"NATURAL HORIZONS" IN SCIENCE EDUCATION

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ABSTRACT: The Integrative Science Program at Cape Breton University in Sydney, Nova Scotia, Canada, is an innovative and creative approach to university-level science education that brings together Indigenous and Western scientific worldviews, with a focus on common ground and a respectful acknowledgement of differences. An important commonality is the recognition of patterns in the natural world; considerable differences may occur, however, in how each expresses these recognitions. In this presentation, I will explore a pattern that emerges from the creative relationship between landscape, skyscape, and observer. I will show how it can be expressed as an "X" in a circle, which is the patterned shape frequently used by modern First Nations' teachers to depict the Medicine Wheel. The pattern reflects the observer's sensed relationships with the rising and setting sun over the course of a year in a particular location, or place. Furthermore, it is much richer than place: my presentation will show how the X in a circle also embeds "emergence" and "participation" to yield "sense of place, emergence, and participation". Mi'kmaq Elder Murdena Marshall of Eskasoni First Nation maintains that this fuller understanding (not just "sense of place" as in much current literature in environmental studies) is foundational in the teaching of Integrative Science. It is applicable to all relational concepts (beyond those of land and sky), leading to a creative learner who is mindfully connected with environment and knowledge systems. This research is funded by Cheryl Bartlett, Canada Research Chair in Integrative Science at Cape Breton University and receives considerable guidance from Mi'kmaq Elder Murdena Marshall of Eskasoni First Nation in Cape Breton.

KEYWORDS: Integrative Science, Sense of Place, Emergence, Participation, Worldviews, Medicine Wheel, Indigenous science, Western science, science, education, natural patterns, mindful, sun.

This paper is based on a presentation delivered at the 4th International Conference on Imagination and Education ("Opening Doors to Imaginative Education: connecting theory to practice") held in Vancouver, Canada, during July 2006. This written version differs from the actual presentation in that during the presentation numerous animated visuals were used to illustrate an oral explanation. This written version features four main components from that presentation: (1) the approach of the Integrative Science Program at Cape Breton University; (2) that program's conceptual framework for pattern recognition, transformation, and expression; (3) one way that this pattern framework can help a learner understand the visual shape of the Medicine Wheel; and (4) the use of such to help foster a learner's sense of place, emergence and participation.

1) The Approach of The Integrative Science Program at Cape Breton University

This research is occurring on the eastern coast of North America in the land of Mi'kma'ki which is the traditional territory of the Mi'kmaq people and which encompasses most of Atlantic Canada plus parts of Quebec and New England. The research stems from the Integrative Science Program at Cape Breton University in Sydney, Nova Scotia, Canada.

The Integrative Science Program is an innovative and creative approach to university-level science education that brings together Indigenous and Western scientific worldviews with a focus on common ground and a respectful acknowledgement of differences. Moreover, the program brings these knowledges together with their community counterparts − Mi'kmaq First Nations' Elders, youth, health care workers, teachers, scientists, RCMP officers, university researchers, funding agencies − on a co-learning journey in which we grow forward together.

The program also seeks to employ mindful learning techniques as a way of fostering learners' acknowledgement of their agency in learning concurrent with their participation in environment. Learners develop and enrich their sense of place through making the transition from recognition of natural patterns to realizing that they can imaginatively and creatively express their understandings of these patterns in various ways that draw upon cultural and/or personal values.

"Sense of Place" is a personal response to the environment of place, both natural and social, and includes the notion of "being oriented". Given that the word "orient" can mean "east" or "to face east", having a sense of place can include knowing how to orient oneself with respect to east in a given place and then to the natural patterns of that place as they emerge in relationship with this direction (which is that of the rising sun).

In this paper, I explore such a pattern − one that emerges from the creative relationship between landscape, skyscape, and observer. I show how this pattern can be expressed as an "X" in a circle to represent an observer's sensed relationships with the rising and setting sun over the course of a full year in a particular place. Moreover, I show how this pattern can be found in the "X" in a circle shape frequently used by modern First Nations' teachers to depict the Medicine Wheel.

