AN ETHNOMODEL OF A TRADITIONAL PENOBSCOT SUMMER DWELLING

UM ETNOMODELO DE UMA TRADICIONAL HABITAÇÃO DE VERÃO PENOBSCOT

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ABSTRACT

Shockey and Mitchell (2006) have engaged an ethnomathematical lens to describe the construction of a Penobscot hemispherical lodge. In that paper, the primary focus was on the *etic* view of the mathematics educators. Here, they consider the pedagogical implications, and have attempted to contribute to ethnomathematics literature by suggesting this was a Native North American perspective. In this article, Shockey and Mitchell revisit a summer dwelling through the emic view by utilizing units of analysis related to Bishop's six cultural activities (1991). This work represents the authors' first attempt with ethnomathematics, used to move from a strictly western *etic* perspective that emphasizes the universal assumptions that we call mathematics.

Keywords: Mathematics Education, Ethnomathematics, Ethnomodelling, Native American Education.

RESUMO

Shockey e Mitchell (2006) têm estado comprometidos com a perspectiva etnomatemática para descrever a construção de uma cabana hemisférica Penobscot. Naquele artigo, o foco principal foi sobre o ponto de vista ético dos educadores matemáticos. Aqui, eles consideram as implicações pedagógicas, sendo que têm tentado contribuir para a literatura etnomatemática ao sugerir que essa era uma perspectiva norte-americano nativa. Neste artigo, Shockey e Mitchell revisitam essa habitação de verão através da visão êmica por meio da utilização de unidades de análise relacionadas com as seis atividades culturais de Bishop (1991). Este trabalho representa a primeira tentativa desses autores com a etnomatemática que foi utilizada para se moverem de uma perspectiva ética estritamente ocidental que enfatiza as suposições universais que denominamos de matemática.

Palavras-chave: Educação Matemática, Etnomatemática, Etnomodelagem, Educação Indígena Americana.

1. Introduction

> Etuaptmumk is the Mi'kmaw word for Two-Eyed Seeing (…) It refers to learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing (…) and learning to use both eyes together, for the benefit of all[1].

We include Two-Eyed Seeing as a way to introduce the authors; one is a member of the Penobscot Nation and the other a Western trained mathematics educator.

With the emergence of ethnomodelling now appearing in English, more scholars are considering this important lens to contribute to the growing ethnomathematics literature (Bassenezi, 2002; Rosa & Orey, 2013a, Rosa & Orey, 2013b). This body of work has been maturing in Brazil and is recently spreading globally through the efforts of Rosa and Orey (2013a, 2013b). In 2006, Shockey and Mitchell acknowledged that important details were lacking in their description of a Penobscot hemispherical lodge, namely details associated with visual measurement, estimation, proportional reasoning, and other elements inherent in Bishop's six cultural activities (1991).

What they did not realize was that the emic view was missing as well, but at that time, neither had considered this critical perspective. In this paper, we attempt to address these ideas informally discussed, as Bishop's six and other ideas by bringing the emic view to the forefront to develop an ethnomodel of a traditional Penobscot summer dwelling.

Before discussing the six cultural activities used as units of analysis to describe the construction of the Penobscot lodge, we delve into a historical review of scholarship to highlight the importance of language and worldviews toward the development of emic and etic. We conclude with remarks on the potential pedagogical implications.

2. Acknowledging a Dilemma

Gilsdorf (2012) in his seminal book *Introduction to Cultural Mathematics* makes clear that using Western mathematics to describe cultural phenomena is problematic.

> Writing about the topic of cultural mathematics for readers with backgrounds primarily in Western mathematics brings one to a dilemma: On one hand, using Western terminology and notation to describe mathematics of non-Western cultures is inherently inaccurate because people in such cultures would not think of the mathematical content in the same way as it is perceived in Western culture. On the other hand, if the goal is for people of Western backgrounds to understand how cultural activities can be understood as mathematics, then one must speak to readers in familiar mathematical terms (p. xii).

[1]http://www.integrativescience.ca/Principles/TwoEyedSeeing/.

This is a dilemma for the authors as well. Shockey, a Western trained mathematics educator does not understand the *Passamaquoddy* language of Mitchell, thus the descriptions are in English, allowing Shockey to understand.

3. Literature

While Pike introduced the emic, etic constructs in 1967, there exists a rich history of the importance of language and worldview preceding this. This literature review includes works from anthropology, linguistics, mathematics education and ethnomathematics. Indigenous research methodologies are included to reinforce the importance of relationships, a critical element of ethnomathematics and ethnomodelling scholarship. One objective of this narrative is the potential for scholars to consider *new* and, or *different* questions in ethnomathematics. Quoting Kluckhohn (1949), we are standing "on the shoulders of those who have gone before us" (p. 56). We attempt to present this material chronologically.

