

**A SELECTION OF WORKS
PRESENTED AT**

**THE 1ST ANNUAL
GPRC STUDENT
RESEARCH
CONFERENCE**

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Foreword

On behalf of the organizing committee, thank you to everyone who made the 1st Annual GPRC Student Research Conference a success! We were fortunate to receive many submissions from talented students from across all disciplines. This document provides just a glimpse the excellent scholarship that GPRC students engage in every day.

This volume contains a selection of student conference submissions from diverse disciplines, each of which has unique writing conventions and citation styles. Submissions varied widely and included summaries, outlines, research papers and technical reports. While efforts have been made to achieve style consistency in this volume, discipline-specific writing styles and citation conventions have been left unchanged.

For inquiries about this volume or the GPRC Student Research Conference, please contact research@gprc.ab.ca.

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A Retrospective Study of Orphaned Lambs

Brianna Bianchi and Jaden Dollekamp

This research team from GPRC's Animal Health Technology program undertook a review of GPRC's artificial rearing protocol for lambs. They reviewed four years of student records to observe lambs' weight gain over time while referencing current guidelines and recommendations for best practices. The retrospective study showed that GPRC's artificial rearing protocol was beneficial for the lambs and in line with provincial standards and guidelines. The following is a short summary of their findings.

Objectives

- Review our current protocol at GPRC for artificial rearing of lambs.
- Monitor the individual growth and health of lamb's part of the artificial rearing at GPRC.
- Develop a feeding method for artificially rearing lambs that can be used at GPRC and in the public.

Abstract

Grande Prairie Regional College (GPRC) Animal Health Technology students have gathered data from the last four years while taking care of orphaned lambs. This retrospective study reviews and analyzes this data to ensure our protocol allows growth that is comparable to bottle fed growth in lambs in Alberta and Western Canada. Our medical records at GPRC contain the appropriate data to calculate daily and weekly average gain. However, considering that all the medical records are mostly done by the students at GPRC, there are inconsistencies as students are still learning to properly write and maintain the medical records as first years in the program. The method taught at GPRC could also help with the treatment of sick lambs that are brought to the clinic. The average daily gain of our lambs is adequate according to the Alberta and Canada guidelines for lamb producers.^[1] In conclusion, we agree that the protocol here at GPRC is appropriate for artificial rearing of lambs.

Methods

The artificial rearing of lambs is a common skill Veterinary Technologists may use in lamb producing areas. Reasons we might artificially rear lambs is that a lamb may be orphaned, an ewe has triplets or twins, the ewe is not able to provide enough milk to the lambs, or the mother has died during parturition.

The protocol for feeding the lambs at GPRC is the lambs are fed with milk replacer through a nipple and bottle. The milk replacer comes in a powder form, which is mixed with warm water suitable for the lambs. The milk should be around 38–40°C (the body temperature of a lamb). It is important to have a clean workspace when preparing the milk to limit proliferation of bloat and contamination with scour-causing organisms.

Following the protocol, the lambs were each offered 500ml of milk replacer per feeding starting at 4 times a day for the first 14 days we had them in our care. As we started the weaning process, the lambs were then fed the same amount of milk replacer at each feeding, only 3 times a day for an average of 7 days. We then reduced to 2 feedings a day for an average of 4 days. Lastly, the lambs received 1 feeding a day for the rest of their stay with us which was only 2 days. The lambs always had access to dehulled soybean meal and water throughout their

stay with us. According to the Alberta lamb code of practice, lambs that are artificially reared should be weaned once they reach a weight of around 7–13kg^[2].

Results and Discussion

The lambs artificially reared in 2015 all tripled or quadrupled their intake weight by the time they were weaned. They all had a high daily rate of growth that plateaued as they were weaned.

The lambs artificially reared in 2017 all tripled or more their intake weight by the time they were weaned. Pink ribbon and Orange ribbon lambs had a high daily rate of growth that plateaued as they were weaned. Yellow Ribbon Lambs had a high daily rate of growth and continued to go up as they were weaned. The lambs artificially reared in 2018 all gained >2kgs on their intake weight by the time they were weaned. Lamb 103 3055 and Lamb 103 2783 had a high daily rate growth that plateaued as they got older and were weaned. Lamb 103 3056 and Lamb 103 2785 had a high daily growth rate that continued to go up as they were weaned. Lamb 103 2784 was brought back to the farm before being weaned.

The lambs artificially reared in 2019 all gained >3kgs on their intake weight by the time they were weaned. Lamb 31's daily rate of growth plateaued at first and then increased as it was weaned. Lamb 62 had a high daily rate of growth that plateaued as it was weaned. Lamb 63 had a low daily rate of growth that plateaued as it was weaned. Lamb 15 did not have enough data to continue with the study.

The protocol developed at GPRC for artificially rearing lambs has adequately nourished the lambs and seemed to have an acceptable daily growth rate according to professional guidelines.^[3] This protocol at GPRC gives students the knowledge and experience of artificially rearing lambs that can be used in a professional setting.

Abomasum bloat in artificially reared lambs is more common than in naturally fed lambs. The lamb can bloat within thirty minutes of feeding, filling the stomach with excessive gas. This can negatively affect the lamb and result in death within minutes and upon post-mortem the abomasum can be grossly distended and may have ruptured. In 2019, Lamb 15 unfortunately had abomasum bloat and died of a ruptured abomasum. One of the doctors on campus performed a post-mortem and diagnosed the lamb with abomasal bloat. Through post-mortems we can further educate not only ourselves but the public on how to care for the lambs and how to prevent abomasal bloat and ulceration.

A source of error that we discovered was the medical records. In the medical records there were some inconsistencies due to the amount of people providing care for the lambs. As a learning institution, all of the students are to write and maintain the medical records that are then reviewed by the instructors. Not all of the past students had gone back to see how the previous group or person had written things down. For example, in 2015 the students missed a weigh-in, leaving us with one less data point.

Conclusion and Further Developments

GPRC Animal Health Technology students have been artificially rearing orphaned lambs and collecting data from the last four years to see if the protocol here at GPRC allows for growth that is comparable to growth in bottle-fed lambs in Alberta^[1] and Western Canada. We discovered that the protocol at GPRC ensures the lambs are getting the adequate amount of nourishment to aid in their growth with multiple milk feedings a day until weaning, and access to water and dehulled soybean meal at all times. The lambs were also given a flake of alfalfa hay everyday throughout the weaning process. As a result, the lambs went back to their flock at the appropriate weaning weight according to the Alberta guidelines^[4].

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The Jesuits in New France

Katie Bryson

In this paper prepared for HI2600: Canadian History 1500 to 1867, the researcher challenges the narrative of Jesuit priests as brutal, self-interested colonizers of the Wendat (Huron). This paper offers evidence that, at least in the early days of contact, relationships between the Jesuits and the Wendat were often mutually beneficial, and that this differentiates the relationship from later interactions between Indigenous peoples and the European colonizers. Finally, the researcher argues that the Jesuits were frequently motivated, not by greed or self-interest, but by a sincere desire to save the eternal souls of the Wendat.

The negative effects of the Jesuit mission to the Wendat are essentially undeniable. The Wendat experienced cultural and religious coercion at the hands of the Jesuits and saw their population nearly wiped out due to disease brought over from Europe. Therefore, the question of whether the Jesuits did anything but harm the Wendat becomes less relevant because of the obvious atrocities faced by the Wendat upon the Jesuits' arrival. What is more contestable is whether the Jesuits' harmful impact was due to their ignorance of the negative effects of their religious fervour or whether it was the result of self-interested hegemony rather than true concern for the Wendat people's eternal fate. The Jesuits should be held innocent in their efforts, to an extent, due to the earnestness of their religious beliefs, their own subjugation by colonial political structures, and the French alliance with the Wendat in the Iroquoian (Haudenosaunee) attacks.

In Carol Blackburn's *Harvest of Souls*, she argues that accounts of conversion found in the *Relations* were "more literary than literal."¹ This means that the conversions related by the Jesuits are archetypal rather than factual in order to establish a relationship of dominance. The idea behind the non-literal (as Blackburn argues) accounts the Jesuits related was to "serve the idea of colonialism."² The dominance the Jesuits express in their *Relations* solidified the belief and the justification of dominance over the Wendat to the people back in France, the eventual colonizers. Although the authority they possess in their *Relations* may not have been an accurate depiction of Jesuit power over the Wendat, the Jesuits' "canonizing" of their authority over the Wendat through their written *Relations* set up the initial and necessary element of colonization: "before places and peoples could be colonized, they had to be marked as foreign, as other, as colonizable."³

The flaw in Blackburn's argument is the lack of acknowledgement of the Jesuits' sincerity in their religious beliefs, particularly the belief in the "immortal soul."⁴ The mindset of 16th and 17th century France was far different from our modern mindset. Timothy Foote notes that "we tend to forget, it was a time when men believed so deeply that the body is but a sleeve of flesh containing an immortal soul, that in good faith they could see other men tortured to save their souls."⁵ Foote

¹ Carol Blackburn, *Harvest of Souls: The Jesuit Missions and Colonialism in North America, 1632-1650*, (McGill Queens-University Press, 2000), 129.

² *Ibid.*, 16.

³ Nicholas B. Dirks, "Introduction: Colonialism and Culture," In *Colonialism and Culture*, ed. Nicholas B. Dirks, (Ann Arbor: University of Michigan Press), 6.

