the persistence of barriers to entry and retention of minorities into CS” (Varma, 2000). However, “There is little scholarly work related to the racial/ethnic gap in IT. Most work has been on broader issues of the under-representation of women in science and engineering, since it is assumed that many of the reasons that discourage women from science and engineering careers may also apply to minorities” (Varma, 2002).

Thus early exposure and experiences is needed at secondary institutions to raise graduation rates in post-secondary institutions. The STEM (Science, Technology, Engineering, Math) movement claims to include computing. However, the “T” in STEM often refers to the use of technology in the classroom to increase academic skills, rather than computing skills. More students are taking STEM courses, but they are taking fewer computing courses. Introductory CS education in secondary schools has “decreased by 17 percent from 2005” says Exploring Computer Science.org. They also point out that Advance Placement (AP) courses in computing have decreased by 33
percent, and that of 42,000 in U.S. high schools that teach computing courses, only 2,100 were certified to teach AP courses in 2011. So, there have been large leaks in the pipeline for all. However, more recent statistics has shown the trend is reversing.

To strengthen computing education in schools, the Computer Science Teachers Association (Stephenson, et al. 2005; Ericson, et al., 2008; Lang, et al., 2013) asserts:

1. Computing skills can provide direct benefit to the student.
2. When the narrative focuses on programming only, it does not give a proper broad view of the profession.
3. Experience with real world applications is important.
4. Interdisciplinary work, applying computing in other disciplines is important.
5. Curriculum should be designed for inclusion of underrepresented minorities and women

Agreement and contrary points to the above:

1. True, that computing skills can provide direct benefit that are applicable in school and for future career, such as problem solving and a structured way of thinking.
2. True, focusing on programming does not give a proper view of computing, however teachers and counselors do not have opportunity to be exposed to the broader field of computing in the real world, plus a need for continuous training to keep up as the field changes.
3. True, real world experience is important, but again, most teachers do not have real world experience, and professional certifications and credentials in the computing profession.
4. True, computing can be applied to other disciplines, however, most teachers are not trained in how computing can be applied in other disciplines.
5. True, curriculum should be designed for inclusion; however, there’s been little focus on this possibility.
These points are important. However, in view of issues with the pipeline, they are compounded for Native Americans. Due to their limited numbers, they are largely invisible in the public educational system. They sometimes stay in the background, feeling that education in general, and computing in particular, are incompatible with Indigenous community and culture, and are part of a resented process of assimilation and enculturation (Champagne, 2003).

2.3 History

As Champagne suggests, low enrollment in computing sciences needs to be viewed against the background of historical experience of forced education that is embedded in Indigenous culture. Forced education in the U. S., including Col. Richard Pratt’s experimentation at Carlisle Indian Boarding School (Reyhner, Eder, 2015) and other programs of forced enculturation and assimilation, influenced Indigenous views on education, as discussed further below. This treatment can be seen as contributory to a continuing negative view of education in general by many Native Americans. This attitude transfers over into computing education and influences identity, attitude and outlook on life.

In the United States, in a relatively short time (around 400 years) the Indigenous people moved from being the majority to becoming involuntary minorities (Ogbu, Simons, 1998). Also, U.S. and Indigenous history is strewn with broken treaties which
have sown distrust in the Indigenous mindset. These elements have become embedded as historic cultural memories passed forward to current generations.

2.3.1 Attitudes towards Education

The earliest account of Native American attitudes toward European style of education found was recorded by Benjamin Franklin from the Treaty of Lancaster in 1744. He says:

“After the principal business was settled, the commissioners from Virginia acquainted the Indians by a speech, that there was at Williamsburg a college, with a fund for educating Indian youth; and that, if the Six Nations would send down half a dozen of their young lads to that college, the government would take care that they should be well provided for, and instructed in all the learning of the white people ... when their speaker began, by expressing their deep sense of the kindness of the Virginia government, in making them that offer; ‘for we know,’ says he, ‘that you highly esteem the kind of learning taught in those Colleges, and that the maintenance of our young men, while with you, would be very expensive to you. We are convinced, therefore, that you mean to do us good by your proposal; and we thank you heartily. But you, who are wise, must know that different nations have different conceptions of things; and you will therefore not take it amiss, if our ideas of this kind of education happen not to be the same with yours. We have had some experience of it; several of our young people were formerly brought up at the colleges of the northern provinces; they were instructed in all your sciences; but, when they came back to us, they were bad runners, ignorant of every means of living in the woods, unable to bear either cold or hunger, knew neither how to build a cabin, take a deer, or kill an enemy, spoke our language imperfectly, were therefore neither fit for hunters, warriors, nor counselors; they were totally good for nothing. We are however not the less obliged by your kind offer, though we decline accepting it; and, to show our grateful sense of it, if the gentlemen of Virginia will send us a dozen of their sons, we will take great care of their education, instruct them in all we know, and make men of them’” (Franklin, 1839).
Interestingly, the speaker makes reference to what we call epistemology and cultural differences today, stating “different nations have different conceptions.” Also there is a question that still looms today asking, what is education? The Indigenous speaker references European science, and the Indigenous speaker in the above quote asks what value it has their form of education if people have not learned the survival skills needed in the world in which they live. The 21st Century educational movement today parallels the speaker’s comment on developing skills necessary to survive in the 21st Century. 21st Century skills, espouses the need for life and career skills, critical thinking, communication, problem solving and creativity, including technology skills (Rich, 2010). Amusingly, the speaker makes a counter offer by saying, “… if the gentlemen of Virginia will send us a dozen of their sons, we will take great care of their education, instruct them in all we know, and make ‘men’ of them.” So, from the past to today, what is education from an Indigenous perspective? Education claims to make students productive citizens, however, in curricula in secondary and post-secondary institutions there are no classes on maturity or becoming men and women.

In the 1800’s, the method changed from discussion in treaty making to forced assimilation. A comment from The Grand Council Fire of the American Indian in 1927 reflects the change that has become embedded in today’s attitudes. The spokesperson states:
“The white people, who are trying to make us over into their image, they want us to be what they call ‘assimilated,’ bringing the Indians into the mainstream and destroying our own way of life and our own cultural patterns. They believe we should be contented like those whose concept of happiness is materialistic and greedy, which is very different from our way. We want freedom from the white man rather than to be integrated. We don't want any part of the establishment, we want to be free to raise our children in our religion, in our ways, to be able to hunt and fish and live in peace. We don't want power, we don't want to be congressmen, or bankers ... we want to be ourselves. We want to have our heritage, because we are the owners of this land and because we belong here. The white man says, there is freedom and justice for all. We have had ‘freedom and justice,’ and that is why we have been almost exterminated. We shall not forget this (Lakotah, 2018).”

2.3.2 History of Indigenous Education

To understand factors leading to underlying educational issues, one must grasp Indigenous history with the Europeans through Indigenous eyes. The following figure, 2.1, illustrates three key time intervals in Indigenous history some derived from the Grand Council Fire comments in 1927 – time period from left to right, the time period prior to first contact, 1500’s to the 1800’s and 1900’s to 2015.

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3 The quote is found in several sources attributed to the council of 1927; however the primary source of the quote is unknown.
2.3.2.1 History Prior to 1492

History prior to 1492 can be seen as a time of freedom, with Indigenous people experiencing their own educational system, religion, government, land, food sources and culture. It was a time of autonomy. It was not a time of utopia, as some see it. Indigenous people had their wars and ongoing conflicts much like the other nations throughout the world.

Indian history and Indian education “is assumed to coincide with ‘European contact.’ This, of course is not the beginning of education. Indigenous people had been educating their children to become successful adult members of their communities for millennia (Medin, Bang, 2014).” The children’s education provided the necessary skills to live in their community and survive and thrive in their surroundings. This interval of time influences who the Indigenous people are. It is from this era that underlying
identity, attitude and outlook carry forward from yesterday to today for the Indigenous people.

2.3.2.2 History from 1500 to 1900

History from 1500 to 1900 can be seen as a time of loss of freedom, where Indigenous people move from being the majority to a minority (Ogbu, Simon, 1998) in their own land. Indian people experienced this as a time of forced assimilation and enculturation, socio-economically and educationally, and imposed religion and government. They also see it as time of greed for land, gold and other natural resources treasured by the Europeans and of their own loss of land, food sources and culture. More importantly, it was a time interval of distrust, due to a cycle of treaties made and broken, and a continual shrinkage of land and food sources. Since many treaties included food, shelter, education and clothing to corral the “Indian Problem,” it was also a movement from independent to dependence on the United State government for food, shelter and clothing for survival.

A key activity that still looms in the mind and attitude of the Indigenous people today was the start of forced boarding schools in the 1850’s by Col. Richard Pratt, based on his experiments managing Indian prisoners of war at Fort Marion, Florida. After this experience, he founded the Carlisle Indian Industrial School, in Carlisle, Pennsylvania in 1879. It was called experimentation at Carlisle, Pennsylvania for Indian children
The school “... played a significant role in policymakers’ efforts to solve the so-called ‘Indian problem’ ... government efforts to aggressively incorporate American Indians into the society engulfing them” (Pratt, 1964). According to Pratt’s autobiography, (Pratt, 1964), Pratt’s core belief was that Indians as a race were genetically the equal of whites, but that they were “culturally ‘savages,’ several steps below whites on the scale of ‘civilization.’” He believed “the Indians’ old cultural ways were all but irrelevant. Indeed, Pratt believed, the Indians’ only hope for survival was rapid cultural transformation along the lines of their conquerors. Hence, Pratt’s dictum: ‘Kill the Indian, save the man.’” His solution was to remove Indian youth from their tribal communities and place them in off-reservation boarding schools where they would be simultaneously stripped of their tribal heritage and tutored in the knowledge, skills, and belief of white society. For Pratt, environment was all. Just as environment had created savages, so a different environment would cause them to discard their tribal ways and lead them towards the promised land of Christian civilization” (Pratt, 1964). Boarding schools were created throughout the United States and several still exist today.

Interestingly, Pratt’s general concepts of assimilation and enculturation have parallels in general public education in the late 1800’s and early 1900’s for other groups as they immigrated to this country. John Dewey, an influential philosopher of education, in his speech to the National Education Association in 1902, has echoes of
Pratt’s version of education. Dewey saw “the power of the public schools to assimilate different races” (Dewey, 1902). He also says in the same speech, “the assimilation of the younger can hardly be complete or certain as long as the homes of the parents remain comparatively unaffected.”

The concept of systematic assimilation and enculturation, introduced by Pratt in the late 1800’s and developed by educationalist like Dewey in the 1900’s, is still a subtle principle within the educational system. Thus, the distrust of American governmental education in Indigenous identity and attitude still persist today; and the education system is still seen as a mechanism for assimilation and enculturation (Bang, Medin, 2013).

Dewey somewhat counteracts himself in his 1902 observation speech, “… observers in both New York and Chicago have recently sounded a note of alarm. They have called attention to the fact that in some respects the children are too rapidly, I will not say Americanized, but too rapidly de-nationalized. They lose the positive and conservative value of their own native traditions, their own native music, art and literature. They do not get complete initiation into the customs of their new country, and so are frequently left floating and unstable between the two.” Echoes of this challenge will be heard in voices of the Indigenous students in this study, “floating and unstable between the two.”
A key event impact in the 1800’s, was the collapse of the Indigenous population from an estimated high of 60 million or a low of 40 million people, depending on sources, to less than a million people by the very late 1800’s (Taylor, 2002). History says the reduction in population was due to disease brought over by the Europeans, to which they had no immunity, beside outright killing, loss of food sources, plagues, and even germ warfare when colonialists consciously gave smallpox infected blankets to the Native people (Fenn, 2000).

Today, in the 2000’s, the numbers still remain low. In recent censuses, the Indigenous population ranges from 1.5 million to 3 million, depending on how the data are reported, with the recent introduction of a multi-race category.

**2.3.2.3 History from 1900**

History from 1900 to today is seen from the Indigenous point of view, as a continuation of broken promises, and a continuation of living within a majority socio-economic system, education, religion and government.

During this time period several key laws were enacted, including the 1924 Indian Citizen Act, also known as the Snyder Act, allowing Indians to become citizens. The 1928 Meriam Report, officially titled, The Problem of Indian Administration, criticized the Department of Interior’s implementation of earlier laws, and overall conditions of
reservations and boarding schools; this influenced the Indian Reorganization Act of 1934. The Meriam report states:

“The survey staff finds itself obliged to say frankly and unequivocally that the provisions for the care of the Indian children in boarding schools are grossly inadequate ... The diet is deficient in quantity, quality and variety ... the best schools ... do not fully meet the requirements for the health and development of the children. At the worst schools, the situation is serious in the extreme ... the boarding schools are crowded materially beyond their capacities ... toilet facilities have in many cases not been increased proportionately ... not properly maintained ... soap and towels had been inadequate ... nearly every boarding school one will find children of 10, 11, and 12 spending four hours a day in more or less heavy industry work ... children not physically well-nourished ... nearly every boarding school visited furnished disquieting illustrations of failure to understand the underlying principles of human behavior” (Meriam, 1928).

The Indian Civil Rights Act of 1968 establishes the Bill of Rights for tribes. The Indian Education Act of 1972 was a major force for improving schools, with funding for culturally based curriculum, to increase teachers, developing language and cultural programs, and for parental participation. The Indian Self-Determination Act of 1975 required the federal government to sign contracts with federally recognized tribes, allowing them to administer funds for schools. The Native American Language Act of 1990 renounced past policies of eradicating Indian languages, and authorized use of these languages. The Bilingual Education Act of 1994 supported language and cultural programs. The Native Language/Immersion Program Act of 2006 seeks to prevent loss
of heritage and culture. All of these are key acts in support of Indigenous voices in rights, cultural heritage and education.

Against this background the Indigenous people form their opinion of the American educational system today. Even the progressive education movement of the 1930’s and 1940’s subtly “reinforced ideals of democracy and a faith in science rather than traditional Amerindian ways of life” (Watras, 2004). Most attempts at schooling were based on idealized visions rather than on understanding the situation. Even today, attempts from the “outside” cannot enable “Native Americans to protect their cultural orientations.” (Watras, 2004). In a way, schooling is still a forced practice, echoing Pratt’s own words from his autobiography at a Baptist Convention in 1883, saying, “In Indian civilization I am a Baptist because I believe in immersing the Indians in our civilization and when we get them under holding them there until they are thoroughly soaked” (Pratt, 1964).

In the 21st century, distrust continues, despite some gains on land, autonomy, socio-economics, food sources, and culture. There persist low graduation rates, low job opportunities on and near reservations, and in larger cities. There also persist low computing knowledge and skills within the Indigenous community.
2.4 Present Effects of Cultural History

This passing of cultural memories forward, engages the mechanism of distributed cognition (Cole, Engeström, 1993) in constructionism. Constructionism sees a person as being voluntarily active in their learning, carrying out knowledge construction. However, cultural memories passed forward can be seen as contributing to involuntary construction of knowledge in a human’s formative years. Being active in one’s learning and knowledge construction can see seen as voluntary construction.

In a sense, these two constructions act as a mechanism passing from the past to current generations. A student in this situation has an “ongoing present experience that accrue from the past as though they constitute a shared familiar past … as an instance of cultural-historically formed beliefs and actions across generations” (Enciso, 2015). Figure 2.2 illustrate historic events driving involuntary construction. Thus, today, Indigenous attitude and identity contain a mixture of autonomy and dependence, complicating how schooling is viewed.
Another mechanism of cultural influence is prolepsis, a “cultural mechanism that brings the ‘end to the beginning’” (Cole, 1996). Cole (1996) explains prolepsis: “[A] culture-using human being [,] can ‘reach into’ the cultural past, project it into the future, and then ‘carry’ that conceptual future ‘back’ into the present to create the sociocultural environment of the newcomer” (Cole, 1996).

Cole’s prolepsis framework describes how parental influence of past experience interplay in raising her child. In his framework, see Figure 2.3, (A) a mother in raising her child, looks back on her own history, (B) then looks forward in time and (C) raises her child according to her experiences.
In this framework, we see involuntary construction and voluntary construction, as a parent who was influenced by previous generations or had first-hand experience living as an Indigenous person in America, looks at her child and sees a world that has not changed in her lifetime and raises her child (involuntary construction on the child’s part), who acquires a similar identity and attitude of the world, (voluntary construction). However, Cole’s view of child rearing is from a Western single family perspective and does not generalize fully to the Indigenous population. His framework was modified in Figure 2.4, to indicate dynamic influences of cultural history and extended family.
This modified framework better reflects Indigenous family structure. It includes not only the mother (A) but also the extended family (A2), how the culture looks back upon historical events (B2) and influences the child (C2).

The perspective of distributed cognition provides another view of involuntary construction. In this perspective (Hutchins, 1991, 1995) cognition and knowledge are not confined to an individual, but rather are distributed across objects, individuals, artifacts and tools in the environment. This reinforces the view that a child’s cognition develops in a large socio-cultural-historic structure. Cole and Engeström (1993) work also include distributed cognition as a “… historically accumulated culturally organized knowledge …” Rogoff (2003) state, human development is a “cultural process.” And the Indigenous cognitive process covers many generations.
These mechanisms bring out how cultural memories are passed forward from historical events within the family structure that influences the mindset and educational mindset of the indigenous people today.

2.5 Computing Education: Indigenous history

In understanding computing education for Indigenous students, Indigenous history is relevant, not only of education in general, as we’ve seen, but of computing in particular. Figure 2.5 presents an overview of historical events in Indigenous computing education, from the emergence of the first literature in the 1970’s. The following sections survey the record. The record is not extensive.
Figure 2.5 Timeline: Indigenous Computing Education

In 2001, a review of educational literature by the late William Demmert Jr. (2001), a prominent Indigenous educational scholar, noted two issues concerning Indigenous education; 1) there is limited evaluative research using technology and 2) limited human development research using technology. These two elements prompted Demmert in the positive to say: “Research into technology used by Native students may be a particularly rich field for evaluation and development studies.”

Although Demmert does not reference the computing sciences specifically, his extensive literature review shows the lack of research in computing education. When
educational studies did involve Indigenous students, technology, and computing, it was found that the researchers were interested more in increasing general academic skills in reading, writing and math, not in computing. Although there is a growing body of literature of computing education, there is a continuing problem with limited studies that involve Native American students due to population size.

The National Center for Education Statistics, Status and Trends in the Education of Racial and Ethnic Groups says:

“...The relatively small sizes of the American Indian/Alaska Native and Pacific Islander populations pose many measurement difficulties when conducting statistical analyses. Even in larger surveys, the numbers of American Indians/Alaska Natives and Pacific Islanders included in a sample are often small. Researchers studying data on these two populations often face small sample sizes that reduce the reliability of results. Survey data for American Indians/Alaska Natives often have somewhat higher standard errors than data for other racial/ethnic groups. Due to large standard errors, differences that appear substantial are often not statistically significant and, therefore, not cited in the text (Musu-Gillette, et al., 2016).”

2.5.1 1970’s

In the earliest paper found related to computing and computing education by a visiting professor, describes the Navajo Tribal College’s (NTC), now Navajo Technical University (NTU), the first purchase and implementation of a computer system, which as the first for any tribal college. The purchase enabled the college to use the computer
for instructional usage. More importantly, Navajo students were learning, “TUTOR, a self-instructional package on the fundamentals of BASIC.” NTC now had the opportunity to teach data processing and computer programming that could not be taught prior to the purchase. It provided opportunities to learn computing from a job standpoint – Native Americans were hired and trained to fully support the new machine. This purchase opened the first doors “to many new computer career opportunities for students on the reservation” (Roth, 1976).

In 1978 Roth described the development of course work in computer science, with a visiting professor funded through IBM’s “Minority College Assistance Program.” It laid the foundation for a computing program. He noted that there was a need to further develop curriculum to “open doors to career opportunities in data processing for Native American students.” Five courses were designed: 1) CS 100 – Introductory Data Process – a non-programming course due to minimal exposure to modern technology and scientific development; 2) CS 150 Computer Programming – teaching BASIC, BASIC-PLUS, BASIC-PLUS EXTENDED for programming experiences; 3) CS 151 Advance Programming in algorithm design, program development and coding; 4) CS 198 Independent Study – advance programming concepts and work with COBOL and FORTRAN; 5) CS 199 System Analysis – an introduction to system concepts and tools for analysis, decision making, project planning and control and philosophical foundations.
These two papers are landmarks, opening the first doors to computing for students at a Tribal College. I have found no other descriptions of programs in the 1970’s for Indigenous students in tribal or public schools or post-secondary institutions.  

2.5.2 1980’s

In the 1980’s Diessner et al. used Papert’s LOGO language in a program for Native students in Canada, not in the United States (Diessner, Rouscul, Walker, 1985). Although the students learned LOGO programming, the study was aimed more at increasing academic skills in reading, writing and math rather than at computing (Carnew, Clark, 1985). Results from this study did positively affect cognitive abilities, improved achievement in reading and writing, however did not affect students’ attitude towards academic subject or in math. Other studies were in this era used computers, however they were using computers in assisted learning, again, to increase writing, attitudes, academic and cognitive skills (Diessner, Rouscul, Walker, 1985; Bennett, 1987).

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4 However, this Indigenous person developed interest in computing in the late 1960 after three professors from a nearby college visited his high school math class. I just happened to be there and it sounded interesting. Later throughout the year, the math teacher took us around surrounding business to visit their computer facilities that kept my interest. When I graduated, I chose Computer Science as my major in college.
2.5.3 1990’s

In 1992, an American Indian Summer Institute in Computer Science, funded by the National Science Foundation, was held at the University of California Irvine. Fifty Native American students were invited from 27 Tribal Colleges and other community colleges in the United States. It was an eight week program, providing hands-on learning and internships at several major corporations. It was a first of its kind, directed by Lubomir Bic (Gustafson, 1993), however this program does not indicate whether any Indigenous students went on to study computing.

In 1999, two papers appeared that foreshadow the current study, with its emphasis on the importance of culture. Langhorst and Cleave (1999) describe “Components of a Successful American Indian Computer Science Program” at a tribal community college, funded by the National Science Foundation to increase diversity in the computing sciences. The program was based on broad traditional values. The paper recognizes Indigenous history and the effect of the United States policy of assimilation: “annihilating entire tribe, displacing countless others and destroying much of cultural heritage of those who survived” as an answer to “The Indian Problem.” “Such atrocities are not soon forgotten and racial discrimination, although these days often not overt, most certainly is also not relegated to the past”. The authors also note that “this mistrust needs to be understood and overcome in the classroom before significant progress can be made.” The approach for the program was based on American Indian values “all
things are related and interconnected.” Additional values were added as “respect for oneself, others, earth and tradition, cooperation, honor and giving back to the community, including humor and spirituality. Their model included six components: 1) having relevant examples for computing; 2) hands-on activities in computing labs; 3) core course integration across curriculum; 4) integrating tribal language as a core in the course work; 5) projects that are relevant to their Indigenous culture and for the student; 6) community building was a key to the success of the program. Langhorst and Cleave (1999) say, “we firmly believe the core of minority-centered education should be sound teaching strategies applied to a specific population but applicable to and effective for all students.”

1999 also saw publication of the first work on *ethnocomputing* (Eglash, 1999). Eglash creates software (web-based applets) that link ethnic design concepts to mathematics. While Eglash’s first work was aimed at African culture, in later work he incorporated designs from several Native American traditions, showing how Native American bead work on a virtual loom uses Cartesian coordinates. He has created like software for Pacific Northwest Basket Weaver designs, Navajo Rug Weavers, Anishinaabe Arcs for angles and coordinates, Yupik star navigator for counting and modular math, and Yupik parka Patterns for transformational geometry.

The 1990’s also saw increased national attention to computing education, including some consideration of Indigenous education. In 1991, congress enacted the
High-Performance Computing act. They saw advancing computer science and technology as vital to the nation, in face of other countries challenging the United States leadership in technology. Although there were no references to Indigenous students or other underrepresented groups, there was a call to expand education and research for undergraduates and graduates in the computing sciences at educational institutions (Congress, 1991).

In 1995 the Office of Technology Assessment and Congress issued the first major infrastructure paper to discuss issues, activities and opportunities for Native Americans to use telecommunications (network, videoconferencing, multimedia, and digital and wireless technologies) in culture, education, health, economics and governance. The report “examines the potential of telecommunications to improve the socioeconomic conditions of Native Americans – American Indian, Alaska Natives and Native Hawaiians – living in rural remote areas, and to help them maintain their culture and exercise control over their lives and destinies” (OTA, 1995). The Congressional document speaks of National Science Foundation programs, societies such as American Indian Science and Engineering Society (AISES), and tribal colleges computer sciences offerings that can support infrastructure development. In 1999 the Benton Foundation followed up the OTA report with a comprehensive overview of basic facts and activities in Indian country (Benton, 1999). However, the data is at the surface level, and the report does not address the underlying reasons for low adoption.
2.5.4 2000’s

In 2000, a report of a cyber conference on the “research foundations on successful participation of underrepresented minorities in Information Technology” (Garcia, Giles, 2000) criticized the OTA and Benton reports for assuming that lack of infrastructure was “the” problem. It identifies other issues, including weak economic base, lack of skills to support modern technology infrastructure, distrust of new technologies, lack of investment on tribal land, poor information on availability of federal assistance and weak government policies to help Native communities on technology infrastructure. It calls for a balance between education and training, to motivate “potential IT workers and enabling them with a broad vision of the field, as relevant to their long term career path … [for] … strong attraction of immediacy for a job …” The report recognizes the importance of secondary programs to support career selection in the IT field, as well as the need for proper STEM academics for post-secondary success. It also recognizes the importance of parental involvement and role models and mentoring at secondary and post-secondary institutions. However, like the other reports, it addresses problems at a surface level, and does not seek underlying factors as to why there is a lack of interest in education and in computing. A 2001 study of computing in two tribal schools also directed attention towards cultural issues, and away from infrastructure. One of the schools were supportive and the other not supportive of technology. The major finding
was “… the digital divide is not so much caused by the lack of funds and material as it is by the difference in cultural values” (Guice, et al., 2001).

