



2019 HAWAII UNIVERSITY INTERNATIONAL CONFERENCES

SCIENCE, TECHNOLOGY & ENGINEERING, ARTS, MATHEMATICS & EDUCATION JUNE 5 - 7, 2019

HAWAII PRINCE HOTEL WAIKIKI, HONOLULU, HAWAII

# INDIGENOUS THEMES IN STEAM: CO-CONSTRUCTING IN TEACHER EDUCATION

CAMPBELL, ROBERT ET AL  
OKANAGAN SCHOOL OF EDUCATION  
UNIVERSITY OF BRITISH COLUMBIA  
KELOWNA, BRITISH COLUMBIA  
CANADA

Robert Campbell, PhD  
Wendy Klassen, PhD  
Desiree Marshall-Peer, MA  
Okanagan School of Education  
University of British Columbia  
Kelowna, British Columbia  
Canada

## **Indigenous Themes in STEAM: Co-reflecting and Co-constructing in Teacher Education**

### **Synopsis:**

Instructors at a small university campus in British Columbia, Canada were tasked with developing and delivering a new teacher education course in STEAM (Science, Technology, Engineering, Art, and Math). To align with provincial curriculum mandates and university and faculty strategic plans, the instructors integrated Indigenous themes into the STEAM components. Action research methods were used to evaluate the design of the STEAM course and the Indigenous themes within it. The Indigenous themes are presented and discussed in this paper as well as the overall design, development, and evaluation of the course. A later portion of this study will examine pre-service teacher candidates' perceptions of the inclusion of Indigenous themes and instructional strategies into the STEAM block.

## Indigenous Themes in STEAM: Co-reflecting and Co-constructing in Teacher Education

Instructors at a university campus in British Columbia, Canada were tasked with developing and delivering a new teacher education course in K-9 STEAM (Science, Technology, Engineering, Art, and Math). As the instructors considered the design of this course, they very much wanted to frame the course with an inclusive consideration of Indigenous knowledge and Indigenous pedagogy. The instructors were highly aware of the international and national initiatives, provincial curriculum recommendations, as well as their own institution's strategic plans and policies that made the inclusion of Indigenous knowledge and Indigenous pedagogies important elements in their university's curriculum. The instructors wanted to Indigenize this course, and they decided that the best way to do this would be by developing content thematic lessons or themed activities that were based upon Indigenous knowledge and Indigenous pedagogy. As the instructors undertook the design of the course they were committed to ensuring that these Indigenous themes would not just be structured as course add-ons, but would be integral to the overall course content and course objectives.

This study presented here provides a background to the creation of this STEAM course by examining the cultural initiatives, curricular contexts, and policy frameworks that helped initiate the Indigenization of the course. Using action research methods, the study also explores how the course was designed and the steps taken by the instructors to develop and implement the course.

Overall, the study addresses the following research question: How can a teacher education course in STEAM be designed so that Indigenous knowledge and Indigenous pedagogy are included in the course content?

### **Background**

There has been an awakening in Canada, and globally as well, shaping new paradigms of respect and understanding of Indigenous peoples and their cultures. These new paradigms are presented in government policies, cultural recommendations, and institutional initiatives that are inclusive of Indigenous cultures and also acknowledge Indigenous knowledge and pedagogy. The instructors designing the STEAM course were intent that the course would reflect these paradigms, would align with initiatives and policies, and would honour recommendations for including Indigenous knowledge and pedagogy.

A foundational document that establishes a new global paradigm for Indigenous peoples is the *United Nations Declaration on the Rights of Indigenous Peoples* (2007). This declaration acknowledges the marginalization, oppression, and exploitation suffered by indigenous peoples. It also defines and delineates Indigenous peoples' rights to cultural and ceremonial expression, identity, language, employment, health, and education (2007).