Kluckhohn (1949) was clear on his view of the outsider looking in when he quoted Sapir: "But in any society as Edward Sapir said: forms and significances which seem obvious to an outsider will be denied outright by those who carry out patterns; outlines and implications that are perfectly clear to these may be absent to the eye of the onlooker" (p. 36). An intent of ethnomodelling is to make the *absent* visible through the language descriptions of the insider.

As Kluckhohn (1949) told us of the importance of language, "from the anthropological point of view there are as many different worlds upon the earth as there are languages. Each language is an instrument that guides peoples in observing, in reacting, in expressing themselves in a special way. The pie of experience can be sliced in many different ways, and language is the principle directive force in the background" (p. 160). We use Kluckhohn's language observation to apply to both the insider and the outsider.

When D'Ambrosio (1985) coined ethnomathematics, he included the 'codes and jargons,' reinforcing the importance of language.

> Any language is more than an instrument for conveying ideas, more even than an instrument for working upon the feelings of others and for self-expression. Every language is also a means of categorizing experience. The results of the 'real' world are never felt or reported as a machine would do it. There is a selection process and an interpretation in the very act of response. Some features of the external situation are highlighted; others are ignored or not fully discriminated (Kluckhohn, 1949, p. 165-166).

Ethnomathematics scholars may need to develop understanding of the discriminating process of reporting as done by their study participants, but this may not be viable, since oftentimes the researcher is not a member of the group under study. Kluckhohn (1949), quoting Sapir:

> Human beings do not live in the objective world alone, nor alone in the world of social activity as ordinarily understood, but are very much at the mercy of the particular language, which has become the medium of expression for their society. It is quite an illusion to

> imagine that one adjusts to reality essentially without the use of language and that language is merely an incidental means of solving specific problems of communication or reflection. The fact of the matter is that the 'real world' is to a large extent unconsciously built up on the language habits of the group (…) We see and hear other otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation (p. 167).

For those engaged in ethnomathematics and ethnomodelling scholarship, we may do well to adhere to Kluckhohn's (1949) responsibility, "the first responsibility of the anthropologist [insert ethnomathematics and, or ethnomodelling] is to set down events as seen by the people he is studying" (p. 299-300).

Assumptions on the part of research, as acknowledged by Whorf (1956a) are critical points of consideration, "I find it gratuitous to assume that a Hopi who knows only the Hopi language and the cultural ideas of his own society has the same notions, often supposed to be intuitions, of time and space that we have, and that are generally assumed to be universal" (p. 57). Scholars immersed in ethnomathematics research are realizing the importance of perspective, embracing emic views, and broadening learning opportunities within ethnomathematics but maybe more importantly for pedagogy.

Whorf (1956c) states, "We are thus introduced to a new principle of relativity, which holds that all observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar, or can in some way be calibrated" (p. 214). He continues, "that modern Chinese or Turkish scientists describe the world in the same terms as Western scientists means, of course, only that they have taken over bodily the entire Western system of rationalizations, not that they have corroborated that system from the native posts of observations" (p. 214). Moreover, continuing:

> When Semitic, Chinese, Tibetan, or African languages are contained with our own, the divergence in analysis of the world becomes more apparent; and, when we bring in the native languages of the Americas, where speech communities for many millenniums have gone their ways independently of each other and of the Old World, the fact that language dissects nature in many different ways becomes patent. The relativity of all conceptual systems, our included, and their dependence upon language stand revealed. That American Indians speaking only their native tongues are never called upon to as scientific observers is no wise to the point. To exclude the evidence which their languages offer as to what human mind can do is like expecting botanists to study nothing but food plants and hothouse roses and then tell us what the plant world is like! (p. 214-215).

This was the view of Shockey, strictly etic, when observing the teaching of Mitchell as he engaged school aged children in the lodge construction.

Whorf (1956d) on talking;

> (…) 'the linguistic relativity principle', which means, in informal terms, that users of markedly different grammars are pointed by their

> grammars toward different types of observations and different evaluations of externally similar acts of observations, and hence are not equivalent as observers but must arrive at somewhat different views of the world (p. 221).

Shockey's grammar that of a Western trained mathematics educator, varied from Mitchell's in this activity. Mitchell is a Western trained academic, but his training for building a Penobscot lodge occurred with tribal Elders.
Whorf (1956d) continues:

> The participants in a given world view are not aware of the idiomatic nature of the channels in which their talking and thinking run, and are perfectly satisfied with them, regarding them as logical inevitables. But, take an outsider, a person accustomed to widely different language and culture, or even a scientist of a later era using somewhat different language of the same basic type, and not all that seems logical and inevitable to the participants in the given world seem so to him (p. 222).

