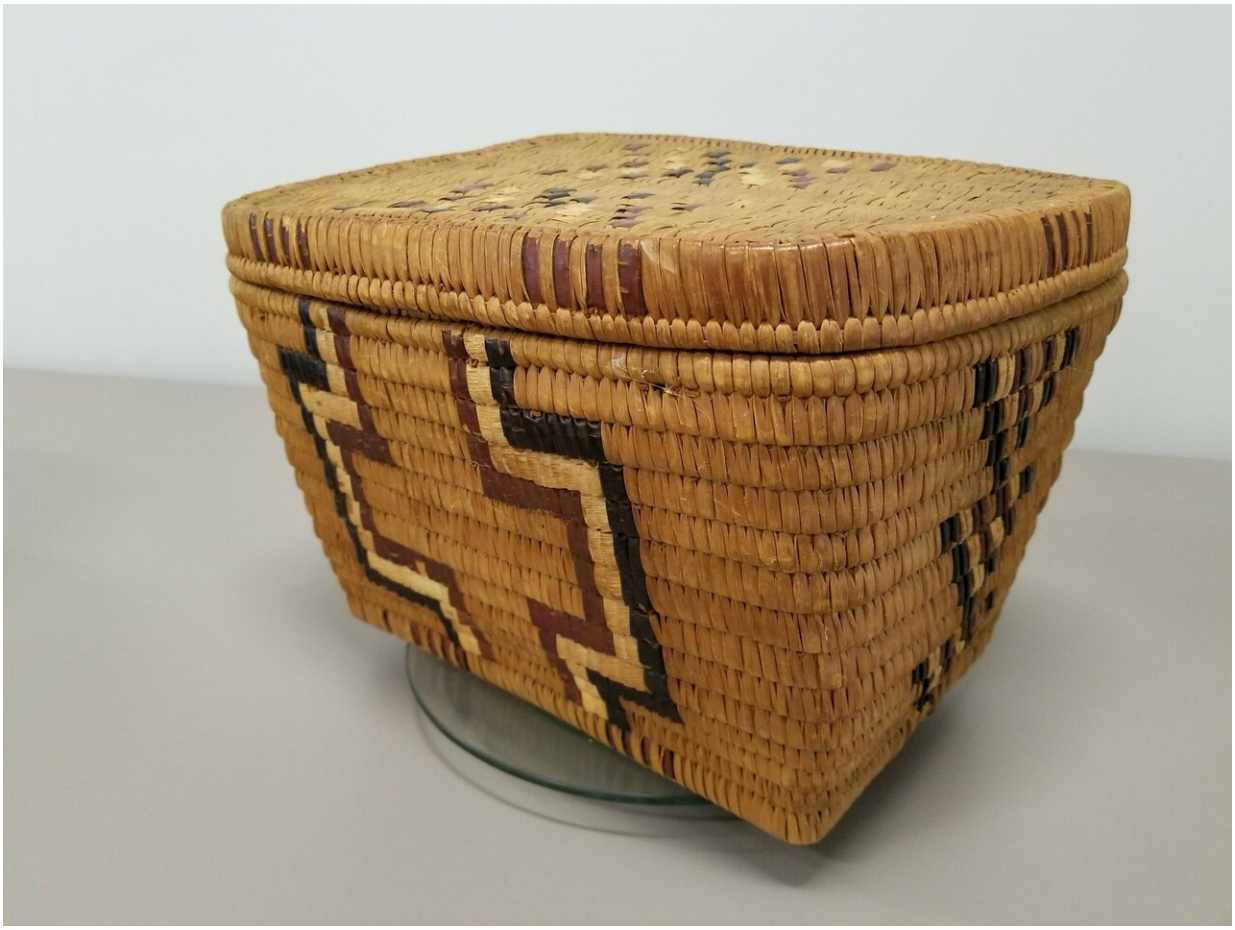
Indigenous basket-weaving makes an excellent digital math lesson

January 24 2019, by Veselin Jungic



Tla'amin Basket. Credit: Alex Sutcliffe, Author provided

Public universities across Canada are committed to addressing the calls

to action included in the final report by the Truth and Reconciliation Commission of Canada (TRC). There is a general expectation that academic institutions and faculty members across the country will contribute to this process.