Emerging respect and regard for Indigenous peoples in the Canadian context is driven by a Canadian federal government apology to Indigenous peoples for atrocities committed against children in Indian Residential Schools. A formal statement was

issued from the federal government in 2008 apologizing for the forced and institutionalized assimilation of the Indian Residential Schools. This was followed by the establishment of the Truth and Reconciliation Commission of Canada, with a mandate of providing “an overall holistic and comprehensive response to the Indian Residential School legacy” (2015). The Truth and Reconciliation Commission issued a final report in 2015 which contained 94 calls to action. An entire section of the report is devoted to Education and it recommends parallel funding for First Nations children, improving levels of success rates, enabling parental and community responsibility, as well as developing culturally appropriate curricula for First Nations’ children (2015).

Within Canada, provincial governments and ministries have taken steps to Indigenous provincial K-12 curricula offerings. The province of British Columbia’s Ministry of Education was in a unique position to do this since it recently revamped the entire K-12 curriculum. Curriculum developers in British Columbia were, thus, able to incorporate Indigenous content and pedagogy into all curriculum areas in an organized and coordinated manner. This resulted in a provincial K-12 curriculum that promotes the study of core competencies (Communication, Thinking, and Personal and Social), and also emphasizes the inclusion of indigenous culture, history, and perspectives (British Columbia Ministry of Education, 2015.).

An additional document published by the British Columbia Ministry of Education that is pertinent to the study presented here is *Aboriginal Worldviews and Perspectives in the Classroom: Moving Forward* (2015). This paper provides a vision for Indigenous Education in British Columbia and it incorporates Aboriginal perspectives and

worldviews and includes sections on responsive learning and also presents indicators of success for systems, as well as indicators of success for students.

In addition to a newly revised provincial curriculum an important document published by the First Nations Education Steering Committee (FNESC) that guides Indigenous education in British Columbia is *The First Peoples Principles of Learning* (FNESC, 2008). This document outlines nine fundamental elements that support the well-being of the self, the family, the community, the land, the spirits, and the ancestors. The document also promotes reflective, experiential, and relational learning, focusing upon connectedness, reciprocal relationships, identity, and a sense of place.

The nine principles are presented here:

- Learning ultimately supports the well-being of the self, the family, the community, the land, the spirits, and the ancestors.
- Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place).
- Learning involves recognizing the consequences of one's actions.
- Learning involves generational roles and responsibilities.
- Learning recognizes the role of indigenous knowledge.
- Learning is embedded in memory, history, and story.
- Learning involves patience and time.
- Learning requires exploration of one's identity.
- Learning involves recognizing that some knowledge is sacred and only shared with permission and/or in certain situations. (FNESC, 2008)

In addition to ministry and documents by Indigenous peoples there are also institutional recommendations that have guided the development of the STEAM course. The goals of the University of British Columbia's strategic plan recommend that the University "build a diverse culture that integrates themes of innovation collaboration and inclusion and infuses them in all our activities" (UBC, 2018). Another goal advocates that UBC "partner with Indigenous communities on and off campus to address the legacy of colonialism and to co-develop knowledge and relationships" (UBC, 2018).

### **Methods**

It is with these recommendations, initiatives, and goals in mind that the instructors set about to design the STEAM course in such a way that it would include Indigenous themes. Six months prior to the start of the course, the instructors began a series of six planning meetings in which they determined course objectives, course content, the instructional strategies, the assignments, and assessment methods for the course.

At the first planning meeting, to ensure that the STEAM course was designed and developed in an effective and reliable way, the instructors decided to use action research methods as they co-constructed the course. This allowed the instructors to design, develop, implement, and evaluate the STEAM course and the Indigenous themes within it, ensuring that decisions made and directions taken were collaborative, well-founded, and documented. An eight-stage model derived from Cohen (2007) was

selected as the action research process the instructors would follow. Cohen's (2007) action research methods are used to chronicle, document, and evaluate the design, development, and implementation of the course. The first five stages comprise this part of the inquiry. Stages six, seven and eight will be examined in a future related study.

Cohen's (2007) action research stages are as follows;

- Stage 1. Determine the problems or needs.
- Stage 2. Identify some causes of the problem or need.
- Stage 3. Brainstorm a range of possible practical solutions.
- Stage 4. Decide solutions to the problems.
- Stage 5. Identify criteria for evaluation.
- Stage 6. Put plan into action: monitor, adjust and evaluate what is taking place.
- Stage 7. Evaluate the outcome
- Stage 8. Review and plan in light of the evaluation.