2) A Conceptual Framework for Pattern Recognition, Transformation, and Expression

In an effort to help learners acknowledge their active role in the learning process and, furthermore, their active role in the creation and expression of scientific knowledge and ways of knowing, Dr. Cheryl Bartlett (Canada Research Chair in Integrative Science, Director of Institute for Integrative Science & Health, and Professor of Biology at Cape Breton University) has developed a simple pattern conceptual framework as a tool for pattern recognition, transformation and expression.

She suggests that we recognize *natural pattern* in the outer environment (i.e. outside our head-mind) and then, as we internalize it within our head-mind, we transform it to create an *ideal pattern,* i.e. an inner version of the outer pattern. This ideal pattern can then be "taken out" of the rich inner environment of our head-mind (as *abstract pattern*) and expressed in ways that both reflect cultural and/or personal values and enable us to share our understandings with others.

For example, let us consider human footprints on the wet sand of a beach. We might recognize four pairs within these and upon internalizing that pattern of footprints transform it into an ideal pattern like those in Figure 1. This inner, ideal pattern of the footprints can then be expressed as an abstract pattern drawing upon or reflecting cultural and/or personal values, possibly as four blocks or as a rich tapestry. Both expressions (and there could be diverse others) help tell the story of how the natural pattern was experienced by the observer-participant-knower.

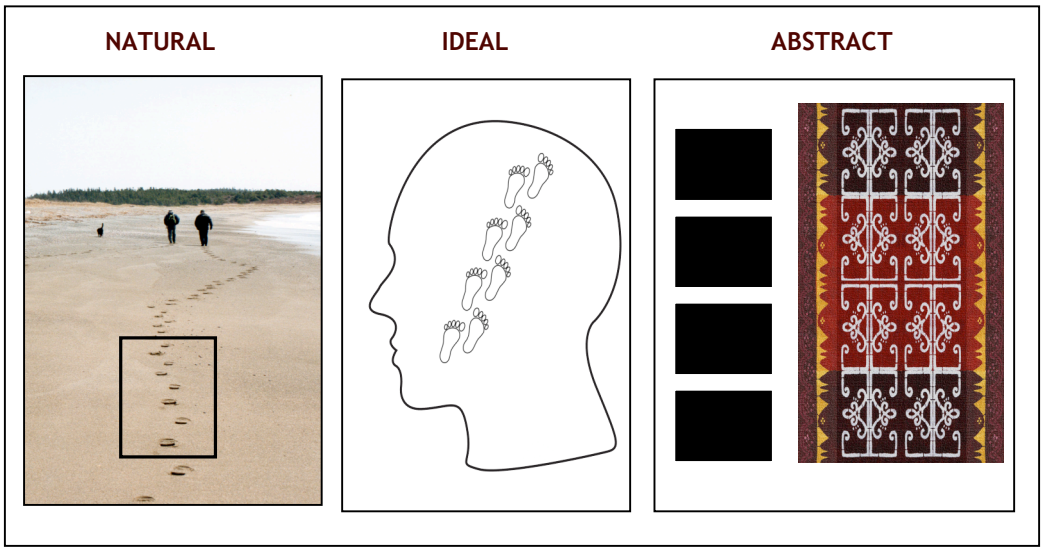

Figure 1. Simple, three piece "Conceptual Framework for Pattern Recognition, Transformation, and Expression" showing natural pattern, ideal pattern, and abstract pattern.

This paper is about the natural pattern of the rising sun on the eastern horizon and how that pattern is transformed to an ideal and then expressed in the abstract pattern of an "X" in a circle, which is also the standard way of depicting the Medicine Wheel.

3) Towards the Pattern of an "X" in the Circle, and This within the Medicine Wheel

Imagine yourself in a natural place. Imagine looking at the horizon, and then turning around while continuing to view the horizon all around you. This creates a circle around you, a bounded spatial context for any place in which you find yourself (Figure 2). As you additionally recognize the cardinal directions (east, west, north, south) in relation to yourself, or "orient" yourself, you can make your understandings into an ideal "+" in a circle, with you at the centre of the "+". Overall, this pattern can be said to represent the recognition of spatial relationships between yourself and your environment, or your orientation (i.e. sense of place) within a natural landscape.

