



CULTURAL COLLISIONS: EXPLORING THE NEXUS FOR STUDENT LEARNING WHEN THE ARTS AND SCIENCES COLLIDE



System Planning
Research and
Innovation Division

Evidence
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INNOVATION
DESIGN &
IMPLEMENTATION



Ontario

Introduction

Cultural Collisions by Origin - Canada was an innovative, interdisciplinary experience for teachers and students to explore the possibilities for learning when the arts and sciences were integrated. As a means of reconceptualizing traditional models of disciplinary education, Cultural Collisions allowed for the infusion of multiple perspectives between the arts and science in order to create an environment where thinking and learning became about melding perspectives, strategies, tools and skills in order to see the science in and of art and the art in science.



PURPOSE

The purpose of this report is to articulate the drivers behind Cultural Collisions, describe the program and reflect on its impact.

Diversity of voice and perspective create the conditions for rich thinking and learning. Disciplines in STEM fields such as physics and engineering continue to struggle with increasing diversity and inclusion. In order to encourage underrepresented student groups to consider science, technology, engineering and applied math (STEM) career pathways, and to help foster a more STEM adept society, Cultural Collisions wanted to provide opportunities for learning that:

- (i) demystified STEM subjects
- (ii) provided experiences that were inclusive, authentic and connected to the lived realities around students.

Students must be inspired to wonder and ask questions. A goal of this project was to provide students the opportunity to take learning from a variety of subjects and apply them into new contexts, in an integrated way, while developing transferable skills that would enable them to solve complex problems.

Guiding Question

The Cultural Collisions project wanted to explore the possibilities that a problem-based, cross-curricular, experiential STEM and Arts learning project, aimed at improving attitudes and perceptions about STEM post-secondary pathways, could hold for students in the intermediate and senior grades. The following guiding question framed the thinking for this project:

Do STEM-Arts partnerships spark interest and engagement in STEM fields for students who were not initially interested, nor saw themselves in STEM fields?

CULTURAL COLLISIONS PROGRAM



ORIGIN Physics is a global network of scientific institutions and network facilities focused on astrophysics and high energy physics experiments and research centres. ORIGIN physics was created in order for global physics research institutions to come together to co-create the exhibit and workshop experience for the Cultural Collisions program in Canada.



The Ontario Science Centre is a global leader in lifelong learning with a mission to inspire passion for the human adventure of discover. The Ontario Science Centre supported and hosted the learning and exhibits (of both presenter and student) for the Cultural Collisions Project



The Innovation, Design and Implementation Team is an Ontario Ministry of Education team dedicated to the promotion, support and catalyzation of innovation across Ontario. IDI developed, facilitated and consulted on the creation and implementation of the Cultural Collisions Project as well as conducted the research on the project in order to test for efficacy and scale-ability.

International and Local Artists - a partnering of artists coming together to share their work through the development of workshops and exhibits which galvanized the possibilities for learning and creation when art and science collide!

Program Design

222 intermediate and senior students from 3 (2 public and 1 private) schools in the Greater Toronto Area of Ontario, Canada, were invited to a STEM-Arts learning opportunity in the form of a 2-day program at the Ontario Science Centre. Upon completion of the program students would then create their own science-art projects for a later planned exhibit at the Ontario Science Centre.

The 2-day program consisted of students experiencing 20 minute art and physics lectures, exhibits and 60 minute workshops on topics such as Building a Cloud Chamber, Science Through Rap (Music), Accelerating Colors, Listening to Einstein's Universe, and What Keeps Us Stuck to the Ground?. The aim of the Cultural Collisions 2-day program was for students to learn about topics spanning particle physics to cosmology and explore concepts through creativity and artistic expression.

Students then applied their learning to the creation of their own 'sci-art' installations in order to communicate what they had learned. Once complete, these creations were curated in an exhibition hosted at the Ontario Science Centre and shared with the public.