Not all that seemed logical to Mitchell was such to Shockey. One such occurrence during the construction of the Penobscot lodge had to do with *Ancestral Engineering* (Personal communication with Corrine Mount Pleasant Jetté whom coined the phrase). In placing the lodge poles about the circumference of the lodge, Mitchell placed the poles at an acute angle facing away from the lodge center. This was counterintuitive to Shockey.

As Shockey continued observing Mitchell's teaching, Mitchell engaged the students to learn how they perceived this placement. It was determined that lodge poles place perpendicularly into the ground were likely to explode out of the ground when the poles were bent toward the lodge center, thus causing harm.

According to Whorf (1956d), when there are changes in reasoning, linguistics plays an important role:

> Why do flames rise? Because of the lightness of the element fire. Why can one lift a stone with a leather sucker? Because the suction draws the stone up. Why does a moth fly toward a light? Because the moth is curious or because light attracts it. If once these sentences seemed satisfying logic, but today seem idiosyncrasies of a peculiar jargon, the change did not about because science has discovered new facts. Science has adopted new linguistic formulations of the old facts, and, now that we have become at home in the new dialect, certain traits of the old one are no longer binding upon us (p. 222).

This new formulation situates the Ethnomodelling work within ethnomathematics.

Consider Whorf's (1956e) statement when considering language and the emic, etic perspectives.

> (…) The effortlessness of speech and the subconscious way we picked up that activity in early childhood lead us to regard talking and thinking as wholly straightforward and transparent. We naturally feel

> that they embody self-evident laws of thought, the same for all me. We know all the answers! But, when scrutinized, they become dusty answers! (p. 238).

4. Indigenous Methodologies

Indigenous methodologies, as stated by Lambert (2014):

> (…) Involve a tribal epistemology, meaning that information is gained through a relationship with Indigenous people in a specific community. While these research methods are aligned with several Western qualitative approaches, there are distinctions. Some of those distinctions include a relationship with the source of the research data, or the person who knows and tells the story. Another distinction is the relationship that the researcher has with the story, how it is told, and how the knower and the researcher interpret the story. I believe that researchers who conduct research with Indigenous communities have accountability to that community's ethics, epistemology, ontology, and methodology. Our sense of community and place, the beat of our drums, and our hearts and minds connect us to one another (p. 2).

Lambert (2014) reminds us that Indigenous research methodology, while her emphasis was psychology, for this purpose "cannot take place without a discussion of culture" (p. 2). Indigenous research methodology is included because as the scholarship on ethnomodelling is emerging, the focus on etic and emic perspectives is suggesting that relationships are critical, as are the local epistemologies.

5. Emic and Etic

Pike (1967) states:

> As regards the nature of the emic units, the nature of the systems containing them, the present volume is written from the point of view that emic systems and emic units of these systems are in some sense to be discovered by the analyst, not created by him (Pike, 1947, p. 64). Etic systems, on the other hand, as assumed to be classifications created by the analyst – constructs for the handling of the comparative data, of for the handling of data before its emic ordering can be ascertained. Etic units, within this point of view, would vary: insofar as they approached the emic units of a system, they would be discovered within that data but to the extent that distortion occurred, they would be only provisional constructs of the analyst. In addition, it should be carefully noted that the etic-emic approach is useful – and necessary – whether or not on adopts this attitude toward data. Practically, the conviction that there is an emic system to be discovered serves as a stimulus to refuse to accept too readily, as definitive description of a particular set of data, any pair of analysis which appear to be equally valid but contradictory. In such a situation the outlook given here would insist that, before accepting such a result, we try to find a third analysis which does violence to neither of the first two, but merges both analysis in a synthesis at a higher level – possibly by bringing in kinds of data or other levels of data - which

> each of the earlier partial analysis rejected as non-relevant to that immediate problem, but which now appear relevant (p. 55-56).

Pike (1967) reminds us of his intent; "the etic approach treats all cultures or languages – or a selected group of them – at one time. The emic approach is, on the contrary, culturally specific, applied to one language or culture at a time" (p. 37).

A critical question for scholarship in ethnomathematics rests on the researchers' perspective: How do we recognize the emic structure of what we call mathematics? Pike emphasizes: "It must be further emphasized that etic and emic data do not constitute a rigid dichotomy of bits of data, but often present the same data from two points of view" (p. 41). This paper is a result of the same data being presented from two points of view.