Delgado explores some of the cultural issues connected with technology in a 2000 essay (Delgado, 2000). She argues that technology for Native America is a “double edged sword.” Technology promotes a disparity “among have and have-nots.” It is accepting the “effects of the machine” without considering the consequences and “dark side” of technology. Technology is seen as an “invasion of privacy,” it is “misuse of control,” a domain for “personal gain,” it “promotes good and bad … [and] … needs ethical attention.” Delgado says:

“Most Native people have been taught that the natural order of living and the simple things in life are what keep our people sane. I do not know to what extent the Western personality can appreciate this mind set; what is obvious is that some have assumed that a slowness to adopt technology reflects a lack of Native ambition and have not recognized the ancient, ecological logic that goes with it.”

In another critical essay, from an Indigenous writer on technology and globalization are seen as “… potentially more dangerous than the last five hundred years of colonial contact” (Champagne, 2002). Champagne says, technology,

“… pose[s] serious threats to Native political, cultural and economic continuity … Native communities will have to accommodate competitive global markets … The cost of not being … engaged in the market is continued economic marginalization … Greater emphasis on self-determination for Native communities means gaining an economic base and developing more effective tribal government[s]” (Champagne, 2002).
In Champagne’s view, globalized culture and technology implies an adaptation of assimilation and homogenization, and that it will be a more effective mechanism of assimilation and enculturation than colonialization policies Native Americans faced in the past centuries and today. The events of technology and globalization are threats to Nation building. However, he says,

“The mode of change, the way that Native groups will respond to this new world, will be similar to patterns of Native change in the past. The responses of Native communities to the twenty-first century will be guided by their cultural and social order … if we are going to be Native nations, we must carry our world views and holistic social-cosmic relations with us into the future” (Champagne, 2002).

He also says, “If Native nations try to adopt Western or American institutions, it is doubtful they will work in Native communities … [and] … the past two centuries, government policies imposed American institutions on Native communities … were never a cultural match …” (Champagne, 2002).

In a 2004 article in the Journal of Law, Technology, and Policy, on the lack of adoption of computing in Native communities, Therese Bissell acknowledges cultural concerns, and their historical origins:

“There is concern that technology will penetrate deeply into Native American communities and lead to greater costs than benefits. … There is concern that technological processes of assimilation will dominate and thus be an effective way of homogenizing Native American communities.
In general, there is a feeling that if Native American nations try to adopt Western or American institutions they will be unsuccessful in Native communities. As previously discussed, past attempts to assimilate Native Americans into American society have had tragic consequences...Given the history of Native Americans in this country, it is not surprising that many are reluctant to embrace technological developments that could potentially lead to greater assimilation and loss of identity and traditions. (p 143)

Bissell nevertheless argues strongly that Native communities must find a way to resolve these issues, since “The lack of information technology on reservations puts Native Americans at a disadvantage when they seek education or employment, for without access to such things as computers and the Internet, they often lack the tools and technical experience needed for many of today’s jobs. (p. 150)”

A National Science Foundation workshop in 2002 sought the advice from the Indigenous community on how to evaluate programs from a cultural perspective (NSF, 2002). The session was organized around three themes: academic achievement of Native students, education/training opportunities for Native evaluators, and developing, maintaining and expanding a network of Native evaluators. A key presentation by one of the participants stressed the importance of historical context and its effect on worldview, values and learning, referring to internalized oppression (Duran, Duran, 1995). She noted a comment from an elder, Lee Staples, saying there is a need for Indians to learn, work and to understand internalized oppression and its effect, otherwise it will subtly affect educational efforts (Staples, 2002).
A key researcher active from the beginning of the 2000’s is Roli Varma of the University of New Mexico, an early researcher on the subject of Native Americans and computing, with an influential series of papers. In, 2000, she noted that computing programs neglected diverse student needs. Her paper spoke about making course work relevant to underrepresented students. She says, “… the CS classroom is not attuned to the emerging needs of students and lacks new ways to make use of diversity brought by minorities” (Varma, 2000). The students felt intimidated because minorities had limited math and computing, and a lack of high school programs that prepared them for college. In 2002, she reported research to understand “what makes women and minority students attach to or detach from … IT related fields” (Varma, 2002), which included Native students. She cited as reasons for this condition 1) the Digital Divide, by which students had no or limited access to computers; 2) Biases in early socialization, with students not seeing themselves in the science, teachers favoring whites and Asians, and teachers not advising Natives to take computing courses; 3) self-doubt in Math and Computing, with Native students less positive towards math and computing, not viewing math as strong subject, and they were not well prepared in high school for computing, and thus not feeling the need to prove themselves to the teacher; 4) Felt need to identify with geek culture, which students often did not want to do; and 5) Wanting to leave, with students finding it hard to support a demanding program of study with a heavy workload, with little financial support and other
demands from family. In 2003 Varma reported a study of minority retention which included Native American students. She reports that while more minority students are starting degree programs in computing, few were graduating (Varma, 2003). In 2004 Varma presented a study of the communication climate in computer science classrooms that included Native American students. She found a homophily effect, a tendency for individuals to associate and bond with similar others. She emphasize the importance of how teachers “communicate to students, the way students treat peers and whether women and minority students feel a part of the culture … “(Varma, 2004).

In 2005, Varma produced a key study with Native Americans in IT with a research question asking, “Why there are very few Native Americans pursuing a degree in CS/CE?” (Varma, 2005). She cites several reasons: 1) the lack of computer resources in communities, leading to non-exposure and unfamiliarity with CS/CE programs; 2) low participation due to perceived conflict with traditional culture; 3) low high school graduation rates and low number of Native Americans in higher education generally; 4) low exposure and interest among parents; 5) lack of cultural value of doing well in school; and 6) lack of visible career paths for Native American students in CS/CE (Varma, 2005). In a 2009 review, Varma concludes, “[C]ultural, social, and economic factors juxtapose and complement each other, and one without the other would not be adequate to explain the challenges Native Americans face in CS education. … [promotion of CS education] must be done hand-in-hand with the incorporation of
Native values, so that it does not translate into a risk for Native American culture, but instead slowly and smoothly grows to become part of it.” (Varma, 2009).

The 2000’s saw a technical development with potential significance for CS education, the emergence of technology for supporting Native languages. In 2004, the author wrote a Master’s thesis on a JAVA based object oriented database as a framework for an Indigenous heritage preservation system (Pohawpatchoko, 2004). By 2006 and beyond, working language applications ideas were starting to appear from other Indigenous programmers on language revitalization (White, 2006). The importance of this development is three-fold; 1) it illustrates the value of technology as an inter-cultural tool; 2) the development is driven from within the Native American community; and 3) it provides more exposure and experience in computing within the Indigenous community.

2.5.5 2010’s

This decade sees several studies responding to the need for cultural engagement in computing education for Indigenous students. Pohawpatchoko (2010) is a preliminary report on the workshop that forms part of the present study. Lameman, et al. (2010), reports on a cultural curriculum for Native students for the design of video games and virtual environments. The instruction included design, art, animation, audio and programming using traditional storytelling techniques in Second Life – a virtual
online world. The authors say, it provided “substantial motivation for both further inquiry into the stories and greater participation in the skills development” (Lameman, et al, 2010).

Weston and Biin employed Indigenous storytelling using programmable JAVA animations in the Alice system to increase “interest in technology careers for Aboriginal learners, as well as increasing cultural literacy” (Weston, Biin, 2013). Unfortunately it is not clear that the cultural connection worked: the investigators found that the students did not see cultural dimensions in the stories they created. They plan to use traditional language, inclusion of elders and time “on the land” in their future work (Weston, Biin, 2013).

Kafai, Searle, Martinez, and Brayboy (2014) used Eglash’s ethnomcomputing concept in an intervention using electronic textile, with the LilyPad Arduino sew-able electronic components, leveraging traditional crafting and sewing to learn about engineering and computing. They report that while the activities were intended to be linked to Indigenous culture, the students were not always interested in these links, and sometimes lacked the cultural knowledge themselves that the activities were supposed to connect to. They note complex issues here: “Craft, like many other types of Indigenous knowledge, is rooted in particular places and connected to activities that extend beyond the space of a classroom and a computer screen. For instance, when we think about integrating community basket weaving practices with e-textiles materials,
we know that there are certain times of the year during which reeds for making baskets can be collected. We also know that particular designs have cosmological significance, ties to origin stories, and are expressed within local aesthetic frameworks. Knowledges of these designs is not something that can be learned by anyone, but something that the learner must be prepared to know, coming to understand the responsibility that comes with such knowledge and the protocols for appropriate use. What might it look like to more fully engage cultural contexts in culturally responsive computing for Native American youth and communities? Would such an approach more fully engage participants and facilitate relationship building amongst participants and between participants and instructors?” (Kafai, 2014).

On the policy front, in 2012, NSF created a strategic plan for broadening Participation in the K-16 pipeline, which included graduate programs and faculty for the underrepresented and Native Americans (NSF, 2012). It noted that it “will take sustaining commitment” to accomplish the goals of the program, which include inclusion of underrepresented groups in research and awards.

Overall, this section indicated there was educational activity but not sustained active that increased interest in computing. However, in 2016, the Obama administration established a “Computer Science for All” initiative aimed at empowering “generation of American students with the computer science skills they need to thrive in a digital economy” (Smith, 2016). Promoters of the initiative mentions
Native Americans among groups underrepresented in computer science today, but it does not appear that the educational programs developed for the initiative contains material specifically for Native American learners.
CHAPTER 3

Cultural Constructionism Theory

“If bricolage is a model for how scientifically legitimate theories are built, then we can begin to develop a greater respect for ourselves as bricoleurs.” Papert, 1993, Mindstorms

3.1 Introduction

Little does a person know that the things that fascinate us early in life will turn out to be our life’s interest. Seymour Papert (1993), early in his childhood, said he developed an interest in chains of cause and effect as he played with automobiles and gears. It served later as a model to understand Piaget’s notion of cognitive assimilation. William Demmert (2005) in his paper on the influence of culture on learning said, he was in a speed reading class and noticed how reading in a cultural context helped in reading, comprehension and learning. I too early in life noticed how musical sounds had effect on people, and later, how historic events had an effect on identity, outlook and learning. Like Papert and Demmert, my curiosity about cause and effect led to theoretical questions on how knowledge is constructed and how historic events and culture influence cognition.

When I was a computing major in college, a friend introduced me to Isaac Asimov’s, 1950, “I, Robot.” At that time in the late 60’s, behaviorism was the main psychological theory being taught. I felt like an aberrant behaviorist humanoid,
controlled by stimulus and response, wandering the academic halls. However, the Asimov book piqued my interest in psychology, the environment and computing. It continues to provide a platform for reflection on how humans process knowledge. It also ties in with my interests in how historic events become embedded in culture, and serve as a background story in the human condition. These interests have led to my theoretical aim to bring together two learning theories in a novel way for a better understanding of human development and the human condition. Two learning theories, with the associated psychological notions, influence of culture, and constructivist, constructionist and socio-historic activity, come together in the abstraction of theories in Cultural Constructionism.

This theory brings culture to the forefront as a cognitive filter. It makes visible the tensions within the nature of knowing and learning in a constructivist socio-historic environment. This cognitive filter, derived from historic events, is a cultural embodiment within a people’s identity, attitude and outlook. This embodiment shapes knowledge construction and learning, as must be understood in a theory of equitable learning theory. By understanding cultural embodiment in a people’s history, and how it acts as a cognitive filter in knowledge construction and learning, one can better understand how to (1) balance cultural tensions in the nature of knowing and in learning; and (2) produce positive interventions in the computing sciences for Indigenous students.
3.2 Theoretical Aims

This research is situated in a larger picture of the ubiquitousness of technology. Looking across a map of the world, where the world is no longer separated by distance, the landmasses and people are brought closer together through computing technologies, and with more connectivity, more voices are heard globally.

Listening in on the conversations of academics, they have been saying, they are concerned about the continuing direction of computer science in the educational system. But indigenous people say, the current theories and pedagogy are more representative of a Western perspective than a global narrative (Rogoff, 2003). We indigenous people are not seeing ourselves in the theory, it is as if we are looking through a window at something on the other side, rather than looking in a mirror.

The challenge for a global narrative is theory creation that is applicable broadly for all cultures, yet applicable specifically to particular cultures. The global narrative must also be holistic, to provide a broader view of human development to increase academic presentation and performance. The same can be said for computing education, where Papert’s (1991) constructionism has been the dominant theory in the computing sciences (Ben-Ari, 1998). However, socio-culture theory is also emerging in the computing sciences (Wertsch, 1995; Bandura, 2001; Kozulin, 2003). Yet, computing education is still “emerging and still giving rise to the literature … [it is] struggling to
find the shape and culture of our literature” as observed by researchers Fincher and Petre (2004).

Outside of Constructionism, computing learning theory and literature draws from a number of established sources and disciplines within education, sociology and psychology (Fincher, Petre, 2004). This current research also draws from those established sources; however, it takes a different approach, using existing applicable theories in an abstraction. In more current terms, Cultural Constructionism is a theory “mash-up”, a way to bring together two or more aspects of previous theories.

As mentioned earlier, Cultural Constructionism surfaces two elements that have an effect on learning, voluntary and involuntary construction. Voluntary construction is the central process of constructivist theory, as a person is active in the construction of self and knowledge. Involuntary construction is processing driven by early influences, prior to full self-awareness, laying the foundations of a person’s identity, outlook and learning. These two processes have effects on learning, one associated in current time (voluntary) and the other situated in historic events (involuntary). The major assertion in this research is that historic events, embodied in culture contribute causally to tensions and learning difficulty. This causation can interfere with learning, a phenomenon that can be described as “cultural cognitive load.” Cultural cognitive load can be seen as background noise and tensions influenced by culture and cultural historic events, (Cultural cognitive load extends the notion of cognitive load as used by
Sweller, 1988 and others, in that it originates outside the learning activity, whereas other cognitive load originates inside the activity). It adds to a person’s learning effort. The key to a positive learning experience, influenced by historic and current events, is an environment that induces safety, open discussion and an opportunity to find cultural cognitive balance between worlds and tensions. With these problems in mind, one can see there is a need for a learning theory that can bring to the surface these issues, to develop better interventions and pedagogy.

3.3 Theory Divide

The Digital Divide is a term that has been used to explain a gap between those who have access to technology and those who do not. In viewing theories on cognition and learning, there seems to be a Theory Divide. Theories have developed along two parallel paths, with no mechanisms to bring them together. On one hand, there are general theories and educational theories arguably applicable for all. (See Figure 3.1) On the other hand, there has been criticism of these (Freire, 1970), and a struggle from the underrepresented, including women, for inclusion. This criticism has developed on a parallel path, as suggested in the figure.
Figure 3.1 Two Parallel Theoretical Paths

Educational institutions have slowly recognized the insights of critical, gender and cultural theories and how they contribute to learning. However, these perspectives have not been fully accepted in the majority narrative, and so continue to develop on their separate parallel path. Media studies describe “asymmetrical interdependence,” where minority production continues to create under the majority; and “cultural proximity” where people are drawn towards media that contains their language and elements of their culture (Straubhaar, 1991). In these two notions, the general theorist may argue that their theory narratives are inclusive, although inclusion theories continue to be created. Those inclusion theories attract the underrepresented because they say to the generalist: “We are seeing theories through a window rather than a mirror.” They say: “We don’t see ourselves; we don’t see who we are; our race; our gender; our culture; reflected in those theories.” These types of comments have led to
alternate theory production not just in the United States; it seems to be subtly emerging throughout the world. Barbara Rogoff is a prime example in her observation that theories and pedagogy are more representative of a Western perspective than a global narrative (Rogoff, 2003), thus seen in this research leading to alternate creation.

Since computing technology has become the economic and information foundation of many nations, it has produced a worldwide concern to educate workers with the skills needed to stay competitive in the global economy. In the rush to educate more workers, constructionism as a learning theory appears as a third parallel path in theoretical production, with special value for computing, as shown in Figure 3.2. While constructionism differs from constructivism, it is not more inclusive. Here, too, the global community is also saying, we are not seeing ourselves in this.

![Figure 3.2 Three Theoretical Parallel Paths](image)

Papert, in the mid 1980’s, was a very early voice for plurality in education and computing. In 1991, Papert introduced Constructionism as learning by making a public
artifact. Constructionism offered insights into learning and espoused epistemological pluralism. However, the acceptance of pluralism in learning and epistemology is an ongoing endeavor. Part of the reason, from a historical perspective, is that our learning institutions still follow the industrial model of education (Collins, Halverson, 2009). They aim to create one educational solution for all (Dewey, 1916), ignoring the world’s need for pluralistic epistemology in learning. Thus inclusion theories continue to develop on a separate parallel path. Constructionism also continues on its path, not widely adopted in mainstream education.

As computing technology continues to dominate socio-economic foundations locally and globally, there is a need for a more holistic understanding of learning about computing. How can the three parallel paths in the figure be brought together to provide this?

3.4 Theory Abstraction and Inheritance

Most research, whether novel or just extending existing research, has been mostly a horizontal exercise. That is, most research has been moving along a horizontal plane, putting new ideas alongside old ones, as a card player opens a new suit next to the others. Something more disruptive is needed to address the pressing and persistent problems of inclusion, while not discarding the insights in current thinking.
Can object oriented (OO) concepts applied in theory creation, to break out of the horizontal mode into a vertical mode? The concepts of OO programming such as Abstraction, Encapsulation, Inheritance and Polymorphism may be adaptable to creating new theoretical structures from existing ones, as they are used to create new software structures, building on an adapting existing software,

“Abstraction” is a conceptual method to manage a complex system. Abstraction is a way to hide all but relevant data in order to reduce complexity and increase efficiency. We humans refer to many complex systems using words, such as car, boat, airplane, etc. Each of these objects is made up of many different parts, with different functions, and their own complexities, and exists in many different forms. Yet humans refer to the whole object with a single word, expressing the abstraction.

“Encapsulation” is simply keeping a collection of things together, safe from external interference, sort of like keeping valuables in a safe from thieves. Thus encapsulation allows a representation of objects in an abstraction like “car” that controls what aspects of the car can be modified, or even examined. “Inheritance” in simple terms is like inheriting a house where some or all of what is inside goes with the house. In this research, inheritance means bringing the tenets of one theory into another.

“Polymorphism” means to do things differently depending on the object being acted upon. A simple example: humans can “drive” cars, boats or airplanes, but the action is very different, depending on what is driven.
Two of these object oriented concepts, abstraction and inheritance, can be applied to adapt and combine theories. Abstraction allows dealing with general ideas rather than specifics. By abstracting some of the concepts in a theory, these concepts can be applied to meet the needs of a particular disciplines or culture, while also meeting the needs of other disciplines or cultures.

In some cases, abstraction can bring together two or more theories, by selectively suppressing the specifics that separated the theories. This reduces complexity and makes the combined theory more easy to apply.

Inheritance enables new objects to take on properties of existing objects. As applied to theory development, a new theory can retain the properties of older ones. The concept of multiple inheritances allows an object to inherit properties from more than one existing object. Applied to theories, this enables a combined theory to provide a more holistic view of cognitive and human development in learning, by bringing together ideas rather than separate theories.

In today’s terms, the process of abstraction and inheritance is a “Mashup”, as mentioned earlier. It is bringing together two or more theories from similar or different sources for interdisciplinary work. This approach agrees with Demmert’s notion of Culture-Based Education that it will not look the same in all settings. It also realizes Papert’s notion of pluralism in learning and knowledge creation.
Now let’s look at the process of abstraction and inheritance in merging Culture-Based Education and Constructionism into Cultural Constructionism with its inherited elements. (See Figure 3.3)

![Figure 3.3 Abstraction of Theories in Cultural Constructionism]

First, starting at the base of the diagram, Cultural Constructionism inherits ideas from the study of Human Computer Interaction (HCI), Human Centered Computing (HCC) and Cyber Human Systems (CHS), as these ideas influence education and other aspects of computing. HCI focuses on ergonomics and usability with computer artifacts. HCC focuses on systems and practice of technology in understanding and modeling human needs. CHS is a new research area, evolved from HCI and HCC, that explores
potentially transformative and disruptive ideas where computing has become a natural extension in our co-evolved human experience.

Second, Cultural Constructionism inherits practices from the two theories being abstracted. From Culture-Based Education on the left side, it inherits the use of cultural language, pedagogy, curriculum, participation in leadership and decisions making and a need to assess performance that meets the cultural requirements and standards. From Constructionism it inherits from the right side, the contrast with instructionism, pluralism in epistemology sociology of knowledge, pluralism in learning by exploration, designing and play, learning by making a public entity and building knowledge structures.

Third, Cultural Constructionism specifically inherits the practices of learning in a cultural context and of learning by making.

Fourth, Cultural Constructionism from the left side inherits the theoretic foundations of Culture-Based Education and Cultural-Historic Activity Theory. From the right side, it inherits the theoretical foundations of Constructivism and Constructionism. Thus the tenets, intension and practices from both theories are inherited in the process of abstraction to form Cultural Constructionism. That is, it inherits not only characteristic practices, but also the motivation for these practices.
3.5 Theoretical Genealogy

The theoretic genealogy of Cultural Constructionism can be viewed in more detail in the following diagram. (See Figure 3.4)

![Theoretical Genealogy of Cultural Constructionism](image)

**Figure 3.4 Theoretical Genealogy of Cultural Constructionism**

Starting on the left side, in blue, Cultural Constructionism inherits ideas from Vygotsky (1978) and his work with colleagues Luria and Leont’ev. Cultural-History Activity Theory (CHAT) has some influence on Demmert’s Culture-Based Education (CBE). Demmert notes in his discussion of CBE, that CHAT underlies CBE as a theory of
human development (Demmert, Tower, 2003). CHAT sees cultural activity among members primarily through semiotic processes that create in learners the internalization of knowledge, values and cognitive routines, where culture is created through historical time spans and processes. Traditional culture is especially likely to contain “an extended body of elaborated meaningful activities … Therefore CHAT places more emphasis on community-level elements for connectivity, thereby multiplying the richness of potential association between the student experience and the academic curriculum” (Demmert, Tower, 2003) in community goals and academic achievement. Demmert says that the basis of education is best built on the experience, values and knowledge of the student and their families, both personal and community. Secondly, Demmert indicates that Jerome Bruner’s observations influenced CBE. Demmert quotes Bruner (1996) indicating that culture influences all aspects of human cognition and activity:

“… there is a close tie between participating in culture, according to Jerome Bruner, and learning, remembering, talking and imaging, the tool kits by which we construct our world and the conceptions of our identity and our powers … culture shapes mind … it provides us with the tool kit by which we construct not only our worlds but our very conceptions of ourselves and our powers … you cannot understand mental activity unless you take into account the cultural setting and its resources, the very things that give mind its shape and scope. Learning, remembering, talking, imagining: all of them are made possible by participating in a culture” (Bruner, 1996).
Continuing on the left side (blue), Michael Cole’s (1996) Cultural Psychology, and his concept of prolepsis, describes how a parent raises her child, responding to past history, looking into the future, and influencing her child accordingly, as discussed earlier. Also, Barbara Rogoff’s (2003) Cultural Nature of Human Development strengthens the basis for Cultural Constructionism, saying that all “human development is a cultural process …” while Western science, even Piaget, is “assumed to represent universal processes.” Both Cole and Rogoff have some agreement with the tenets of Demmert’s Culture-Base Education and provided additional insight and support for Cultural Constructionism.

On the right side (green), Papert (1980) in his writings notes the theoretical influence on Constructionism from Jean Piaget. Papert’s playing with gears served as a model to understand Piaget’s notion of cognitive assimilation. The gears example helped Papert formulate his early ideas of learning and says, “Anything is easy if you can assimilate it to your collections of models. If you can’t, anything can be painfully difficult” (Papert, 1980). He says this is

“… resonant with Piaget’s ‘… understanding of learning must be genetic.’ It must refer to the genesis of knowledge … Thus the ‘laws of learning’ must be about how intellectual structures grow out of one another and about how, in the process, they acquire both logical and emotional form.”

However, he felt Piaget missed the “affective component.” This component “develops a new perspective for education research focused on creating the conditions
under which intellectual models will take root.” Papert saw gears being a formal system of connections having effect on one another. He envisioned the computer providing the affective component that can be “flexible enough so that many children can each create for themselves something like what the gears were for [him].”

As a framework for Constructionism, Papert took Piaget’s “model of children as builders of their own intellectual structures” and married it with his notions of “child as builder.” Where he varies from Piaget is seeing the role of surrounding culture “… as a source of these materials. In some cases the culture supplies them in abundance, thus facilitating constructive Piagetian learning.” However Papert saw as a critical factor that a culture may have a “poverty” of material on which to build. In those cases “culture may provide materials but block their use.” As an example he says, “In the case of formal mathematics, there is both a shortage of formal material and a cultural block as well.” He describes this as “mathophobia” which in “contemporary culture blocks many people from learning anything they recognize as ‘math.’” In parallel with the math scenario, Papert suggested that while people could respond to computers with computer-phobia, he hoped they could instead see computers as a medium, “that children can learn to use computers in a masterful way and that learning to use computers can change [construct] the way they learn everything else…”

In the center, light purple, abstracting and inheriting from Culture-Based Education and Constructionism creates a holistic framework, connecting Cultural
Historic Activity Theory and Constructivism in knowledge creation. This framework led into Cultural Constructionism, where cultural activity from past and present intermix with building activity in creating a public artifact in knowledge creation. This notion of knowledge creation embedded in a curriculum and in the learning environment influences creation and in making a meaningful cultural artifact, which in turn makes culture and learning more meaningful.

Papert makes an important comment about differentiated learning: “When one looks at how people think and learn ones sees clear differences. Although it is conceivable that science may one day show that there is a ‘best way,’ no such conclusion seems to be on the horizon” (Papert, 1991). Similar ideas appear in Tomlinson’s (2001, 1999) differentiated instruction and in Howard Gardner’s (1983) multiple intelligence theory that people learn in different ways. By embedding Constructionism in Cultural Constructionism one brings more to the surface that all people think and learn differently. This is important, as our educational system continues to press the idea that there is a singular way in which all people think and learn, as far back as John Dewey (Dewey, 1916). Papert suggests that our educational system assumes that different ways of learning are a matter of “‘taste and preference’ rather than a matter of ‘scientific truth’” (Papert, 1991). Demmert agrees with Papert about our educational system needing to support multiple ways of knowing rather than one way.
By embedding Culture with Constructionism it becomes more inclusive of all world cultures and humankind, realizing Papert’s idea that Constructionism is the “…only framework that has been proposed that allows the full range of intellectual styles and preferences to each find a point of equilibrium” as a strong claim. Adding the prefix of “Culture” to Constructionism opens the intellectual doors for its next evolution.