Curriculum Connections

The Sci-Art learning the students engaged learning which drew from and connected to the curriculum strands of:

Biology

Chemistry

Communications Technology

Computer Science

Construction Technology

Dance

English

Integrated Arts

Intermediate Math

Intermediate Science

Manufacturing Technology

Media Arts

Music

Physics

Senior Maths

Visual Art

Technology Design

SKILL DEVELOPMENT

More central to the project than the curricula itself was the attention paid to the development of key skill sets necessary for modern learning, irrespective of pathway or discipline. Skills developed during the workshops and the development of their art installations included the:

Creative Process

Critical Analysis Process

Design Process

Technological Problem Solving

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Workshops Offered

What Keeps Us Stuck to the Earth?

Perimeter Institute for Theoretical Physics

We all experience gravity every day, but do we truly understand how it works? Newton pictured gravity as an invisible force, while Einstein thought of it as the curving of spacetime. How do we know which model to use? In this workshop -- using only masking tape and beach balls -- we will gain a better understanding of gravity and see how Einstein's model can be verified by real-world technologies such as GPS.

Playing with Data

CMS - CERN

Collisions don't only happen with cars. CERN's Large Hadron Collider collides protons. The collisions are analyzed both visually and statistically. In this session, participants will use visualisation software to learn about particle collisions and how physicists analyse them in experiments like CMS. They will select aspects of individual collision events and conduct a simple exploration of particle properties.

Building a Cloud Chamber

CMS-CERN

In this hands-on session, students are introduced to cosmic rays and particle detectors. Students assemble a real particle detector -- a "Cloud Chamber" -- and observe the tracks of cosmic particles that are made visible by the chamber.

Listening to Einstein's Universe

LIGO

The faint cosmic whispers detected by LIGO can be represented as "chirp-like" patterns of sound, which helps us to understand the amazing technological challenge of detecting them above the constant "noise" from other sources of disturbance -- from the LIGO instruments and their surrounding environment. In this workshop we will use some interactive demonstrations to explore the science behind detecting gravitational waves that lets us listen to Einstein's Universe.

Accelerating Colours

Art@CMS - CERN

Where does science end and art begin? How much art is in scientific expression? And how can we use colour to see the relationship between the two? The Accelerating Colours Workshop teaches participants about energy and momentum conservation, relative motion, as well as data visualization through the use of particle physics detectors.

Science through Rap

Consensus

Hear from a professional rapper from the UK who has created several science raps on particle physics. Learn how he chooses a scientific topic, relates it to everyday life, imagines a storyline around it, and creates lyrics in the rhythm and beat of modern rap music. Then begin creating your own rap, or some other form of creative expression, blending imagination, lyrics and music to communicate the relationship and impact of science on our own lives. Some compositions may be selected to perform during the final exhibition.

Creative data to sound

BEER, University of
Birmingham

Sonification is the act of turning data into sound. In this workshop, we will use common household items as well as large particle physics detectors to conduct experiments that generate random data. We will then map this data to musical notes and create musical compositions.

Experiments with Art and Particle Physics

Art@CMS - CERN

Students will be presented with a variety of apparatuses used in particle physics experiments and create artworks with them. Via hands-on exercises, students will engage with aspects of the devices used in particle physics experiments, in ways that are both playful and critical.

STUDENT AND TEACHER 'FEED FORWARD' ON CULTURAL COLLISIONS

Based on feedback provided by participants in the Cultural Collisions project, overwhelmingly, students and teachers enjoyed participating in the experience. Engagement was demonstrated through their active participation in the workshops, lectures and exhibits, and in their commitment to exploring ideas and extending the experience into the classroom while creating their sci-art projects.

In describing the learning sessions, students most often used the adjective "fun", seconded by "informative" to share their immediate thoughts on the program. Students reported finding the experience "practical" and "interactive" relative to their daily schooling experiences. Such feedback indicates that students found the learning meaningful and engaging in that it differed positively to their daily school experiences in science.

Responses such as "This experience was better, more interactive, more developed/going deeper than school activities" and "This was more practical, more interactive [than school], Training from scientists seems more real, more credible" speaks to the success of the project meeting a goal of providing an authentic and realistic experience.