⁴ Timothy Foote, "Europe in the Age of 'Discovery,' 1450-1500" In *Interpreting Canada's Past, Vol 1 Pre-Confederation 2nd edition*, ed. J.M. Bumstead, (Toronto: Oxford University Press, 1993), 32.

⁵ Foote, 32.

captures here what Blackburn leaves out, that the Jesuits' belief in immortality commanded their actions, and it is this belief in immortality that preoccupied their lives and priorities. The Jesuits' end goal was not to conquer the Wendat for the sake of power, but rather they used power as a means to their end goal of conversion to a single unified religion, "to declare to them the true God and his son, Jesus Christ, the universal saviour of our souls."⁶ Blackburn is not wrong in her identification of the Jesuit exercise of power over the Wendat, but she underestimates the influence and sincerity of religious beliefs of the Jesuits.

Another issue with Blackburn's argument is her assertion that *The Jesuit Relations* were intended to "serve the idea of colonialism."⁷ Indeed, in 17th century France, the Church and State were essentially married. Thus, the lines between political motives and religious motives of people and authorities could be easily clouded because they were so tied together (unlike today). However, the Jesuits did not want French settlers to come to New France, which is inconsistent with colonization.⁸ Blackburn sees the Jesuits' exercise of power through the *Relations* as mainly an effort to colonize and overtake the Wendat. However, Bruce Trigger more accurately explains that, unlike the Recollet missionaries who saw "colonization as essential for the work of conversion... [t]he Jesuits believed that they alone could best instruct the Indians on how to act as true Christians and they feared that settlers would provide models of European vices."⁹ The Jesuit beliefs and efforts may have been misguided, but they were sincere in their goal of conversion rather than colonization. And, if the *Relations* did serve the idea of colonization later on, it was not the original intent of the Jesuits themselves.

Blackburn's idea that the Jesuits intended their *Relations* to be a means to a colonial end is flawed. However, her argument that the Jesuits were a precursor to colonialism in New France is much stronger and deserves expansion. Blackburn is accurate in arguing that the *Relations* served colonial ends and justification, but this was not the intention of the Jesuit authors. Blackburn's second point is that because the Jesuits themselves were born into the French colonial culture of hierarchy and integration of church and state, they are also subjected to this system of hierarchy: "Two general aspects of his calling determined the attitudes of the Jesuit Missionary. In public he appeared as a French Jesuit and hence subject to God, his general, and his king."¹⁰ The Jesuits' cultural background may explain why they exercised dominance as their means of conversion as well as how the Jesuits were sent as a means of colonization by higher-ups, making the Jesuits subject to higher political powers.

To get a clearer picture of this, Trigger gives an excellent bit of insight into how 17th century Frenchmen viewed power: "he [Champlain] viewed all power as being delegated from above, [and] he did not comprehend that Indian leaders could not decide matters but had to secure individual consent from their followers as each new issue arose."¹¹ Power in the French 17th century culture was concentrated into the hands of few and was seen to be granted by God. The level of power that a government leader could exercise over someone held great potency for it was equated with subjection to God. For people who believe unwaveringly in the divine, this

⁶ S.R. Mealing, *The Jesuit Relations and Allied Documents: A Selection*, (Ottawa: Carlton University Press, 1985), 46.

⁷ Blackburn, 16.

⁸ Bruce Trigger, *Natives and Newcomers: Canada's "Heroic Age" Reconsidered*, (Kingston & Montreal: McGill-Queens University Press, 1985), 202.

⁹ Trigger, 202.

¹⁰ J.H. Kennedy, *Jesuit and Savage in New France*, (Hamden CT: Yale University Press, 1950), 57.

¹¹ Trigger, 199.

naturally leads to an exaggerated hierarchical system, for it is relatively easy to refute the power of a single person over oneself but it is much more intense to stand against the ‘power of God’ over you. This is important because it explains that the Jesuits indeed held power, but ultimately remained subject to the King’s and to Champlain’s rule. Their understanding of power and where it came from was so different from today that the Jesuit exercise of power could be and was justified in their day because, after all, it was “given to them by God.”¹²

The final point to argue is that the Jesuits are not wholly responsible for the fate of the Wendat in the trading alliance between the Wendat and French fur traders. The trading relationship between the Wendat and the French was, at first, mutually beneficial.¹³ For the French it meant better furs as the Wendat had access to furs from farther north, which were thicker and fuller. It also meant that the French were farther up the St. Lawrence and thus guaranteed first contact with Indigenous traders. For the Wendat, it meant a monopoly on the furs going out, which supplied their economy with European resources, and it meant military aid against the Haudenosaunee. The Jesuits became part of this alliance between the French and the Wendat. The Jesuits were then not forced upon the Wendat, but were a part of their trading deal.¹⁴ The Wendat were active participants in this trade relationship, and the trade alliance the Wendat had with the French was a coveted one, as well as a two-sided one that required input from both sides of the alliance.¹⁵

This is important for understanding the Jesuits among the Wendat because it shows that their actual relationship was one of more balanced power and give-and-take.¹⁶ The Jesuits were not simply colonizers of the Wendat, and the Wendat were not simply victims. The Jesuits, then, cannot be fully held accountable for the fate of the Wendat. Just as the Jesuits had influence on the fate of the Wendat, the Wendat also had influence on the fate of the Jesuits. The Jesuit and Wendat relationship was not a one-sided affair. Furthering this argument is that it was the Haudenosaunee who brought the eventual ruin of the Wendat, and in the Haudenosaunee raids, several Jesuits were also killed. Indeed, the Haudenosaunee coveted the Wendat’s trade relationship with the French and this raised tensions between the two groups, but the Haudenosaunee raids cannot be blamed on the Jesuits.

There is one aspect of the Haudenosaunee raids in which blame rests upon the Jesuits. As stated above, the French and Wendat were allies, and when the Haudenosaunee began their raids on the Wendat, the French did step in to try and help.¹⁷ The Haudenosaunee had been acquiring guns from the Dutch traders which gave them a big advantage over the unarmed Wendat. The French planned on supplying the Wendat with guns to protect themselves against the Haudenosaunee, but the Jesuits convinced the French officials to provide guns only for those Wendat who had converted to Christianity.¹⁸ So, while the Jesuits cannot be blamed for the raids of the Haudenosaunee, this last move was a rather absurd abuse of power. Had the Jesuits not done that, outcomes for the Wendat may have been improved. This decision of the Jesuits is important

¹² Ibid.

¹³ C.E. Heidenreich, "Huron-Wendat," In *The Canadian Encyclopedia*, Historica Canada. Last modified October 10, 2018 <https://www.thecanadianencyclopedia.ca/en/article/huron>.

¹⁴ Trigger, 229.

¹⁵ Blackburn, 130.

¹⁶ Ibid.

¹⁷ Zachary Parrot, Tabitha Marshall, "Iroquois Wars," In *The Canadian Encyclopedia*, Historica Canada. Last Edited July 31, 2019 <https://www.thecanadianencyclopedia.ca/en/article/iroquois-wars>.

¹⁸ Ibid.

because it illustrates that while the fate of the Wendat cannot be blamed on the Jesuits solely, the Jesuits did have influence on the fate of the Wendat and even exercised some coercive power over the Wendat.

The Jesuits indeed held influence over the Wendat. It is seen through their trade relationship and even in the Jesuits' odd decision to withhold weapons in a time of warfare. However, the Wendat also at times enjoyed a beneficial relationship with the French and thus with the Jesuits. This influence is seen in the trade alliance and the French military aid against the Haudenosaunee. The 17th century French mindset of authority and the belief that it came from God influenced Jesuit practice and beliefs about their own authority and the authorities they were subject to. Lastly, it is the fervour and absoluteness of the Jesuits' religious beliefs that complicate the interpretation of their relationship to and dealings with the Wendat. The Wendat indeed came to a sad fate after the encounters with the French and the Jesuits. However, theirs was a fate with many different actors influencing it, and this is why the fault for the Wendat's fate cannot be placed entirely upon the Jesuits.

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Motor Lead Identifier

Ryan Cote

This self-directed project proposes an innovative way of identifying motor leads, a normally difficult and time-consuming procedure. The researcher proposes a cost- and time-saving tool for automated testing using microprocessors, electronic switches, and analog-to-digital converters.

Introduction

When motor leads are not clearly identified or only partially labeled, users must go through a convoluted procedure to correctly identify the leads. Instead of this convoluted procedure I am developing a new and improved way of accomplishing motor lead identification using existing technology in a new application.

Improved Electronic Testing

I have an idea to automate the motor lead identification process using microprocessors, electronic switches and analog to digital converters (ADC) for analog sampling. The testing procedure is nothing new; however, automating this testing procedure for faster, simpler and more accurate results does not exist currently. My suggested method should make the testing procedure go faster with less error, also, reducing down time, saving money and potential costly mistakes.

This new concept for a device could be used across multiple industries: motor manufactures or repair shops, or technicians in a wide range of industries who need to troubleshoot motors.

Use of Tool

Ideally, the user of my tool would hook up nine leads of the tool to the unknown leads of the motor. Connections to 3-phase power (rated for the motor) would also be required to bump test the motor to check for proper phasing of coils with proper rotation direction. The user would initiate the testing via touch screen. Once the tool has completed the automated switching and testing, results would be shown on the screen.