The instructors' planning meetings followed Cohen's (2007) action research stages, which allowed the instructors to chronicle the initial design phases, through to the implementation stage and the delivery of the STEAM course. During these meetings the instructors divided the work between specific STEAM areas and outlined lessons and activities that could serve as themes to carry Indigenous knowledge and content. At each planning meeting the instructors reviewed, edited, and revised previous iterations of the course. This systematically enabled the instructors to brainstorm a range of Indigenous themes that could be effectively included in the

course, and set forth a plan to assess the effectiveness of their design, development, implementation; so that the course, and the Indigenous themes included in it, could be further developed and refined when the course is offered again in the future.

Throughout the development of the STEAM course the instructors worked in consultation with Indigenous educators and coordinators from the local school districts that are within catchment area of the university campus.

### **Data Sources**

The STEAM course instructors relied on discourse and notes from course planning meetings, collaborative discussions, as well as field notes documenting the effectiveness of the thematic units. Additionally, data from student course evaluations were used to determine the strengths of the STEAM course and to highlight any perceived areas where improvements can be made.

### **Results**

The action research stages led the instructors to develop the STEAM course for teacher candidates with the following thematic lessons and activities that include Indigenous content and pedagogy:

#### ***1. Theme: Indigenous Arts and Culture***

##### *Local Art Gallery and Museum Visit (Drama and Visual Art)*

The timing of the course permitted the students to visit the local art gallery and heritage museum which had opened a special joint exhibit of children's art from the Inkameep

Day School from 1931 to 1942. It was very unusual at this time for a government school to operate in this way, but the tenets of this school honoured the children's Indigenous life, culture, and narratives in both visual art and drama. This activity in the STEAM course is specifically an Art activity; however, it presented a unique opportunity to introduce the teacher candidates enrolled in the STEAM class with an Art experience that showcased the lives and work of Indigenous children. It also allowed the teacher candidates to see pedagogy at work that was culturally respectful in era where the standard education of Indigenous children was implemented through Indian residential schooling and was done through forceful assimilation. The teacher candidates were also able to participate in a hands-on painting activity in which they focused on Indigenous language and the uses of local plants.

## **2. Theme; Flora and Fauna**

*Dis/Re-covering Indigenous Species WebQuest (Math, Science, Technology, and Visual Art)*

This activity focused on the biodiversity of natural spaces that surround the university campus. Students played various roles as part of a bio-inventory research team that assesses Indigenous species in a small undeveloped area of the campus. Using online software the team creates a web-site that list Indigenous flora and fauna in that area of campus. The intent is to find Indigenous species that grow on campus so that they can be reintroduced any time building and physical development of the campus disturbs natural habitat.

### **3. Theme: Cosmology and Celestial Skies**

#### *Indigenous Skies (Math and Science)*

This was scheduled as an evening class on cosmology and celestial skies. It provided teacher candidates with an Indigenous perspective of constellations and creation myths presented by a school district Indigenous coordinator. This was followed by local members of the Royal Astronomical Society of Canada's presentation of the cosmos and an outdoors telescope activity viewing stars, planets, and galaxies. The theme of Indigenous perspectives of celestial objects was also undertaken in trip to a science centre where Indigenous cosmology was displayed and discussed in a planetarium setting.

### **4. Theme: The Art of Math**

#### *Birch Bark and Reed Weaving (Math, Science, and Visual Art)*

This activity modeled a lesson for mid-to upper elementary and middle school teaching. Teacher candidates determined weaving designs with warp and weft using birch bark and cattail reeds. The lesson teaches numerical size and length and width of the final product through calculation of width of bark and reeds. The lesson permitted students to design woven squares and other forms and also examine traditional Indigenous plants that can be used to create clothing and household goods. The lesson also allowed for the identification of mathematical patterning.