"On avait vu un atelier au Centre des sciences où on pouvait manipuler les explosions - voir le trajet de chaque particule on pouvait voir le trajet, c'était un peu comme une fleur, des graphiques qu'on pouvait manipuler sur des tablettes..."

"...le matériel qu'on avait. On voulait vraiment juste pouvoir représenter comme le mouvement. On avait d'autres idées avant, c'était plus comme la collision après, mais le mobile, on pense que ça va mieux montrer la collision pendant parce que les particules vont se toucher."

Breaking Down Barriers

Teachers were also pleased to express their uttermost admiration for what the Cultural Collisions project aimed to accomplish, as it held the ability to help students unpack the biases students may have had in regards to science learning.

“The Arts and Cultural Collisions project has been really good at breaking down barriers for our kids unconscious biases and assumptions they have in their head about what is science and what is art. I think it has been really good at helping them look at scientist as human beings to perform and act in society, just like how they see artists responding to question from society. Seeing that parallel has been really helpful.”

“J'ai adoré. Ça m'a ouvert les yeux, je ne savais pas c'était quoi CERN. Je ne savais pas ce qu'ils faisaient, J'ai appris énormément. Je pense que les élèves ont une chance inusitée de vivre ça. D'ouvrir leur horizon, voir plus grand que seulement leur école. Même si on a accès, à travers, ça leur donne des pistes de découverte.”

Collaboration between teachers and professionals of a variety of disciplines also allowed for professional learning beyond our own training. A local artist who participated in this project was asked, "As-tu déjà eu à expliquer un concept scientifique au-travers des arts?"

She stated,

"JAMAIS. J'ai aussi appris beaucoup à travers de ce projet là. Je trouve ça super intéressant Dans mes créations, je pourrais inclure cette pensée-là."

A teacher voiced the gap in course calendars, as science and art are usually separate which could contribute to the biases around science and art. But, is hopeful in the Cultural Collisions project and its aim to transform student's thinking,

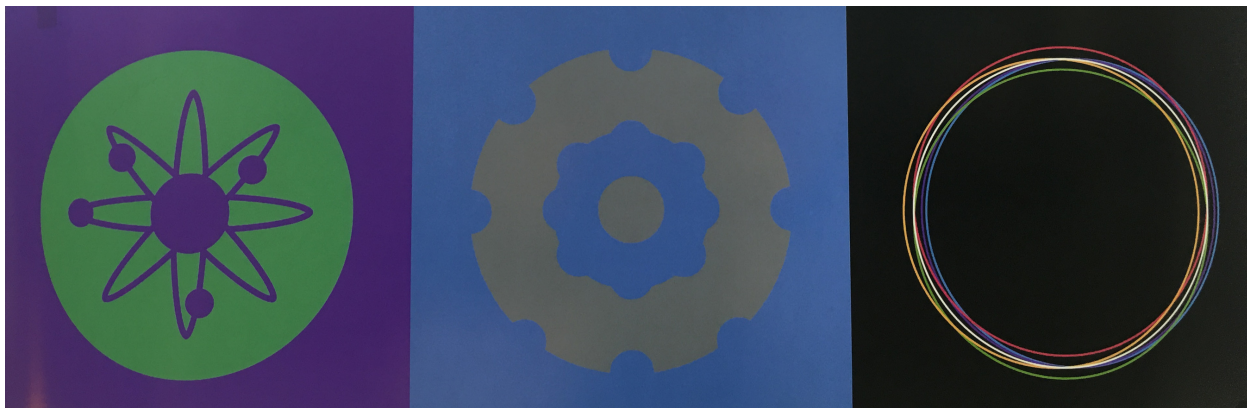
"So seeing these parallels and seeing that there is not much of a gap, as it appears when you look at it under a course calendar, when you see all the art courses under visual arts or music and all the science courses under science, and I think that's a real helps as it breaks down boundaries that exists in the real world but also kids' minds. We are trying to transform kids to see that there is a world that they can look at from different lenses. It's been a wonderful journey, it's also pushed kids to go beyond what they feel is comfortable."