Methods of Automated Testing

The 4-wire resistance testing process (Kelvin Method) has greatly improved the accuracy of low resistance measurement. The Kelvin method accomplishes high precision by pushing a known amount of electrical current through an unknown resistance that is to be measured. Once the amount of current is known and the voltage drops across the device under test, Ohm's law can be used to calculate the unknown resistance. By measuring resistance in a constant current loop, sources of external resistance can be removed. Otherwise, lead and connection resistances would induce sources of error affecting the precise measurement of such low resistances.

The Kelvin Method uses a simple current source to precisely push a known amount of current through the coil under test. An operational amplifier configured as a differentiator will output a signal proportional to the voltage drop across the coil under test. This amplification of small signals can increase measurement resolution ever further.

I have made a software controlled *H-Bridge* (Switching) for lead selection and coil polarity reversal. Depending on how the H-bridge is controlled, the microcontroller will be able to select

coil position and polarity. This will allow the microcontroller to have full control over choosing the proper coils in sequence to automate the testing.

Due to the massive amount of switching, there is a need to address all switches required for testing. Shift registers have been used for addressing the many switches required to select the leads and enable coil reversal. With multiple 8-BIT shift registers, I am able to control the many switches required. The shift registers are used to reduce the actual number of digital I/O pins required, on the microcontroller. The shift registers only require 3 I/O pins, to control a nearly infinite number of I/O pins.

Further Research

A proof of concept has been made, but further research is needed to improve switching algorithms. Additional switching hardware will need to be integrated to add bump testing features required for the test. This will increase the ease of use and will not require any connection changes by the user once the testing has started.

Improvements on sensor resolution could be improved by using a higher bit analog to digital converter.

By adding a shunt in the current loop, it would be possible to measure the actual in situ current. This would further increase the accuracy of the calculations by using actual measured values instead of calculated.

This device could be adapted to perform a health check on the motor by showing and comparing coil resistances and looking for shorts. This information could supplement predictive maintenance programs and help with troubleshooting. Data could be collected and stored about specific motors across an entire site, giving insight on when motors may fail. This would save time and money helping reduce unexpected costly outages.

Mathematical Calculations

Using Ohm's Law, one can calculate very low resistance precisely using the Kelvin method. Accordingly, a 20 mA current through an unknown resistance resulting in a 3.1 mV voltage drop identifies the unknown resistance as 0.155 Ω .

$$R_{\text{unknown}} = (3.1\text{mV} / 20\text{mA}) = 0.155 \Omega$$

By using a 10-BIT ADC and a 1V reference, accurately measuring 0.0009 mV is possible.

$$\text{Resolution: } (1\text{V} / 1024) = 0.0009\text{mV}$$

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Case Study: Sight Word Recognition, Chunking, and Decoding

Nicole M. Dubé

The following is a text summary of a full research paper prepared by Nicole Dube for EDPY 301 Inclusive Education: Adapting Instruction for Students with Exceptional Needs.

Rationale

This project was a qualitative case study for EDPY 301 Inclusive Education: Adapting Instruction for Students with Exceptional Needs. The intent of the research project was to investigate the following question: **What is the effectiveness of a chosen instructional strategy for a student with exceptional needs within an inclusive classroom?** In today's classrooms, including students with a diverse range of needs is a key consideration for classroom teachers. Through the investigation and implementation of different strategies, I was able to develop a certain level of comfort and self-efficacy in my own abilities when working with students who have exceptional needs.

Background

I chose to work with an elementary student who has a learning disorder that affects their ability to receive, process, and communicate information in reading and writing. The student was three grade levels behind in reading abilities at the time the case study was being conducted. After discussing with the classroom teacher and reviewing the current literature, I hypothesized that through isolated sight word presentation, the student would be better able to chunk complex words into smaller, more manageable parts, and therefore improve their decoding and overall reading abilities.

What is Decoding?

Before a child is able to read with fluency and expression, they must first be able to recognize letter-sound relationships in order to correctly pronounce words. "This decoding, or word solving as it is sometimes called, has to happen efficiently and quickly while reading so the reader does not get bogged down; otherwise, comprehension will suffer" (Rodgers, 2017, p. 526). Decoding enables readers to recognize familiar words quickly as well as allow them to apply their knowledge to make sense of unfamiliar words.

What are Sight Words?

Sight words are high frequency words that students will encounter often when they read. Students should be able to recognize them at a glance without having to sound them out (Whitaker et al., 2006).

Procedure

The research process started with receiving informed consent from both the student and their parents.

Following that, I met with the student one-on-one, once a week over the course of five weeks.

Each session was structured as outlined below:

- *The presentation of Dolch (1936) sight words in isolation.* We began with grade one sight words and quickly progressed to grade two sight words to provide the student with more challenge.
- *Discussion of chunking strategies.* Each session we would review how to chunk and identify sight words within larger words.
- *Reading.* We would finish each session by reading a book chosen by the student that was suitable for their individual reading level. While reading we would work on identifying sight words and using the sight words to chunk larger, unknown words.

Findings

Qualitative data was collected through the use of anecdotal notes. Notes were taken after each session and used to inform subsequent sessions.

Improvements in Decoding

Throughout the project, the student showed gradual improvements in decoding ability I found that the more we worked with the sight words, the better the student was able to decode and, as such, the more fluently the student would read. I also determined that a large piece of the puzzle for this student was confidence. This individualised time allowed the student to have my undivided attention and to grow confidence while reading in a non-judgemental and positive environment.

Increased Enjoyment of Reading

An important result of this case study was that the student developed a love of reading that was not present before. The student would often tell me how much they were reading at home, and took great pride in reading more than what was assigned. The student also developed more patience with reading, and less frustration enabled more success. This love of reading was a huge step for the student, as when we started the student was very reluctant to read any kind of text.

Personal Reflection

I believe that the instructional strategy that I implemented for the student was effective and that the isolated presentation and interactions with the sight words enabled the student to chunk and decode more effectively. However, there was another important result that emerged from this case study. Through these sessions, I was able to help the student develop a love of reading which was not there before. I believe that the interpersonal relationship we had allowed me to help the student improve their reading. The student did not perceive the sessions we had together as scary, but rather as an opportunity to improve skills in a positive environment with an adult who is invested in helping them succeed. This highlights the importance of the teacher-student relationship and how relationships are the foundation of effective teaching. This experience has taught me that regardless of ability, every student deserves to feel the satisfaction of success and to develop a love of learning, and it is my job as an inclusive educator to provide them with the tools to accomplish their goals.

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Positive Steps to Decolonization in Education: In New Zealand; 6 Nations Reserve, Ontario; and Grande Prairie, Alberta

Becky McKay

This research paper, prepared for AN2270: Indigenous and Cultural Minorities in the Modern World, investigates the concept of decolonizing education. The researcher considers a variety of cultural backdrops and implementation methods to compare and contrast, and also explores larger questions of what decolonizing education really means.

In this paper, I will examine positive steps that have been taken towards decolonization in New Zealand (Maori Aotearoa), Six Nations Reserve (Ontario), and Grande Prairie, Alberta. I particularly want to examine how steps to decolonizing can be enacted within school settings. I have a personal interest in this concept, having grown up with aboriginal sisters and having three aboriginal children of my own. Decolonization is not simply about making the current colonial system more “Indigenous friendly” or less oppressive, because the current system is flawed (Smith, 2010).

Activism in settler society may advocate for social justice within society’s rule, but decolonization anticipates the end of such rule, and the advent of an egalitarian society where justice does not need to be fought for (Morgensen, 2012). We must examine and develop theories that seek to fundamentally transform the education system and conditions of life for Indigenous and non-Indigenous people, on lands where all can live relationally (Morgensen, 2012). As a society and as individuals, we must endeavor to dismantle and de-normalize the conditions in which these systems of colonization and violence are produced (Morgensen, 2012). Indigenous methodologies model a system that can draw Indigenous and non-Indigenous peoples to work in interrelationship towards the goal of decolonization (Morgensen, 2012). Indigenous researchers begin with traditions of knowledge and relationships without presuming their commonality but inviting their connection. Knowledge and action together are distinctive paradigms held by Indigenous governance (Morgensen, 2012). By challenging the academic institutions (elementary, high school, and post-secondary) to include stories, representations, relationships, and ceremony as legitimate and essential elements of education, we are embarking on a journey towards the decolonization of the school system (Morgensen, 2012).

New Zealand

New Zealand is a sovereign island country in the southwestern-most part of Polynesia, and is located more than 1,000 miles off the southeast of Australia. New Zealand was the largest country in Polynesia when Great Britain annexed it in 1856. It did not become fully independent again until 1947. It remains a member of the British Commonwealth and its official languages are English, Maori, and New Zealand Sign language. Contemporary New Zealand has a majority of people of European decent, and a minority of indigenous Maori people. Modern Maori culture is rich in heritage; important elements include art, legend, tattoo, dances, hospitality, and community. Indigenous Maori people face challenges as they engage in a global society while reclaiming a voice all their own.