More complexly, an "X" in a circle (rather than a "+" in a circle) is a way for you to relate to that landscape or place over time, particularly natural, i.e. cyclical time. This "X" in a circle is an ideal of the natural pattern of the rising and setting sun over the course of one year. It represents recognized relationships between yourself and your spatial context (sense of place) enriched by your sense of cyclical time as bounded by one solar year.

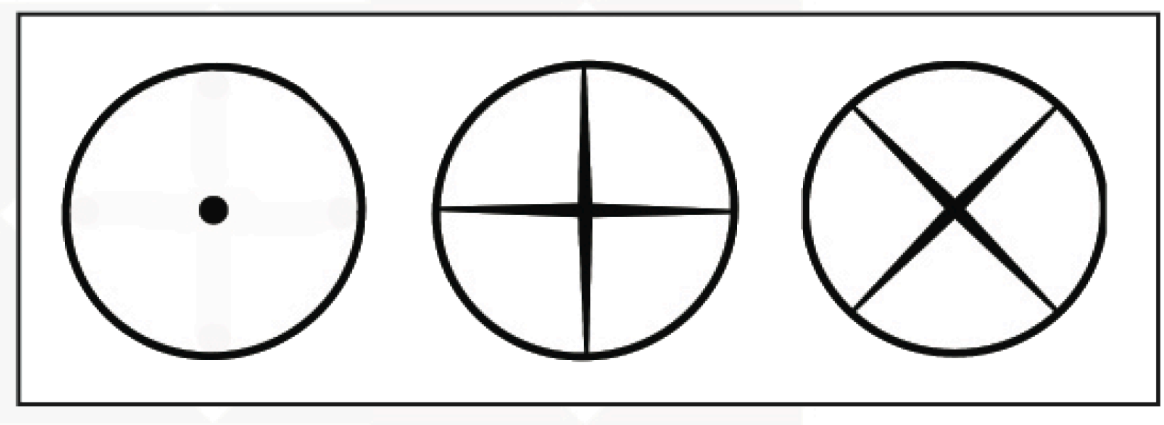

Figure 2. The relationships of self with place and cyclical time. The dot in circle represents self in place, the "+" in circle represents self in place within the four cardinal directions, and the "x" in circle represents self in place within cyclical time.

Let me explain further … if you were to stand facing east, you would see the sun rise in the morning (with "sun rise" used herein to denote "pop up spot" for the sun on the eastern horizon). However, the sun rises exactly due east on only two mornings of the year: spring equinox and fall equinox. Every other morning of the year it rises to the north or to the south of due east.[1]

On the morning of spring equinox, the sun pops up on the horizon at due east. The morning after, it rises slightly north of east, and the morning after that, it rises further north and so on until the morning of the summer solstice when the sun rises at its northern-most position on the eastern horizon. The morning after summer solstice, the direction of the sun's path is reversed and it rises slightly to the south (of its extreme northern-most position) and so on until the morning of the fall equinox when it again rises at due east. It then rises to the south of due east until its southern–most position on the morning of winter solstice, and it then reverses to begin the journey back to due east for the morning of spring equinox.

If you were to watch this pattern over the course of one full year starting with the spring equinox, the rising sun's "traveled path" on the horizon is from due east to northeast (summer solstice) to due east (fall equinox) to southeast (winter solstice) and back again to due east (spring equinox) (see Figures 3 and 4).

[1] We acknowledge that the position of the sun does not change but rather that it is the earth's position in orbit around the sun that is constantly changing. This, plus the earth's tilt on its axis, makes it appear to the observer on earth that the sun rises in a different location each day. Furthermore, in acknowledging this, we wish to emphasize the fundamental role played by the observer in the observation, the learner in the learning, and the knower in the knowing.