3.6 Culture-Based Education

In Demmert’s argument for Culture-Based Education he stresses five key points:

1. The recognition and use of Native or heritage language

2. Pedagogy that stress traditional cultural characteristics, adult-child interactions as the starting place for one’s education. Pedagogy which teach strategies that are congruent with the traditional culture as well as contemporary ways of knowing and learning as in opportunities to observe, opportunities practice and opportunities to demonstrate skills.

3. Curriculum based on traditional culture recognizing importance of Native spirituality and places the education in a contemporary context (e.g. use and understanding of the visual arts, legends, oral histories and fundamental beliefs of the community)

4. Encouraging Native community participation including parents, elder, other community resources in curriculum, planning and operation of school/community activities

5. Considering knowledge and use of the social and political mores of the community as in a strong language base, and building partnerships between universities, schools and other organizations

6. Using principles defined by the Center for Research on Education, Diversity and Excellence (CREDE), for example, teachers and students working together, developing language skills within all curriculum, connect lessons to
students lives, engaging students with challenging lessons and emphasizing dialogue over lecture.

Demmert also states a need for socializing children in joint meaningful activity with more accomplished participants, as does Vygotsky. This socialization provides cultural continuity and the cognitive tools for individual and group problem solving and adaptation. It is primary in developing understanding, and is a joint activity setting for developing language, cognition, patterns of activity in culture. He also implies that a child’s education must include social, emotional and ethical competencies, including academics, in a cultural compatible and supportive environment.

Demmert stresses the need for tools to measure reading, writing, math and oral competence within Culture-Based Education. He also includes a need to train, hire, maintain highly qualified educators who understand and support the social and cultural mores of Indigenous people. He stresses the importance of “ownership of schools” when talking to the Indigenous population. People must get involved in the excellence of schooling for Indigenous people today and in future (Demmert, 2010).

Demmert says, “…cultures are in a constant state of change, there are beliefs and customs that endure and help sustain a people’s identity. For American Indians and Alaska Natives, these beliefs and customs are best expressed in their original languages (Demmert, 1994).” Thus learning mediated by cultural cognition is in constant change but also offers stability, for cognition is language, cognition is culture, cognition is one’s
beliefs, customs, identity, attitude, outlook, it is past and present. Culture mediates the context of language, thought, customs and beliefs; thus one could say these are also constructed and in a constant in state of change.

Demmert notes that Culture-Based Education (CBE) will not look the same in all communities. All cultures are not the same and do not function the same, so the African community, the Hispanic Community, the Indigenous Community or any Community, will apply CBE in their cultural paradigms with some or all of the components of CBE.

3.7 Culture-Based Education and Constructionism

Papert says, “The essence of Piaget was how much learning occurs without being planned or organized by teachers or schools. His whole point was that children develop intellectually without being taught” (Papert, 2002). In this form, the ideal of culture-based education can be seen as a tribal way of teaching, exemplified through immersion where all members, young and old, participate in learning. Papert saw this in the Samba schools, where the older, middle and youth come together to teach, get better, obtain feedback and learn the art of traditional dance in South America (Papert, 1980).

Demmert and Papert’s views come together where the community comes together to participate in learning. Cultural Constructionism thus becomes a cultural
learning within a community in which one grows and learns by making within one’s cultural community.

As we’ve just seen, the ideas about human development of Demmert and Vygotsky, on the one hand, and Papert and Piaget, on the other, are similar. The main difference is that Demmert’s conception of Culture-Based education and Vygotsky’s Cultural-History Activity Theory emphasize how external group context influences the individual, while Papert and Piaget emphasize processes within the individual. Thus abstracting from these two perspective, allows a more holistic understanding of human development that reflects both individual learning and learning in a social context.

3.8 Defining Cultural Constructionism

Defining Cultural Constructionism by the simplest Papertian catchy phase, it is “learning-by-culturally-making.” To further define its activity in Papert’s words, it “happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity.” Cultural Constructionism retains the psychological theoretical inheritance of both constructionism and constructivism – and their “connotation of learning as ‘building knowledge structures’” (Papert, 1991).

Cultural constructionism is not a pipeline model of transmitting knowledge. It is a model of individual knowledge construction and group meaning-making, and favors guided active learning rather than learning “in an instructionist mode (Papert, 1991).”
Cultural Constructionism agrees with Papert (1991) on epistemological pluralism, that people think and learn differently. Cultural constructionism as a framework also agrees with Papert in allowing a full range of intellectual styles and preferences. It provides closeness to objects, allows abstract and formality that goes beyond specific skills and learning richness. It broadens integration with cognition and learning that can enhance the effectiveness of instruction given by a teacher.
CHAPTER 4

Workshop

How does one test an idea?

This chapter describes the 2010 workshop, Native Science @ the Museum, and its curriculum based on Cultural Constructionism’s theoretical framework.

4.1 Background

Native Science @ the Museum was a two-week workshop conducted in 2010. The objective was to evaluate the potential, feasibility, and effectiveness of Cultural Constructionism applied in a curriculum with Indigenous students. The workshop provided an opportunity for Native American high school students to experience a sample of professional computing work in a museum setting. In addition, the students were accepted as interns so the activity could be listed on their college application. The workshop included behind the scenes tours, hands-on experience working with collections, and developing analytical, research and presentation skills. The computing experience involved developing an interactive exhibit proposal with a working model of the exhibit for one of the dioramas to enhance a museum visitors’ knowledge of Indigenous life yesterday and today (See Appendix I for original workshop proposal).
4.2 Curriculum Development

A proposal was developed and presented to several secondary educational institutions and then a museum. Only the museum opted to approve and host the pilot project, since the schools were concerned with meeting their required agenda. The objective of the workshop was to expose the Native students to computing principles and future career possibilities. They would experience the role of a computing professional in developing and designing displays, and gain hands-on experience in creation of an interactive exhibit about Native culture and life for a select diorama.

Bi-weekly meetings by the workshop teachers were held to develop the curriculum. The focus in the planning was the integration of computing, education and Indigenous culture that would provide a lasting benefit to the participants. The museum had wireless capabilities and the network was utilized for the workshop. Also, since this was a computing workshop, laptops were needed to conduct the workshop. Ten students were selected, thus ten laptops were purchased. Funding came from the museum and private sources. These laptops served a dual purpose; first, they were used as a workstation for the participants, and second, since funding was limited in Indigenous families, the participants would receive the laptop as a tangible reward to help further their education.

The workshop provided:
1) a realistic exploration in the use and principles of computing.

2) development of soft skills associated with computing and education as in analysis, research, writing and presentations;

3) exposure to higher education, from visiting college/university representatives. Knowing education and higher education is sometimes not a priority, or unattainable within Indigenous families, the workshop creators thought having visits from university representatives would set an expectation towards post-secondary education;

4) exposure to higher education research from graduate students and professors. The creators thought visits from students and professors to high light their story and academic interest would also set an expectation towards post-secondary education;

5) a time for open honest discussion on computing and educational experiences;

6) structured discussion time to develop a broaden outlook on computing and its effect locally and globally; and

7) structured time at the end of the day to present positive concepts for living called Tools for Life or T4L.

All of the above were conducted in a cultural context and guided by an Indigenous computing professional with assistance from a seasoned Indigenous teacher and an Indigenous assistant (intern) at the museum (as described further below).
The workshop was guided by a storyline, given to the students as follows:

_They were hired by the museum to develop an interactive exhibit to accompany one of the Native American dioramas. They were to research, conduct analysis, conduct meetings, design and work on teams to create the interactive interface. The goal of the project was to increase museum visitors’ knowledge of Indigenous life, culture and science, both in the past and today. They were to include in their design accessibility for visitors with disabilities. The final product must be well-designed, with clear navigation, and be historically accurate with a working prototype of an interactive exhibit for one of the dioramas. The students will present their proposal for acceptance or modification to the museum staff at the end of the workshop._

The curriculum covered:

1. How museums can be used to explore computing careers.

2. How to obtain knowledge and experience of a computing career through analyzing and designing systems.

3. Exposure to and experience with human-computer interaction (HCI) principles and career possibilities.

4. Hands-on activities in creating a public artifact.

5. Understanding the impact of computing.

6. A positive outlook on computing for Indigenous uses.

7. Obtaining a balance between being Indigenous and while working with computing - all within a cultural context in an integration of computing, education and culture.
4.3 Indigenous Issues

The workshop addressed several issues faced by indigenous students in the school system having limited or no knowledge of the computing profession.

1. There are Indigenous programs in some school districts. However, in most schools the numbers of Indigenous students are limited, so the students feel alone in the school system with limited opportunities to be together with other Indigenous students.

2. There are few Indigenous teachers in the school system to act as role models. In the metro area where the workshop was held, there were only three professional teachers in the surrounding districts.

3. Indigenous students have limited knowledge of the computing profession.

4. Students do not take computer courses because they do not know how it can benefit them and other Indigenous people. There is limited or no exposure, to how computing can benefit them and the native community.

5. They have limited opportunity to experience all things Indigenous in the classroom. Very rarely are Indigenous teachers, students and curriculum integrated in the educational system.

6. There is limited or no exposure to effects of technology and globalization

7. There are limited or no Indigenous computing professionals in their communities; thus they have limited or no role models to hear from.

4.4 Participants

4.4.1 Teachers

The teaching staff consisted of three Indigenous leaders: the author, an Indigenous computing professional, male; an Indigenous professional teacher, male; and an Indigenous museum staff member, a female with previous teaching experience.
4.4.2 Students

Participants were 10 Native American 10th and 11th grade high school students, five males and five females, ages at the time of the workshop were 16 and 17. They responded to the following recruitment process.

Applications were created with basic information, requiring two short essay questions. It was felt that requiring recommendation letters and lengthy essays would eliminate a large portion of the application pool. The application also stated there was no minimum GPA. It was agreed that GPAs were not always an effective measurement of intelligence and capabilities (Duckwork, Seligman, 2005), especially among Native students. Applications were sent to surrounding school districts, The Indian Community Center, made available on the museum website, and distributed through Indigenous community channels (websites, word of mouth) in the metro area. The workshop was seeking Indigenous students who were interested in integrating computing, education and Indigenous culture. The initial deadline was extended from April to May, due to low submission. A total of 17 applications were submitted; two were incomplete, three did not meet requirements and the remaining 12 were selected. Rejection letters were sent to the five who were not selected for the reasons stated, however each was sent eight vouchers for free admission to the museum. Prior to the workshop, of the 12 admitted, one student opted not to accept, due to work demands, and another did not respond to the acceptance letter or phone calls. However, in post-
review of the workshop it was found 10 students was an optimal number for the workshop.

4.5 Workshop Equipment and Materials

The equipment and materials used in the workshop were:

1. Laptop with Microsoft Internet Explorer (IE) and Firefox – Laptops were purchased for use in the workshop and preloaded with IE and Firefox. These two products were used for internet research. As mentioned earlier, at the end of the workshop the interns were awarded the laptops for their participation and to help further their education since many Native families could not afford them.

2. The laptop were preloaded by the computing professional with Microsoft Suite – Word, PowerPoint, Excel – this product was donated by a local school district since several of their students participated in the workshop. PowerPoint was the main product used in creating the mock webpages and saved as JPEGS. PowerPoint allowed quick modifications to mock webpages without extensive knowledge of HTML and JavaScript language.

3. Student Question Guide – Thought questions for analyzing the museum’s existing Native American exhibit:

   a. Which display(s) do you like best? Why?
b. Which display(s) do you like least? Why?

c. Is your tribe(s) represented? How does the representation/lack of representation of your culture make you feel? If you were to design an exhibit about your tribe or Native people in general, what would you include? Why?

d. What is missing? What do you think should be included in the North American Indian exhibit? How do you think it should be implemented?

e. Additional thoughts, comment…

4. Museum Library – the students were given full access to the museums’ extensive library for research.

5. HTML – a two week workshop was not adequate time to teach languages and tools to create a real webpage. Instead, the students created their mock up webpages in PowerPoint and saved as JPEGS. Thus a HTML framework displayed the PowerPoint JPEGS that looked like webpages, and it included on mouse clicks, simple forward, backward and jump navigation that mimicked webpage functionality for the student’s exhibit prototype.

4.6 Curriculum Framework

The curriculum framework consisted of:
• Opening Breakfast with Prayer and Blessing – a traditional way to bring students, parents, elders, community and both teaching and museum staff together to share a meal and become comfortable with the project and with each other.

• Professional Development – the students were brought in as interns and given a full new employee orientation with expectations, signed a contract, issued pictured ID badges for entry, exiting and time keeping, a tour of the museum, including behind the scenes, all on the morning on the first day. After lunch, the students were given an overview of the workshop, the project they were to complete as an exploration of a computing career, they were to receive hands-on experience with collections, hear from experts in various fields, learn how to use technology in the museum to enhance a visitor’s educational experience for their interactive exhibit, and to develop their proposal and presentation. In order to work on the project, the workshop provided short lessons on the tool they will use in developing the overall project. These consisted of some programming, how to conduct research and design using storyboarding, and office skills as in the use of Word, PowerPoint and Excel.

• Teamwork – teamwork in the computing profession is an essential skill due to the ubiquitousness of computing, where other team members may be
located locally, nationally or internationally. Some team members may be working together on the same project or in conjunction with other members or teams who are working on different parts of a larger project. Thus the students worked in teams of two producing their select part of the larger project. Rather than assign the students to a team they were allowed to form a team by similar interest.

- Research, Critical Analysis, Writing and Presentation skills – skills important in computing capacity building. The students were coached on developing these skills at the beginning with short lectures, exercises and practice.

- Multiple Intelligence Assessment – the students took a short assessment to learn their learning preference which worked best for them, which provided insight in the design and development of their interactive exhibit on how people learn.

- Talking Circle (TC) – In addition to short lectures on the first two days, daily Talking Circles were embedded, except the last day, as a traditional way to bring all ages together to teach, listen, learn and share. TC served two purposes, 1) an informal venue to share feedback throughout the workshop and 2) to build stronger relationships with their peers and workshop facilitators.
• Educational Visits – students may not be aware of opportunities and support available, thus visits from all the local colleges, universities and educational organizations were brought in during lunch to share with the students

• Expert Visits – experts in various fields were brought to give a short lecture for consideration on developing the overall project i.e. one expert discussed design must include persons with disabilities – hearing, sight, wheelchair, etc., other lectures were on new technology that could be used

• Tools for Life (T4L) – at the end of each day, a short one or two word concept lesson was given to highlight that day’s activity and guidance applicable throughout their academic and professional careers

• Early, Mid, End Assessment – time allocated for students to present their design and work completed to staff and teams

• Open Room/Work Time – an open room concept is essential so students can see each other’s work and discuss their work with other teams. The open room concept is large space or a room where the students can see each other and see each other’s project as they work individually or in teams.

• Rehearsal Time – time allocated for the students to rehearse their proposal and staff can help and coach

• Luncheon, Final Presentation – as in the beginning of the workshop, the students, parents, community and staff shared a meal together to indicate it
was a group effort and afterwards the students gave their proposal with their working interactive exhibit model

- End Note - the leaders of the workshop took on the role of facilitators and coaches guiding the students as they learned during the hands-on activities rather than a lecture style

### 4.7 Curriculum Theoretical Framework

The workshop was based on Demmert’s and Papert’s theoretical constructs. The following provides an understanding how the curriculum framework coincided with Demmert and Papert’s theories within the curriculum in the following table. (See Table 4).

<table>
<thead>
<tr>
<th>Curriculum Element</th>
<th>Demmert</th>
<th>Papert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>Acknowledgement of preexisting cultural knowledge</td>
<td>Acknowledgement of prior knowledge</td>
</tr>
<tr>
<td>Breakfast, Prayer, Blessing</td>
<td>-Strong, Family, Community Involvement</td>
<td>-Epistemological pluralism recognizing multiple ways of knowing learning at the beginning of the workshop</td>
</tr>
<tr>
<td></td>
<td>-Curriculum based on spirituality and social mores of the community</td>
<td>-Samba school concept of adults and students together</td>
</tr>
<tr>
<td></td>
<td>-Strong Native Community participation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Cultural based pattern of leadership and decision making</td>
<td></td>
</tr>
<tr>
<td>Professional Development</td>
<td>-Contains cultural context and content</td>
<td>-Real Experience</td>
</tr>
<tr>
<td></td>
<td>-Exploration as cultural ways of knowing and learning</td>
<td>-Ensuring activity of constructing a public artifact has a role in the real world</td>
</tr>
<tr>
<td></td>
<td>-Education in contemporary</td>
<td></td>
</tr>
<tr>
<td>Teamwork</td>
<td>-Curriculum that is based on traditional culture and recognizes the importance of Native spirituality while placing the education of young children in a contemporary context -Engaging students in challenging lessons</td>
<td>-Student active in building new knowledge -Pluralism in epistemology sociology of knowledge -Student as builder -Constructionism supports full range of intellectual styles and preferences -Student lead, student ownership</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
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</tr>
<tr>
<td>Research, Critical Analysis, Writing, Presentation</td>
<td>-Contains Cultural Context and Content -Increase researchers, variety of research methods -Adult/Student interaction -Pedagogy close to cultural ways of knowing and learning -Education in contemporary context -Engaging students in challenging lessons</td>
<td>-Student active in building new knowledge -Pluralism in epistemology sociology of knowledge -Student as builder -Constructionism supports full range of intellectual styles and preferences</td>
</tr>
<tr>
<td>Multiple Intelligence Assessment</td>
<td>-Curriculum that is based on traditional culture and recognizes the importance of Native spirituality while placing the education of young children in a contemporary context -Educational system needs to support multiple ways of knowing rather than one</td>
<td>-Student active in building new knowledge -Pluralism in epistemology sociology of knowledge -There are clear differences in learning -There is no one best way -Learn about their preference of learning</td>
</tr>
<tr>
<td>Talking Circles/Planned and Adult Student participation</td>
<td>-Student active in building new knowledge -Pluralism in epistemology sociology of knowledge -Student as builder -Constructionism supports full range of intellectual styles and preferences</td>
<td>-Student active in building new knowledge -Pluralism in epistemology sociology of knowledge -Student as builder -Constructionism supports full range of intellectual styles and preferences</td>
</tr>
</tbody>
</table>
| Open Discussions | -Knowledge and use of the social and political mores of the community  
|                  | -Connect lessons to students lives  
|                  | -Engaging students in challenging lessons  
|                  | -Immersion in culture  
|                  | new knowledge  
|                  | -Pluralism in epistemology sociology of knowledge  
|                  | -Computers can change the way one learns  
|                  | -Learning occurs without being planned or organized  
|                  | -Students develop intellectually without being taught  
|                  | -Samba School concept where older, middle, youth come together to teach, get better, obtain feedback and learn  
| Educational Visits | -Community Participation  
|                   | -Partnerships with universities, colleges, community  
|                   | -Student active in building new knowledge  
|                   | -Pluralism in epistemology sociology of knowledge  
|                   | -Samba School concept adult working with younger  
| Expert Visits | -Community Participation  
|                | -Partnerships with universities, colleges, community  
|                | -Student active in building new knowledge  
|                | -Pluralism in epistemology sociology of knowledge  
|                | -Samba School concept adult working with younger  
| Tools for Life | -Adult Student participation  
|                | -Knowledge and use of the social and political mores of the community  
|                | -Connect lessons to students lives  
|                | -Engaging students in challenging lessons  
|                | -Students active in building new knowledge  
|                | -Pluralism in epistemology sociology of knowledge  
|                | -Samba School concept where older, middle, youth come together to teach, get better, obtain feedback and learn  
<p>|</p>
<table>
<thead>
<tr>
<th>Early, Mid, End Assessment</th>
<th>-Method of assessing students’ performance in a cultural content and context</th>
<th>-Samba School concept where older, middle, youth come together to teach, get better, obtain feedback and learn -self-assessment -Guided instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Room/Worktime</td>
<td>-Emphasizing dialogue over lectures</td>
<td>-Constructionism over instructionism -Comparing work with others’ work in self-assessment -Learning by making a public artifact -Pluralism in learning, exploring, designing, playing -Student led, student ownership</td>
</tr>
<tr>
<td>Rehearsal time</td>
<td>-Emphasizing dialogue over lectures -Method of assessing students’ performance in a cultural content and context</td>
<td>-Constructionism over instructionism -Samba School concept where older, middle, youth come together to teach, get better, obtain feedback and learn</td>
</tr>
<tr>
<td>End Luncheon and</td>
<td>-Provide opportunity for Native students to successful complete and participate in larger economy</td>
<td>-Learning experienced by making a meaningful public artifact -Sharing, discussing through a formal presentation</td>
</tr>
<tr>
<td>Presentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End Note on Facilitating</td>
<td>-Facilitator, emphasizing dialogue over lectures</td>
<td>-Facilitators, constructionism over instructionism</td>
</tr>
<tr>
<td>versus Instructing</td>
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</tr>
</tbody>
</table>

**Table 4 Elements with Demmert and Papert Theory Tenants**

With the curriculum one of Demmert’s theoretical constructs that said students learn best in their own language could not be addressed. The workshop students were from multiple tribes which made it impractical to have a common Indigenous language,
and the students had limited knowledge of their original language. However, there was a common non-verbal language of a shared history and educational experience among the facilitators and students. Although the students and facilitators were from different tribal groups, they all shared similar historic events with the United States.

4.8 Workshop Timeline

The workshop was held over a course of two weeks. The first two days provided the skills that the students needed to accomplish their proposal with a working model. Open discussion times (talking circles) were included and five of those times were dedicated to stimulate and broaden their worldview. The schedule allowed time to work in pairs. There were several slots and lunches open for college and special guest visits to set a trajectory towards college and obtain a different perspective on computing from academic guests. At the end of each day, a single topic was presented to the students to highlight the workshop activity and as positive life principles for educational and professional careers. The following table provides an overview of the schedule. The actual schedule can be found in the Appendix II.
<table>
<thead>
<tr>
<th>Day One</th>
<th>Day Six</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome</td>
<td>Open Time</td>
</tr>
<tr>
<td>Introduction and ice-breaker</td>
<td>Students Work time</td>
</tr>
<tr>
<td>Volunteer Orientation</td>
<td>Talking Circle – What tools could be used?</td>
</tr>
<tr>
<td>Independent exploration of Crane Hall</td>
<td>Guest Speaker – Film Making</td>
</tr>
<tr>
<td>Talking Circle – Discuss Crane Hall</td>
<td>Watch Documentary</td>
</tr>
<tr>
<td>Tour of Crane Hall with Curator</td>
<td>Wrap-Up/T4L</td>
</tr>
<tr>
<td>Wrap-Up/T4L</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Day Two</th>
<th>Day Seven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Time</td>
<td>Open Time</td>
</tr>
<tr>
<td>Talking Circle – Crane Hall Tour, Pairs</td>
<td>Students Work time</td>
</tr>
<tr>
<td>Computer set-up</td>
<td>Talking Circle – What are our needs?</td>
</tr>
<tr>
<td>Interface Design/Storyboarding</td>
<td>Guest Speaker – Museum Experience for Impaired</td>
</tr>
<tr>
<td>Student Assessment</td>
<td>Students Work time</td>
</tr>
<tr>
<td>PowerPoint</td>
<td>Guest Speaker – TBD</td>
</tr>
<tr>
<td>Wrap-Up/T4L</td>
<td>Wrap-Up/T4L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day Three</th>
<th>Day Eight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Time</td>
<td>Open Time</td>
</tr>
<tr>
<td>Research</td>
<td>Students Work time</td>
</tr>
<tr>
<td>Talking Circle – Where are we?</td>
<td>Talking Circle – How do we get there?</td>
</tr>
<tr>
<td>Students Work time</td>
<td>Students Work time</td>
</tr>
<tr>
<td>Guest Speaker</td>
<td>Guest Speaker – TBD</td>
</tr>
<tr>
<td>Wrap-Up/T4L</td>
<td>Wrap-Up/T4L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day Four</th>
<th>Day Nine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Time</td>
<td>Open Time</td>
</tr>
<tr>
<td>Students Work time</td>
<td>Students Work time – Prep time final presentation</td>
</tr>
<tr>
<td>Talking Circle – Where are we going?</td>
<td>Wrap-Up/T4L</td>
</tr>
<tr>
<td>Students Work time</td>
<td></td>
</tr>
<tr>
<td>Planetarium Show (optional)</td>
<td></td>
</tr>
<tr>
<td>Wrap-Up/T4L</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day Five</th>
<th>Day Ten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Time</td>
<td>Run-Through final Presentation</td>
</tr>
<tr>
<td>Finalizing Selections</td>
<td>Luncheon – Families, staff, community members</td>
</tr>
<tr>
<td>Student Presentations</td>
<td>Final Presentation</td>
</tr>
<tr>
<td>Talking Circle – Final Project Focus</td>
<td>Program Introductions</td>
</tr>
<tr>
<td>Wrap-Up/T4L</td>
<td>Student Presentations</td>
</tr>
<tr>
<td></td>
<td>Judging</td>
</tr>
<tr>
<td></td>
<td>Student Recognition</td>
</tr>
<tr>
<td></td>
<td>Wrap-Up/T4L</td>
</tr>
</tbody>
</table>

Table 5 Workshop Schedule
4.9 Data collection

Data collected included the student applications, photographs taken during the workshop, notes taken by the facilitators, and seven videos of the Talking Circles.
CHAPTER 5

Method

*How does one uncover the past?*
*How does one use a structure to understand?*

Five years after the workshop, participants were interviewed to understand how the workshop, designed based on Cultural Constructionism, had affected them. The delay was motivated by the idea that thoughts, feelings, attitudes and identity needed “... time to build personal connections” (Resnick, 1996) and to become embodied, before the intervention could be fully evaluated. Further, the delay means, that the interviews can serve “...two primary purposes: to describe patterns of change and establish direction … and magnitude [of change]“ (Menard, 2002).