For generations, the Maori people have had their lives disrupted and manipulated by the prevailing Anglo-Saxon culture of New Zealand (Kepa & Manu'atu, 2002). The Maori propose an educational system that blends both European New Zealand methodologies and those of the Maori, a people who are aware and proud of their own languages and cultural practices. The reality is that schooling is a political act (Kepa & Manu'atu, 2002); a practice that has continued the colonization of a people long after we have learned to do better. The school environment can be a positive force for transforming social and cultural relationships by reflecting the ideas, perspectives, interests and activities of all the cultures represented and not only those of the dominant group (Kepa & Manu'atu, 2002). Indigenous educators can help shed light on what culture can and should mean in the context of school (Kepa & Manu'atu, 2002).

There is a tendency in western-style formal education to focus narrowly on knowledge and skills at the cost of devaluing values, ideas, ways of knowing, and a sense of belonging to a group (Kepa & Manu'atu, 2002). The focus inadvertently becomes on familiarity with the dominant culture in order to succeed academically and professionally. Requiring migrant or indigenous children to be examined in English so that they can advance leads to disempowerment and privileging "sameness" over "difference." Communities who suffer language and culture loss are forced to "assimilate" to the mainstream culture. Likewise, those who are positioned at the bottom of the social, economic and political ladder often find themselves being discriminated against. Those who are able to assimilate to the fullest are able to navigate the world of higher education and professional and managerial classes (Kepa & Manu'atu, 2002).

Schooling is not neutral, and it can be used to transmit or destroy culture. Earlier curriculum was found to be disempowering to Maori people (Hokowhitu, 2004). Thirty years ago, Maori immersion schools began to be offered in some New Zealand locations (Hokowhitu, 2004). Although this was a great option for students able to access this avenue to education, it was not available to all Maori students. Moreover, it still did not offer a solution to the racist discourses and exclusionary practices of mainstream education (Hokowhitu, 2004). Culture is central to helping people understand the world around them. Embracing cultural diversity within a school setting is a holistic approach that allows people to draw on their experiences and empowers students and teachers to participate as agents of transformation, empowering a lifestyle of diversity and respect (Kepa & Manu'atu, 2002). By reconnecting people (including people's personal experience of history), students can begin to make sense of themselves as they increase their understanding of the social, historical and cultural forces surrounding them.

When English language, school rules, choice and presentation of knowledge are privileged to the exclusion of the Maori languages, what is lost is an intricate way of looking at the world. Cultural understanding is very much wrapped in its languages. Language becomes the connection between history, art, music, care for the environment, education, spirituality and emotion (Kepa & Manu'atu, 2002). Language conveys knowledge, and Indigenous ways of talking are not always parallel to the linguistic patterns of English (Kepa & Manu'atu, 2002). Consider a newcomer to Canada who knows only a little English or French. There is much that he or she will not understand about Canadian culture until he or she has a greater grasp of the language. Likewise, by preventing the use of Maori language, much transmission of cultural values and traditions would be lost. The goal of the educational paradigm should be for Maori people to be free to

experience schooling that embraces their language and heritage alongside the officially sanctioned school curriculum (Kepa & Manu'atu, 2002).

For the Maori to maintain cultural relevance, schooling be permeated with innovative perspectives, philosophies and approaches through practices that can overcome social and cultural relationships (Kepa & Manu'atu, 2002). Plans for successful inclusive programming should include deconstructing the telling of the historical narrative, sharing the decision-making power in the creation of the curriculum, integration of Maori ceremony, and decolonization of the educators (Hokowhitu, 2004).

Teachers must be willing to adopt a belief that Maori culture has something to offer. By providing Maori students with access to traditional values and knowledge, they are able to feel pride and strength in their heritage. Many non-Maori teachers feel unqualified to teach Maori language, games, or dances, but one does not need to be an expert to provide enriching opportunities. By allowing students to help teach, or inviting knowledgeable community members to engage with the students, the class will have many occasions for personal and cultural growth. With each opportunity to meaningfully engage in cultural events, there will be one less ignorant person (Hokowhitu, 2004). Taking the time to explore and gain meaningful understanding behind each ceremonial dance allowed the students to perform them with passion and conviction (Hokowhitu, 2004).

Canada: Re-Educating and Reuniting Canadians

The six Iroquois (Haudenosaunee) Nations are Mohawk, Cayuga, Onondaga, Oneida, Seneca and Tuscarora. Six Nations Reserve is the largest reserve in Canada, with 27,276 members. This land represents only 5% of the land granted to the Six Nations by the Haldimand Treaty in 1784 (Johnson, 1964). Six Nations Reserve, as well as some other communities in Canada, have begun to develop their own grassroots movements to educate beyond the settler narrative.

In Six Nations Reserve, an innovative educational experience was undertaken to join Onkwehon:we (Indigenous) youth with non-Onkwehon:we youth in a land-based learning adventure. Twenty-two young people experienced workshops about sovereignty, food, ceremonies, treaties, decolonization, art, residential schools, cultural pride, and language (Whitlow et al., 2019). Using Indigenous facilitators, the students were able to see the “teachers” as not simply Indigenous people, but also as educators, health care workers, artists, and dancers. By shifting the focus away from deficits and trauma and towards a strength-based approach, the participants elevated traditional knowledge, life-giving stories, beautiful traditions, and sustainable living practices, creating a powerful environment for cross-cultural exchange and healing (Whitlow et al., 2019).

Historically, formal education has fallen short for the students of Six Nations Reserve. They have experienced racism and teachers who are unprepared for the realities of their students' daily lives. With Indigenous education classes taught by non-Indigenous teachers, there can be problems because of a lack of lived experiences (Whitlow et al., 2019). Creating spaces for Onkwehon:we students to engage in choosing their own curriculum to reflect their culture and values allowed them to see themselves accurately represented and valued through participation in hands-on experience. Experts suggest that offering alternative learning spaces with traditional and

experiential learning methods promotes cultural knowledge and pride, and is indispensable in creating stronger mental health (Whitlow et al., 2019).

Being a guest on the land had a boundless impact on the non-Indigenous youth. After entering into life and relationship with the Onkwehon:we youth, the non-Onkwehon:we youth felt a growing accountability to become change agents. As part of the uniqueness of the endeavor, the facilitators chose a peer-to-peer format for recruiting and teaching, and a unique, graffiti-based educational experience. Contributing to the peer-to-peer format instilled confidence and pride in the Onkwehon:we students and relatability between each of the participants (Whitlow et al., 2019).

Since the Truth and Reconciliation Commission (TRC)'s calls to action in 2015, the Canadian Government appears committed to doing the work required to make substantial amendments to the ways in which Indigenous issues are considered. Scholars question whether the institutionalization of reconciliation can effect real change between Settlers and Indigenous peoples; however, I propose that it is an integral "first step" (Arellano, Friis, & Stuart, 2019). All Canadians have an obligation to engage in confronting the ongoing colonial "status quo." Education has an indispensable role in introducing respectful dialogue (Arellano et al., 2019). Article 57 of the TRC report specifically encourages revising curriculum to include focus on intercultural competency, conflict resolution, human rights, and anti-racism. By engaging in this paradigm shift, we can hope together for effective change in the hearts and minds of both Settlers and Indigenous peoples (Arellano et al., 2019).

Another innovative Indigenous program is in the community of Kitcisakik (located within the borders of La Verendrye Wildlife Reserve, Quebec). It is a four to ten-day immersion trip offered to non-Indigenous and Indigenous youth. This project invites students to share Anicinape ways and experience living off the land together. This is a social economy initiative, where students engage in forest trapping, learning about medicinal plants and their uses, preparing and eating traditional foods, arts and crafts workshops, sweat lodge ceremonies, community gardening, and playing hockey with community members (Arellano et al., 2019). This program is a model both for continued Indigenous resurgence and for revitalizing Indigenous knowledge, and it also presents an opportunity to envision more formal or extensive land-based learning opportunities (Arellano et al. 2019). By participating in such programs, students would have the opportunity to intellectually, physically, and spiritually experience Indigenous perspectives and resilience.

Land-based learning acknowledges the land and nature as a source of learning and as a teacher. The maintenance of tradition itself is empowering, and for those in the Kitcisakik community, maintaining traditions of hunting, trapping, and fishing endorses the survival of traditional ways of knowing. For non-Indigenous students, a land-based learning experience could be their first encounter with such ways of knowing, opening up opportunities for a lifetime of developing awareness and respect (Arellano et al., 2019).

Indigenous resurgence in the education system and elsewhere involves not only cultural revitalization, but also intense political action required to dismantle existing structures of colonialism and instead support Indigenous alternatives to the current systems (Arellano et al.,

2019). New public and private education strategies, combined with community engagement and hope for the future, can produce social transformation. “Educated hope” is a force to be reckoned with: that is, holding authority accountable, prompting respectful dialogue and social transformation (Arellano et al. 2019). Hands-on learning environments favour sharing and strengthening Indigenous knowledge. Expanding Settler awareness and educational experiences would facilitate intergenerational transmission of awareness and restoration (Arellano et al. 2019).

Holistic learning is based on the values of love, respect, trust, curiosity and creativity. Indigenous knowledge is relational, mainly conveyed by family and community members by modeling, practice, and oral traditions such as story telling (Arellano et al., 2019). As an alternative to simply “participant observation,” Indigenous scholars are building bridges for their compatriots to grow together with these traditional ways of knowing. Participant observation would become shared experiences of hospitality; gathering as families and community, and taking part in daily activities cooperatively. Students all participate in food gathering, cooking, serving, preparing teepees, and sharing stories (Arellano et al., 2019). Participants who experience land-based education gain deeper understanding of the community’s continued economic, social, and political realities.