I have witnessed that many in the mathematical community are finding it a challenge to use their disciplinary expertise to make a meaningful contribution to the reconciliation process.

Community-university collaboration

In what follows, I will briefly describe the Callysto Salish Basket project at Simon Fraser University. This project led to the creation of an interactive online tool that combined basket weaving patterns from the Tla'amin Nation, mathematics, and modern technology. By doing this, I hope to encourage mathematicians in particular and the STEM community in general to build a relationship of trust with their local Indigenous communities.

The Callysto Salish Basket project was built on four pillars: the Tla'amin tradition of basket weaving; the nine-year-long collaboration between the Tla'amin Nation and SFU's Math Catcher Outreach Program; the Callysto project; and the expertise, talents and skills of my colleague Prof. Cedric Chauve and his students Laura Gutierrez-Funderburk, Jenifer Pham and Howell Tan.

Tla'amin mathematical stories

The Tla'amin baskets are examples of functional mathematics and art. Baskets of all shapes and sizes are built with the purpose of packing food, storing goods or even as baby cribs. Building a basket is a small bio-engineering project that requires mathematical thinking and math-related skills. These skills include precise measurement, the creation of

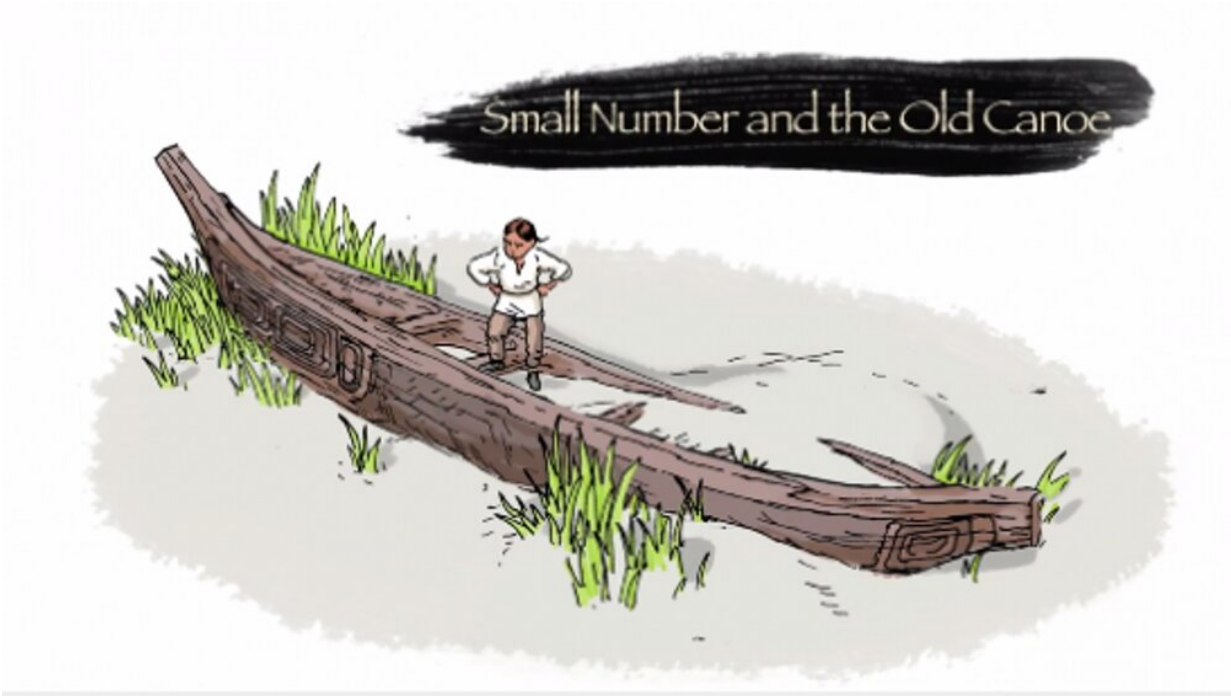
appropriate shapes and adhering to certain well-established patterns.