The methods used were an interpersonal process recall interview session (Larsen, Flesaker, Stege, 2008) and a structured interview session (Charmaz, 2008). The responses, along with materials from the original workshop, were coded using an Interaction Design framework (Engeström, 2005).

5.1 Participants

The participants included three former students from the 2010 workshop, one male and two female. At the time of the workshop they were 16 and 17 years of age, and when interviewed for this study they were 21 and 22. Two were in college, one was
in a profession. Two of the facilitators who assisted in the workshop were also interviewed.

5.2 Recruitment

All of the workshop participants, 10 in all, were contacted via phone and emails in 2015. Of the 10, four, two males, two females could not be contacted or did not respond to phone messages or emails. The remaining six participants were initially willing to participate. However, two females, when contacted to set up their interview sessions, opted not to participate.

The remaining four participants, two male and two females were interviewed. Although all had consented to be interviewed, one participant did not provide final consent to be included in the study.

The two teachers, one male and one female, were also contacted by phone and email. They readily consented to participate in the study.

5.3 Procedure

An approved Institutional Review Board (IRB) consent form was used which explained the procedure, the interest of study, goals, and the benefits and risks. A separate consent procedure was used to obtain permission to use artifacts and recordings from the 2010 workshop in the follow-up study from the museum.
The three student participants and the two teachers were interviewed, individually, at a place of their choosing when called to setup the interview. Two chose a restaurant; two because of distance were interviewed by phone, and one at an office. Those interviewed by phone were emailed a copy of their application (for the student participants), and images from the workshop. The Interview protocol (see appendix) had two sections that were conducted back to back in a 1 to 1½ hour session. The first section used a personal process recall methodology, with video and photographs from the original workshop as prompts. The second section used ethnographic questions. “Ethnographic” means here a qualitative procedure, “… for describing, analyzing, and interpreting a culture-sharing group’s … patterns of behavior, belief, and language that develop over time” (Creswell, 2008). The same protocol was used for both students and facilitators. All interviews were tape recorded.

The first interview section lasted from 20 to 30 minutes. As mentioned earlier, it used interpersonal process recall (Larsen, Flesaker, Stege, 2008) with photographs, videos or still images from videos. Interpersonal process recall is a recall strategy developed by Norman Kagan (1980) in which the participant watched a video or listens to audio (in this study photographs were added) to help re-experience thoughts, feelings and attitudes from a past activity. Interpersonal process recall is a way to place the “… participant at the heart of their experience … [where] … the individual knows
best about the meaning of their own experience ... [and where] ... each individual is a unique authority about her/himself” (Kagan, 1980).

The recall procedure started with general statements to put the participant at ease. Using a diagram of the workshop timeline (See Figure 5.1) and associated videos or photographs, the interviewer pointed to eight points and asked the participant to recall any feelings, attitudes and insights that they may have experienced, at these times, prior, during and after the workshop.

Figure 5.1 Points for Interpersonal Process Recall Sessions

As the figure shows, the eight recall points were:

- **Point 1** before the workshop. They were asked a series of questions: How did you hear about the program? Who were you prior to the program? What made you decide to participate?
- **Point 2**, receiving their employee badge from the museum. They were asked their thoughts on who they were at that time.
• Point 3, in the Talking Circle with the topic question, “Where are we?” They were asked, “Who were you at this point?”

• Point 4, in the Talking Circle with the topic question, “Where are we going?” They were asked, “Who were you at this point?”

• Point 5, in the Talking Circle with the topic question, “What are our needs?” They were asked, “Who were you at this point?”

• Point 6, in the Talking Circle with topic question, “How do we get there?” They were asked, “Who were you at this point?”

• Point 7, the students’ project presentations. They were asked “Who were you at this point?”

• Point 8: Now, five years after the 2010 workshop, looking back. They were asked a series of questions: What changes did you experience? When did the change take place? How did the program help in change? Who was key in those changes? Did it make a difference where you are now?

At the end of this section a short break was taken.

The second interview section was conducted without photographs or video, using a structured protocol (Charmaz, Belgrave, 2002) consisting of 15 questions. The protocol “framed questions to study processes in individual experiences, thoughts, feelings, and actions … it needs to be sufficiently general to cover a wide range of experiences and narrow enough to elicit and explore the participants’ specific experience … [however] … keep[ing] the interview informal and conversational” (Charmaz, Belgrave, 2002).

The series of 15 questions sought insight in five areas:
1. The participant’s general trajectory from 2010 to 2015, to explore the impact of the workshop nearly six years ago.
   a. First, tell me about what you done since the workshop to now?
   b. Now, if you were to stand in front of an audience, looking back, what would you share about the impact of the workshop upon you?

2. The next three questions asked about the participant’s educational history and the role Indigenous culture may have played in their lives.
   a. Who influenced you about pursuing education? What is their educational level, and in what way did they influence or not influence you? What is the highest level of education in your family? What your parent’s level of education?
   b. Do you think issues of American Indian history impacted your thoughts about education and your pursuit of higher education today? What are some barriers in Indigenous culture that hindered education? What are some positive influences in Indigenous culture to pursue higher education?
   c. How do you think culture played in your view of education in general and higher education? What is your view on computer science? How do you think culture played in your view?

3. The next three questions were asked about their experience with the educational system and a need for their culture, and how it may have affected them cognitively, and in their educational choices.
   a. While you were in high school, did you have a hunger for your culture? Tell me about it…
   b. Do you think if culture were a part of your high school learning experience, would it have made a difference in your education? What value would it add to your learning experience?
   c. Was computer science as a career talked about while in high school, or ever offered as a career choice? If you had known an Indigenous computer science person in high school, not the workshop, would it have make a difference in your career choice? If computer science was offered in high school with an Indigenous approach would you have taken it? Why?
4. The next four questions asked about the workshop and curriculum, and the Indigenous cultural elements included in it.

   a. If you were to compare the workshop to your regular high school classroom, how your participation working with a professional in the workshop affect your learning experience? Did having culture in the workshop change the meaning of the workshop? Did you see how your high school classes such as research, writing and presentations related to a profession? In what way?

   b. Don’t know if you thought about this, but on a scale of 1 to 10, one being low and ten high, what role do you think Indigenous culture played in the workshop learning environment, as well as, the Indigenous subject matter in developing the interface? Why did you give it that rating? What were some of the cultural elements that enhanced your learning experience?

   c. Don’t know if you noticed or not, the workshop had many Indigenous elements? How did having Indigenous culture integrated in the workshop make a difference to you? Can you name some Indigenous elements in the workshop and how it made a difference to you? Did you feel a strong sense of you Indigenous after participating?

   d. We covered five questions in Talking Circles in the workshop that focused on our Indigenous people, such as, “Where are we? Where are we going? How do we get there? What tools could be used? What are our needs? How do we get there?” How did these questions impact you? How did these questions enhance your learning experience? How did they broaden your view? What if these questions were not asked, would it have made a difference in your outlook?

5. The last three questions asked about the impact of integrating culture and computing science, with the final question asking if they wished to add any additional comments.

   a. Interestingly, there were a number of positive comments about the workshop, but no mention of computer science. What were some comments you heard and why do think there was little or
no talk about computer science or the Interface Development workshop?

b. Looking back on the workshop what would you say had the biggest impact on you that you carry on to today? Was there anything in the workshop that challenged you to overcoming personally? Looking back, again, was there something in the workshop that helped you grow as person? What was it? Let look at it in a different way, do you think absence of your culture in the learning environment limited your growth? Why?

c. At the end of the session, they were asked if they had any additional comments.

At the end of the second section the interviewees were thanked for their participation and wished well in the next steps in their life.

5.4 Analysis

5.4.1 Framework

As mentioned earlier, the data analysis used Engeström’s (2005) Interaction Design framework. The framework provides a method to identify activity and the effects of culture, past and present, in an interactional system in making a meaningful cultural artifact. (See Figure 5.2)
The following is Engeström's explanation of the framework and provided a foundation for use in this study. The framework is a next generation of Vygotsky’s foundational work to understand cognitive development within cultural history and activity. “Cultural-history activity theory looks at artifacts and people … embedded in [a] dynamic activity system” (Engeström, 2005). Using the upper triangle of the framework to illustrate its use in describing activities, a person (the Subject) at their work may form an idea (the Object). The idea in progress then develops into a final complete idea (an Outcome). The entire process is mediated by artifacts (Tools and Signs).

Engeström states the bottom section “calls attention to the work ‘Community’ in which the [person] is a member … within the community, the member continuously negotiate their ‘Division of Labor,’ including the distribution of rewards … the
temporal rhythms of work ... the use of resources, and the codes of conduct are continuously constructed and contested in the form of explicit and implicit ‘rules.’”

Continuing the example using the bottom half of the framework:

A person who is a member of a (Community) has a portion of work (Division of Labor) split with other members, which uses resources from that community, and must work within a certain set of (Rules).

Engeström (2005) argues that this framework makes a person’s work activity visible in an interconnected complex system and also helps the person make “sense of their own work as a collective activity.”

5.4.2 Thematic coding

Data from the students’ applications, the Talking Circle videos, and follow up interviews were transcribed, entered into a spreadsheet, and coded by broad theme: attitudes, identity, outlook, self, and views on computing. This coding makes it easier to identify any changes from 2010 to 2015, helping to trace possible effects of the workshop on the participants.

5.4.3 Activity coding

The coded data were them placed in the Engeström framework. There were two phases in this process. The first phase examined data relevant to the effectiveness of the
workshop. The second phase examined data relevant to participants’ experience in the workshop.

In the first phase, the Workshop is the “Subject,” the workshop Objectives will be the “Object,” and the role of the workshop in helping the participants in “sense/meaning” making in creating a public cultural artifact is the “Outcome.” Computing is the mediating “Tools and Signs.” This analysis also investigated how the participants worked in “Community,” how they viewed their “Division of Labor,” and how the “Rules” applied.

In the second phase, the Participant is the “Subject,” the interactive exhibit is the “Object,” and the activities that helped the participants in “sense/meaning” making in creating a public cultural artifact is the “Outcome.” As in the first phase, computing is the mediating “Tools and Signs”, and the analysis also investigated how the participants worked in “Community,” how they viewed their “Division of Labor,” and what “Rules” applied.
CHAPTER 6

Student Responses

The data in this chapter is presented in two sections. The first section provides a pseudonym for each participant, background information and a short biography created from their applications and interviews. The second section provides responses by each participant from 1) their application essays 2) videos of Talking Circles during the workshop, 3) interpersonal process recall sessions, and 4) interview questions seeking information about their experience in the workshop and their educational trajectory since the workshop. The interviews were transcribed. As the reader will see from the material quoted from the transcripts, the language student’s used is often rough and informal.

6.1 Participants

Janice

- Female, Native American, No dominant tribal membership, a mixture of multiple tribes, but identified as Osage.
- 2010 – Participant in the workshop - Age 16, in High School, Grade 10.
- 2015 — Age 21, some college, currently working at a preschool.

Janice’s Short Biography
At the time of the workshop it was not clear if Janice resided in single parent home with her biological mother, or with relatives. She was not involved in her indigenous culture, was not sure of her beliefs, and wished she knew more of her culture. She noted that she had no Indigenous teachers while in school - K-12. She felt that her mother had abandoned her, at some point growing up, whether physically or attitudinally, she did not elaborate. When her father was there, prior to leaving, he was abusive. It was not clear if early abuse was to her mother or her, or both, nor what type. While growing up she was taken out of school many times, and she said school was not a priority for her mother.

At the time of the 2015 interview, Janice had completed several semesters at a tribal college/university, performed poorly academically, and was suspended. Her major was early education. In her interview, she said she was no longer living in the city where she participated in the pilot workshop. She was employed at a preschool. She was thinking about returning to college, once the suspension is over, or possibly going into the Air Force as a healthcare specialist.

Nancy

- Female, Native American, dominant tribe, Northern Cheyenne, a mixture of other tribes
- 2010 – Participant in the workshop - Age 17, in High School, Grade 10
- 2015 – Age 22, some college, currently a Highway Patrol Officer
Nancy’s Short Biography

Nancy, at the time of the workshop, resided in a single parent home with her biological mother, no mention of her father. She was involved in her indigenous culture, planned to major in education, and to become a high school teacher. She mentioned she had ADHD. It had not held her back and she had learned to manage. She enjoyed sports and being involved in her culture. She also enjoyed history, and learning about the past. She also enjoyed black and white photography. Later, in conversation during the workshop, Nancy said she has a sister who became pregnant in her teens, and Nancy planned not follow her sister’s life course. It seemed she has another sister who had gone on in higher education.

Her educational experience was not positive. She says, the teachers sat her at the back of the class. The teacher would not work with her and only helped the “blond” girls. She noted that being “brown,” she felt stupid, not smart, and that was hard to get out of her head. She also felt she was just another “brown” person and said “they just pass you along.” In her sophomore year, she was almost kicked out of school, but was helped by the director of Indian Education at her school. The Indian Education director worked with her to help her pass her classes. She shared that in her schooling, she encountered only one non-native teacher who took an interest in her and helped her.
At the time of the 2015 interview, she had completed several semesters at a community college, and planned to transfer to a university. Her academic performance was above average. Her major was Education. She said she had had a goal to become a teacher, but her focus changed. In the background she had an interest in law enforcement, but felt that her family’s involvement with protesting would affect that direction. Later, she applied and was accepted in a police academy and became an officer. She currently serves as an officer in her state.

**Xander**

- Male, Native American, member Navajo tribe
- 2010 – Participant in the workshop - Age 17, in High School, Grade 11
- 2015 – Age 22, currently in four year college, major Engineering

**Xander’s Short Biography**

Xander resided at the time of the workshop in a single parent home with his mother and siblings. He was involved in his indigenous culture. He was sure of his beliefs, growing up on the Navajo reservation. He noted he had some Indigenous teachers while in school - K-12. In the reservation school he was able to take cultural classes, including Navajo history and language classes. His mother did not finish high school because of early pregnancy about 16 or 17 years of age. The family had no car early in his life and they had to walk. Later his mother earned a certificate (unknown) and he says “life got better.” He implies that although his mother experienced
hardships, she was a positive person. She encouraged him to pursue graduating from high school and to get positive things out of life. He had a cousin who went to college but did not finish. With determination, he says proudly, he will be the first generation to graduate from college. A person who knew his family, said, when family life got tough on the reservation and money was limited, he was sent to his relatives, who lived a large city, because there was not enough to eat.

At the time of the 2015 interview, he had completed several semesters at a Christian college and was now attending a land grant college near home that offers free tuition to Indigenous students. His academic performance is positive. His major is civil engineering.

6.2 Applications

The students were asked, “Briefly describe why you would like to participate in this program?”, “How you think you will benefit from this program?” and “Tell us about you! In this section, you may wish to include, but are not limited to, information about your interests, hobbies, future goals, academic achievements or family.”

Janice

Janice’s response to the first question:

“I would like to participate in this program because it would open my eyes to different opportunities for jobs that I would look into to possibly
wanting to do or be good at. Also I would want to be looking to learn about my resume’ building and to do better on research. I also think it would be awesome to do the back scenes and also get hands-on experience.”

To the second question Janice responded:

“I really love to play basketball. I’m good at sports. I’m a quick learners. I am a gang. I love to have fun. I hang out with a lot of my friends. My hobbies are I play my viola. I have played it for about nine years and I know in my heart that I am going to college. I am not to sure about what my major will be but hopefully this program can help me out to figure what my major will be.”

**Nancy**

Nancy response to the first question:

“I would like to participate in this program because I love learning about history, I find learning about the past very interesting. I am working towards becoming a high school history teacher and this will be a very valuable experience for me to have.”

To the second question Nancy responded:

“Well my name is Nancy but you probably already knew that but anyways, I’m a very outgoing and friendly person. I have ADHD which makes it hard to accomplish things but I manage. I love sports, volleyball and basketball. I also powwow a lot so I know a lot about my culture. I love black and white photography not digital but the old fashioned way film. After high school I plan to attend college to become a teacher.”

**Xander**

His answers were hand written and some sections the author could not interpret.

“I would like to participate in this program so I am have a lot from the knowledge...knows. From anything I also this program ... help my future
reference such as college this program ... and showing ... me field in education and career, plus it helps me ... new knowledge.”

To the second question Xander responded:

“My interest in going to and to graduate from college. The field of my interest is variable, due to keeping my options open to different fields of education. My hobbies are hanging out with friends, play basketball and to dance. I like to keep busy by doing .... My future goal is to go to college. My academic achievement is being a National Honor roll in eight grade year.”

6.3 Video from Talking Circles

6.3.1 Video 1

The first Talking Circle was a discussion on their observation how Native people and culture were exhibited in the museum.

Janice’s Response

“I first noticed the Navajo building. It really showed what they lived in, amazing. It showed what they had. I did not find tribe that I’m in, it hurt me. I only seen five tribes, it hurt me. It showed only surface of what tribe does. It’s a picture back then, not a picture of what we do now, how we improved, what we lost. Maybe add phones, ear phone to learn more, and a story to go with it about style of clothing because I see phone automatically use. Maybe use elders to tell the story, what they did, not what happened. Make it more, more educational.”

Nancy’s Response
“It shows individually, not all together, shows we all lived in teepees. There so much more, only small displays of tribes. Shows surface of our culture, what is underneath. It does not show our stories, that we are not all buffalo hunters, shows what is on TV. Who actually knows, depends on who tells the story. Feel, native church is wrong to display. It is sacred, to those leaders, grandmother and grandfather. Need to tell the creation story, from actual leaders, not text book, what they do, determined by life, some were nomadic. For younger generation, we are in the city. For the next generation, question who I am or am I just blending in, betraying. This is important for next generation”

Xander’s Response

“I like displays arts and craft, show what we had, different section, background history, tools used, working with bones, tools, special, use stones, singing, play maybe colors may not be right years of practices, Make jewelry, six years, passions, want to do it, patience, Learn from elders on Colonize Mar, not same as earth, don’t care what others think, because I know who we are, how keep culture alive.”

6.3.2 Video 2

Talking Circle Two began with the question, Where are we? This question asks where are the Indigenous people in relationship to the rest of the world through, globalization, economics, education and capacity building, as well as, negative and positive impact of former.

Unfortunately, “video 2” could not be analyzed. The session was situated outdoors with too much background noise to capture the discussion. However observing the video, the students did not respond to the questions. It was expected because these were questions they have not previously encountered or thought about, observing their empty stares. They were still getting to know each other and the workshop leaders.
6.3.3 Video 3

Talking Circle Three began with the question, Where are we going? This question asks where are the Indigenous people in relationship to technology literacy, adoption and technology education. It asks, do we have the computing skills for today. The questions also asks how diffused is technology in our communities and how is it accepted. Where are we educational in advancing skills in technology for business, health and education?

Janice’s Response

“if we don’t do anything, we don’t change. We want to get out of the cross roads. We are visual learners, geometric, with no visuals. Expected what you want to be to go to college. Didn’t know what I want go, but be an RN. There’s a, fear financial, if it has what I need to get going.”

Nancy’s Response

“I feel we are at cross road. It is a blend of tradition with computers. Lot to expect an educational leader, not want to settle and not be happy.”

Xander’s Response

“People make the choice their selves, why we are at a cross road. If person not at his best or worst, update, graduate first, then can help today. It is all involving, 2 to 3D. Degree will provide a better life style. Each of us, work in team or individual; set more example, more Native American working together. Going back home, not a place to be, but a start, example this program, is a native hope, helping our people like suicide prevention, does have an impact on native, believe in yourself.”
6.3.4 Video 4

Talking Circle four began with the question, What tools could be used? This question is a follow-up question to where are going. It asks what tools could be utilized as we move into the future concerning technology, Information, communications, in Indigenous initiatives and to address issues.

\textit{Janice’s Response}

“Scholarships are the main problem, scholarship for the applicate. We are passionate, like basketball, we want our dreams. Ten years out of college, help out with children. Hopeful have careers to do, have my own place.”

\textit{Nancy’s Response}

“No much to say, I know about it. Learn technology and used on my grandma side. I don’t plan anything, it happens it happens, don’t know where I’m going to be, today, tomorrow”

\textit{Xander’s Response}

“Don’t know much, time goes by fast, skip college, more obstacle, need will power, main stream college first, but maybe start at 2 year, but glad had people to talk to us and people, accomplish our own goals, tech bridge way between each other, pull us together 10 years, settle with one things, Different interesting in other field, new opportunities for younger, don’t know where I’ll be in ten year.”

6.3.5 Video 5

Talking Circle Five began with the question: What are our needs? This question discusses a need for new leadership, innovation, health system to fight issues
of diabetes, obesity and alcoholism, a better education, success in our communities and a need to build capacity – we can’t move forward without capacity to move forward.

After asking this question there was a lot of silence in the group.

Janice’s Response

“We need technology in our houses. To go to sites for directions, need printers. Education on the Rez is needed in school. We need better education on the Rez, how it can make better. We need to address what they struggle with, get a better view what changes.”

Nancy’s Response

“So like webcam, online tours other countries, museum, person guiding through it. Have an aunt teacher who teachers algebra. If family not there to support, family being education, not just kids, parents and grandparents involved, everyone, technology can be used by families for education”

Xander’s Response

“Need better politics tribal and government in Indian health care. Politics are family, need other candidates, get to know others, not just vote for family. We need to see the bigger picture. How to improve.”

6.3.6 Video 6

The last Talking Circle, Talking Circle Six, began with the question, How do we get there? This question discusses a need to become change agent for organizational/tribal change. It presents what a change agent is, such as they live in the future, not in the present; change agents are fueled by passion and inspire others; they are strongly self-motivated; they understand people; they are catalyst in organizational
and community change; they are capacity builders, community builders through innovative thinking.

Janice’s Response

“We need support, be open minded, be motivated, be confidence. We don’t have the motivation. As kid younger on the reservation in Montana, all teachers were mean, sending to office for something smart said. Mother said, you need to stop being stupid, mother repeated the stupid comment to a point I didn’t’ care anymore. She abandoned me. My father was abusive. I had it in my head that I was stupid, afraid of college, felt stupid. You can change those tapes in your head and had a teacher like that, it is in the book, look it up, it is why be call a teacher.”

Nancy’s Response

“The board at XYZ, Mark tried to make it better. The older don’t like it, kicked him out, saying there are better ways to do things. Board upset with fired people, work there for years, now under investigation, the meetings are closed. The way they elect board member, don’t involve others. The community is everything, to include others opinions.

“ The HIS (Indian Health Services) clinic is unhelpful, local in Denver. I go to New Mexico for medical help have appointment in two months. To make better, funding, open programs, hire someone new ideas, perspectives, some are qualified, but they don’t want to deal with it, politics in culture, things will not change. Just because, I know you, they are not qualified. More people want to do better, rather than complain do something different. Their Indian crabs.

“Kids impacted by meth, drugs, to make money, forego education make money later, every one of us, before twenty were drinking and into drug. Seen sixth graders hooked on meth. There are enough people who are successful, to be mentors. They can influence boys in second grade. If we have more success and want to help, the only way is to have mentors, to help change.

“I had a problem in my sophomore year, ditching class, shutting down. Susan one of the strong ones, found (started crying) they were trying to
throw out of school. I asked for help, and Susan stepped in to keep me in school. Honor teacher is the meanest teacher, would not answer questions, or about papers. Susan, help on me on my research paper. I got a B on the paper, wish I had teachers that cared, rather someone just there. The International Baccalaureate program, we are only here for them, but one teacher help on math, other didn’t help.

“In Grade 3 when I was wrong, teacher was a racist teacher, she me in the back of the classroom. She only help only blond hair girls, the teacher would not work with me. They wanted to medicate me because I’m dysfunctional, you’re brown, not smart, it’s hard to get out of your brain, you’re just another brown person, just pass them along.”

**Xander’s Response**

“Finish school, information. Setting example, aware what they do, good modeling If Indians to run clinic, people quit, lower pay, but need new perspective Yes, agree, only known people in position or in office, not qualified Would you want to change or evolve, see bigger picture, why need to improve How been discover, friend smart, ivy school material, help discover bright kids, take time, could be done If say, responsibility is it own, but we need someone to meet you half way. Had to stay after school, music, volley, basketball practice, couple a time math, taught not like the book, but it was in the book, calculus on board, need more like him was helpful”

6.3.7 Video 7

Video 7 was the video of the final presentation to the curators of the museum on the students’ proposal and working model for an interactive interface for one of the dioramas. This video shows the confidence each student gained over the two weeks’ discussion of issues, and in creating their portion of the interactive interface.
After the final presentation, the students and leaders met back in the classroom. The students were asked to share a comment about their experience in the workshop.

**Janice’s Comment**

“At times it got boring but over time, I thought wow I didn’t know that! I’m glad I got to know stuff that I didn’t know before. Since, I’m going out into the real world, now that I know this, I can apply it”

**Nancy’s Comment**

“Talking circles widened my view of the world. I’ve been aware of the changes that our people are going to be facing in the next 20 to 30 years, now [I’m] aware how fast things are coming.”

**Xander’s Comment**

“It was really great to hear from other Native people that college is not out of my reach. I will be the first person in my family to go to college and my whole life I have never been encouraged to pursue a college education until now.