6. Ethnomodelling

According to Rosa and Orey (2013a), "The ethnomodelling process starts with the social context, reality, and the interests of students and not by forcing a set of external values and decontextualized activities without meanings for students" (p. 79). They continue and provide their translation of Bassanezi (2002, p. 208), "This process is defined as "the mathematics practiced and elaborated by different cultural groups, which involves the mathematical practices present in diverse situation in the daily lives of diverse group members" (p. 79).

Putting this together, Rosa and Orey (2013a) conclude, "ethnomodelling uses mathematics as a language for understanding, simplification, and resolution of problems" (p. 79). Ethnomodelling is a paradigm shift for ethnomathematical scholarship with the etic and emic views elaborated. The scholar working in ethnomodelling may, as suggested by Pike (1967):

> Through the etic 'lens' the analyst views the data in tacit reference to a perspective oriented to all comparable events (whether sounds, ceremonies, activities), of all peoples, of all parts of the earth; through the other lens, the emic one, he views the same events, at the same time, in the same context, in reference to a perspective oriented to the particular function of those particular events in that particular culture, as it and it alone is structured. The result is a kind of 'tri-dimensional understanding' of human behavior instead of a 'flat' emic one (p. 41).

7. Synthesizing

Pike (1967) introduced the emic, etic discussion, but a closer look through literature presented above is used to create a possible trajectory for building the supportive argument for these important elements of Ethnomodelling. While not intended to be exhaustive, viewing literature different from ethnomathematics and mathematics education offers opportunities for us to consider new questions and consider ethnomathematics through different lens. Building an ethnomodel, we believe is based on relationships and an appreciation for local epistemology.

If the researcher is not a community member of the group under study and is not a speaker of the language, gaining the emic perspective, may present challenges, but as

researchers we should attend to what is shared as much as what might be discriminated by the sharer. An articulated ethnomodel has the potential for presenting language to build new knowledge, at the very least new knowledge for the researcher. It may be an open question as to when an ethnomathematics scholar understands, or if a developed ethnomodel understands the phenomena under investigation. We offer the following caution.

8. Caution

Strathern (1993), an anthropologist, had this to say about the understanding, "the question of what is meant by 'understanding' is clearly a philosophical one" (p. 76). With that stated, Strathern offers what we interpret as a caution when engaging in scholarship:

> When we say that we 'understand' some feature of a culture we are studying, what sorts of things do we generally mean by making such a claim? It seems to me we are claiming that we can first grasp the feature within its own context and then successfully translate it in such a way that it appears meaningful to us…Anthropological analysis goes further that this; it purports to be able to explicate other cultures *in their own terms*, and simultaneously be able to *explain* them by reference to theories essentially drawn from the observer's own cultural and historical milieu. These two aims of understanding and explanation are therefore usually separated. There may be conflict between them, since 'understanding' may be set up as a rival form of explaining to the word 'explanation' itself. Regardless of this, both approaches are vulnerable to what may be called 'hidden ethnocentrism', in which we think we are applying value-free or objective concepts to our data whereas in fact we are still unconsciously importing ideas of a cultural kind, which may or may not be suitable to the task in hand (p. 76-77).

Strathern (1993) tells us that "until one knows the emics, one transcribes etically and works toward the emic. Etics are in this regard a step towards emics, not a privileged or superior level of discourse". He continues, "So with anthropological ethnographies emics are said to yield the local, particular. To make comparisons we require etics" (p. 103). Finally, Strathern offers "conventionally we recognize also that ethnography much be a blend of emic and etic; it must give a feel of the view from inside the culture and at least a touch of analysis from outside it" (p. 182). This is a *must* of ethnomodelling.

9. The Situation

John Bear Mitchell, Penobscot, was invited to construct a traditional village on Penobscot Ancestral grounds in southern Maine in 2005. Students, k–12, from private, public, and home school situations spent two weeks learning how to build. Shockey attended the sessions with two purposes in mind, first to learn about the pedagogical style of Mitchell and second to understand the mathematics inherent in the project, a strict etic view.

The setting was such that groups of students would arrive in the morning, work until lunchtime then return to their respective schools. In the afternoons, a different group of students would arrive and work until their regular school day concluded. Many of the home-schooled students would spend entire days working at the site.

10. Building an Ethnomodel

Orey and Rosa (personal communication) have initiated the international conversation about the consideration of other scholarly fields and their potential contribution to ethnomathematics. Dana (1993), discussing how psychology must consider perspectives that were originally developed for Anglo-Americans, suggests that psychology consider important that "an emic perspective is culture-specific and examines behaviors from with a culture, using criteria relative to the internal characteristics of that culture. An emic approach acknowledges that persons from non-Anglo-American cultural groups must be understood on their own terms" (p. 21). While Dana's emphasis is on assessment, it suggests that a one-size fits all approach in psychology is not appropriate. We believe that in ethnomathematics, too much etic emphasis, can be improved with a balance of etic and emic perspectives.