CONCLUSIONS

The responses above demonstrate that there is a clear and necessary role for cross-curricular integration of subject specific content as a means of supporting student engagement and learning. Participants of the Cultural Collisions project gained and changed perspectives about the possibilities for understanding and knowledge acquisition when presented with learning in integrated and immersive ways.

Students were easily able to demonstrate their knowledge by providing in-depth explanations of concepts using specific terminology and definitions. Making connections to personal experiences and real-world realities, using analogies and engaging in inquiry, students were able to clearly demonstrate their learning.

Lastly, student engagement with the Cultural Collisions exhibits and workshops were instrumental in helping inform student learning. Undoubtedly, the findings from this project offer insight into how to innovate for STEM learning and demonstrates the importance of relevant, cross-curricular and integrated STEM education that meets students' interests.



SCALABILITY

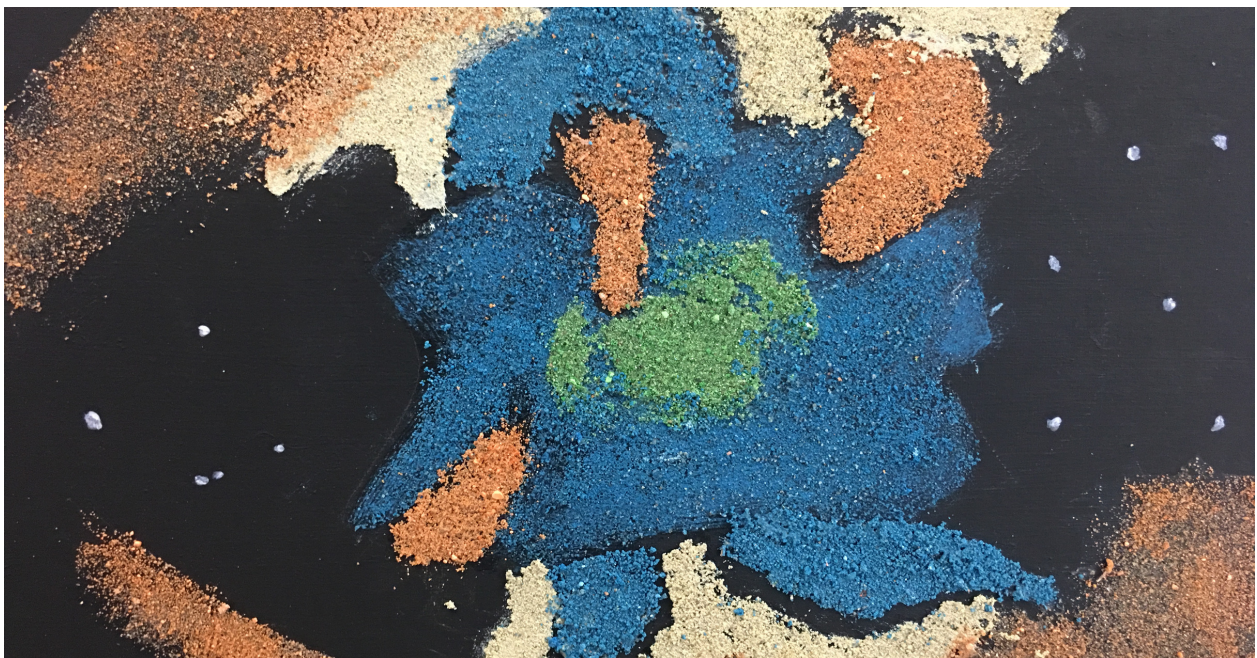
The Cultural Collisions by ORIGIN-Canada project shows great potential for growth. The resources and exhibit content curated for this program has become collaborative property of the Ontario Science Centre, Ontario Ministry of Education and ORIGIN-Canada. There is keen interest from collaborators, educators and students to continue and expand Cultural Collision by ORIGIN-Canada.