**5. Theme: Natural Products***Indigenous Plant Paints and Dyes (Science and Visual Art)*

This place-based learning activity took place in a natural setting on the university campus. Using art paper, the teacher candidates explored Indigenous plants (flowers, leaves, and bark) that could be used to dye materials or paint imagery. These activities led to a discussion of which Indigenous plants could be used for medicinal purposes as well.

**6. Theme: Indigenous Arts and Culture***Showcasing Indigenous Artists with Infographics (Art and Technology)*

This activity allows teacher candidates to become familiar with the lives and work of Indigenous artists. The biographical portion of the assignment often leads to important discussions of race, poverty, and discrimination. The teacher candidates worked in teams of two or three and, using print or on-line resources, explored the work of artists who identify as Indigenous. Then, using online software, the teacher candidates created an infographic about one selected artist showing examples of that artist's work along with a brief biography of the artist. The infographics were presented to the entire class.

**7. Theme: Indigenous Arts and Culture***Okanagan Bundles Activity (Visual Arts, Language Arts, and Science)*

Members of the Sylix Okanagan nation presented this activity to the teacher candidates enrolled in the STEAM course. The intent of the bundle activity was to provide teacher candidates with an opportunity to familiarize themselves with a natural item of value to the Sylix people, thereby giving them an entry into both Indigenous sciences and traditional ecological knowledge, as well as a sense of place.

### **Educational Importance**

This study examined the ways instructors co-developed the inclusion of Indigenous content and pedagogies into a K-9 STEAM course. This examination provides insight into how curricula can be Indigenized through a range of content areas. This study focused on the development of the STEAM course curricula and followed the first five stages of Cohen's (2007) model of action research. Studying the teacher candidates' perceptions of Indigenizing STEAM will form a future continuation of this study based on stages six, seven, and eight of Cohen's action research model. The study in total will assess the effectiveness of the STEAM curriculum and guide future development of how to effectively include Indigenous content and pedagogies in teacher education. It will also examine how the alternative teaching and learning perspectives identified in the First Peoples Principles of Learning (2008) can serve to support instructional content and strategies.

## References

- British Columbia Ministry of Education (2015). *British Columbia K-12 Curriculum*.  
(2015). Found at <https://curriculum.gov.bc.ca>
- British Columbia Ministry of Education (2015). *Aboriginal education in British Columbia*.  
Found at <https://www2.gov.bc.ca/gov/content/education-training/k-12/aboriginal-education>
- British Columbia Ministry of Education (2015). *Curriculum overview*. Found at  
<https://curriculum.gov.bc.ca/curriculum/overview>
- British Columbia Ministry of Education (2015). *Aboriginal worldviews and perspectives in the classroom: Moving forward*. Found at [https://www2.gov.bc.ca/assets/gov/education/administration/kindergarten-to-grade-12/aboriginal-education/awp\\_moving\\_forward.pdf](https://www2.gov.bc.ca/assets/gov/education/administration/kindergarten-to-grade-12/aboriginal-education/awp_moving_forward.pdf)
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in Education* (6<sup>th</sup> ed.).  
New York: Routledge.
- Walsh, A. (Ed.) (2005). *Nk'Mip chronicles: Art for the Inkameep Day School*.  
Osoyoos, BC: Osoyoos Museum Society and Osoyoos Indian Band:
- First Nations Education Steering Committee (2008). *First Peoples' Principles of Learning*. Found at <http://www.fnesc.ca/wp/wp-content/uploads/2015/09/PUB-LFP-POSTER-Principles-of-Learning-First-Peoples-poster-11x17.pdf>
- The University of British Columbia (2018). *Shaping UBC's next century: Strategic plan*.  
Retrieved from <https://strategicplan.ubc.ca/wp-content/uploads/2018/04/2018-UBC-Strategic-Plan-Full-20180425.pdf>

The University of British Columbia (2018). *Shaping UBC's next century: Our goals*.

Retrieved from <https://strategicplan.ubc.ca/wp-content/uploads/2018/05>

[/2018\\_Strategic\\_Plan\\_Poster-20180514.pdf](https://strategicplan.ubc.ca/wp-content/uploads/2018/05/2018_Strategic_Plan_Poster-20180514.pdf)