In discussing the differences of etic and emic, the linguist Pike (1967) states: "The etic approach treats all cultures or languages – or a select group of them – at one time. The emic approach is, on the contrary, culturally specific, applied to one language or culture at a time" (p. 37). For our purposes, we engage Gilsdorf's (2012) definition of culture: "When a collection of people follow a similar trend in assigning meanings and beliefs, they have what anthropologists call a culture" (p. 4).

Rosa and Orey (2009, cited in Rosa and Orey, 2013a) state their definition of an ethnomodel as "cultural artefacts that are pedagogical tools used to facilitate the understanding and comprehension of systems taken from the reality of the cultural groups" (p. 80). We engage Bishop's (1991) six cultural activities to analyze and understand the artifacts within the Penobscot view. We acknowledge that Bishop's (1991) six is etic, from an academics' perspective.

11. Units of Analysis

Shockey and Mitchell engage Bishop's six cultural activities (1991) to develop an ethnomodel of a Penobscot summer dwelling (Figure 1).

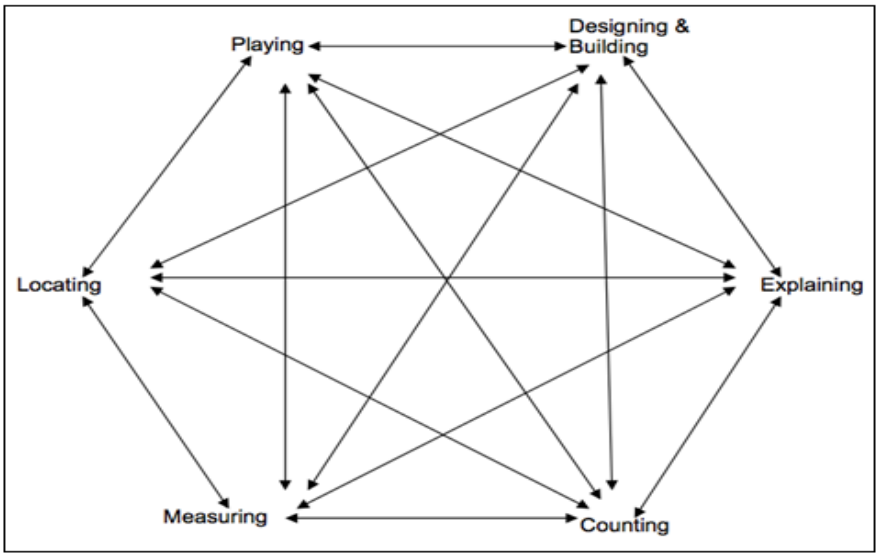

Figure 1. Bishop's six cultural activities (1991). Adapted by Shockey, Mitchell, and Barta

In Figure 1, we are purposeful in the arrows; each of the activities in our experience is linked to the other five activities. We do not view these events as mutually exclusive.

12. Building the Emic

We use the six cultural characteristics of Bishop (1991) to build the emic portion of this ethnomodel. The ethnomodel is focused upon a traditional summer dwelling of the Penobscot people (Figure 2).