Indigenous people internalize that the value of knowledge and wisdom is its ability to be applied to everyday life. By facilitating place-based learning in the context of Indigenous places, listening to Indigenous community members, and participating in cultural practices, students are able to internalize their learning (Gahman & Legault, 2019). Place-based learning can be instrumental in “mobilizing compassion and culturally safe action” for the facilitators, students, and community participants together (Gahman & Legault, 2019).

Settlers’ grasp on Indigenous peoples and their collective histories has often fallen short. The TRC’s call to action recommendation # 62 proposes to finally remedy this reality by incorporating age-appropriate education on Residential schools, Treaties, and include the contributions of Indigenous people in the telling of Canadian history (Arellano et al., 2019). The government must also provide the necessary resources to educate teachers on how and why to incorporate Indigenous knowledge and methods of teaching in their classrooms. Land-based activities are entirely and fundamentally different from classroom or textbook learning. Activities are not as constrained to times and dates and a more delight-based learning approach. The Kitcisakik initiative indicates an inspiring shift in educational paradigms, created by Indigenous peoples to promote solidarity and imagining a better shared land.

A similar place-based learning experience takes place in the Okanogan Valley on unceded Syilx Territories (Gahman & Legault, 2019). Decolonial place-based learning methods can be leveraged against settler colonial discourses to unsettle their claims for authority over land and learning. Dominant voices in the Okanogan Valley frequently romanticize the area’s history as a story of brave pioneers, conveniently neglecting realities of cultural genocide, social alienation, and environmental devastation of Indigenous peoples (Gahman & Legault, 2019). Place-based learning has transformative power to build mutually supportive relationships in the pursuit of global decolonization.

The En'owkin Center in Penticton, British Columbia is a vibrant centre for decolonization. The centre offers a “living classroom” (land-based learning opportunities), Indigenous arts, crafts, customs training, early childhood education and language survival programming (Gahman & Legault, 2019). Additionally, the Syilx Language House offers an immersion program of intensive Nsyilxcn lessons. Local Friendship Centres and Métis Community Services serve the entire community by inviting the community to engage in healing circles, support groups, the Missing and Murdered Indigenous Women’s vigil, the Sisters in Spirit walk, and annual Powwows. Many of these organizations also work with local schools to teach administrators and students about different ways of presenting Indigenous education, and Aboriginal storytelling (Gahman & Legault, 2019). Educators are inspired and challenged to commit to promoting Indigenous theories, perspectives and voices (Gahman & Legault, 2019).

Grande Prairie and Area

Grande Prairie is located approximately 500 kilometres northwest of Edmonton, Alberta. The population is close to 70,000. Grande Prairie is primarily a farming and oil and gas community and was settled by immigrants from Eastern Canada, the United States, and Europe. Before that, the area was already home to many Cree, Dene, Beaver, and Métis people. The cultural majority in the Grande Prairie area is Euro-Canadian, but there is a visible minority of Indigenous people. There are 28 schools in the Grande Prairie Public and Catholic School Divisions.

Historically, education offered to Indigenous children was aimed at assimilation to a white status quo. Currently, curriculum, research methods, building names, languages spoken, and knowledge in general remains a principally “white” domain. Decolonial rhetoric without supporting action often has little effect in helping the struggle with and for Indigenous communities (Gahman & Legault 2019). Estimates are that 60%–80% of Canadian Indigenous students will drop out of secondary school before graduating (Scully, 2012). Canada must engage in better decolonial projects and re-education projects in just and honorable ways. We must deconstruct our shared past and build our shared future (Scully 2012).

By employing large or small-scale place-based education, we can create a disruption in racialized perceptions and create stronger bonds between peoples and lands of Canada by gaining mindsets of decolonization, rehabilitation, and reconciliation (Scully 2012). In 2016, Grande Prairie Regional College (GPRC) offered a land-based education program to Indigenous students and any students taking Indigenous studies. While it was a great opportunity, it was not well-advertised, and could benefit more people if a larger range of students had the opportunity to participate. Students would also benefit if this opportunity continued to be offered at GPRC. At Saint Mary’s Catholic School in Sexsmith, the younger students make frequent trips to the woods to connect deeply with the land around them. The children have daily access to an Indigenous faculty member who enriches their learning experiences by teaching basic Cree, facilitating blanket exercises, opening dialogue about residential school and displacement of peoples, choosing Indigenous featured books, teaching bannock making, inviting local elders to teach and share stories, ceremony, and dance. The children are encouraged to learn their traditional languages, skills, and traditions.

Conclusion

Examining how other cultures have actively used decolonization strategies within the educational system can inspire and equip us to make similar informed changes in our own education systems. In order to commit to educational decolonization, we must stand as willing participants on the road to social transformation and renewed cultural relationships. We must also endeavour that our efforts toward decolonizing do not transpire disingenuously through meaningless words without action. Educational institutions must dedicate themselves to resolutely examine the current impacts of colonialism, land dispossession, and white supremacy on the daily lives of local Indigenous culture. As we become better educated and in turn educate our children to honour the ways of those around us, we can build a future of strength and reconciliation, and leave a legacy of hope for other nations to follow.

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The Strain of Being a Student with Vision Loss

Nikita Phillips

This submission investigates the barriers faced by post-secondary students with visual impairments. Instead of a full research paper, the following is a research outline adapted from an assignment for Sociology 1000: Intro to Sociology.

1. **Title:** The Strain of Being a Student with Vision Loss
2. **Introduction:**
 - a. **Capture Interest:** One thing that people with vision loss can say is that when it comes to receiving support in any field, the person is overlooked if they do not advocate for themselves.
 - b. **Thesis:** Sociologists can look at three sociological understandings that explain why blind students are not successful in educational institutions by the condition of anomie, the way that mass media portrays blindness, and symbolic interactionism's concept of the interpretive process as applied to minorities.
3. **Definitions: all definitions are paraphrased or quoted from Little (2016).**
 - a. **Anomie:** "when people do not feel connected to society and feel normlessness" (p. 44).
 - b. **Mass media:** "how information is transmitted on a mass scale socially and culturally" (p. 365).
 - c. **Conflict theory:** "concentrates on the study of how our everyday lives are structured by the connection between relations of power and economic processes" (p. 33)
 - d. **Symbolic interactionism:** "a sociological perspective that looks at how an issue affects a person's view of themselves" (p. 46).
4. **Body**
 - a. **Argument 1:** Anomie that results from lack of support is one of the reasons that students with vision loss struggle in school.
 - i. **Supporting argument 1:** If they do not get the right eye care, then they have no basis for financial aid for accessibility in their courses. Then society will overlook them, and they will not be connected to social programs. This highlights Durkheim's theory of anomie.
 - Evidence 1: "Compared with urban centres, rural areas have a lower density of eye care providers, in particular ophthalmologists, making it more difficult for rural residents to access eye care services" (Lee et al., 2018, p. 342).
 - ii. **Supporting argument 2:** Conflict theory is the perspective that the powerful overrule the lesser. The powerful could be the sighted world, which is the dominant, and the subordinate are the visually impaired. The sighted exclude the blind because it costs more money to fund blind students. Institutions have to fund those necessities to help students be independent.
 - Evidence 1: "Due to high costs, time-consuming administrative processes, and misinformation, gaining access to these supports can be a challenge in itself, to the point of being detrimental to the success of students" (Ostroski, 2016, p. 15).

- Evidence 2: Visually impaired students thus feel disconnected from the regular student population. According to Human Resources and Skills Development Canada, “reports indicate that nearly 30% of people with visual impairments in Canada did not have their needs fully met with assistive technology, suggesting that further research is needed to improve the efficacy of assistive technology” (As cited in Ostrowski, 2016, p. 19).
- iii. **Supporting Argument 3:** Earlier education creates lower expectations of students who have disabilities. A student is not able to experience higher expectations, which means that they are not challenged or inspired to do better because they are just expected to do the minimum. It makes a model that is not positive for a student with vision loss because the teachers only expect them to do the minimum and do not think they can achieve higher. However, in post-secondary, more is expected because the student is an adult and no longer has the “training wheels” of lower education.
- Evidence 1: “Higher education has needed to create a series of versions of “lower education” to justify its work and to ground its exceptionalism, and the physical gates and steps trace a long history of exclusion” (Dolmage, 2017, p. 27).
- a. **Argument 2:** The media can play a big role in how blind people see themselves and others. If they have a negative perspective on themselves, it affects their ability to work in that environment.
- i. **Supporting argument 1:** Representations of visually impaired people in media can lead to stigmatization and miscommunication. In media, blind people are often represented as helpless, unemployed, and disconnected from mainstream society. People just rely on these common-sense stereotypes for how to treat people with visual impairments. They give false implications of how blind people actually do things in their daily life, which could lead to miscommunication in education.
- Evidence 1: For example, critically acclaimed 2004 Disney movie *Going to the Sun* has a scene where the blind protagonist, Jason, touches a girl’s face so that he knows what she looks like. Because of this assumption that we use our hands to figure out what objects look like, I have had awkward experiences with strangers. This instance from a movie is an example of how people are not educated about how blind people work in the real world.
- b. **Argument 3:** From a symbolic interactionist perspective, the interpretive process is a micro-level view of how a person internalizes an issue that is given to them (Little, 2016, p. 31). A symbolic interactionist can differentiate between how the public sees students with vision loss and how these students see themselves. If blind people don’t have others to advocate for them, they might not learn to advocate for themselves, which in turn leads to uncertainty in self-confidence.
- i. **Supporting argument 1:** People who are blind may internalize the inequality of social access to opportunity, which leads to mental illness. According to Papadopoulos et al. (2014), “satisfaction with available perceived support is negatively related to depression.” Blind students often

do not have a good transition from high school to post-secondary and may not be aware of the financial assistance and programs that are available for visually impaired students.