6.4 2015 Interview Part 1 – Interpersonal Process Recall

As discussed earlier, the questions asked were semi-structured, seeking the students’ sense of who they were prior, during and after the workshop, using photographs and videos to stimulate recall. They were asked a series of questions not necessarily in this order: How did you hear about the programs? Who were you before, during and after the workshop? Who were you the first day, middle, afterward? Other questions were asked on more specific subjects as they arose.
**Janice’s Responses**

“Pictures threw me back. All those memories, I’ve studied education, and no longer in school. I was at the school, not involve in my culture, unless going to the dances. I did not know much about what they believed in. My cousin introduced me to the program. Said it would be a great opportunity to learn. So went along with it. Better understanding how other tribes work, function. Good learning opportunity. Expanded my brain. Native American learning experience. *(Asked about her thought on the Talking Circles)* Like because everyone was involve. I got to chance to hear other thoughts and opinion on where we are and where we are going. How we can fix a problem if there is a problem. Made me think more, more ideas. Now that you said that. *(What changes did you experience in the workshop?)* Made me open my mind more and my culture, my tribe, my beliefs. What we can fix, how to get it going. To do this day, that we can make things better and be happier. Changed my thinking. Before I wasn’t thinking about. That things are fine, but during, I find things were not fine and what can we do to fix them. *(Were there any key things that stood out?)* Talking education, now that am in college, realize reservation does not have libraries to read for school. Heart breaking. They have a down fall. They don’t have the same education. If I had the knowledge that I have now, it could have been address sooner than later. *(What did you experience giving the proposal presentation?)* I’m not a person to stand up, I’m not focus and I mess up on my words but that day, more calm because I spend a lot of time with you guys – students in programs, felt like a comfortable place to do that. *(What difference did the workshop make?)* It did make a difference, I feel whole, the same friendship. Knowing that I had the opportunity. Life changing, I did not know as much information as I did when I came out of it. And still want to make a change on the reservation. Give library and this. I would not know this if it did get the experience in the program and expertise. *(Did you know it was computer science workshop?)* No! *(At the end of program describe yourself.)* That day, was last day, it was hard, spent so much time with you guys, and kids. Glad it happen. Most people can’t say they went and did that. Glad for opportunities because it changed my thought process and to work better in groups and talking at situation. What if my opinion is wrong. Should I ask this question or not. When I went through that for several weeks breaking out my shell. I said ok, this group talking is pretty cool. I like it. Great bonding experience and
to break out my shell and be able to talk about my opinion and how I thought about the situation I was talking about, it was good. I don’t know if I could do that now.”

Nancy’s Response

“Laughing, it is funny, that funny, weird. My mom got an email from Terry House about an internship, looking for Native Americans for the internship, my mom prompting to apply. Five years, I know, looking at my goals, I’m an officer, how much I changed, how it is all different now. I know I wanted to be a teacher and along the way things changed. (She was shown several pictures during the workshop and asked to describe who she was) “Oh, I think I graduated, senior in high school, Trying to think back that far, I think I was two very different people to where I am now, back then. I didn’t have any direction, didn’t know where I wanted to go in life. I still was considering all different options. Did know what I was doing career. Two different people, internship was something to do. To be perfectly honest, I don’t remember that part... I don’t know, five years ago a completely different life....A lot, I don’t know, lost at that point in my life. Shy at first meeting people, standing back waiting to see what others are doing. I kind of like that. (She was shown a second set of pictures and asked how felt at the beginning) See how skinny I am, I’m a girl. I remember thinking, I come to this museum all the time and its really cool, that we’ll have a chance to update this stuff that’s in there, it not that it is so old, but it kind of funny, hopefully something good will come out of this. So skinny why can’t I go back to that? (Experience any changes in the middle of the workshop?) Hard question, getting research together, everything together, enjoyable, didn’t feel like work. remember at the time, I think it would be fun to be a teacher on the reservation. Just because they may be having the same problems as I did, and I remember thinking maybe it is a something to think about. (What other experiences helped her in the workshop?) Problems in school, fitting in, being around people like me, different being an Indian on a Rez versus in city, being the token Indian but nice to be around people, like Mexicans, but I not. Just being around people with same struggles and it was kinda nice. Talking Circle widen my view of the world. (Could you explain?) Think talking about what we wanted to be, where we saw our lives going, stuff like that. Made me think about where I want to be and what I want to do. (How did you feel at the end of the workshop?) Pretty accomplished, learned a lot about work, about each other. I remember it was sad that it was ending.
As standing giving presentation, saying, don’t mess up, don’t mess up, don’t mess up. Yeah a destine program – don’t have to cite any thing any more MLA format. I fidget when I talk.”

“Still sad it is over, it fun, putting presentation together, getting to know people, I still talk to half the people. Still after five years later we are still good friends. I don’t know. Why still talking? We still have a lot in common. Most of growing up in the city with same struggles, still good friends, lot in common. We just clicked, I guess.”

**Xander’s Response**

“Actual from my sister, told about program. Living in Window Rock, Uncle, Joe dad, kept up with Joe. Yeah, inexperience, a little anxiety, didn’t know if accepted, other people and natives. Mostly for the experience and background experience. A Person a follower than a leader, than I am today, not as confident, little doubt, first step to a brighter future, challenge to take on the year, 5 years, still a kid, did not know what to expect in real world, just knowing that I was in that positive environment help me steer myself in right direction that I am today”

“Nervous, really nervous, working with other students, I didn’t know them, not sure that I would make any friendships that last, or just trying to fit, didn’t know if I was in the right crowd or not, other than that I was pretty anxious and excited just to be there, knowing that other native American, not only help their selves but help community as well. We had a lot of native teachers, other foreign teachers, school mostly all natives. (Who were you in middle of the program?) Not confused, but building confident, we started figuring what we’re going to do with the project, how we’re going about it. And later down the road, I think either the beginning or towards the middle, you told us that we would present to some of the board members and above. Don’t say there was a lot of pressure on me, but more of what I could accomplish. Knowing I wasn’t alone, everyone else was coming from the same tradition that I was. I wasn’t the only one going through it, there was Joe, Nancy that I could talk to and could help me out. Help them out. I feeling like team work, was very awesome” (Who were you at the end of the program?) “Feeling pretty nervous, we had our lines, present, remember my part of presentation. Relieved, accomplished. Mostly in the beginning, as a person, more of a followers, not put my ideas out through, now can voice opinion, and direction I want to go in, Oh yeah, helped change. Mostly the
instructors, to voice opinion, other presenters, open a lot of doors and option, different view of world, how project progress, team can make them happen, people back of project, stepping stone, want something change knowing how to present it. Other side projects, did help, open my mind to other things”

6.5 Interview Part 2 – Ethnographic Interview

Part 2 followed after a short break from the interpersonal process recall session. This interview addressed four themes. The first theme was the participants’ life trajectory after the workshop. The second was their education, their parent’s educational background, and the participants’ thoughts on culture. The third theme was participants’ experience in the educational system. The fourth theme was the workshop and curriculum.

6.5.1 Theme 1 – Trajectory/Change

Question 1

First, tell me about what you done since the workshop to now?

Janice’s Response

“I’m a Sophomore today. Finished high school, went off to college, Haskell, took some history courses, what learn in the program I wanted to learn more and reading articles how other tribes see things, living. Working at a kiddy college. Read articles wanted to do long. What do I do it now. While in high school, I want to learn more about tribes and the way they were living. I couldn’t because it wasn’t available to me. It was really hard to get articles that were true. Then the school had 1% Native American. But to go to a college that had all those things available. If I
didn’t have the program I would never have got that and wanted to learn more.”

Nancy’s Response

“I graduated from high school, became an officer, state patrol, went to academy. (Why a change?) Since I was little thought about it, being a cop, since I was little, family had a role in things that it shouldn’t, like American Indian Movement, anti-establish. Two years ago, I decided I rather be happy doing the things I want to do, rather than doing what other people thought I should be doing. And I’m still helping people, helping people in a different way than teaching; I like my job, agency and the person I’ve become. Down an interesting road”

Xander’s Response

“After workshop, worked staying in Denver. I’m in my junior year, working different jobs, canvassing. I went to Bacone college in Oklahoma in 2013, afterward, I’m at Ft. Lewis College. I just got done with pollen circles community services, current waiting to start up college again.”

Question 2

Now, if you were to stand in front of an audience, looking back, yes five years back, what would you share with them about the impact of the workshop upon you? (Like did it increase your Indigenous identity? Did it change your view on the world? Increase your interest in technology for Indigenous usage? Etc. etc.) If you did not take the workshop where do you think you would be now?

Janice’s Response

“Well, would be much better now than I was five years ago. honest that it important to have a program. You don’t opportunity because people don’t tell you about them. And if people don’t have people to tell you about it
then you don’t have. Don’t be stand-offish. Be yourself. Changes to not be afraid. If you have a change in mind, you can make it change. Native identity, yes, view of the world, yes. Some reservations don’t have as those off Rez. I learn to make a power point. What can I do for them and make them see that they can do. Make something for them to see. Ok let make a change and do something. It made me open my eyes, be awake. With what I have, the people on the Rez don’t have. That all it made think of . ok can I make a change for them. What if you did not take work. I probably be at the same place but would not have the same mind set. Still be in school. Not learning more about culture and way. I would be just going to school. Ok, dig deep. Different mindset. Technology. Yes, PowerPoint, picture and information wanted to use. But having technology available be great to have. Because people are more visual and hands on. Good to have PowerPoint and all technology available to us.”

Nancy’s Response

“Being people who had the same struggles, same problems, which was kind of nice to know people who were going through the same struggles, issues in school that I did. Part of it, Susan Harding and district tried to get kids together same thing, but it didn’t do anything for me. We united under one project, working towards the same goal and now got to know each other; they actually cared about being there. We played a bigger role, rather hey, glad to me yeah. (Did it increase your indigenous identity?) Yes, it did, I didn’t feel so weird anymore. (Help in world view?) I’m more comfortable with my Native Identity, it help me know it know into one. I think I remember back then, ok this part of me, I’m native and about this stuff in my head and the other me being that in school didn’t have any one to share that with, now that I’m older and that workshop did a big part in that, I am who I am and they’re going to melt together at some point, I’m definitely more comfortable with that now than I was. (Interesting the workshop was designed to create more interest in technology?) Funny. I’m not hearing that…For me I think it was, the project was fun, enjoyed doing all the research, enjoyed coming up with the idea of the touch screen interface to the interactive display I guess, but I mean, I guess I’m so much a people person that even now in my job, my interactions with the public, like that its a little bit different for me than other people, I guess, although it involved technology, it involve other people who were like minded. Its mainly what I got out of that. (If were not a part of the workshop?) I don’t know…the work did have impact on
me…but I think I changed more a year or two ago…hard to say, difficult…it is."

**Xander’s Response**

“Teamwork, mostly because nothing from the projects always come together, biggest aspects how all this came together, none of us got into any argument, or conflict with one another, personal don’t opportunities go to waste. For instance if I didn’t take this opportunity to attend the workshop I won’t have met different people, would not have experienced a real life business situation, stimulations, opportunity to stand up in front of others, not taken work shop, how system works, biggest eye open. You can have so much good intentions to do something great, change your community, just because you want to do that, it doesn’t mean that it going to happen, you got to like know people to get certain things done, it shows me, you got to know people to get certain things done really. Have people interested in what you are doing.”

**6.5.2 Theme 2 – Educational Background and Culture**

**Question 3**

Who influenced you about pursuing education? What is their educational level, and in what way did they influence or not influence you? What is the highest level of education attained in your family? What your parent’s level of education?

**Janice’s Response**

“A cousin, education is the number one priority. Not into school. If I went to school, behind me I would be something greater in my life. Parents – dad bachelor, mom has assoc. degree.”

**Nancy’s Response**
“School was never my strong suit, I like learning and I like traditional route did not work for me, in terms of studying and homework. I don’t have a clear cut define goal, I just don’t know. I may at some point go back to school and want to go higher up with it. As of right now, as a person, school is not a good idea, it would be a waste of money, it’s a fact of truth. I don’t know. Grandmother has master’s, was head of indigenous studies at CU Boulder, Dad, bachelors CU, Boulder, my mom just about to graduate from Metro, I mean they are all in school in college, they are education. For me it not my strong suit, I mean I just don’t like it, it’s harder for me than most people.”

Xander’s Response

“Mostly my mom, she never finished high school, she got pregnant 16, 17 around that. Growing up wasn’t too bad, but it wasn’t the greatest, how living now, Just how we evolved, not poor but not rich. How mom, walk to store, walk to hospital. Eventually mom got her certificates and after that we got a better life. How my mom dealt with all her hardships. How she kept on encouraging us to pursue a high education. Just so we can have items that we want. Highest degree – cousins has a BA, none immediate has a college degree yet, yes I will be first generation.”

Question 4

Do you think Issues of American Indian history impacted your thoughts about education and your pursuits of higher education today? What are some barriers in Indigenous culture that hindered education? What are some positive influences in Indigenous culture to pursue higher education?

Janice’s Response

“Love learning history. This generation so much available. If live in 1800’s I would not have. They still learn and do better. What make them do that, what they were thinking and what they were thing that way. Barriers – alcoholism, parent don’t believe in education, my biological mom more
concern with going to pow-wows, and take me out of school, out of state. Now I missed so much education. Alcoholism people depress. Kids grow up and be the same. If not in home, they would be better. People on Rez did have same opportunities. Parent though process not towards school - depressed – people hold a grudge because they don’t get the same resource. Job pay different. It is hard on person. Don’t think it puts them in a depression because they see things are not going to get better. They can’t see a way out to a better place. Drink it off. Alcohol at top of list. Why are we number one. We should make a change for the next generation – positive – people trying to make a change. Built a library. Completely change people, grades higher. People on rez want to help, to make changes. Make people want to change. The thought processes.”

_Nancy’s Response_

“Not higher education, remember in grade school, we were studying native America history and all others were making teepee, and my mother and I made a Hogan. I remember my teacher arguing with me that I wasn’t authentic, that wasn’t legit. My arguing with her that we are Native American, we grew up on reservations, we know all about this stuff, the more frustrating part is that, even still going to school, student teaching at Lion Creek, Their unit taught so much stuff that was so not correct about tribes. They talk about totem poles belonging to California tribes, more Inuit people, it just, thinking it was more frustration about education is so left field, it is so irritating. Now that they find out I’m Native, I’m constantly saying no I don’t go to college free, no I don’t get money, no I don’t do this, it is just easier to not have to fight fiction. Even in Higher Ed, professors still have this misguided perception about native, you guys have your PhD’s, you are so very wrong about a lot of the stuff I just have to laugh al little bit. I don’t know, it still a struggle, but not so much of struggle as it used to be, I think I’m more at a point, where if at some point one person find the truth at some point it will make it around.

“

_Xander’s Response_

“Yes, lot of people don’t know the true history, even the government and how many treaties that they have broken, they would hire people to kill certain animals so they can starve them out, there has been a lot of history that been covered or touched, the schools did teach you or cover any of
this stuff. They just show you what they want to show you. So, me, trying
to get a high education, I kind of like, want to educate more people, like
my culture, to help promote my culture, because it is slowly
dying(concern for disappearing culture), it is definitely something I want
to preserve. yeah, mostly nobody want to know the truth, really, no one
wants to know that they were trying to gave smallpox blankets to native
people. They just want to turn a blind eye. They want the truth, but not
willing to commit to the truth, I think is the problem. Some people frown
upon other people trying to obtain high education, oh, you are just trying
to be more like a white man, and your native roots, like they try to belittle
you, just because you are trying to improve yourself. (At Reservation
school?) little bit, people trying to study, or if people don’t want to get
pick on, they would intentionally not do the homework, intentionally act
stupid so they can fit in or they just don’t want to get picked on really,
(Workshop a positive influences?) A lot, if we can take like the white
man and how they do stuff, and slowly integrate with our culture, and
help preserve our way of life, it can do tremendous benefits, it is more like
keep on learning, like you learn more knowledge how to improve the
knowledge you knew before.”

Question 5

What role do you think culture played in your view of education in general and
higher education? What is your view on computer science? What role do you think
culture played in your view of CS?

Janice’s Response

“Positive things Osage, if you go to school and enrolled in tribe, do good,
money for college, books, classes, things need for school. Some don’t have
much good grades there possible to go to college. View of computer
science, don’t get much of it. PowerPoint, excel I don’t know anything.
Someone taught me something about it. Its great technology, can pursuit it
and get a job”

Nancy’s Response
“I know it is helpful, in some ways it’s a good talking point, I know going through the interview process, my sergeant, knows me because I’m the token Indian. In some ways it is a good talking point because some people don’t know much about us and at the same time it just irritating that their more interested in Indians than me as a person. And it is the same thing in education, had professor had been so miss guided and had no idea was so miss guided and had no anything about Native Americans.”

**Xander’s Response**

“For me, very supportive, knowing that I’m native American and want to get higher education, knowing I want to improve myself, knowing I want to improve my life style, also I know I want to come back to my community and help my people, we on the Navajo Rez is the largest Rez out there are a lot of things we can’t do for our own people. So it makes me a little sad that, seeing the living conditions people actually live out here. So getting a higher education, I can take want I learn and bring it back. *(Did you know the workshop was about Computer Science?)* not really, I knew I was like computer interface integrated, making more electronic, but I really didn’t see it like that, most it was like a lot of hands on research, I didn’t exactly know that. *(Did they talk about CS in HS?)* they did, but you had to request, to know more about those career fields, in general the schools didn’t tell us much about it.”

6.5.3 Theme 3 – Educational System

**Question 6**

While you were in HS did you have a hunger for your culture? Tell me about it...

**Janice’s Response**

“Not really. Just because the only thing was the Osage dances. More tribes in me. After the programs and learn more about my tribes. They were rivals, and they are in me.”

**Nancy’s Response**
“I’ve always pretty involved in my culture, just because always going home in Az, I guess the trouble for me is melding those two together. I knew who I was outside of school, powwow, families and all that good stuff. In school I was more lost, I didn’t know where I fit in because nobody else had that connection that everyone else, no one really understood what it was like, other say it went so and so, and I said I went to pow wow in Montana ...definitely an interesting experience for me. (Do wish you had more cultural connections in HS?) No because always pretty connected in school, I was ok with my culture but it got to a point where I started putting away and stopped dancing for a while, I didn’t go home as much, because I didn’t know how to be that person all of the time. I don’t know. It’s a difficult question. I was comfortable, but because I was pulling away it was just kind of difficult to be whole.”

**Xander’s Response**

“We had a native literature class. We had an advance class, Navajo language course, intro to literature one and two.”

**Question 7**

Do you think if culture were a part of your HS learning experience would it have made a difference in your education? What value would it had added to your learning experience? -

**Janice’s Response**

“Culture in school – yes. The fact since I learned all that. I would have taken schools more seriously. And inform other natives about.”

**Nancy’s Response**

“Hmm. I think it might have. Would it add value? ...not the pressure, but elevated some of the problems trying to just fitting in and I think I could have focus more on school and more of a connection, I guess.”
**Xander’s Response**

“Yeah, it learning about another culture, knowing different knowledge of other people, project based on Cheyenne tribe, *(In High School?)* Oh yeah, a lot, native intro at Bacone College, so many natives there. They knew their own culture, they knew some stories, they know what happened, and there were many other natives there that didn’t know much about their culture. it made me feel proud because I did know a little about my culture, so when someone ask me about it. I can tell them about it. So taking some classes in high school, Definitely helped me a lot. Know a lot of my culture is, is definitely awesome.”

**Question 8**

Was Computer Science as a career talked about while in HS, or ever offered as a career choice? If you had known an Indigenous computer science person while in HS, not the workshop, would it have made a difference in your career choice? If CS was offered in HS with an Indigenous approach would you have taken it? Why? -

**Janice’s Response**

“No not offer. No I want to work with children. Next year, I’ll enlist in air force, wanted to be a nurse practitioner. It would not have changed my career choice. Yes I would have. Why. If I see another Native American teacher oh yes I’m taking your class.”

**Nancy’s Response**

“Was computer science ever talked about or offered as a choice? No really, in eight grade we learned how to use them, when I got to high school it kind of like, even now, hey I have a computer, but I don’t know anyone who writing script or programming. I see guys did, always wanted to do, I guess. In high school I don’t remember anyone talking about computers or classes or anything like that. Went to Ironwood HS. If like workshop would have taken? Yes I might have to see what it’s about, but more the
Indigenous part of it than the computer part. Know my way around, but not something I’m super interested in. I know enough to get myself into trouble. I not one of those we keeps up on the latest, greatest. I don’t know.”

Xander’s Response

“Yeah, because now I’m pursuing engineering now, and if I had some cool pal back then, that show me what I can do and see how much applications can be used for, would persuade me to pursue my major. Mostly things that intrigues me is things that I can see, like five lines of coding, it’s is pretty cool, I wish I could do that, and would encourage me to follow that career path.”

As discussed earlier, computer science as we use that term is just one part of the computing field. The student responses indicate they did not see computer science as a part of the workshop.

6.5.4 Theme 4 – Workshop/Curriculum

Question 9

If you were to compare the workshop to your regular HS classroom, how did participating, working as a professional in the workshop, affect your learning experience? Did having culture in the workshop change the meaning of the workshop? Did you see how your High School classes such as research, writing and presentation relate to a profession? In what way?

Janice’s Response
“Lived in SC, Kansas and then Haskell. Compare workshop to high school. One more professional than a regular class. If it was more professional more people would have taken. Workshop more professional. Setting, down to business, knew what is expected. Culture bring more meaning – yes, knowing I am native and learn more native American. Two more of a connect. Your Native American and I Native American it’s a connections. (There a connection between the workshop and what you learned in high school.) – no, I don’t know how to think about.”

Nancy’s Response

“I like the workshop because I said traditional school wasn’t for me. I think I liked about the workshop is, hey this is what needs to get done, and figure out how to do it and it wasn’t like you have to do this and this and this, it was more like hey you guys here’s what we’re doing, here’s the parameters, and you guys gave us greater control, it was nice to say all of us said, hey this is what we should have, hey if we all got together. If school could have been more like this workshop, I could have done better at school. What do you think made the difference? More relax, but still expectation to get the work done and that we complete all of our task, but I couldn’t really tell you. (Did having indigenous culture bring more meaning to the workshop?) Yeah, chance to be in a museum that works with an exhibit. I think it would have been another education tool. I always interested in education. To me to educate others what we are about. It was definitely a motivator for me. Even now I have conversation with others and when they find out that I’m native, we have an hour long conversation that hey there will many people come through on an hourly basis to learning about our culture. it was a chance to put it out there, that we wanted to be. As opposed to school, like text books that we all live in teepees and hunt buffalo and this is just not the case. (How did culture bring about more meaning to the workshop?) Having native educators was nice, because I think in native culture there are norms that are understood, communication and how we do things. I know that it is easier to relate, felt more relaxed, hey this person gets it. That’s what I got. That’s how I felt. Other have said, I don’t have to explain myself. Yeah there no business doing what I’m doing, why I think this way. We all think the same. That same cultural, mean its not the disconnect, not the hey, this is why I do this, ok this why I do this and they understand why and its kind of works out a little bit smoothly. Even now with my job there’s a
disconnect with my boss and in the way I communicate. I communicate total different way than she does. It’s a battle, its nice to do your job and someone ask hey, why are you doing this. We know why this is happening and I can be more of myself. Its just a cultural difference, it’s the only way I can explain it. Its our culture. Had same feeling I don’t have to explain myself, but don’t know how to express myself. Learn quite a bit. High school daily work get done. But workshop more like work because they hired you to do this. We could be creative. We came up with the idea and we when from there. (Do you feel like its traditional?) I do, it was definitely different. We all kind of think the same. We made friends because we are all the same type of people. Professional we all worked together on actual. It definitely better to have the same type of people work together because it gets the idea and help develop further. Diversity good, but we were all native and we worked on a native project we all had the same end goals in terms of application for general population in mind. We went from there. It was easier to handle because we were all equal and we wanted to educate the people, how do we do that.”

Xander’s Response

“Exactly how you would present it, find out what wrong, how we can make it better, who is it pointing to, what demographic, a team of works who would do it eventually, do what we did, trying to some jobs, some people doing research, spot on simulation how we would present something (The learning experience) yeah, give me some insights on how things would go, it was a practice like real life, so we started getting everything together and make our practice run, even our practice presentations, even that helped a lot, just help us for the actual presentation, yeah, a lot really, did take a little pride from me, but it would help me educate other people about people who use to live there, they had to immigrate so that other people had to live there, it showing people just actual history, it took pretty much a lot of pride.”

Question 10

Don’t know if you thought about this, but on a scale of 1 to 10, one being low and ten high, what role do your think Indigenous culture played in the workshop learning
environment, as well as the Indigenous (Cheyenne) subject matter in developing the interface? Why did you give it that rating? What were some of the cultural elements that enhanced your learning experienced?

**Janice’s Response**

“Role of culture 10, subject matter better/worst – it was good to have that, to learn bigger diversity for the workshop. When we looked at the exhibits just learning that. See that made a big difference.”

**Nancy’s Response**

“For me 8 or 9, one of my tribes is Cheyenne, and nice to learn more about that tribe than Navajo. I like learning about native stuff and other tribes because it fascinating, I just like learning about North American native culture. You mention teacher, subject, common goals it did enhance your learning experience – Yes. Explain more about that! We all thought along the same line. We had a common goal that we had. It was easier to focus on the research we wanted to put into it. As opposed to getting stuck on a certain aspect, hey I don’t know if I can do it this way. And having to battle through that before we can get the heart of the actual project. Being around people we think the same, it is easier to get to the end goal, to get where we are going, when everybody is on the same wave link. Makes it more easier.”

**Xander’s Response**

“Pretty high, like a 10, mostly it had to do that it is Native American related and I could related to it.”

**Question 11**

Don’t know if you noticed or not, the workshop had many Indigenous elements. How did having Indigenous culture integrated in the workshop make a difference to
you? Can you name some Indigenous elements in the workshop and how it made a difference to you? Did you feel a strong sense of your Indigenous after participating?

Janice’s Response

“When we did circle talking, stick (feather), held it when talking that was cool.”

Nancy’s Response

--- Thinking, but no response, shrugged shoulders

Xander's Response

“Yeah, I meant, work on project, learning about the Cheyenne culture, food, games, nomadic, more detail, made me learn more about my tribe. Encourage me to read more about my tribe, pretty big impact.”

Question 12

We covered five questions in Talking Circles in the workshop, that focused on our Indigenous people, such as “Where are we?”, “Where are we going?”, “How do we get there?”, “What tools could be used?”, “What are our needs?”, “How do we get there?” How did these questions impact you? How did these questions enhance your learning experience? How did they broaden your view? What if these questions were not asked, would it have made a difference in your outlook?