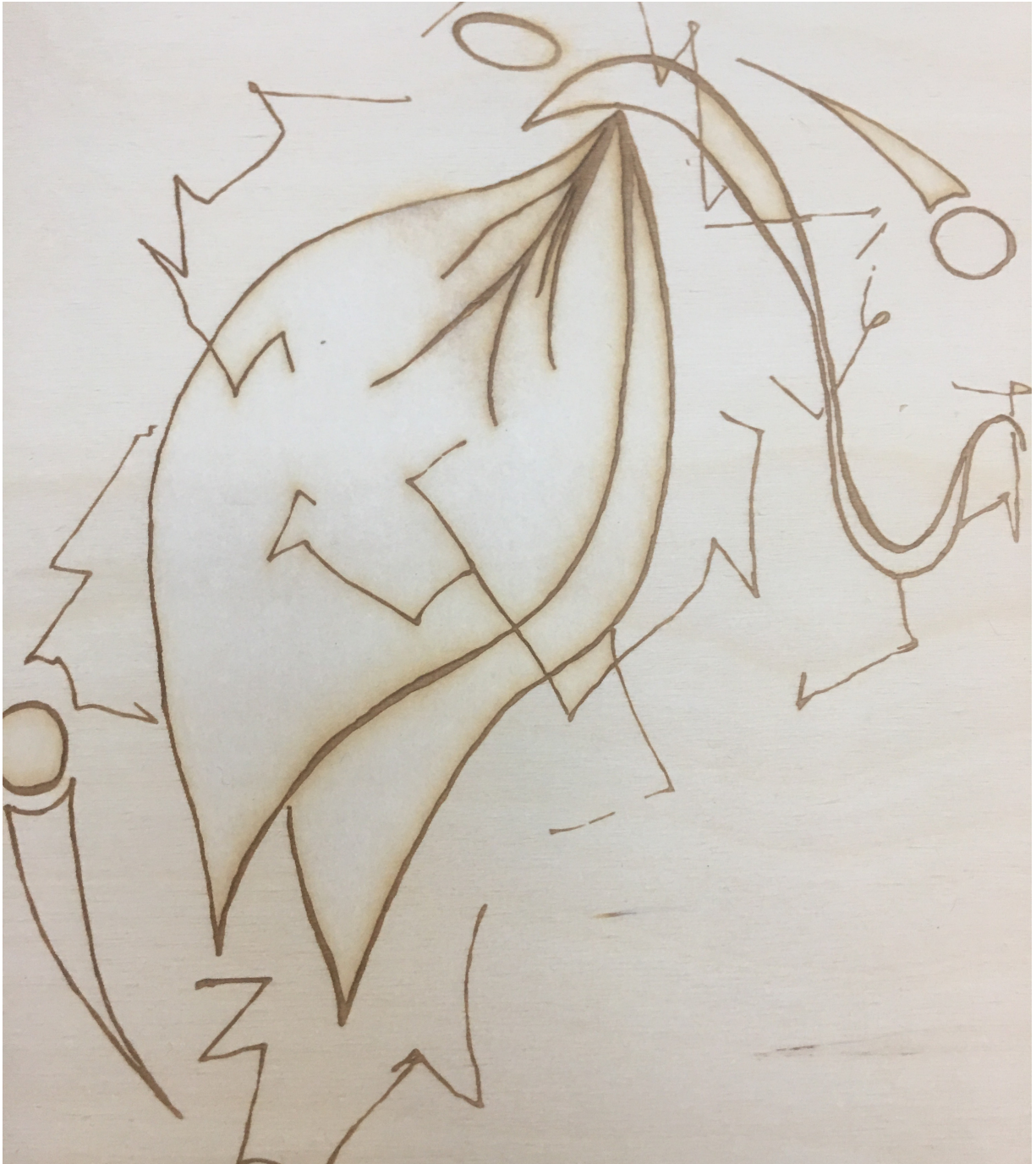
Potential next steps include:

Co-create a new iteration of the prototype as a mobile program possibly housed in libraries, community centres or school boards, especially for locations without immediate access/close proximity to a Science Centre
Connect with Canadian Artists, Musicians and Scientists to create a list of mentors for participating educators and students.

Co-create an experience that extends the learning into public spaces for community participation.

Further the research on efficacy of the program for engaging student voices not typically represented in STEM pathways.





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