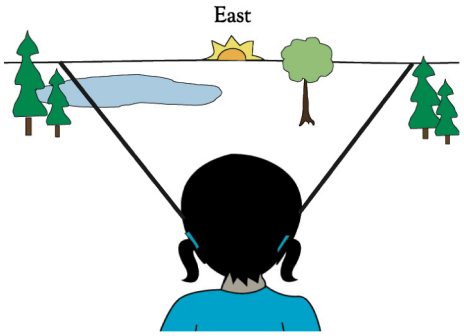

Figure 3. The observer's view of the rising sun on the eastern horizon and this as a pattern over one full year. Due east is marked by the sun rise at equinox (either spring or fall). The observer's V marks the extremes noted in the sun's path at the solstices (extreme left marks northeast at summer solstice, extreme right marks southeast at winter solstice).

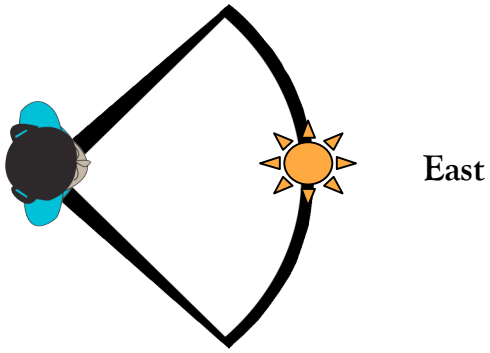

Figure 4. Re-representation of Figure 3 looking down on the observer's head, with the eastern horizon indicated as an arc (corresponding to the arc on the right hand of the ideal "X" in a circle).

The pattern formed by the shifting sun rise position ("pop up spot") on the eastern horizon is reciprocated on the western horizon as the sun sets. Therefore, when the sun rises at its northern-most position on the eastern horizon (summer solstice), it sets at its northern-most position on the western horizon. Similarly, when the sun rises at its southern-most position on the eastern horizon (winter solstice), it sets at its southern-most position on the western horizon. Thus is completed the other side of the "X" within the circle (Figure 5). Finally, at the equinoxes the sun rises due east and sets due west.

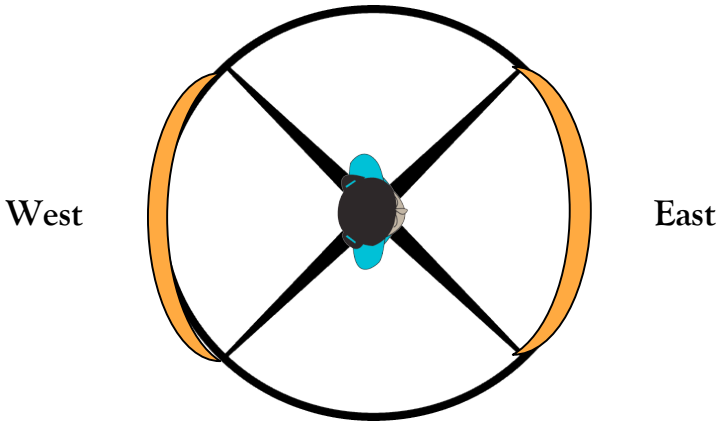

Figure 5. View from above of the pattern of the rising and setting sun on the eastern and western horizons, respectively, over the course of one year.

This "X" in a circle is an ideal pattern for the natural pattern of the rising sun. It is ideal because the observer (you or I) can recognize the cyclical pattern of the sun's movement over one full year and can transform this to an ideal pattern ("X" in a circle, with four equally sized quadrants).

Ideal pattern is not necessarily a precise representation of natural pattern. For example, depending on the exact latitude of one's location, the sun at the summer solstice may or may not rise due northeast (where "due northeast" means at the midway point between the right angle of due north and due east of the cardinal directions of the "+" in the circle), or similarly at due southeast at the winter solstice. Thus, depending on your place, the shape of the ideal "X" will vary as you try to make "ideal" more closely reflect "natural".

At Cape Breton University in Sydney, Nova Scotia, Canada, where the latitude is 46°10'N, the sun rise extremes (at the solstices) are very close to northeast and southeast. Thus, the ideal of the "X" defining four equal or "balanced" quadrants within the circle (as in Figure 5) is appropriate.