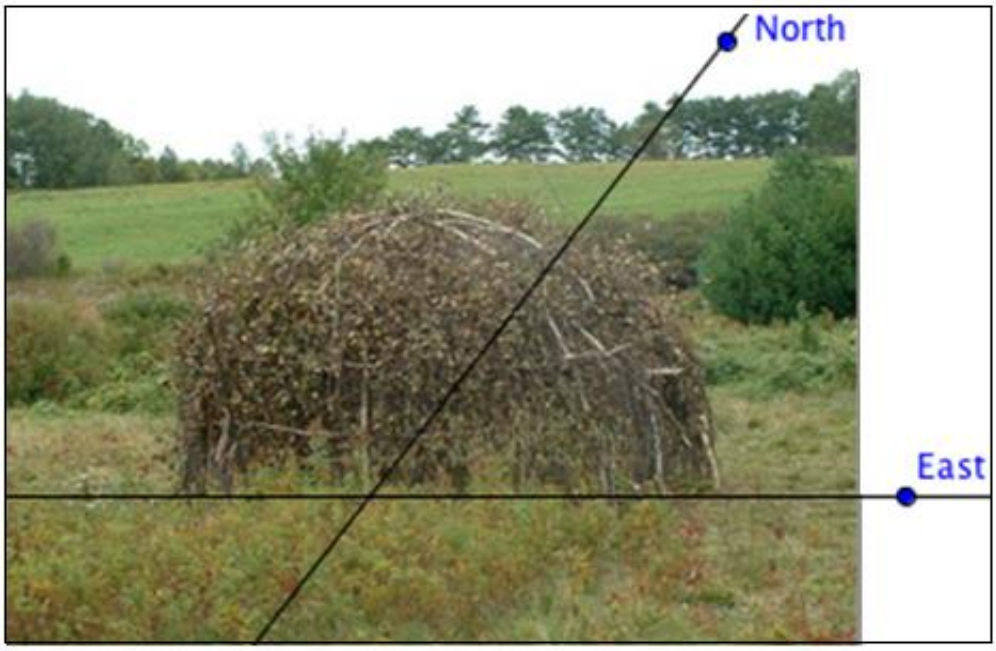

Figure 2. Traditional Penobscot hemispherical lodge

12.1. An Emic Perspective

Revisiting the construction of the dome lodge, John Bear Mitchell *explains* in detail the elements from his emic perspective that are important.

12.2. Locating

Searching for the location to place a dwelling and searching for the location of material for that dwelling are very important. Firstly, location is always chosen based on the resources that surround the area where the dwelling will be placed. This is beneficial for the builder(s), in that they expend a lot less of their physical energy on transporting the dwellings structural poles and the various coverings.

This allows the dwelling to be completed in a timely manner where most of the summer dwellings are temporary and really do not need to be manufactured to sustain long term structural integrity although the frame of the dwelling, if properly constructed, can last for up to five years. Secondly, the physical location of the dwelling is important because it will serve as a rallying point for very important hunting and gathering activities. Dwellings are constructed in areas where hunting and gathering will take place over the course of a few days to a few weeks.

12.3. Designing and Building

The question with designing and building is based on the materials at hand and/or the placement of the dwelling based on the location. If the dwelling is built on an ocean shore, it will need to be able to withstand constant wind. Either heavy wind or simply a constant breeze, the *A* frame style will not suffice (Figure 3).

Figure 3. Frame dwelling

The *A* frame style of lodge will not withstand or deflect the wind without the possibility of the dwelling blowing over. The conical shaped dwelling would be a better style where the wind will roll off, no matter which direction the wind decides to blow from (Figure 4).

Figure 4. Conical structure

The conical lodge is also quickly erected and requires no bending of poles and can be easily assembled by one person. Keeping in mind that any dwelling is built with poles that are stuck anywhere from 10 inches to 12 inches into the ground – this in itself does not guarantee that the dwelling will withstand severe wind or weather (Figure 5).

Figure 5. Initial placement of semi hemispherical lodge pole

However, the strongest of all dwellings is the semi hemispherical lodge (Figure 2). This lodge requires a minimum of two people to build. Where it requires the bending and joining of poles, which are bent at the builders hip, two builders must bend the poles at the same time and bring them together at the top thus creating an arch.