Janice’s Response

(Accidentally skipped.)
Nancy’s Response

“Remember one on technology, we wonder, do we want to be young professional and still don’t know how to tie that in with our tradition and culture, and less of a struggle now. I think those questions real helped in terms of what you want to do in life. How incorporate being indigenous and being young professional and modern but still keep a hold of our roots. I like those questions because I never really thought like that. I always had to struggle because I going to school and being native. All goes back to the same thing. I’m seeing progress as young natives because they’re trying to be cultural and modern the same time. Its nice to know there are more young natives fighting that battle than I use to see, I guess. Oh you can be one or the other but you can’t be both. But there are more like me, more modern but still tied into culture. It’s nice because to tie together. (Workshop act like bridge?) Yeah, I know this workshop really did help with that, because before this workshop I was two different people and end of the workshop, I said well you know use it to my advantage. Mean might as well be who I’m going to be, how it’s going to be, I’m going to give up one or the other just because the rest of the world doesn’t understand me. Personally I like those questions, because the conversation we had, were really interesting made us all think about where were heading, what going to be happening in coming years. So it did broaden your view? Yes, it definitely made me think about in term of technology, to our advantage. There is a language immersion in Oklahoma showing to preschooler in Oglala. It is evolution and interesting. (If questions weren’t asked?) At the time I would have not noticed. Prolong my thought process. I don’t think I would have thought on it on my own but some not presented that question to me. I think it just made it easier for us to open up to each other. Joe, Xander had conversation on what it was like it like to be native and go to school. I think I would have just gone on to think this was my own personal battle I was having. I think I would have gone on much more confused. Internally battling this issue that has gone on so long. I don’t know, it was just nice to talk about that with other people.”

Xander’s Response

“Made me realize as indigenous people where we stand as a people, the first question, for some reason just stuck in my head, it makes people
think, that we are stuck, we still live in teepees, they still think live like this and we are not up to date like everyone else, they think we still live in teepees, (resaid again we are lacking) yeah it is definitely a question that we have to answer ourselves, but we just experience a 3 million gallon spill, waste in river, chemical going directly to Navajo nation and we are finally trying to come together, were we couldn’t do this before. We can help people recognize that we are still here, it a question that lot of native need to ask their selves, and how they want their community to get stronger. (other questions) yeah it really broaden my view, it kind of opened my eyes a lot, how do we reach our goal to help our people, how can we ensure that our culture is being preserved, make sure our language is still being spoken fifty years from now, how can we do this, is there an answer to this question, while participating in the project, alright what can I do. Every now and then you guys would bring in promoter people who would tell about schools, basically about high education, it finally click for me, that higher education, I can get a degree, I can use what I learn and bring it back to help my people. Going to this project was pretty inspiring. (if questions were not ask?) difference would not be as big, I would be going on what I got to do, like even more confident, because I feel like I have a sense of purpose, something I got to do, and knowing that I’m on the right track, it has helped me more just to reach my goal.”

**Question 13:**

There were a number of positive comments about the workshop [in the discussion], but no mention of computer science. What were some comments you heard and why do think there was little or no talk about computer science or the Interface Development workshop? (Note: In later analysis, Victor agreed to be a part of this study however he opted out to have his data included in this study. He was also the student who did not engage with other students in the workshop and the author made him the coding webmaster. He was the student that went on to major in computing at a local college.)
Janice’s Response

“Because it did not feel like a computer science program. Felt like a program. You tricked me. It didn’t feel like a computer science program.”

Nancy’s Response

“Because Victor, he was the only one work on the computer part of it, the programming working with you and the rest of us focused on the research on the development on how we wanted to work and how we wanted it to look. I think if we all been involved the actual computer part of it, what it took to write the script that goes into it, the programming. I think we would have been more interested in that part. For me, I know he was going to take care of that part, so I’ll worry about x, y, z, well some else is taking care of it, I’ll do my part.”

Xander’s Response

“Know, CS, Victor coding, how we can use phones, scanning code, type of CS wanted to do, there was more than sitting at the laptop and transmitting numbers, it kind of thinking that was what we were going to do, but started looking at history books, looking for things on line, we started pooling to get our jobs accomplish.”

Question 14

Looking back on the workshop what would you say had the biggest impact on you that you carry on to today? Was there anything in the workshop that challenged you to overcoming personally? Looking back, again, was there something in the workshop that helped you grow as person? What was it? Let look at it in a different way, do you think absence of your culture in the learning environment limited your growth? Why?
Janice’s Response

“I think, it was when I had to speak. I had to face my fear. If I didn’t do it I would not be doing it today.”

Nancy’s Response

“Being able to put both of me together into one. In the talking circle, we had about indigenous people and technology and what going to be happening, I’m more conscience on the type of native person I want to be because I’m twenty some. For me the point is try to, I get this question a lot when I first join the patrol, oh your native, oh you were all alcoholics, its stuff that comes out of their mouth because that is all they know about us. And for me this workshop with the chance to say hey, you know we’re here, we’re not alcoholics, we all don’t live on a reservation, This workshop really help me see that, hey this is my duty to educate people on native Americans and show them that we are not all crazy and run around doing nothing with our lives. The workshop helped with that a lot, in terms of just accepting it. A lot of an internal battle of mine. Like hey I’m native and I don’t think it my job to educate people. And now it becomes one of the things where I enjoy doing it because that is one less person, who is misguided about us. It makes me feel a lot better when I have a conversation with someone like, um, yeah I’m twenty-one, yeah I’m odd, yeah I’m native. No I don’t drink. No I don’t do drugs. Yeah I have a clean back ground. A part of me gets me because there’s a lot out there about reservation and how bad it is for natives and how all we do is drink and do drugs. We don’t do anything for ourselves and we enjoy living in poverty. And the other part of me is like, you know, as much as those people who like to look like that I don’t have to. And it still a little bit of a battle because the frustration in me because you know why don’t you guys bring yourselves up with the rest of us. And you know instead of getting off on these Diane Sawyer reports that says “poverty born” or something like that. And I just so struggling with that a little, because I’m a person that so driven where I want to be, but I feel like being native is sometimes a draw back because people have these perceptions about our people, it’s frustrating. So in a way you are saying, the influence that is out there, is a struggle, what I call Cultural Memories not just for the current times but for the past. Yeah, I think it’s the same struggle. It has definitely changed from generation to generation but I don’t think
anything is really going to change until more native think, finally say yeah maybe it’s not ok to look like this. And its going to take more people like myself and my sister who just graduated going to med school. Some of us that are driven, like yourself, unfortunately we are the exception not the norm. it is a struggle and hope in the future generations that come along and that more and more native are going to stop living in chaos.

What if the workshop put one non-native in? I think that person would have felt very, very … I would want to say left out, but would have felt weird in terms of, thought process. I think we as Native Americans have a different point of view than other people do. I’ve notice that would have felt a little out of place and probably felt like most of us feel when we are not with other natives. Notice with my co-worker we are on different waves links because we have different beliefs, morals that as a native person that we all seem to carry. Regardless it we actually killed them or not. Think they would have had a rough time. (How do you think the class would have responded?) I think it would have depended on the person, I think if they would have tried to understand where we were coming from and understand our thought processes and open to receiving them, I think it would have worked out really well, because we would have gotten the perspective from someone who doesn’t not know about our culture, and looking at the interface and clicking here, oh this and this, it would have been helpful in terms of that, it would have been helpful in terms of process because we could have gotten a different perspective. If the person would have not been close it and close to thought processes it would have been difficult. Just depends on the person.”

Xander’s Response

“I think, it has to be up there either public speaking, confidences in public speaking, mostly quit a few things that impacted me. Standing in front of people was pretty huge, there are core vendors and people from different departments, it was exciting, just Joe’s family, my family was back at home.”

6.5.5 Interview Closing Comments

Any additional Comments?
Janice’s Response

“Just the fact we were all different and we came together. We were introduced, and had the same feelings and have a bond with them. Feel comfortable, change attitudes, belief what did take, safety in classroom, made a different, using technology and culture. (If you had a non-native teacher, would it make a difference?) Maybe not have the same connection. They knew they had education but not the same connection. Agree with West’s comment. Not hungry for culture but you did thrive in it. Comfort, took load off of you as a people. Thoughtfully designed program!”

Nancy’s Response

“I had a lot of fun, with our internship, it’s definitely an experience, thought I was a part of it. It was nice to be, stress relief I was going in to be with other people like me and it was nice for a while. Because unfortunately we don’t get a lot of that. It was a lot of fun. We laughed a lot, we done a lot of crazy stuff but at the end of the day. We got our research done and got it taken care of. I think it all came together really well. And for me as a person it impacted me because of the conversation we had about being native and technology impact has on all of us. It was definitely an experience and I’m very grateful for it.”

Xander’s Response

“The project did so much for me, it open a lot of doors I can go through, it opened new careers I want to pursue, there so much that program done for me that I can’t every repay you guys really. All of it had to do with experience and all the experience helped me so much that answering questions how to let people know what I bring to the table, just telling people like I done something for my life. I been to this. I met some pretty cool people, I know people, how to account me. I really enjoyed these programs, it great. Honest, what we did for the program, it like something I’ve done in College. Like first week of school, you get to people you don’t know, they could be freshman or returning students, and the professor says, these are your group members, you present this at the end of the semester, how me feel I get mostly because it comes back to the experience, experience working with new people, we did not have a
problem, we got together, we made a schedule. I already felt like I know what I was doing, kind of like comfortable. I think it was amazing, I would say grateful, because I take a part of it. Lot to take in because, it didn’t seem like much, but the way you broke it down, there’s so much behind it, it put in to it, it paid off pretty well. I thought it was pretty cool, thought it was great, thought they were funny, it’s pretty cool, very friendly, thought it was awesome, yeah, a lot of time the (non native) teachers think we got a free pass, they don’t realize that we have our own set of problems, it’s weird, it is easy to connect to a teacher knowing that they are native, like us, it makes a difference, relationship wise, it’s a barrier that can be broke, you can’t judge a book by its cover, (learn better) yeah, learning more about researching really, trying to get primary resources, rather than secondary, researching goes a lot in colleges, like you were trying to find historical facts to write in a paper, it gave me few tips on finding cool resources, not remembers, remember 3d printers.”
CHAPTER 7

Interpretation

“Children who are comfortable with their own culture and the position of their culture in the larger society are more apt to do well in school than children who are uneasy with the use of their Native language and cultural heritage.” William Demmert – Blue Print for Indian Education (1994)

This chapter brings together the 2010 workshop and 2015 interview data to investigate the Indigenous computing experience. It was hoped the investigation would help to understand what affect limits movement towards computing and what affects positive movement towards computing in an intervention (See Figure 7.1).

![Figure 7.1 Subjects in an Intervention with Two Possible Outcomes](image)

This chapter relates the students’ responses to the research questions:

1. What effect does Cultural Constructionism in a learning activity have on the educational plans of Native American students?
2. What effect does Cultural Constructionism in a learning activity have upon Native American students’ identity, attitude and outlook, on self and on computing?
3. How do Native American history and computing history contribute to the Indigenous computing experience?
4. Can Cultural Constructionism be used to improve the Native American computing experience and increase interest in the computing sciences?

Please note, in this chapter I will switch to first person as needed to provide insight within the investigation. Also what this investigation observed and reported is not typical of all Indigenous students. This investigation brings out what three students, Janice, Nancy and Xander, described as their experience. In addition, as an Indigenous researcher, I brought insight into the students’ experience from an Indigenous cultural perspective. I am aware that concerning the insights I provide, some will find agreement and others will have disagreement. I’ve tried to be true to what the students shared about their lives, being and learning in this investigation.

7.1 Research Question #1 – Effect of the Theory Longitudinally

What effect does Cultural Constructionism in a learning activity have on the educational plans of Native American students?

![Diagram](Figure 7.2 Seeking the Effects of the Theory Five Years Later)

In developing this question, I wanted to know if the workshop would influence any student to study computing after high school at a post-secondary institution. Over
the five years, I tracked all 10 students. I wanted to see if any student would be swayed to study computing from the workshop. If one student did major in computing, I would consider the workshop had some measure of the effectiveness. I also wanted to know, if any student did choose to study computing, what factors, if any, influenced the student and what discouraged other students from studying computing.

One student did select computing as a field of study at a local college. This one student did agree to be a part of the study and was fully interviewed as the other three. However, he opted not to provide final consent to be included in the study. His reason for opting out of the study is unknown. Thus this investigation cannot report what the student shared concerning what may have influenced his notion to study computing. On the other hand, from a participant/observant perspective, I am able to provide insight on what may have influenced the student’s decision to study computing. After several hours of class time in the workshop, providing the tools the students needed, it came time for the students to select a subject. All students did select a subject, however one student (the one who opted out of the follow up study) did not engage. I had to make a decision on how to engage this student, thus producing a tension between me, lead facilitator, and the student. I had planned on all students to have some experience to undertake some elementary programming and navigation using JavaScript. However, since I had one student who was not engaging, I decided to select him as the
webmaster. As the webmaster he did all the programming and navigation for the workshop with my assistance.

Looking back, because one student did not engage, the opportunity to create interest in computing leaned heavily towards that one student, because of my decision. My decision meant the other students did not have the opportunity to experience any programming and navigation. I believe this was a major factor that influenced that student to study computing and handicapped the other students. Very early studies have shown that previous programming experience influences majoring in computing (Kerstenn, Linn, Clancey, Hardyck, 1988). It is a belief, still followed today for programs offered by Code.Org, Lockheed Martin Code Quest, MIT Scratch, CodeHS, etc.

In 2011, Xander, a promising 2010 candidate for computing advancing to the 11th grade at the time, was asked if he would like to come back the following summer in 2011. His job was to publish the 2010 workshop exhibit on the web using Google Sites and with Quick Read code (QR Code). He was shown how to recreate the working model utilizing Google Site and he proceeded to recreate. During that time working with Xander, I had meetings coming up at Google and to attend a teacher’s engineering workshop at a local college. I took Xander with me to both. At Google, we both sat in on their discussion on their further development of HTML5. Xander was in awe of the surroundings and the discussion. At the teacher’s engineering workshop we both participated in a Lego’s robot programming session. He was intimidated by seeing
himself as just a high school student in relationship to Tribal College professors; however he did learn to program the robot to conduct several functions. He was surprised how easy it was and that he had the ability to program.

However, as stated above, the 2010 assumption did not play out as thought. More exposure to the computing profession and programming should have enticed him to select computing as an interest of study when he entered college. He did choose engineering as a course of study… why not computing?

In further investigating what he shared in his 2015 interview, there are some contradictions. He implied that if he had more computing experiences during his high school years, it would have persuaded him to choose computing as a career, even though he had obtained a broad exposure the second year in the summer of 2011. In his interview, he said that, “If I had some cool pal back then (high school) that show me what I can do and see how much application can be used for would persuade me to pursue my major.” This seems to indicate that peer influence may be more important than exposure and experience to computing. He may be saying that, someone like him who is an Indigenous peer in high school may have been a stronger factor in enticing interest in computing.

However, there are indications a lack of early exposure to computing in secondary schooling is also an important factor. All three student, Janice, Nancy and
Xander, in their interview indicated that computing was not a subject talked about in their high school when asked. From their perspective there were no opportunities for Indigenous student to obtain experiences in computing in their high school. As Xander mentioned, there were no Indigenous peers with interest in computing or Indigenous role models. If there were computing courses offered like other subjects as biology, chemistry, literature, history and math they may have enticed interest with an informal workshop after school or in the summer, to pursue as a course of study.

Janice said in her interview about computer science classes in high school, “No not offer ... view of computer science, don’t get much of it ... I don’t know anything. Someone taught me something about it [after high school]. Its great technology, can pursuit it and get a job.” However, she said, “I want to work with children .... Wanted to be a nurse practitioner. It would not have changed my career choice.”

Nancy said in her interview, if programming was offered in high school like the workshop, she may have taken interest. She said, “Yes, I might have to see what it’s about, but more the Indigenous part of it than the computing part. Know my way around, but not something I’m super interested in. I know enough to get myself in trouble ... I don’t know.” She also said, “I think if we all been involved the actual computer part of it, that it took to write the script that goes into it, the programming, I think we would have been more interested in that part.”
Xander said in high school they did talk about it, but you had to request information and not much was said. To quote again from his interview, “… they did, but you had to request to know more about those careers, in general the schools didn’t tell us much about it … if I had some cool pal back then, that show me what I can do and see how much applications can be used for, would persuade me to pursue my major. Mostly things that intrigues me is things that I can see, like five lines of coding, it’s is pretty cool, I wish I could do that, and would encourage me to follow that career path.”

As mentioned, when interviewed, Xander was engineering major. Janice on the other hand was interested in education and nursing and majored in education in college. However she was poorly prepared for a post-secondary education and dropped out after two years. She said while she was in high school her “… parents don’t believe in education, my biological mom more concern with going to pow-wows, and take me out of school, out of state. Now I missed so much education.” She was working at a Kiddy College when interviewed five years later. Nancy also had interest in education and eventually dropped out of college too after two years. At the time of her interview she was working in law enforcement. She said, “I’m an officer … I know I wanted to be a teacher and along the way things changed.”

Of the seven remaining students who did not participate in the follow-up interviews, the one that majored in computing changed majors after two years. Two
females did not progress to college, though one was thinking about law enforcement too. One male and one female could not be found. One female was still in college in a general major. One male was majoring in civil engineering but dropped out two years later and has a family.

7.2 Research Question #2 - Effect on Identity, Attitude and Outlook

What effect does Cultural Constructionism in a learning activity have upon Native American students’ identity, attitude and outlook, on self and on computing?

![Figure 7.3 Seeking Effects on Identity, Attitude, Self and Computing](image)

In developing this second research question, I wanted to know if the workshop integrating Indigenous culture with Constructionism positively affected the Indigenous students’ identity, and attitude to self and to computing. Investigating this question, I found it difficult to separate the students’ identity, attitude and self because each influenced each other. I also found it difficult to pinpoint theoretical elements that may have had effect on the student. It seems that the responses the students were sharing were coming from internal and prior constructed experiences within the student, more than expected experiences in the workshop in relationship to computing.
This realization took some time, because I had an investigative agenda, and it was overruling what I saw. Only when I came to focus on the students, and not on my agenda, did I realize the students were sharing their experiences not from the theory but from two constructed worldviews, “intercultural” and “intracultural.”

First to define what I mean by “worldview,” it can be described as “a comprehensive conception or apprehension of the world especially from a specific standpoint” (Merriam-Webster). An intercultural worldview is a person’s constructed experience derived from tensions between two or more cultural communities. An intracultural worldview is a person’s constructed experience derived from tensions within their cultural community. These tensions may be derived from a mixture of past historic events and current events.

These internal tensions may be derived from voluntary and involuntary cognitive construction, as described in Chapter 2. As discussed there, voluntary cognitive construction means knowledge constructed (voluntarily) after critical thought and investigation. Involuntary cognitive construction is knowledge constructed freely without question (involuntarily) from sources of authority such as parents, grandparents, relatives or others within their socio-cultural group or a teacher that shape their perception of their worldview. Both voluntary and involuntary construction happens from early childhood into adulthood.
To further define intercultural and intracultural community; an intercultural community can be described as *Indigenous people interacting with the greater society outside their Indigenous community.* In this investigation the intercultural interactions were mostly with the educational community. Intracultural community can be described as *Indigenous people interacting with other Indigenous people within their community and other Indigenous people outside their community.* A more complex definition is, it is an interaction between two people groups which includes their written and unwritten social rules and philosophies of human history and activity.

### 7.2.1 Intercultural Tensions

The first day in the workshop, intercultural tensions appeared as the Indigenous students discussed how they saw their culture depicted in a museum. Janice said, “It showed only surface of what tribes does. It’s a picture back then, not a picture of what we do now, how we improved, what we lost.” Nancy said, it “… show[ed] we all live in teepees … it does not show our story … shows what is on TV.” Xander with a strong sense of his identity said, it “show[ed] what we had … colors may not be right for year of practice … don’t care what others think, because I know who we are, how keep culture alive.”
The students’ comments in the videos recorded at the workshop revealed further intercultural tensions, coded as 1) the Reservation School System; 2) the Public School System; and 3) the general Educational System (See Figure 7.4).

**Figure 7.4 Intercultural Tensions in 2010 Workshop**

### 7.2.1.1 Reservation School System

All of the students who participated in the follow-up study had experience in reservation schools. When the reservation school employed more non-Indigenous contract teachers and few Indigenous teachers, the tensions were high among the students. The non-Indigenous teachers represent the dominant culture, and the
Indigenous culture, the minority culture. Xander attended a reservation school system that employed more Indigenous teachers, which he felt gave him a strong Indigenous identity and more self-confidence. On the other hand, Janice and Nancy’s schooling started in a reservation school system that employed more non-Indigenous contract teachers, thus feeling less Indigenous.

7.2.1.2 Public School System

In the Public School Systems that Janice and Nancy moved to, tensions between teacher and student were high. The students in this setting had no or limited contact with other Indigenous students. The tensions were compounded as the students saw the whole educational system with no, or limited Indigenous teachers, counselors or students. They felt alone, with a lack of support from the system or from teachers. They saw the system as a white/brown divide.

7.2.1.3 Indigenous Culture in School

The students shared feelings about Indigenous culture in their schools that fell in four coded subcategories as Might Have; Would Have; Being Native, Having Native Teachers; and Limited Opportunities (see Table 6).

<table>
<thead>
<tr>
<th>Indigenous Culture in School</th>
<th>Might Have</th>
<th>Would Have</th>
</tr>
</thead>
<tbody>
<tr>
<td>Might have made difference</td>
<td>Would have helped with fitting in</td>
<td></td>
</tr>
</tbody>
</table>
Might have taken school more seriously
Might have focused more on school
Might have created opportunity to relate culture to education
Might have understood the connection of culture to school
Might have brought more meaning with connection to culture

<table>
<thead>
<tr>
<th>Being Native, Having Native Teachers</th>
<th>Limited Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being Native, learning about one’s culture would have brought connections to school</td>
<td>Limited opportunity to discuss, think critically about tradition and culture</td>
</tr>
<tr>
<td>Being Native and having a Native teacher would have brought connections to school</td>
<td>Limited opportunity to discuss, think critically about culture and being modern</td>
</tr>
<tr>
<td>Having a Native teacher I don’t have to explain myself</td>
<td>Limited opportunity to talk with other Indigenous people</td>
</tr>
<tr>
<td>Having a Computing Native teacher would make a difference to learn computing</td>
<td>Limited opportunity to resolve inter and intra cultural conflict</td>
</tr>
</tbody>
</table>

Table 6 Feelings If Indigenous Culture Offered in School

**Might Have**

In this category, Indigenous culture was not offered in the urban public schools they attended. The students said it “might have” made a difference in their educational experience, had they had Indigenous cultural classes in school. They might have taken school more seriously and been more focused. They also said it might have created opportunity to relate culture to education, and to understand the connection of culture to school, and could have brought more meaning to their school experience.
Would Have

Beyond the “might haves”, some student comments suggested that more engagement with Indigenous culture would have helped them fit in the school system and would have helped them to know about themselves culturally, to learn more about their culture and to know more about their culture.

Being Native, Having Native Teachers

The students felt that having a Native American teacher would have supported a connection to school. They also said that “having a Native teacher” they would not have had to explain themselves. Feeling isolated in the urban school system, in a culture not their own, and feeling misunderstood by the non-Indigenous faculty and staff, they had no one who had the same experience they had. They knew from previous experience if they had a Native teacher, the teacher would know where they were coming from. If they had a Native American teacher who taught computing they would have enrolled in their class to learn about computing.

Limited Opportunities

The students felt they had limited opportunities in school to discuss, and think critically about tradition and culture, with more mature Indigenous people, especially how to be cultural and modern at the same time. They felt this opportunity would have helped resolve the intercultural and intracultural conflicts they were experiencing.
The students experienced tensions with the Educational System as a whole from the 2010 workshop. They felt the system did not offer a pathway to post-secondary education for Indigenous students. They saw the system lacking role models like them, programs, funding and Indigenous staff. Overall the students saw the educational system as not Indian, not like us, and felt they were a minority in their own land. They saw themselves undervalued compared to non-Indigenous students.

Janice said, “there’s a fear, financial … scholarships are the main problem … we want our dreams … hopefully have careers to do, have my own place … we need better education on the Rez, how to make better … address what they struggle with, get a better view what changes [need to happen] … as kid younger on the reservation … all teachers were mean … I had it in my head that I was stupid, afraid of college, felt stupid … [however] you can change those tapes in your head and had a teacher like that.”

Nancy said, “Lot to expect an educational leader … I don’t plan anything, it happens it happens, don’t know where I’m going to be, today, tomorrow … more people want to do better rather than complain … kids impacted by meth, drugs, to make money forego education, make money … seen sixth graders hooked on meth … there are enough people who are successful, to be mentors … if we have more success … the only ways is to have mentors to help change … in my sophomore year … they
were trying to throw me out … honor teacher is the meanest teacher, would not answer questions or about papers. Susan [Indigenous liaison] helped me … on teacher help … others didn’t help … in grade 3 when I wrong, teacher was a racist teacher. She put me in the back of the classroom. She only helped blond hair girls, the teacher would not work with me. They wanted to medicate me because I was dysfunctional, your brown, not smart. It’s hard to get out of your brain, your just another brown person, just pass them along.”

Xander says, “example this program is a native hope, helping our people … skip college more obstacle, main stream college first, but maybe start at 2 year … glad had people talk to us … accomplish our own goals … don’t know where I’ll be in ten years … we need to see a bigger picture, how to improve … “

Five years later, in 2015, another set of coded tensions can be seen, as illustrated by Figure 7.5.
As the students looked back on their high school experience, two tensions stood out: the feelings of being a “token Indian” and a “struggle in two worlds.” Token in this sense means the students were the sole member of a group or seen as the sole representative of their group within a larger group. Struggle in two worlds means the students see the Indigenous world separate from the greater society. Being both a token Indian and living in two worlds creates a feeling of isolation, being a single person within a larger group, and not having similar culture of beliefs, different skin color, history, physical traits and customs of the larger group. Although in some cases the
students were with others who were “brown – of the same skin tone”, Nancy brought up that it was not the same as being with other Indigenous students.