- Evidence 1: In my experience, because my school did not help me transition to higher studies, I had felt the lack of opportunity. This led to anxiety because I didn't know what was going to happen after I left high school.
- Evidence 2: "On the basis of their own experiences, the students and staff perceived that students may not apply to institutions of higher education because of low self-confidence. Having low self-confidence may reflect an accurate perception of poor preparation for higher education" (Reed & Curtis, 2012, p. 422).

ii. **Supporting argument 2:** The student with vision loss is being modelled to fit a certain quota in grade school and high school, but when they get to post secondary, they need to develop their own quota instead of just meeting the expectations of that institution. For example, the term "passing," used by Michalko (1998), depicts a person with vision loss who is trying to fit being partially sighted into the sighted world. Now, being fully blind, he cannot fit that model that is expected for a sighted person. His connection to society's views on himself is being alternated into a new view that is not the "norm".

- Evidence 1: "Passing was my way of inserting myself into the social world in the face of the deplorable condition of blindness" (Michalko, 1998, p. 130).

5. **Conclusion:** These perspectives help explain why some blind students do not graduate from educational institutions. For instance, conflict theory explains that the sighted population has a difficulty with funding students who are blind. This macro perspective provides insight on how the sighted institution inflicts their desire to avoid expenses upon blind students. With this lack of support, blind students have too much difficulty to succeed. By having assistance with course work, social programs, and advocating for themselves, visually impaired students can be able to be an applicant to graduate from educational institutions. Blind students need support in transitioning to post-secondary so that they will be successful graduates. Further research is needed to get a consensus on how the student will succeed in the workforce.

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Self-Monitoring Grow Cubes: An Experiment in Measuring Lettuce Plant Health

Breann Thiessen

This submission is an abridged version of the final technical report submitted by Breann Thiessen to GPRC Research and Innovation in October 2019. It details her experiments building and testing self-monitoring grow cubes as part of her winning proposal for the GPRC Student Research Award. The report has been edited for conciseness and to protect certain proprietary project details.

Introduction

Whether it be traditional farming, hydroponic farms, or greenhouse operations, measuring plant health and monitoring growing environments are both crucial to any business in the agriculture sector. Drones, robots, and other automated solutions are being used on large-scale crops in order to increase output and accrue higher revenue. Along with the increase of the integration of automation and agriculture, there is a larger market for alternative growing methods on a smaller scale. Aquaponics, hydroponics, and intercity growing operations are becoming a popular way for city dwellers to grow their own vegetables. By integrating these alternative growing methods with automated solutions, those who would not be able to grow fresh produce can gain access to fresh food while also enjoying the benefits of automation. The main goal for this project was to develop a prototype for an automatic vegetable growing system that can operate within a smaller space while accurately measuring plant health. Inspired by the “plant computer,”¹ this version of a grow cube structure is aiming to be user friendly and to allow people with little experience with electronics and coding to easily grow and maintain fresh vegetables. The prototype offers easy interaction and allows for remote monitoring so that users can recognize whether their plant health is increasing or decreasing. Inspired by the internet of things platform, remote monitoring and data collection was performed to allow the user to access information regarding plant health while away from the grow cubes.

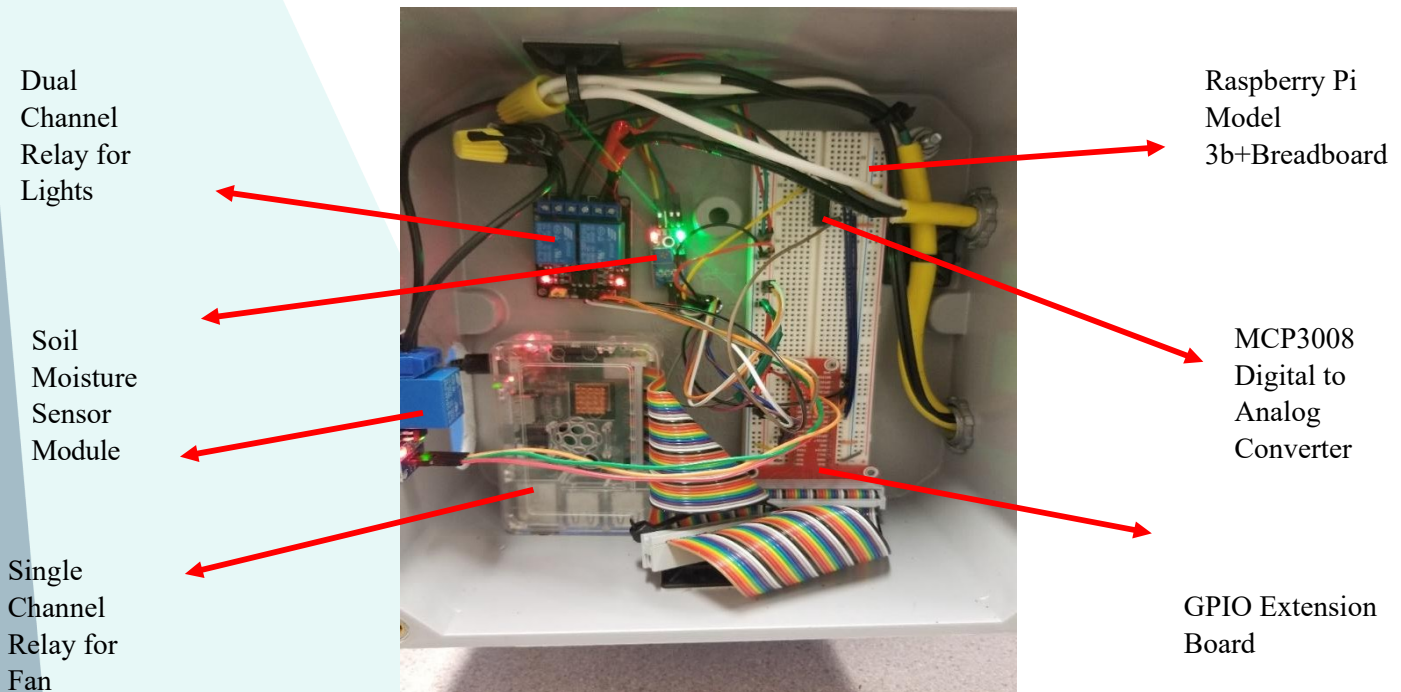
The internet of things (IoT) is a system that uses cloud computing so that embedded devices can send data to a common database. Cloud computing offers users the ability to access applications on demand while using a virtual infrastructure for analytic tools and data storage.² For example, a business can have all devices connected to a network and data will be sent to a “cloud” database that can analyze and recommend processes that will improve business optimization. Another example is that a homeowner can have all embedded devices sending data to an application system so that when the alarm clock in the morning goes off, their coffee maker turns on, all the lights turn on, and their toaster starts toasting bread. These grow cubes utilize the data sharing and management aspect of an IoT platform to allow users to view their plant data remotely and act when their plants’ health is suffering.

Originally this experiment was going to compare two grow cubes, each containing one lettuce plant, with one cube placed outdoors and the other cube placed indoors. The idea was to compare the plant health of each grow cube and determine which cube produced the healthiest plant. The purpose of this design was to show that both indoor growing and outdoor growing operations could communicate to the same database and offer potential users different types of growing environments. However, due to the difficulty of tracking outdoor environmental variables and a short time frame, the study decided to focus on building a single prototype and investigating

whether the prototype measures plant health reliably. This project now forms the base work of what could be a larger experiment with one thousand grow cubes using a robust IoT platform that would allow for more complicated data analysis and database capabilities. In the future, a second prototype can be developed to offer more benefits to users, such as automatic watering systems, fertilizing systems, and temperature manipulation.

Equipment and Testing Phase

The cubes were constructed from Rubbermaid containers with a Raspberry Pi 3b+³ mounted to each side. General-purpose input/output (GPIO) extenders and breadboards connected to the soil moisture sensor⁴, photoresistor⁵, PiNoIR camera⁶, and the relays to controlling both the fan and the two lights. Both the soil moisture sensor and the photoresistor were controlled by the SpiDev module⁷ and were converted from digital signals to analog signals through an MCP3008⁸. The PiNoIR camera used the PiCam module⁹ that was developed specifically for that camera and the raspberry pi. The camera was mounted on the top of the grow cube directly facing downwards on the lettuce plant.



Data Collection and IoT Framework

Data was collected using two Google API's, Google Sheets and Google Drive. GSpread¹⁰ was the chosen Python platform to send data from the Raspberry Pi Sensors to Google Drive and Google Sheets because it was the easiest method to use and did not require any payment for Google Console services.