12.5. An Etic Discussion of Figure 5

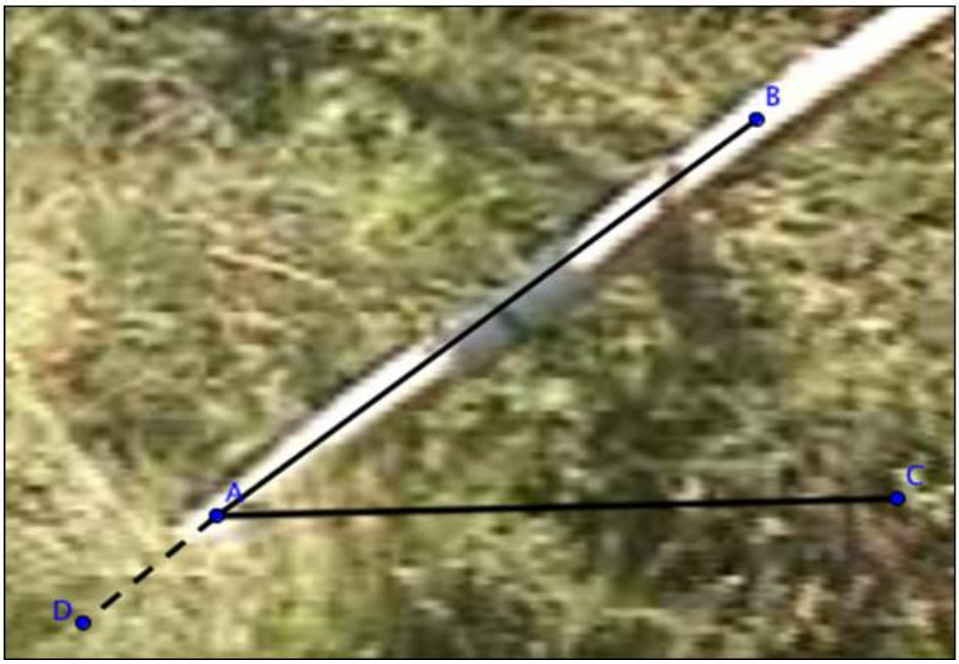

Figure 6. Ancestral engineering placement of lodge pole

Figure 6 depicts the position of a lodge pole once it has been inserted into the ground. Segment *AC* denotes the ground; observe the acute angle formed at *A*. This lodge pole was rotated counter clockwise from point *A*. The counter clockwise rotation is in the direction of the center of the lodge. Segment *AD* denotes the length of the lodge pole that is underground.

In a discussion with the participants, Mitchell shared that the placement of a lodge pole straight into the ground, 90^0, had the potential of causing harm when pressure was placed on it to rotate it toward the center, it was likely to pop out the ground and strike the person working on the lodge. By placing the lodge pole as shown in Figure 6, injury was avoided and structural integrity was improved for the lodge.

12.6. Counting

In order to build any dwelling, the builder needs to know how many poles, squares of bark, or mats of grass (Figure 7) it will take to cover the dwellings. The poles, 12 for a semi hemispherical and conical dwelling, will need to be gathered. Quality of the poles only has to be of high quality when building the semi-hemispherical lodge. All other poles can be from blow down trees and/or a lesser quality tree that may be growing in the vicinity.

Figure 7. Grass mat coverings

The number of poles needs to be harvested for each lodge - plus two more, just in case one breaks or one does not bend properly. Where the poles are tied together with either small spruce roots or rope made of cedar or basswood bark, an estimate of materials would also have to be estimated by knowing how many poles and support sticks are going to be used for each dwelling.

12.7. Measuring

Somewhat like counting, the builder must be able to estimate the approximate size of the dwelling. Again, this goes back to access for the materials. Square footage needs to be estimated so that the builder can know about how much/big the panels of bark or grass coverings need to be. For instance, if the builder sees that there are birch, elm, or bass wood trees around, he would need to be able to figure out how much bark each tree will yield. A tree that is a foot thick would be the ideal size where the bark panels will be about 3 feet wide. The builder will cut 3-foot long strips to obtain a 3 x 3 foot sheet of bark.

From this, he can estimate the size of the lodge and know about how long it will take, time wise, to cover the dwelling. If he is going to use grass mats to cover the dwelling, it will not be as much of a problem to gather or estimate where he can tie the mats to any size he prefers. Keeping in mind that the dwelling is not necessarily going to be tall enough to walk around in, the height of the trees gathered needs to be twice as tall as the lodge is going to be. When the poles are bent, the height of the inside of the lodge will decrease in the semi-hemispherical dwelling.

For the lodge not to be too big or too small, the builder only wants the size of the lodge to be practical for its use. This is usually based on the occupant's height and physical

size. In this case, an eyeball estimate is taken and the lodge poles are harvested for practical use rather than that of a winter lodge, which would be constructed much differently. Comfortable sleep areas with a small work area for foul weather are just enough space.

12.8. An Etic View of Bark Dimensions

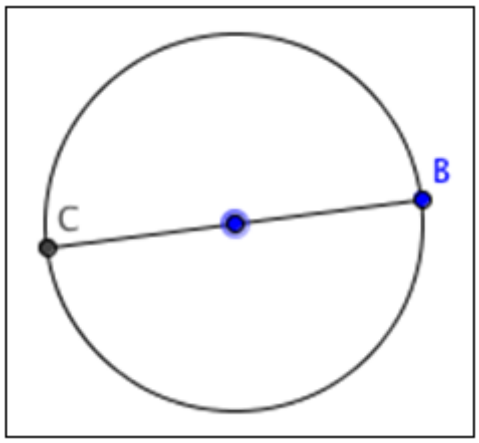

Figure 8. Top view of a tree

"A tree that is a foot thick would be the ideal size where the bark panels will be about 3 feet wide" acknowledges the relationship between diameter and circumference. If diameter *CB* is 1 foot, then the circumference of the circle is 2 pi. Approximating pi to be 3, the width will "be about 3 feet".

The reference to 3-foot strips would be a cut downward on the tree surface. Understanding the relationship between circumference, diameter and the distance of the cutting of the bark allows the builder to harvest squares of bark. The squares of bark, think of a two-dimensional model, are created from a three-dimensional situation, from an idealized cylinder.