At a location much further north in Canada the sun's path would define a longer arc on the eastern horizon and the "X" might better be depicted as vertically stretched (Figure 6).

Figure 6. Ideal pattern, with "X" vertically stretched within the circle.

At a location much further south and close to the equator, the sun's path would define a shorter arc on the horizon and the "X" might better be depicted as horizontally stretched (Figure 7).

Figure 7. Ideal pattern, with "X" horizontally stretched within the circle.

Regardless of location, however, the ideal pattern of these X's could still be the "balanced" version (i.e. four equal quadrants of Figures 5 or 8) in an effort to represent the reciprocal pattern of the rising and setting sun that you, the observer, would still recognize.

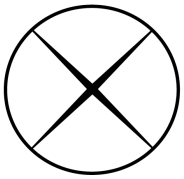

Figure 8. Ideal pattern, with "X" creating four equal quadrants, i.e. a balanced "X" in the circle.

The key central position within the pattern conceptual framework for the ideal pattern, i.e. for the "internalized and transformed" natural pattern, highlights and emphasizes the role of the observer, i.e. the role of agency, of knower in the knowing.

Now, let us return to the pattern conceptual framework and move beyond recognition (natural) and transformation (ideal) to expression (abstract), still using the rising sun as the natural pattern and the ideal of the balanced "X" in a circle[2]. You, as the observer, can, depending on your cultural and/or personal values and inclinations, move your pattern understanding out from your head-mind where it is ideal pattern and express it as abstract pattern.

[2] There are many ways to show the ideal pattern of the rising sun; this is one way that we have represented it, as a way to help explore the patterns and the "balance, wholeness, and change" teachings of the Medicine Wheel.

Figure 9. First Nations' Medicine Wheel

The Medicine Wheel (Figure 9) is a widely-used First Nations' teaching and learning tool that helps express wholeness, balance and change. The Mi'kmaq Nation of Eastern North America has accepted it as a modern means of expressing traditional Mi'kmaq teachings, and it can also be used to foster learning about place. As previously explained, the centre represents the self within a circle of place, the "+" represents the four directions and the relationships of self with place, and the "X" represents relationship of self with place over cyclical time. The Medicine Wheel of Figure 9 is enriched with the Four Sacred Colours relevant to the Mi'kmaq people plus shells and feathers of organisms indigenous to Mi'kma'ki.

The symbol of an "X" in a circle is not unique to any one culture or to North America. If we interpret the symbol as representative of the pattern of the rising sun, we will readily understand that the sun rises all over the world. Thus, if we wish, we might also choose to interpret use of the "X" in a circle by other peoples and cultures as abstract representations of the sun's natural pattern while seeing variation due to cultural values. For example, an "X" in a circle can be seen within Persian rugs, Chinese pottery, Tibetan mandalas, East Indian wheels, Chinese pottery, etc. The ideal within the abstract pattern could be interpreted as a representation of the same natural patterns, reflecting an individual's (the observer's) or culture's relationship with environment (i.e. place).

4) Fostering of Learners' Sense of Place, Emergence and Participation

This paper is based on an activity from a first year course in the Integrative Science Program at Cape Breton University. It is meant to foster learners' sense of place, both physically (through orienting themselves in their environment by observing natural patterns) and culturally (by recognizing how they perceive and express patterns in and from their place). By learning how values influence pattern recognition, transformation, and expression, observers recognize their agency as observers and learners recognize their agency in learning, making these understandings much richer than mere information about a location. Mi'kmaq Elder Murdena Marshall of Eskasoni First Nation maintains that personal understanding about a place also embeds "emergence" and "participation" to yield "sense of place, emergence, and participation". She says "When you know your place, you know where you are, you know who you are, and you know your potential". This fuller understanding (and not just "sense of place" as in much current literature in environmental studies) is applicable to all relational concepts (not just those of land and sky), leading to a creative learner who is better able to participate mindfully in his or her own learning, as well as knowledge creation and application, and also make the journey into greater knowledge inclusivity such as that required in bringing together Indigenous and Western scientific world views.