Method and Results

NDVI Explanation

The most agreed upon way to analyze plant health is by calculating the Normalized Difference Vegetation Index (NDVI).¹¹ This index is commonly used by crop farmers to calculate the overall health of plants and crops. In order to calculate the NDVI, the near infrared (NIR) and the red-light values are used. Plants with foliage reflect light in the NIR spectrum and absorb the red light. The more chlorophyll a plant contains, the greener it is and the higher amount of NIR that will be reflected. Due to normalization, NDVI is measured on a scale from 0.0 to 1.0. If the result is 0.0 than a non-vegetative substance is being measured, and theoretically a measurement of 1.0 is the reading of the healthiest plant.¹²

The standard NDVI formula is:

$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})^{13}$$

When calculating the NDVI, the slope between the red value and the NIR value is what is calculated. The red light is absorbed by the plant and represents the visible light, and the NIR is reflected by the amount of chlorophyll in the plant.¹⁴ This means that the steeper the slope between the visible light and the NIR, the healthier the plant is. If a NDVI reading comes out low on the scale between 0.0 and 1.0 that means that the slope between the visible light and the NIR is not as significant and represents an unhealthy plant. To measure this with the PiNoIR camera it is important to realize that both red and blue are absorbed by the plant, while green is reflected. Therefore, both red and blue can be used to represent the visible light spectrum when calculating the NDVI. However, since there is no infrared filter on the PiNoIR Camera, red values captured by the camera actually represent the NIR. This means that the red values cannot be used to represent the visible light spectrum when calculating NDVI. A blue filter is provided with each PiNoIR camera so that the visible light spectrum can be caught. Therefore, the blue value is used to represent visible light. With red representing NIR and blue representing visible light the NDVI formula for the PiNoIR camera is as follows:

$$\text{NDVI(PiNoIR)} = (\text{Red} - \text{Blue}) / (\text{Red} + \text{Blue})$$

Therefore, based on both the standard NDVI formula and the PiNoIR NDVI formula, the general formula that is represented by both the PiNoir formula and the standard formula is:

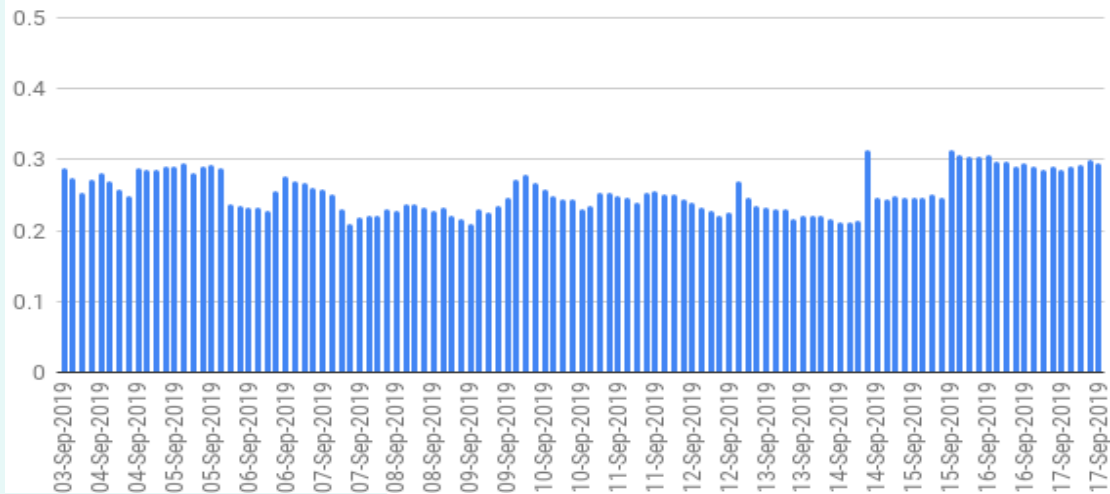
$$\text{NDVI} = (\text{NIR} - \text{VIS}) / (\text{NIR} + \text{VIS})$$

Experimental Phase:

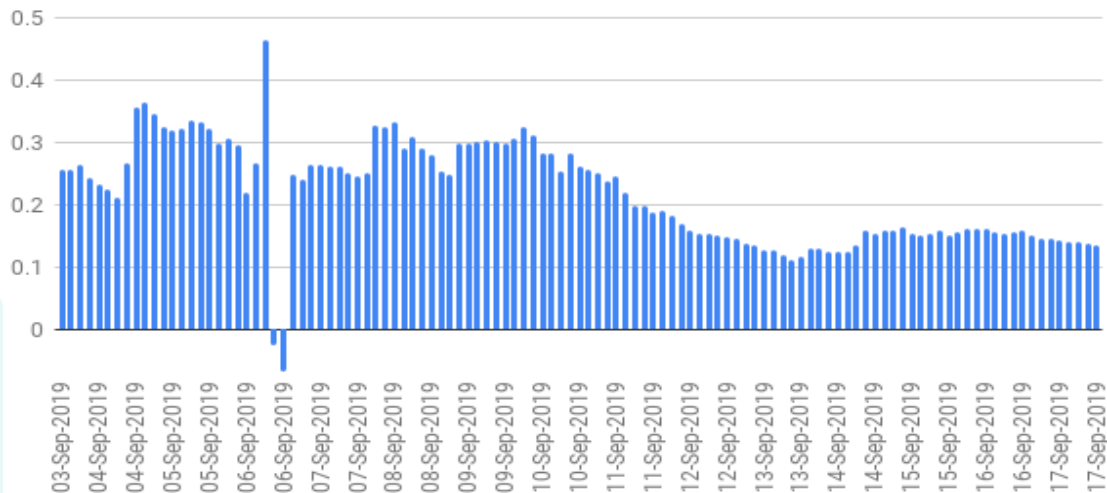
An experiment was conducted for fourteen days total, from 15:00 on September 3, 2019 through to 15:00 September 17, 2019. Both cubes contained lettuce plants that had been growing for 73 days (June 19, 2019 – August 31, 2019). The plant in cube 2 was left without water to monitor changes associated with its declining health and the plant in cube 1 was watered regularly. Data pertaining to soil moisture, light amount, and plant health were collected every three hours and inserted into a Google spreadsheet. There were some difficulties with the blue filter falling off in cube 2 on September 6, resulting in negative values on cube two's histogram until this was rectified.

The following histograms represent the NDVI data collected from both cube 1 and cube 2 over the fourteen-day period:

Cube 1 Health



Cube 2 Health



From the above graphs, it is evident that as the plant in cube two died, its NDVI declined, whereas the NDVI of the lettuce plant in cube one stayed relatively the same over the experiment period. These results show the ability of the prototype grow cubes to successfully calculate the NDVI and communicate that a plant is either thriving or declining in health. These graphs were accessible remotely using the Google API platform, which means that in the future, users can see whether their plants are doing well. Having this information on hand allows users to take action when their plants are not doing well, meaning that they can successfully grow healthy vegetables indoors.

Chlorophyll Extraction

At the end of the 14-day experiment, five lettuce leaf samples were chosen from the two lettuce plants, two from the dead plant in cube two and three from the healthy plant in cube one. The goal of this step was to develop a method of calculating a scale for lettuce plant health that could be used in future experiments. A picture of each sample leaf was taken with the PiNoIR camera and the NDVI was calculated and then matched with the chlorophyll absorption rate. To read the chlorophyll absorption rate, the following steps were taken:

1. Measure out 0.20 grams of each sample leaf
2. Use acetone to extract the chlorophyll from each sample using a mortar and pestle.
3. Strain the chlorophyll samples with more acetone and measure out each sample to equal 25 ml.
4. All sample were run through a centrifuge to remove leftover plant debris from the samples
5. Use a spectrophotometer was to read the absorption rate of each sample taken using the spectrums of 663 nm and 645 nm.

This method was taken from Sudhakar, Latha, and Reddy's book, *Phenotyping Crop Plants for Physiological and Biochemical Traits*.¹⁵ Using this method in future experiments would ideally be done at the beginning by first growing the same type of lettuce species and building a spectrum off of those samples before a larger experiment takes place.

Variables:

Volume (V) = 25 ml Weight (W) = 0.2 g

Absorbency (A) = Chlorophyll/Tissue

Formulas:

Chlorophyll A = $12.7(A_{663}) - 2.69(A_{645}) * V/1000 * W$
 Chlorophyll B = $22.9(A_{645}) - 4.68(A_{663}) * V/1000 * W$
 Total Chlorophyll = $20.2(A_{645}) + 8.02(A_{663}) * V/1000 * W$

Sample Spectrophotometer Values:

Sample	A645 nm	A663 nm
1	0.14	0.12
2	0.236	0.273
3	0.22	0.26
4	0.169	0.331
5	0.35	0.647

Final Calculations for Absorbency and Corresponding NDVI:

Sample	Chlorophyll A	Chlorophyll B	Total Chlorophyll	NDVI Index
1	0.005737	0.013222	0.018952	0.09131858422798239
2	0.0141613	0.0206338	0.0347833	0.04760015164375416
3	0.013551	0.019106	0.032646	0.06515503642694367
4	0.01874545	0.0116051	0.0303421	0.16418045023131667
5	0.036377	0.0249352	0.0612947	0.38447058143439383

Based on these numbers, there is an inability to produce a tangible scale of plant health that corresponds between the amounts of chlorophyll taken from the five samples, and the NDVI

index of each sample. However, in the future this method can be performed multiple times to produce more reliable results.