They mentioned the early conflict with teachers and the school system. There was a lack of opportunity to learn about their culture, and the school did not connect to their culture and cultural issues. They felt if they had had cultural classes it might have helped being a better student and better prepared for college. They said some non-Indigenous teachers were supportive, yet there were negative feelings towards the school system. They also mention in comparison to the workshop and school, knowledge making was not in their control, meaning curriculum and textbooks were slanted more towards the majority culture and Indigenous culture was not included. As mentioned earlier, they said Computer Science (CS) was not offered, or talked about. Thus they had limited knowledge of how computing could be applied within a future career. There was no connection of computing or technology to Indigenous culture. If CS had been offered with culture it might have influenced their future direction.

7.2.2.2 College

All three did progress to college because there were expectations from family, the Indigenous community and others influences, to go to college. However there were tensions as to the lack of funds or scholarships to attend a post-secondary institution. There were tensions because they felt they were not prepared for college. Once enrolled
they had a high expectation from their college experience, however there were tensions because faculty and staff had stereotyped views of Indigenous people, such as, getting free tuition, textbooks, housing and extra funding, as well as faculty who had no, or limited knowledge of Indigenous people. They expected the textbooks would be more inclusive but they found, as they experienced in high school, that the textbooks were slanted again towards the majority.

7.2.2.3 Interpersonal Feelings

The students shared feelings about themselves being Indigenous, in their school, work, in their community, and outside the community. The information shared by the students fell in three coded subcategories identified as, Me Hiding, Me Living in Twos and Me in School, in the following table (see Table 7).

<table>
<thead>
<tr>
<th>Interpersonal Feelings</th>
<th>Me Hiding</th>
<th>Me Living in Twos</th>
<th>Me in School</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Me Hiding</strong></td>
<td>Isolated, Lost, Confused</td>
<td>Not whole, two people, two identities</td>
<td>No connection with other Natives in school</td>
</tr>
<tr>
<td></td>
<td>Living in a shell</td>
<td>Being both an Indian on Rez, an Indian in City</td>
<td>No connection to culture in school</td>
</tr>
<tr>
<td></td>
<td>Always barriers</td>
<td>Don’t know how to be one identity, be whole</td>
<td>Peer pressure to be only Indigenous</td>
</tr>
<tr>
<td></td>
<td>Living with unfairness</td>
<td>Lack cultural friends</td>
<td>No opportunity to relate to teachers</td>
</tr>
<tr>
<td></td>
<td>Depression, No direction</td>
<td>Can’t fight the idea that you can be Indian and modern</td>
<td>Do not know anyone or peer interested in computing</td>
</tr>
<tr>
<td></td>
<td>Being the token Indian</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not fitting in</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not accomplished, No role models</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Being a novelty, a curiosity</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Me Living in Twos</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Me in School</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

155
Not seeing things get better  
No others with like mind or experiences  
Irritation with continuous misconceptions of Indigenous people  
Want to improve self, community, but can’t  
Don’t know how to express myself  
Not feeling equal

| personal battles  
| Didn’t know others have same battles  
| Living in chaos  

Table 7 Subtle Feelings the Students Experienced

Me Hiding

The students expressed that in school they felt isolated, lost, confused, not fitting in, being the token Indian, not accomplished, having no direction, and wanting to improve themselves and their community, while not being able to do so. They felt they were living in a shell. They felt depressed by not seeing things get any better in their lives and others. They felt the world they lived in was unfair. They saw themselves as a novelty, an object of curiosity, not feeling equal, irritated with continuous misconceptions of them and the Indigenous people by the non-Indigenous, with no role models like themselves, with like mind and historical experiences.

Me Living in Twos

Students expressed feelings of not being whole, but being two people, with two identities, being both an Indian on the reservation and an Indian in the city. They did
not know how to be one identity, whole, living in two worlds, fighting the idea that you can be Indian and modern at the same time, while peers were pressuring them to be only traditional.

**Me in School**

Being the only Native American in a class or sometime in the whole school, the students felt they had no connection with other Native students. They felt isolated because their culture was not covered in school, and thus they felt no connection to the school. Because there were no Indigenous teachers they had no one to relate too. Concerning computing they did not know any peers, Indian or non that had interest in computing.

**7.2.2.4 Work World**

Janice and Nancy progressed to the work world and Xander was in his junior year in college. They pointed out that jobs and other opportunities on the Reservation were not the same as large urban centers. As with school the feeling of being a token still persisted, in the work place. As well, there is the continuing problem of non-Indigenous people having incorrect knowledge about Indigenous people in general.
7.2.3 Living with Miseducated

The students feel, in general in the greater society, they have to correct people about their history, because of the limited information and misconceptions provided in schools about Indigenous people’s history and lives. They felt that the non-Indigenous want to know about the Indigenous people, but they do not want to know the truth about the mistreatment and slaughter of Indigenous people by the Europeans. Most books provide an abbreviated version of history and a positive view of “conquering the wild-west” rather than of the killing and taking of the land of the Indigenous people. They felt there was a constant need to educate the educators that the all Indigenous people did not have the same beliefs, or the same language, or lived in teepees.

Nancy said, “Not higher education, remember in grade school, we were studying native America history and all others were making teepee, and my mother and I made a Hogan. I remember my teacher arguing with me that I wasn’t authentic, that wasn’t legit. My arguing with her that we are Native American, we grew up on reservations, we know all about this stuff, the more frustrating part is that, even still going to school, student teaching at Lion Creek, and their unit taught so much stuff that was so not correct about tribes. They talk about totem poles belonging to California tribes, more Inuit people, it just, thinking it was more frustration about education is so left field, it is so irritating. Now that they find out I’m Native, I’m constantly saying no I don’t go to college free, no I don’t get money, no I don’t do this, it is just easier to not have to fight
fiction. Even in Higher Ed, professors still have this miss guided perception about native, you guys have your Ph.D.’s, you are so very wrong about a lot of the stuff I just have to laugh at little bit. I don’t know, it still a struggle, but not so much of struggle as it used to be, I think I’m more at a point, where if at some point one person find the truth at some point it will make it around. “

7.2.4 Intracultural Tensions

As mentioned earlier, intracultural tensions are tensions the students experienced within the Indigenous community. The following are tensions expressed by the students within community.

7.2.4.1 Uncertain Identity

Nancy’s comment on the first day brought one of the tensions to the surface in the discussion of how Indigenous people are exhibited in museums. She said, “For the younger generation, we are in the city. For the next generation, question who I am or am I just blending in, betraying. This is important for next generation.” By this comment she brings up an unwritten rule that presents a dilemma for Indigenous students seen by peers as trying to be someone other than an Indigenous person. The peers imply that one cannot be Indigenous and non-Indigenous from their perspective. It is seen as a betrayal to the Indigenous people. If someone is not indigenous, then they are seen as denying their Indigenous identity and trying to being white, assimilated and
enculturated into the dominant culture. This rule says although an Indigenous person lives in two worlds they can only belong to one – the Indigenous world. If they do not live within the Indigenous world they are denying and betraying their culture and their identity, and they are no longer Indigenous. They are seen as an “apple”, red on the outside and white on the inside.

This is also a dilemma the students face trying to do well in school or studying. If they do, they don’t want to be seen as an “apple,” thus they shy away, try to blend in or hide. This dilemma or tension has its roots embedded in the long history of the Indigenous people from forced assimilation and enculturation through education. It comes out as an attitude of distrust with both Indigenous and non-Indigenous people. What the community see is that they are willing to become assimilated and enculturated into the Non-Indigenous World. It is a subtle issue and a struggle on the minds in the Indigenous community.

However, there is an interesting paradox: when someone is successful or completed their degree or degrees, they are celebrated. On the other hand, they present a threat to those who see themselves as keepers of Indigenous tradition. Many on both sides of the issue observe and speak about a need for change, how the Indigenous people can be better individually, how change can make the community’s situation better. However discussion often comes back to naught, caught in a crossroads of a dilemma – to change is to be non-Indigenous, it is betrayal, a loss of identity and being
assimilated. Janice said, “If we don’t do anything we don’t change. We want to get out of the crossroads.” Xander said, “People make the choice their selves, why we are at the crossroads.” Xander also said, a “degree will provide a better life style.” But he also implies many give up on higher education. He said, “Going back home, not a place to be … skip college, more obstacles.” Janice also said, “We are passionate … we want our dreams … hopeful have careers to do, have my own place … we need motivation, be confident … yet feel stupid …” But always in the background, is the pull of the dilemma, where new ideas, change, wishes and hopes, pushes outside the borders of being Indigenous. This can be seen stemming from a historical perspective of fear from too much loss, too much change, too quickly, pushing towards the border of being non-indigenous. On the other hand, it is not clearly defined what being Indigenous really is, as well as, being non-Indigenous. On the positive side, there is talk in the Indigenous community, understanding they are at a crossroads and a need to blend tradition with modernity and computing. Although Nancy on the first day took a hard line on being Indigenous, she does arrive a different point in later discussions, pointing out, “I feel we are at a crossroads. It is a blend of tradition and computers.”

7.2.4.2 Leadership

Indirect intracultural tensions may also contribute to dysfunction with the leadership of Indigenous communities. Although the students are not directly involved in leadership, they are affected by the tensions. There can be fear that leaders are
moving to non-Indigenous ways. There can be fear of having an unknown person in a leadership position, which may not be effective. Infighting, and electing unqualified people or family members to leadership positions are ongoing problems. Nancy describes this situation from her observation. She said, “The board at XYZ, Mark tried to make better. The older don’t like it, kicked him out, saying there are better ways to do things … board upset … now under investigation, the meetings are closed. The way they elect board members, don’t involve others. The community is everything.” Xander said, “… need a new perspective. Yes, agree, only known people in positions or in office, not qualified … need better politics in tribal and government … politics are family, [we] need other candidates … get to know others, not just vote for family.” Nancy continued on the subject and said, “To make better, funding, open programs, hire someone new ideas, perspectives, someone [who] are qualified, but they don’t want to deal with it, politics in culture, things will not change. Just because I know you, they are not qualified … more people want to do better, rather than complain do something different.” However they do see a need for mentors for leadership. Nancy said, “There are enough people who are successful, to be mentors. They can influence boys in second grade. If we have more success and want to help, the only way is to have mentors, to help change.” Xander also said, “… we need someone to meet you half ways.” Both imply there are a lack of mentors and role models in the Indigenous
community and they can influence change since they were able to blend being successful and being Indigenous together.

Nancy said, “There are enough people who are successful, to be mentors, They can influence … if we have more success and want to help, the only way is to have mentors, to help change … Yeah, I think it’s the same struggle. It has definitely changed from generation to generation but I don’t think anything is really going to change until more native think, finally say yeah maybe it’s not ok to look like this. And its going to take more people like myself and my sister who just graduated going to med school. Some of us that are driven, like yourself, unfortunately we are the exception not the norm. It is a struggle and hope in the future generations that come along and that more and more natives are going to stop living in chaos.”

7.2.4.3 Historical Tension

Historical events also cause for intracultural tensions, such as a low value on education and lack of hope. As described in Chapter 2, many Native Americans, (including this researcher’s parents) were sent off to boarding schools under programs starting in the 1850 and ending in 1950. This situation is causal for a distrust of the educational system and placing a low value on education. This distrust is passed on to later generations through voluntary and involuntary cognitive construction, even if today’s students did not experience the boarding school situation directly. They
experience it indirectly. The students today see this coming to realization in their lives with non-caring non-Indigenous teachers, since the majority of their teachers were non-Indigenous, with very few Indigenous teachers both on the reservation and in public schools.

Historical tensions also arose from lack of hope as a minority, dysfunctional families and early introduction to drugs and alcohol. Janice said, about her family, “Mother said, you need to stop being stupid, mother repeated the stupid comment to a point I didn’t’ care anymore. She abandoned me. My father was abusive. I had it in my head that I was stupid, afraid of college, felt stupid.” She did share that even though she experienced a negative situation and had a teacher that helped. She said, “You can change those tapes in your head and I had a teacher like that.” Nancy observed in the community, “… Kids impacted by meth, drugs, to make money, forego education make money later, every one of us, before twenty were drinking and into drug. Seen sixth graders hooked on meth.”

7.2.4.4 Parental Influence

The students felt that their parents did not push or pressure them towards higher education. From distrust from forced boarding school deep in cultural memory, some parents do not believe in education or in a need for higher education. Their main
concern was for their children to participate in their cultural events rather than in school.

7.2.4.5 Services

Lack of good health services provided by the government for Indigenous people is viewed as normal. This causes one to see self as not worthy, a second class citizen. Nancy, said, “The IHS (Indian Health Services) clinic is unhelpful in town … I [have] to go to the next state over for medical help …”

7.2.4.6 Peer Pressure

Where the students had Native American peers in their school, they wanted to do well in school, but, as discussed earlier, there was a fear of being accused of being white, an exception to the norm of their peers, that is, not being an Indian. Xander said, “Some people frown upon other people trying to obtain high education, oh, you are just trying to be more like a white man, and your native roots, like they try to belittle you, just because you are trying to improve yourself.”

7.2.4.7 Intracultural Summary

These are some examples of Intracultural tensions expressed by the student living within the Indigenous community and can be seen as unwritten rules from the community that have effect upon the student’s identity, attitude, self and computing.
7.2.5 Unmet Needs and Aspirations

The students identified five (5) other coded tension areas in which they felt limited in satisfying their needs and aspirations. Some of their comments I derived from what they said positively about the workshop, rewritten to reflect their contrasting school and life experiences. For instance, all three said they felt comfortable, short term stress relief, having teachers like them because they understood where they were coming from while in the workshop. I took this to mean that in their school experience they wanted to feel comfort being Indigenous in the classroom, in school and about themselves. They wanted to feel stress relief from being and seen as the token indigenous person. They wanted to be able to connect with a teacher like them because they felt misunderstood in the school system.

The areas fell in five coded subcategories identified in the following table (see Table 8).

<table>
<thead>
<tr>
<th>Limited Opportunity</th>
<th>To Discuss Issues Culturally and Personally</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To Associate to Learn with other Indigenous Students</strong></td>
<td>To have open discussions</td>
</tr>
<tr>
<td>To be with other native</td>
<td>To think/discuss critical about culture</td>
</tr>
<tr>
<td>To know others with same struggles</td>
<td>To compare community with world</td>
</tr>
<tr>
<td>To feel stress relief being indigenous</td>
<td>To think critically about misrepresentation</td>
</tr>
<tr>
<td>To work with other Native students</td>
<td>To think outside the cultural box</td>
</tr>
</tbody>
</table>

To talk/learn from successful role models
To have help on career direction
To reach personal goals
To bring culture and self together
To be traditional and modern
<table>
<thead>
<tr>
<th>To Experience Success</th>
<th>To Experience a Positive School Environment</th>
</tr>
</thead>
</table>
| To be accomplish, work on meaningful projects  
To make a difference in community  
To learn in real life projects/situations  
To feel a sense of purpose and support | To be involved with Indigenous culture in school  
To experience real life careers in school  
To learn about Indigenous people  
To experience programs in Computing  
To hear about programs  
To work with latest technology to use in community  
To experience full aspect of computing profession |
| To see others and be with others who are successful  
To feel accomplished, doing something for the community  
To play a bigger role in the community | To see where we are, to compare how others see us and we see ourselves  
To voice opinion  
To have personal growth  
To fight stereotyping of Indigenous people  
To discuss how computing is impacting Indian people |
<table>
<thead>
<tr>
<th>To Experience Success</th>
<th>To Experience a Positive School Environment</th>
</tr>
</thead>
</table>
| To be accomplish, work on meaningful projects  
To make a difference in community  
To learn in real life projects/situations  
To feel a sense of purpose and support | To be involved with Indigenous culture in school  
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| To be accomplish, work on meaningful projects  
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To voice opinion  
To have personal growth  
To fight stereotyping of Indigenous people  
To discuss how computing is impacting Indian people |
To Associate with Other Indigenous Students

They felt a need and a limited opportunity to be with and work with other Native American students. There was an underlying struggle to know that others were having the same struggles in school. And if they did have an opportunity to talk with other Indigenous students it would provide a stress relief that they were not alone with the same feelings being an only Indigenous student in a classroom or in a school.

To Learn from Role Models

They had limited opportunities to talk with and learn from successful role models. If they were able to see, talk and learning from successful role models, it would have helped in reaching their personal goals and career direction. They would possibly learn how to bridge culture and self and still be traditional and modern. Through learning from successful role models they may be able to feel accomplished in playing a larger role and doing something for the Indigenous community.

To Discuss Issues Culturally and Personally

The students said they had limited opportunities to discuss and think critically about culture, misrepresentation, thinking outside the box, voicing their opinions,
fighting stereotyping, and to seeing where the they are and the Indigenous people are in relationship with the world, with older more experienced Indigenous adults. They wanted to grow and learn. They learned in the workshop, discussing with the facilitators how computing is impacting the Indigenous people, and in the process resolved having two identities, being traditional and modern into one.

7.2.5.4 To Experience Success

They wanted to have a feeling of being accomplished, working on something that had meaning, making a difference in their community and gaining real life skills. A feeling of accomplishment provides a feeling of purpose, and one success can lead to another.

7.2.5.5 To Experience a Positive School Environment

The students shared what would have been a positive school environment. The school environment which they were in did not provide this. To them a positive school environment meant an opportunity to be involved and learn about their Indigenous culture in school. It would involve experiencing real life careers. The environment would be friendly to them, enable them to learn college skills, have teachers like them, and feel comfortable in class, in school, and with themselves. To be around other Native students compared in some ways to the experience of being around other brown people, but it was not the same as being around someone with the same experience and
cultural heritage. Also from a computing perspective, they wanted the opportunity to have classes or other educational programs, to communicate about programs available, to work with the latest technology, to learn about the profession and to learn how it can be used within the community. At the end of their schooling, they want to feel grateful for a positive educational experience.

7.2.6 Personal growth

The students raised issues placed in six coded subcategories related to this theme. They are identified in the following table (see Table 9).

<table>
<thead>
<tr>
<th>Personal Growth</th>
<th>Barriers</th>
<th>Parental Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living with the Miseducated</td>
<td>Low income limits education opportunities</td>
<td>Limited parental push towards higher education</td>
</tr>
<tr>
<td></td>
<td>Poor preparation for schooling and college limit opportunities</td>
<td>Some parents don’t believe in education</td>
</tr>
<tr>
<td></td>
<td>Being Brown limited their secondary and post-secondary opportunities</td>
<td></td>
</tr>
</tbody>
</table>
Much of what are in these coded categories under “Personal Growth” have been discussed above. It is shown here, because the students expressed they also have a relational impact upon the students.

However, rather than seeing the world through negative experiences, the students identified a need for an attitude of change, to make changes in their selves and in their culture. They also saw a need for a better view of the world, and where they are in it. They would be able to see how they fit or not fit in, in relationship to other people. They noted that it was different living on the reservation and living in a city. They struggled with why others do not want to be accomplished and why the Indigenous
people do not take what is good in other cultures and make it their own, rather than complain about what they do not have. Although when asked if they had a hunger for their culture they answered no, in some ways they wished for it.

7.2.7 Summary

The key take-away from this section is an understanding that some, if not all, Indigenous students carry some of these tensions into the classroom as a Cultural Cognitive Load, developed over time through voluntary and involuntary construction. This load may be a major hindrance if not accounted for in the learning environment, whether it is within a regular classroom or in a computing classroom. It is important for the teacher or facilitator, curriculum and educational pedagogy to have an awareness of these effects working with Indigenous students.

7.3 Research Question #3 - Effect of Cultural History

How do Native American history and computing history contribute to the Indigenous computing experiences?

![Figure 7.6 Seeking Effects of Cultural History](image_url)
The analysis in the last section brings out these influences. In particular, material in sections 7.2.4.1, Uncertain Identity, 7.2.4.3, Historical Tension, and 7.2.4.4 Parental Influence, suggests ways cultural history and computing history is affecting the students today.

7.4 Research Question #4 - Contribution to Computing Education

Can Cultural Constructionism be used to improve the Native American computing experience and increase interest in the computing sciences?

In other words, using the pipeline description from Chapter 2, there is a very leaky and mostly dry pipeline into computing for Indigenous students. This dry pipeline stems from an absence of knowledge and education of computing within the Indigenous culture. Students get no computing experience to draw from to understand the computing profession. Further, students experience an additional struggle with identity, not knowing how they might combine being Indigenous with computing.

In the 2015 interviews the students were asked whether they knew that the workshop was based on Computer Science.
Janice said, “No! [did not know workshop was about computing] … View of computer science, don’t get much of it … it did not feel like a computer science program. Felt like a programs. You tricked me. It didn’t feel like a computer science program. “

Nancy said, “… we are at a crossroad. It is a blend of tradition with computers … No really, in eight grade we learned how to use them, when I got to high school it kind of like, even now, hey I have a computer, but I don’t know anyone who writing script or programming. I see guys did, always wanted to do, I guess. In high school I don’t remember anyone talking about computers or classes or anything like that. Went to Ironwood HS … Yes I might have to see what it’s about, but more the Indigenous part of it than the computer part. Know my way around, but not something I’m super interested in. I know enough to get myself into trouble. I not one of those we keeps up on the latest, greatest. I don’t know.”

Xander said, “Not really, I knew I was like computer interface integrated, making more electronic, but I really didn’t see it like that, and most it was like a lot of hands on research, I didn’t exactly know that.” He was asked about CS in high school, he said, “They did, but you had to request, to know more about those career fields, in general the schools didn’t tell us much about it … I think if we all been involved the actual computer part of it, what it took to write the script that goes into it, the programming. I think we would have been more interested in that part … Yeah,
because now I’m pursuing engineering now, and if I had some cool pal back then, that show me what I can do and see how much applications can be used for, would persuade me to pursue my major. Mostly things that intrigues me is things that I can see, like five lines of coding, it’s pretty cool, I wish I could do that, and would encourage me to follow that career path.”

As discussed earlier computer science as we use that term is just one part of the computing field. The student responses indicate they did not see computer science as a part of the workshop.

During the workshop, the students shared that they had little experience with computing, did not have intimate knowledge of computing, had no computing education programs, and no opportunity to work with computing, no peers, and no opportunity to experience the computing profession. The computing knowledge they did have was basic application skills. Prior to the workshop experience, they saw “computing” as only programming, with no knowledge that it could be utilized in the Indigenous community.

As Nancy said, Indigenous people are at a crossroads, calling for “… a blend of tradition with computers.” In their follow-up interview all three students could make a connection between computing and their own lives. Janice: “I learn to make a power point. What can I do for them and make them see that they can do. Make something for
them to see. Ok let make a change and do something. It made me open my eyes, be awake. With what I have, the people on the Rez don’t have. That all it made think of. ok can I make a change for them.” Xander: “…[T]here was more than sitting at the laptop and transmitting numbers, it kind of thinking that was what we were going to do, but started looking at history books, looking for things on line, we started pooling to get our jobs accomplish.” Nancy said, Indigenous people are at a crossroads, “I feel we are at cross road. It is a blend of tradition with computers.” Each of these quotes each from the students had acquired the sense of computing in the broader sense, even though they did not recognize computer science in what they had done.

But in the absence of computing in the Indigenous community there is a question how to achieve this blend. The students felt there was a need for programs to bridge computing with Indigenous culture. Does the Cultural Constructionism framework have promise for providing this bridge?

7.4.1 Theory

As discussed earlier, Cultural Constructionism is an integration of two learning theories: William Demmert’s Culture-Based Education and Seymour Papert’s Constructionism. Overall the 2010 Workshop met the majority of Demmert’s and Papert’s tenets with only a few exceptions. Blending culture in a constructionism
learning environment from this study show some promise with a need for more application.

7.4.2 Culture-Based Education

William Demmert’s notion of Culture-Based Education consists of six critical tenets. Although his aim for Culture-Based Education is to increase educational performance of Native Americans in general, and not related to computing in particular, this section will explain how the elements of the theory can contribute to the Indigenous computing experience to increase interest in the computing sciences, as illustrated in the design of the workshop.

1. *Recognition and use of Native Language*: This element was most valued by Demmert because he saw that one learned best in his/her original language. The workshop was located in an urban setting where the students were from different Indigenous tribes, so facilitating the workshop in one Indigenous language was not practicable. Some students, including the facilitators, knew more or less words and phrases in their language but were not fluent in their language. Thus the workshop was conducted in the English language on which the students had more fluency. However, while there was no common tribal tongue, there was a shared non-verbal language of shared history and shared educational experiences among the students and the facilitators who
conducted the workshop. This common sharing of historic culture elicited a feeling of comfort for the students. Janice said, “we were all different and we came together … [we] had the same feelings and [we] have a bond … [it] felt comfortable, [there was] safety in the classroom …” Nancy said, “… we were all native … [and] we were all equal … it was easy to connect to a teacher knowing that they are native like us, it makes a difference, relationship wise.” Xander said, “It was really great to hear from other Native people … everyone else was coming from the same tradition that I was … knowing I wasn’t alone … just knowing that I was in a positive environment help me steer myself in right direction that I am today.”

2. Pedagogy that stresses culture and adult/child interaction: The workshop included Talking Circle times, led by a facilitator using a series of five thought-provoking questions. This allowed open adult/child interaction and discussion. All facilitators and students were Indigenous. This allowed the students to feel comfortable and freely discuss cultural issues. Janice said, “Like because everyone was involved. I got a chance to hear other thoughts and opinion on where we are and where were we are going. How we can fix a problem if there is a problem. Made me think more, more ideas … Made me open my mind more and my culture, my tribe my beliefs. Nancy said, “Talking Circles widened my view of the world … remember one on
technology, we wonder, do we want to be young professionals and still don’t know how to tie that in with our tradition and culture, and [it is] less of a struggle now.” Xander said, “Made me realize as Indigenous people where we stand as a people. The first question, for some reason, just stuck in my head.”