13. Pedagogical Implications

The pedagogical implications are many. First of all, a person who is going to explain the purpose and use of the lodge is going to have to be able to explain what the materials of the lodge do. It would be beneficial for the builder to be able to *teach as they build* in order to show what is meant about dwelling types and the types of materials. A lot of counting and estimating will be done in this process. Time management from material collection to building will need to be considered as well as where the dwelling is going to house the builders.

History of the area where the dwelling is being built can be told as the dwellings construction is being performed. The science of why the lodge is being built can also be discussed. The lands resources are yielded at certain times of the year – hunting, for instance. When do the animals travel through the area and/or what time of year certain wild plants can be harvested? What time of year certain fruits or berries, or roots are in need of gathering? This suggests that we expand Bishop's six cultural activities (1991) to seven, which includes the diversity of *calendar*.

Another important pedagogical perspective is the teaching style of John Bear Mitchell. The teaching cliché, 'we teach the way we were taught,' needs elaborations. Modelling was a critical element in the teaching of constructing the dome lodge. Mitchell would model activities in the sequence that when finalized would yield the dwelling. His teachings were mixed with stories and opportunities for discussions to assure that the students understood tasks clearly. Once Mitchell was convinced that students understood them, he would stand by and allow them to work.

This is an artifact of his learning. His role became that of an observer. He would answer questions and participate as a *helper* when the students might need assistance to, for example, lash materials together. Mitchell did not interfere with the sense making by the students at the different constructions stages.

In 1928, Schlauch wrote:

> Any normal child is blessed with natural curiosity – that heritage of the evolutionary struggle during which not to comprehend the environment and its dangers meant death. Children take joy in mastering knowledge, which they can see has some relation to the phenomena of their lives. It is only the mass of abstract material in a dull curriculum, unpedagogically presented, that finally kills the desire to learn (p. 28).

Ethnomathematics and ethnomodelling embrace and nurture curiosity.

14. Some Etic Thoughts

The mathematical etic implications abound throughout the construction. The dome lodge has a circular base, placement of the lodge poles, so that each is equi-spaced on the circumference, and may be considered from a central angle perspective. The proportional reasoning is associated with the length of the lodge pole, so that when it is bent, it satisfies a height requirement, as well as being long enough to be lashed to the opposite lodge pole.

Spatial reasoning has important considerations throughout the building process. In the builder's mind, he has to consider that there will be enough area at the base of the lodge to satisfy sleeping and work area requirements. Determining the square footage to cover the lodge, oftentimes done in multiple layers to assure inhabitants can stay dry in wet weather, is done within the builder's mind.

15. Discussion

During the time of this project, all participants were experiencing Two-Eyed Seeing, although none were aware of the phrase attributed to Mi'kmaw Elder Albert Marshall. The student participants were all immersed in Western schooling and the stories and guidance of John Bear allowed them experiences that in some regards were contrary to their academic experience within the confines of school walls. One remarkable example to support this occurred when the students were wrapping thin poles around the perimeter of the lodge. These poles added strength to the dwelling and were to be parallel to one another.

The students' strategy was to place the first wrapped pole near the base, and then the remaining poles would be parallel to that. It was immediately obvious to the students that the second pole, as it was being wrapped and *eye balled* for being parallel, was not close. One student stopped the construction acknowledging there needed to be a method to assure parallelism. Without prompting, she placed her elbow on the first wrapped pole, made a fist with her hand, establishing the non-standard unit of measure that would assure the placement of the remaining wrapped poles would be parallel, the distance between her elbow and closed fist.

An etic discussion, Western mathematics, of parallels on a hemisphere could have led to rich discussions to investigate what does parallel mean in the plane and how can that understanding transfer to a curved surface. We infer that this student recognized a problem, and, from her personal emic perspective, derived a solution. She did not need standard units of measure and was able to improvise with an immediate solution to satisfy her interpretation of parallel on a curved surface.

The emic perspective of this construction was rich with Ancestral Engineering (personal communication Corine Mount Please Jetté). Mitchell brought his learning of constructing this lodge and used the language *parallel* while discussing the wrapped poles. This student brought her western understanding of parallelism and a generalization about equidistance that are not in standard units of measure, but it could mean a body dimension.

16. Conclusion

We acknowledge that this is one example that amplifies the importance of the emic perspective. Through careful guidance, students were able to construct some remarkable dwellings. Students were able to make sense of their responsibilities, for example in parallelism when the teacher switched his role to observer. The many demonstrations of Ancestral Engineering made it abundantly clear that the Two-Eyed Seeing was beneficial for all.

17. References

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