Needless to say, the baskets are also very beautiful pieces of Indigenous peoples art. In anthropologist Dorothy Kennedy's book Sliammon Life, Sliammon Lands, expert Tla'amin cedar root basket maker Rose Mitchell explains that production of the baskets reached its peak in the late 1800s when Sliammon women learned the art of basketry from Interior Salish women.

Collaboration between SFU and members of the Tla'amin community started in 2010. The first project was the animated film *šɛ nuxʷɛɬ hɛga Mɛnaθey* that uses Tla'amin elder Betty Wilson's narration of the story "Small Number and the Old Canoe." Later, this partnership included the creation of a bilingual picture book, several more films in the Tla'amin language, school visits and community events on the Tla'amin traditional territory, joint conference presentations, and other projects.

Digital classroom learning

Callysto is a multimodal learning platform available to grades 5-12 students across Canada at no charge. It was launched in fall 2017 by the Pacific Institute for Mathematical Sciences (PIMS) and Cybera, an Alberta-based digital infrastructure non-profit organization. The Callysto program lists as its main goal "help[ing] young learners complete high school with the fundamental skills —computational and design thinking —required to be able to tackle any challenge they might face." The funding was provided by the Canadian federal government through the CanCode program.



‘Small Number and the Old Canoe,’ written by Veselin Jungic and Mark MacLean and illustrated by Simon Roy, is a mathematics story featuring a young boy called Small Number. Credit: Simon Roy

Still, the real starting point for the project was Chauve's and my shared wish to create a learning resource that would be an application based on the mathematical patterns in the traditional Tla'amin basketry. Instrumental was Chauve's willingness to assemble, lead and supervise a group of undergraduate students majoring in mathematics as part of the Callysto program.

Digitizing tradition

In May 2018, Chauve and myself were invited to visit Tla'amin and meet with a group of the community members to discuss our collaboration on the project of creating an interactive visualization of the traditional

basket designs. After hearing about our idea and asking a series of questions, our Tla'amin hosts generously shared with us part of their history. We were taken to another room to see a collection of baskets, some of them more than 100 years old. It was one of those very special moments in life: on the one side there was a group of Tla'amin people proudly showing the art and talent of their ancestors and on the other side were two mathematicians humbled by the beauty of the displayed artifacts and the trust of their hosts.

With the approval of Hegus Clint Williams, the leader of the Tla'amin community, our project was ready to take off.

Fast forward, several months later, Chauve's group completed the creation of two Jupyter notebook online applications inspired by Tla'amin basketry.

Using Jupyter Notebooks, an open-source web tool to create and share documents, we created shareable documents that contain narrative text and interactive visualizations. The Jupyter Notebooks allow users to view the results of executing a program —such as a visualization animation or tabular data produced by some calculation —immediately beside the program's code. These notebooks create full transparency, enabling users to inspect the code for accuracy or further their understanding of the algorithms and techniques that underpin the program. In general, users can change the code to make the program suit their needs or to confirm their understanding of the code's inner workings.

The building blocks of the interactive visualizations contained in the two notebooks were the three basic patterns, that we call atomic motifs: Broken Line, Triangle, Diagonal Lines and seven operations with the atomic motifs: Vertical and Horizontal Flip, Vertical and Horizontal Reflection, and Vertical, Horizontal and Diagonal Stack.

Creating, combining and editing motifs

The first notebook, called Atomic Motifs, allows the user to create and save a desirable pattern by choosing a motif and adjusting its parameters like height and the number of colours.

The second notebook allows the user to combine and edit motifs to create three-dimensional decorated basket models. The final design may contain patterns obtained by manipulating different atomic motifs. Several designs are pre-loaded for the user's convenience.

The main goal of our project is to provide students and teachers a multidisciplinary learning resource that may be used at different levels of instruction. At the same time, and equally important, we wish to share with the academic and non-academic community our belief that incorporating elements of Indigenous cultures and traditions in Canadian classrooms must be done in collaboration with the Indigenous community and with mutual respect. In addition, with this project we wish to promote the Callysto program and the use of the Jupyter notebooks as a powerful tool in creation learning resources and a learning resource itself.

Provided by The Conversation

digital-math.html