3. Teaching strategies close to cultural ways of knowing and learning (opportunity to observe, practice and demonstrate skills): Most of activity in the workshop was based on Constructionism (learning while creating a public artifact). There were two lectures on the first two days providing skills needed to accomplish the task. The workshop did not provide an opportunity for the students to observe skills by the facilitators. However, they did connect to the facilitators as they shared in Talking Circles, which is a cultural way of knowing. The facilitators shared their experiences with the students, including how the facilitators overcame similar issues that the students faced. In the short lectures, Richard Mayer’s theory on multimedia was followed. Mayer says, “Students learn better from words and pictures that from words alone” (Mayer, 2002). To ensure learning in a cultural way, Indigenous visuals were used to provide a cultural cognitive connection. Janice said, I have a “better understanding how other tribes work, function. Good learning opportunity. Expanded my brain. [A] Native American learning experience ... culture
brings more meaning ... I’m Native American, it’s a connection.” Nancy said, “Having Native educators was nice, because I think in native culture there are norms that are understood, communication and how we do things. I know that it is easier to relate, felt more relaxed, hey this person gets it. That’s what I got. That’s how I felt. Others have said, I don’t have to explain myself ... We all think the same. That same culture, means it’s not a disconnect, not the hey, this is why I do this, ok this why I do this and they understand why and it kind of works out a little bit smoothly.” Xander said, “For me, very supportive ... just knowing I that I was in that positive environment help steer me in right direction that I am today.”

4. **Curriculum based on culture and spirituality:** To respond to this tenant, Since the workshop was based on Indigenous culture, and had Indigenous facilitators, students and subject, it was decided to open the workshop with a meal with the students, their parents, facilitators, museum staff and other guests, and to bring in an Elder to give a blessing in his traditional language on the workshop and with an open prayer for the meal. Having Indigenous facilitators, students and addressing an Indigenous subject in discussion also created a feeling akin to spirituality in some students. Janice said, it “did make a difference. I feel whole … great bonding experience and to break out of my shell … Life changing.”
5. **Strong native community participation**: In the initial workshop design, several Native educators and community people participated in discussion of the needs of the students. The workshop also included presentations by representatives of Indigenous organizations.

6. **Knowledge and use of social and political mores of the community** – In an urban setting where multiple tribes live, the social and political mores of the community are unclear. Although there are some common beliefs among tribes like respect of elders, what surfaced within the workshop and in the interviews were the unwritten negative rules. Prominent in this respect is negative peer pressure on education. As discussed earlier, Xander said, “Some people frown upon others people trying to obtain high education. Oh, you are just trying to be a white man … they try to belittle you, just because you are trying to improve yourself.” Nancy said, “I always had to struggle because of going to school and being native ... I’m seeing progress as young natives because they’re trying to be cultural and modern at the same time. It’s nice to know there are more you natives fighting that battle than I use to see. Oh, you can be one or the other but you can’t be both. But there are more like me, more modern but still tied into culture.” The Talking Circle time provided opportunity for the students to discuss these unwritten rules and by
hearing others they were experiencing the same, they were relieved and able to resolve within their mindset.

7.4.3 Constructionism

Seymour Papert’s Constructionism is not as explicitly defined as Demmert’s. I have selected several key points which are reflected in the design of the workshop.

1. *Affective component* – Papert’s examination of Piaget’s theory of assimilation and accommodation in learning suggested that it was missing an affective component. I felt that Papert’s theory, as originally framed, lacked an affective component for Indigenous students. The students said that without culture being a part of their learning experience it would not have been as effective. With culture added in the workshop design they had a stronger connection to the workshop’s objective to provide a real computing experience. With culture added they had immediate connection to the facilitators, to other students and the subject matter. With culture added to the workshop curriculum design, the Indigenous students saw and experienced the value of computing for utilization from their cultural schema for usage within their Indigenous community.

2. *Epistemological pluralism in learning* – Seymour Papert and Sherry Turkle say that their “central thesis is that equal access to even the most basic elements of computation requires an epistemological pluralism, accepting the validity of
multiple ways of knowing and thinking (Papert & Turkle, 1991).” By inclusion of culture in a constructionism learning environment, one can include different ways of knowing and learning in the design of curriculum and pedagogy.

3. *Construction over instruction* – Papert states the “we do see statistically hard evidence that constructionist activity … enhances the effectiveness of instruction given by a teacher … (Papert, 1991).” The workshop dedicated several hours to providing the students with the skills necessary to develop the interactive exhibit. Nancy’s comment suggests this was effective: “I like the workshop because I said traditional school wasn’t for me. I think I liked about the workshop is, hey this is what needs to get done, and figure out how to do it and it wasn’t like you have to do this and this and this, it was more like hey you guys here’s what we’re doing, here’s the parameters, and you guys gave us greater control, it was nice to say all of us said, hey this is what we should have, hey if we all got together. If school could have been more like this workshop, I could have done better at school.” Janice also said, “One more professional than a regular class. If it was more professional more people would have taken. Workshop more professional. Setting, down to business, knew what is expected.” Xander, “Honest, what we did for the program, it like something I’ve done in College. Like first week of school, you get to people you don’t know, they could be freshman or returning students, and the professor says, these are
your group members, you present this at the end of the semester, how me feel I get mostly because it comes back to the experience, experience working with new people, we did not have a problem, we got together, we made a schedule. I already felt like I know what I was doing, kind of like comfortable. I think it was amazing … For instance if I didn’t take this opportunity to attend the workshop I won’t have met different people, would not have experienced a real life business situation, stimulations, opportunity to stand up in front of others, not taken work shop, how system works, biggest eye open.”

4. **Participants’ active in their learning** – Papert notes that his theory “shares constructivism’s connotation of learning as ‘building knowledge structures’ irrespective of the circumstances of learning.” (Papert, Harel, 1991) Within the workshop, besides the project activities, the students built new knowledge structures during discussions, engaging with thought-provoking questions, as suggested by comments presented earlier.

5. **Learn best by making a public artifact connected to the real world** – As Papert and Harel note, “computer culture … favors forms of knowledge based on working with concrete material rather than abstract propositions (Papert, Harel, 1991).” The workshop took advantage of this to give the students a professional opportunity to create a computational presentation that could be publicly shared, like the author has done in the real world.
6. *Communication a valued part of learning* – Papert observed how different a middle school art class was from a math class. He said, “In this particular art class they were all carving soap … it allowed time to think, to dream, to gaze, to get a new idea and try it and drop it or persist, time to talk, to see other people’s work and their reaction to yours.” (Papert, Harel 1991) The workshop provided similar opportunities. Students worked in pairs in a big open area, where they could see how others were progressing. Talking Circles and other open time slots allowed time to think, plan, and discuss in pairs and with other groups.

In realizing these six aspects of Papert’s Constructionist framework, the workshop drew heavily on cultural context, as called for by Demmert, to produce Cultural Constructionism. The contributions of cultural context are substantial. The students experienced comfort; which is important to learning. Talking Circles provided an open discussion time, creating a connection to other participants and subject matter in the workshop. Curriculum based on culture and spirituality created a positive learning environment, unlike the students’ public school experiences. Native community participation from local colleges, universities and other organizations that stress higher education assisted in a positive trajectory towards higher education. Open discussions of unwritten negative community rules helped the students feel they were not alone with interpersonal struggles, and helped them resolve inter identity conflict.
7.5 Broader Impact of the Workshop

There are some in the Indigenous community who see themselves as keepers of traditions, and if they see anyone moving close to the border of being non-traditional they accuse that individual as being white. Many on both sides of the issue speak about the need for change, yet talking about it does not produce change, and this presents a problem and dilemma for today’s Indigenous students. There is no clear leadership position on the change or not to change issues.

The three students, Nancy, Xander, and Janice voice their opinion how the workshop impact their thought and how it helped them positively resolve internal intercultural and intracultural conflicts.

Nancy said, “... we wonder, do we want to be young professional and still don’t know how to tie that in with our tradition and culture, and less of a struggle now. I think those questions real helped in terms of what you want to do in life. How incorporate being indigenous and being young professional and modern but still keep a hold of our roots. I like those questions because I never really thought like that. I always had to struggle because I going to school and being native. All goes back to the same thing. I’m seeing progress as young natives because they’re trying to be cultural and modern the same time. It’s nice to know there are more young natives fighting that battle than I use to see, I guess. Oh you can be one or the other but you can’t be both.
But there are more like me, more modern but still tied into culture. It’s nice because to tie together … I know this workshop really did help with that, because before this workshop I was two different people and end of the workshop, I said well you know use it to my advantage. Mean might as well be who I’m going to be, how it’s going to be, I’m going to give up one or the other just because the rest of the world doesn’t understand me …”

Xander said, “People make choices their selves, [its] why we are at a crossroad … going back home, not a place to be … Would you want to change or evolve, see bigger picture, why need to improve … You can have so much good intensions to do something great, change your community, just because you want to do that, it doesn’t mean that it going to happen, you got to like know people to get certain things done, it shows me, you got to know people to get certain things done really. Have people interested in what you are doing … [The questions] Made me realize as indigenous people where we stand as a people, the first question, for some reason just stuck in my head, it makes people think, that we are stuck, we still live in teepees, they still think live like this and we are not up to date like everyone else, they think we still live in teepees … it is definitely a question that we have to answer ourselves.”

Janice said, “If we don’t do anything, we don’t change. We want to get out of the crossroads … we need to address what they struggle with, get a better view about changes … We need support, be open minded, be motivated, be confident. We don’t
have the motivation … [I thought] that things were fine, but … I find things were not fine … I still want to make a change on the reservation … be yourself, changes be not afraid, if you have a change in mind, you can make it change … let make a change and do something.”

7.6 Chapter Summary

A major theme in these findings is the importance of having an opportunity to have facilitators and students from the same culture in the same classroom. The facilitators most likely had similar struggles, outlook, identity, attitude as the students, which the students perceived as a point of safety and comfort. Because they felt a similarity, they felt they did not have to explain who they were. This situation helps lift cognitive barriers and ease interaction with the other Indigenous students. An environment with facilitators like them brought them out of a shell and helped resolve the feeling of un-wholeness.

A second theme is the importance of recognizing that others share the same struggles. In group discussion sessions the students learned that others had similar challenges in public school, and fell similar tensions in trying to blend tradition with modernity, and with hope for the future. They came to be less fearful of change whereas in the past it meant a loss of their Indigenous identity.
These themes suggest that the workshop was successful in addressing some of the challenges Indigenous students face. What about its aim of informing the students about computing, and encouraging their participation in it? The workshop, and the students’ later comments, revealed how little they knew about computing, its uses, and computing careers. They had no role models, Indigenous people with careers in computing. The workshop provided a real experience for the students, in a real world setting with an Indigenous computing professional.

Further, the workshop gave the students the chance to use computing to address an issue relevant to their culture and their community. The students had an immediate connection to the subject, understood the problem, and developed a plan of action. In the end, they saw how computing could address cultural community issues.

The students’ comments and reflection, during and after the workshop, reveal a lot about themselves. They gained a much needed positive view of themselves. They could identify with computing, in the broad sense used here. The skills gained helped Janice, Nancy and Xander adjust within the greater society. The results confirm with William Demmert’s (1994) observation: “Children who are comfortable with their own culture and the position of their culture in the larger society are more apt to do well in school than children who are uneasy with the use of their Native language and cultural heritage.”
7.7 For the Future

Here is a summary of the features of the workshop that appear to have promise for future activities for Indigenous students, in computing education.

1. Form a group of Indigenous students, so that they can share experiences, and recognized shared challenges.

2. Provide Indigenous facilitators, to provide comfort having someone like me, so as to permit discussion of challenges faced by Indigenous people, and to provide role models.

3. Integrate thought-provoking questions with discussion to stimulate thought and interpersonal exchange.

4. Utilize cultural issues from their Community, so that the students have an immediate connection.

5. Show how computing can create a meaningful artifact that can help a community, and how the students can participate.

6. Recognize that a program should not only stimulate computing/programming knowledge but stimulate personal growth.

The findings highlight broader issues that also need attention in supporting Indigenous students. The history of Indigenous people influences self-perception, attitudes, identity and parental views on education, creates inter and intra cultural tensions. Unfortunately teachers rarely understand these issues, either in public or tribal
schools; cultural programs for teachers are needed. More Indigenous teachers in high school and post-secondary institutions would help.

Parents and teachers need more understanding of the potential value of computing, especially for Indigenous communities. Tribal education departments and others in Tribal government need to know more about the computing profession and the value of computing to the community. Outreach on this would be valuable. Returning to the workshop, some questions for further work are raised. The workshop included some Web technology, but not programming. Would an introduction to programming have added value? How might similar activities be conducted with a mix of Indigenous and non-Indigenous students, as might be necessary in some settings? Could the sharing and support that was so valuable in this workshop be sustained in a mixed group?
CHAPTER 8

Implication, Contributions and Future

“... it is difficult to find research recommendations concerned with knowing and learning in and out of schools and across the lifespan that take into account the kind of holistic integration that Vygotsky had originally championed.” Roth & Lee – “Vygotsky’s Neglected Legacy (2007)”

The goal of this research was to explore the theory, Cultural Constructionism, applied to an intervention, to address the limited numbers of Indigenous students in the computing sciences. The investigation followed three Indigenous students over a span of five years to understand their Indigenous Computing Experience. With the theory and the intervention, I wanted to open a cultural space in computing and in the computing educational narrative for the Indigenous, with implications for other underrepresented groups.

8.1 Observations on Theory

While researching theories, I was disappointed with the single theories I found that did not reflect how culture and history may affect the human condition mentally and people’s actions for learning in the computing sciences. Demmert’s Culture-Based Education fulfilled one aspect of my interest, wanting a theory that addressed culture. Papert’s Constructionism fulfilled my other interest, by addressing computing. The
theories were built upon psychological foundations that added to my interest. Demmert’s theory had connections to Vygotsky’s Cultural Historic Activity Theory, and Papert’s theory had connections with Piaget’s assertion that a person is active in assimilating and accommodating in learning. However, I faced a dilemma on how to bring these ideas together. Since this was a computing investigation, I thought, why not use the programming concept of abstraction? In programming, abstraction is a way to bring complex routines together to form a unified picture. Using abstraction I was able to bring my key concerns under one theory, Cultural Constructionism. Thus the theory brings together computing as an external tool, and culture as internal cognition, to understand historical and cultural factors as they affect Indigenous students as they learn about computing.

I used Cultural Constructionism to explore how integrating Indigenous culture in making a public artifact could be a useful theoretical and pedagogical vehicle, making computing more appealing. Chapter 7, “Interpretation,” brought out the association of constructivism and socio-historic events with mind, activity and history, as a cognitive filter through which the students engaged. The framework brought out tensions not only among the ways knowing and learning, but also between cultural systems. The Interpretations chapter also brought how historical events, embodied as cultural memories, still affect Indigenous students’ identity, attitude and outlook. This embodiment either shapes or becomes a barrier in knowledge construction and learning
from other human contact, in voluntary and involuntary cognitive construction. By understanding these connections one can see that prior subject knowledge, and new knowledge construction, often the main focus of educators, are just some aspects of learning, along with many underlying influences.

8.2 Utilizing Engeström’s Framework to Describe Key Findings

Scandinavian researchers Yrjö Engeström has extended the work of Vygotsky and others to provide a useful diagrammatic presentation of activity theory. Engeström’s framework provides a way to organize the investigation’s key findings, and the implications of the study for computing education for Indigenous students. I found his framework very useful for discovery, however the result from finding of this study indicate some suggested modifications.

Here we will walk around a revised version of Engeström’s activity diagram, starting at the top and working counter clockwise (Figure 8.1). At each stage we’ll consider aspects of the design of the workshop, and of the findings of the study, that relate to each element of the diagram. I hope this version will not seem sacrilegious, moving away from Vygotsky and Engeström’s triangle.
8.2.1 Motive, Reasoning, Objective

The motive, purpose and reason for the workshop activity and the students’ project, provided a full professional computing experience for Indigenous students, not just programming. Most educational programs from 1970 to today still see learning a programming language as the heart of computing. However, in my career, I saw that new graduates entering the computing field required more than hard programming skills. They also needed soft skills, such as working individually or on a team, communicating, being creative in problem solving, conducting research and giving presentations. Accordingly, the workshop activities included these elements. The workshop project accorded with Engeström’s requirement that the Object of an activity
is “step-by-step invested with personal sense and cultural meaning … [that] goes through multiple transformation until it stabilizes as a finished outcome”

As the workshop progressed, I found I was not able to provide both elementary hard skills-- programming-- and soft skills. But the students were able to learn that the profession required more than programming. They were surprised that what they were doing, researching, creating, problem solving, and presenting a working model, was part of the computing profession.

Thus to better understand the Object or objective of the study, I provided three elements - motive, purpose and reason – for consideration to clarify motive behind the activity. These would help in pre-post analysis of a study.

8.2.2 Subject, Actors

As discussed, ten students participated in the workshop, with three facilitators; all facilitators as well as students, were Indigenous. Four out of the ten students participated in a follow-up interview, five years on (but one of these declined to permit his interview data used.) Thus making the Subject or Actors plural, the framework will allow for more Actors that influence the study.
8.2.3 Tools, Mediating Artifacts

In a constructionism project, one might expect that the mediating artifacts, computing tools and curriculum materials, would strongly shape student learning. But in fact the relationships between the Indigenous teachers/facilitators and the students, part of the Community element of the diagram, seem to have been more important in shaping the students’ experiences. I return to this below.

An artifact that was influential was the design for an interactive exhibit that the students created. Because the exhibit was about Indigenous culture, it connected computing to culture and community, and gave the students a digital voice in which they could share a perspective on Indigenous people and their lives with people in majority culture.

By adding more descriptors to this category, it helps clarify and open influence from other physical and non-physical artifacts.

8.2.4 Division of Labor

The students worked in teams of two to design their exhibits, sharing ideas and learning from each other. At the end of the first week each team presented their ideas, and were evaluated and given feedback by the facilitators and by other teams. This reflects Papert’s view that peer communication is important in creating new knowledge, and Engeström’s idea that participants negotiate “their division of labor, including the
distribution of rewards [and] uses of resources.” Here a descriptor helps clarify on the framework.

8.2.5 Rules, Social, Historic Culture

Engeström’s Rules are “codes of conduct [that] are … continuously constructed and contested in the form of explicit and implicit rules” during an activity. The discussions in the workshop invited the students to consider not just the activity in the workshop, but also the activity of their whole education, with the workshop being a part of that.

The Rules in this larger activity were laden with tension for the students, as discussed earlier. These included tensions from different educational expectations from parents and teachers, some of which reflected historical abuses. They also experienced tensions with Indigenous peers, concerning unwritten Rules that govern behaviors that are or are not acceptable for Indigenous youth.

It appears that the Talking Circle discussions helped the students to recognize and partially resolve these tensions. They learned that they were not the only ones experiencing the tensions. They came to feel that they can be both traditional and modern, resolving what they saw as two identities into one identity. With the dilemma resolved they were freed from a type of cultural cognitive load, more able to better
themselves and their community. They were also able to see that computing, while certainly not traditional, can have value within the Indigenous community.

By inclusion of historic and other influences within the descriptors of this element, it bring to the surface visible and unwritten rules bring clarity to all rules that may influence the activity.

8.2.6 Community

The same connections between the workshop and the students’ larger educational experience also brought into focus a larger community than just the students and the facilitators. Further, this larger community consists not just of people but of systems: the school system, governments (Tribal, local, State and Federal), often divided between Indigenous and non-Indigenous. Like the Rules, this complex community also created tensions for the students, for example in their relationships with non-Indigenous teachers.

The workshop, with all-Indigenous students and facilitators, was intended to provide a setting in which these tensions could be discussed safely. As discussed in the Interpretations chapter, the students indeed shared complex responses to these tensions, including Hiding or Living in Twos.

The follow up interviews suggest that this setting, and the strong connections among the students, and between the students and the facilitators, were very important
to the positive impact of the workshop. This is a neglected issue in the literature on computing education.

Thus the descriptor opens the Community element intercultural and intracultural influences upon the activity.

8.2.7 Tensions, Risks, Time

Engeström recognized in his framework the existence of tensions in studying human activity and contradictions as keys to understanding situations that cause conflict. I’ve added risk and time constraints. As discussed earlier, I had to take a risk in modifying the workshop plan to provide a role for a student who was not engaging. The results were mixed: the students were engaged, but they took over work that would be valuable for the other students. Time constraints kept me from compensating for that by adding more activities and instruction for the other students.

Tensions, Risks, and Time are new elements for inclusion

8.2.8 Sense Making

These Outcomes can be seen as the result of a sense-making process in which the students engaged, during and after the workshop. In the interviews, the students mention several times how the workshop affected them and how it helped in personal
sense and meaning making. They came to terms with their personal struggle and with roles outside of their culture. By adding descriptors helps clarifies.

8.2.9 Outcome(s)

In a narrow sense the Outcome of the workshop activity was the exhibit designs the students produced. But of course the larger Outcome was the impact the workshop had on the students’ lives after the event.

The specific goal of the intervention was to inspire or influence at least one of the students to study computing in college. In tracking the ten students over five years, one student did select computing at a local institution. I considered this as a partial success of the theory and intervention. Unfortunately this is the student who declined to have the data from his follow-up interview included in the study. That means I can’t report on the specific factors that may have influenced his decision.

More broadly, the follow-up interviews suggest that the workshop had positive effects for the students, apart from specific career choices, as discussed earlier. The students came to see their lives differently. The added descriptor added three elements for consideration for pre-post studies – expected outcome(s), actual outcome(s) and unexpected outcome(s).
8.2.10 Setting

Engeström does not include Setting in his framework, but the museum setting was certainly important in this study. The museum supplied assistance, and much in-kind support for the study. More important, the museum setting made the students’ project work, including its cultural aspects, much more authentic. The museum actually does have exhibits dealing with Indigenous culture, so the students’ work had practical value. Setting is a new element for inclusion.

8.2.11 Final Observation

Figure 8.2, below, provides an overview of what was observed as the major progress of the student’s activity in the 2010 workshop and from insights from the 2015 interviews about their Indigenous computing experience. It describes how the students entered the workshop with three internal conflicts causal towards interpersonal conflict. However, it shows that within a positive cultural computing environment the students were enabled to resolve internal issues to a sense of wholeness.
8.3 Value of This Research, and the Future

This study explored:

1. The value of integrating culture into learning activities to increase interest in the computing sciences.
2. The value of integrating culture and existing learning theory, each with its underlying psychological theory.

3. The value of research with a long timeline. The five year span of the study brought insight into the experience of three of the students that were not accessible during the workshop itself.

This study is the first to integrate constructionism with cultural context, including attention to the current cultural effects of historical events. When the mind is tangled with cultural negative history it cannot fully grow to its potential. Students may be seen in the classroom as troublesome, experiencing mental and attentional disorders and personal issues, and posing retention problems. These troubles find their origins in history. The status of computing as a non-Traditional activity makes these problems more acute for computing education in particular. Understanding this situation can help the teacher choose pedagogy that connects better with the student, in the regular classroom and especially in the computing classroom.

Can Cultural Constructionism be as effective with other underrepresented cultural groups? It should be tried. There is power in seeing one’s self connected to computing by gaining a digital voice in one’s community and in the greater society.
References


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APPENDIX I – ORIGINAL PROPOSAL

A Workshop for Creating Interactive Displays

SUMMARY

*BPC-CBE* is a two week workshop, limited to twelve Native American High School students from the greater Denver metropolitan area. It is designed to broadening participation in computing using a novel approach through cultural based education to create an interactive display for a museum employing educational, Native American culture and the arts. Through this experience the students will understand the importance of acquiring technology skills for future career options, learn about their Native Culture and be guided towards a technology career.

The workshop will be an integration of technology, education, culture and the arts. The workshop will be flexible and adaptable for including the integration and creativity. The workshop will invite number of professional guest lecturers to talking about the role of technology and how it being used in the four integrated areas and including museum studies, science and culture.

Key features include:

- Two week workshop, limited to 12 Native American High School student to work in pairs
- In order to guide their mindset, they will be asked to take on a professional role of an HCI technologists employed to create an interactive display for the museum
- They will hear how technology is used from professional lecturers in each of the subjects
- The students will be given an opportunity to explore exhibits, conduct research by observation and/or surveys, create an interactive prototype and present their project based on elements of education, Native culture and art appropriate for a particular part of the museums.
- Examples of an interactive display:
  - Health – Native names of the body, possible medicines plants
  - Science – Native names of Native star systems, how stars were used to understand seasons or used in navigation
  - Native Culture – A display of Native history, languages, songs, stories
Nature – Native names for North American animals

- The internet will be used to explore and acquire information for their displays and use HTML and/or other technologies
- In the last week the students will build their interactive display and give a final presentation
- The families can attend a culminating event where students present their exhibits

*BPC-CBE* will be developed in collaboration with community members, educators, Denver Museum of Nature and Science, and the University of Colorado, Boulder, GK-12 project – Integrating Computer Science into Traditional Studies.
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<td>12:00 p.m.</td>
<td>Lunch Break: Pizza</td>
<td>Lunch Break: Sandwiches Curtis Esquibel (Denver Scholarship Found.; College Horizons)</td>
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| 12:45  | Talking Circle — What tools could be used? technology help tribes ICT4D and issues | Talking Circle — What are our needs? New Leadership and Innovation in Native Communities | Talking Circle — How do we get there? Being a Change Agent in Organizational Change | Prepare for final presentation | Final Presentation:  
- Intro of program  
- Student presentation  
- Student recognition |
| 1:00   |                                     |                                       |                                         |                                       |                                       |
| 1:15   |                                     | Sonny Evans                           | Student work time                      | Student work time                      |                                       |
| 1:30   |                                     |                                       |                                         |                                       |                                       |
| 1:45   | Ricketson Tour                       |                                       |                                         |                                       |                                       |
| 2:00   |                                     |                                       |                                         |                                       |                                       |
| 2:15   |                                     |                                       |                                         |                                       |                                       |
| 2:30   | Watch Film: (184 minutes) The Only Good Indian | Guest Speaker: Clayton Lewis (FLUID); Antranig Basman (sp?) | Guest Speaker: Jeff LaMarche: 3-D Printing and Visualization |                                       |                                       |
| 2:45   |                                     |                                       |                                         |                                       |                                       |
| 3:00   |                                     |                                       |                                         |                                       |                                       |
| 3:15   |                                     |                                       |                                         |                                       |                                       |
| 3:30   |                                     |                                       |                                         |                                       |                                       |
| 3:45   | Wrap-up/T4L: Priorities             | Wrap-up/T4L: Health                   | Wrap-up/T4L: Leadership/Advocacy        | Wrap-up/T4L: Confidence                |                                       |
| 4:00   | Dismissal                           | Dismissal                             | Dismissal                               | Dismissal                              | Dismissal                              |