Discussion and Future Research

The background work performed in building a prototype has eliminated most of the trial and error that would take place at the beginning of a larger experiment that involves these grow cubes. Therefore, these prototype cubes could be built quickly and with the proper equipment in a short amount of time. The future experiment would consist of one thousand cubes, each using the same network on their own Raspberry Pi. With more time, a larger IoT platform would be used, or an independent web server and database would be constructed to handle the large amounts of data that would be relayed. With these one thousand cubes, the plant health would be monitored along with the environmental variables. As within the prototype, light exposure and soil moisture would be monitored, as well as temperature and humidity. With a more complex sensor system and larger area an automated temperature regulation system and watering system would be added as well.

The next step for the database and processing system would be to program the system so that the code detects the healthiest plant and simulates the environment of the healthiest plant in the rest of the cubes. Now, because these cubes do not have to be in the same area to relay data to the same database, the future experiment could incorporate having different cubes placed in different spaces while sharing the same database.

Collaborations

Electrical/Industrial Mechanic Department

Due to the electrical wiring and setup involved in building the grow cubes, the Electrical/Industrial Mechanic Department at Grande Prairie Regional College were consulted for help and the grow cubes were built there. Charles Sanderson and Kevin Young explained how basic wiring works and recommended the safest and most practical equipment to use. Jeff Johnston who teaches those enrolled in the Electrical program allowed for sit-ins and participation in classes and labs to learn how to program with larger electrical components.

Biology Department:

Dr. Jessie Zgurski was consulted on how to properly extract and measure chlorophyll levels from the lettuce plants. She aided in extracting the chlorophyll and using a spectrophotometer to measure the level of light that was absorbed by five lettuce samples.

Computer Science/Mathematics Department:

The main focus in the project was the coding and the results from collecting data on the lettuce plants and then placing this data on a platform to allow for remote access. Franco Carlacci guided the software installation, coding, and configuration process. Dr. Brian Redmond, the main mentor on the research project, guided the thinking behind which data to collect, how to represent the data, explained mathematical concepts behind the NDVI calculations, and helped design the main experiment.

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How Do Leadership Cults Arise?

An Analysis of the Sociological Factors That Collectively Lead to Leadership Cults

Nic Wright

This submission is the outline of a research paper adapted from an assignment for Sociology 1000: Intro to Sociology.

Introduction

What causes a “Hitler”? How do leaders of movements become lifted to a place of near-worship? How does a leader of a socially deviant movement gain exaltation from their followers? In this paper, I will refer to such movements as Leadership Cults. Mudde and Kaltwasser (2017) define a leadership cult as the artificial creation through various means of communication of the sublime and faultless nature of an individual. This paper will be organized into a literature review and discussion of four factors that collectively lead to leadership cults. The review of relevant literature will indicate if further research is necessary. The literature will be reviewed to see if it lends support to the following thesis: A cult of leadership occurs when mysticism surrounds a charismatic authority figure who offers social cohesion during a time of society-wide, or stratum-wide, normlessness.

Literature Review

The factor of charisma.

- It is important to understand the Weberian definition of the charismatic leader. This leader is one who is exalted and seen as having remarkable abilities and skills that set them apart from the masses (Robert, 1968).
- According to Robert (1968), charismatic leaders appear at various levels. On one end, they can be seen among movements from grassroots all the way up to international. Roberts (1968) writes, “they appear in diverse forms of social democratic and authoritarian, Western and non-Western, highly developed and under-developed economically. And they cross ideological lines” (p. 738). This recognition is fundamental in understanding leadership cults. Charisma is a great equalizer; it crosses boundaries, both socio-economic and national.
- Hitler is a classic example of how charisma can act as the foundation of a movement. Propaganda and media fabricated a large portion of Hitler’s public character. However, Hitler demonstrated extreme giftedness in writing and public presentation (Takala & Auvinen, 2016).
- The historicity of charisma in leadership is as wide as it is varying. Examples of the charismatic leader can be seen through Communism’s Lenin, Black Muslims of America, and Fidel Castro, (Robert, 1968). The fact that Hitler, Gandhi, Lenin, Stalin, Jong Il, and Mandela all have the common thread of charismatic leadership strengthens the theory itself. Otherwise, these leaders have little in common.
- This charisma is not always shown in all aspects of a leader’s life. Gandhi and Hitler were both leaders of cults of personality according to Mudde and

Kaltwasser's (2016) definition. While they both ruled the public stage, their private lives were not equally flawless (Takala & Auvinen, 2016).

- Trump demonstrates skill in his public speaking. Trump, like Hitler, saw a pre-existing fear among his audience. Trump focused on Christian nationalism. This focus was crucial in that it attracted voters to a man who was not seen as religious (Whitehead, Perry, & Baker, 2018). Charismatic here does not mean smooth or educated. Charisma is seen in the skill it takes to communicate ideas. In Trump, we see a bad speaker, but an incredible communicator.

Discussion on Charisma

- At this point, a weakness of this viewpoint must be mentioned. In order to fully prove the charismatic factor and its role in cult leadership, an exhaustive study on each known case of cults of leadership should be done. One of the limits to Weber's charismatic authority theory is its broadness. Further development in the form of case studies, primary source review, interviews, and other means of data collection would need to be done to "prove the rule."
- Charisma is a fundamental of a cult of leadership because it acts as a vehicle for a movement or regime's ideas and concepts: this explains why more time has been given to its study in this essay. Charisma is the packaging. We see in these leaders the ability to communicate and advertise their intended narrative. Without charisma, the success of this communication would be drastically lower. It is the coat hanger on which the other factors hang.

The factor of mass anomie

- There is a connection between charismatic authority and society-wide or stratum-wide normlessness (Robert, 1968). Durkheim defines this normlessness as anomie (Little, McGivern, & Kerins, 2016).
- Whitehead et al. (2018) state that Trump focused on five key things: "white working-class economic anxieties, misogyny, anti-black prejudice, fear of Islamic terrorism, and xenophobia" (p. 149). Whitehead et al. (2018) go on to summarize how Trump sensed the normlessness within certain strata of America and capitalized on it.
- Hitler and the Kim dynasty also responded to social problems that were seen to create normlessness (Takala et al 2016).

Discussion on mass anomie

- If charisma is the vehicle for cults of leadership, anomie is the road. Anomie creates the environment for the charismatic ideas to be communicated.
- Interviews from the symbolic interactionism perspective would provide crucial development of the importance of anomie in cults of leadership.
- Leaders of personality cults, like Hitler, tell the story that their followers want to hear and can identify with (Takala et al 2016). This story both highlights social anomie and offers a solution for it.
- Americans leading up to the Trump campaign felt anomie in a crescendo of strength. Trump's solution-based proposals attracted even those who had once voted for Barack Obama (Whitehead et al., 2018).

The factor of social cohesion

- Leaders of these kinds of cults promise what Durkheim calls social cohesion (Little et al., 2016).
- Identifying anomie is not enough. Leaders of personality cults communicate a solution to the anomie and are seen as the messianic personification of this promise (Robert, 1968).
- The 2016 American election was “repeatedly labelled as conservative Christians’ ‘last chance’ for citizens to protect America’s religious heritage...” (Whitehead et al., 2018, p. 153).
- The opportunity to be freed from societal struggles provides a substantial incentive for following the one who extends this opportunity (Robert, 1968).
- Hitler failed the moment his followers realized he could not come through with the cohesion that he promised (Takala et al., 2016).
- Pre-election polls for the 2016 American election revealed working-class Caucasians to be the most numerous allies of Trump (Whitehead et al., 2018). This stratum of American society was identical to Trump’s targeted audience.

Discussion on social cohesion.

- Leaders of personality cults are akin to prophets. They predict that under their tutelage, regime, or direction they can bring lost cohesiveness to society again. Under them, things will be “normal.” This offer of cohesion is crucial to the leader because without answers, putting a voice to the concerns of strata of society is not enough.
- An interesting way to develop this topic would be to interview those who voted for Trump in the 2016 election and discuss their reasoning.

The factor of mysticism.

- A level of mysticism surrounds the leaders of these cults. For example, Trump’s catchphrase was turned into a hymn (Whitehead et al, 2018). According to Whitehead et al. (2018), a view was held that there would be divine accountability if Trump was not voted into power.
- After death, Lenin was raised to near saint-like veneration (Robert, 1968). As a symbol, Lenin’s cult of personality lived on well past his death.
- Ferdinand Lassalle reached near godlike status (Robert, 1968).
- Hitler was seen as a legendary hero who would lead his people to a better world (Takala & Auvinen, 2016)

Discussion on mysticism.

- Mysticism allows a leader to transcend the flaws of man. Through mysticism, a leader changes from mere human to symbol. As a symbol, a leader of a personality cult can represent the messianic solution to their follower’s problems.

Further Discussion/Conclusion

- As research continues on how cults of leadership form, it must seek to prove or disprove the four theorized factors of cults of personality: charisma, anomie,

cohesion and mysticism. The literature reviewed provided an adequate foundation for this topic. However, it remains ethereal and locked in theory. Through studying the literature, a broadness stands out. In order to develop this thesis further, individuals should be interviewed. Past and present governments and movements with leaders who exhibit these four factors should be studied. This topic remains relevant because these cults of leadership still operate today. Further data collection on these movements is required in order to fully understand their cause and effect. However, based on the literature, it can be said that there is enough credibility within the presented thesis to warrant further research.

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