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A study on university student engagement within a forensic science course

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Abstract

Society's fascination with forensic science has been on an increase for many years. Evidence of this is supported by the development of many tertiary education forensic science programs and the continued increase in student numbers within these programs. In this project, we investigate the reasoning behind why students find forensic science an engaging field of study. The students (n=88) of a third-year undergraduate crime scene investigation course were surveyed at the end of the course. A study was completed using the quantitative data collected that was then validated with the qualitative student responses. The message from the students was clear, with 81.61% indicating that collaborative laboratory sessions and crime scene house attendance were the favorite teaching techniques. The lab sessions being the favorite at 59.77%. The survey results suggest that the reason for engagement is the effect of a collaborative work environment that has extensive hands-on course content.

Keywords: Crime scene investigations, forensic science, pedagogy, student engagement, training

Introduction

The public appeal of forensic science's role in crime scene investigation (CSI), including the CSI effect, has been well documented globally (Chan 2013, Hayes and Levett

2012, Holmgren and Fordham 2011, Khey 2006, Maeder and Corbett 2015, Kobus and Liddy 2009). Weaver et al. (Weaver et al. 2012) has specifically researched the CSI effect on university students enrolled in forensic science programs. Their results suggest students believe the CSI television programs were unrealistic but provided value for student recruitment and pedagogy. Although forensic science university and college programs continue to flourish, little is known as to *why* students like to engage in these programs (Jackson 2009, Samarji 2012, Illes et al. 2016). In particular, there is insufficient research at the tertiary level to answer why and how students remain or are engaged with forensic science in the classroom. Although student engagement, or what is also referred to as involvement, has been studied extensively (Carini, Kuh, and Klein 2006, Willms 2003, Kamilah et al. 2016, Lietaert et al. 2015, Nagro et al. 2016, van Uden, Ritzen, and Pieters 2016, Wilson et al. 2015), there have been no studies with a direct focus on forensic science student engagement.

Student engagement is a wide-ranging phenomenon, but can be defined as a basic sense of belonging. Engagement is measured by the extent to which a student will participate within both academic and non-academic activities. The engaged student understands and recognizes the value of schooling outcomes and how being involved can contribute to their time in school and success upon graduation (Willms 2003, Krause and Coates 2008). Researchers do not agree that engagement can be directly related to better grades; however, it is generally acknowledged that students who engage in school will be more persistent and satisfied which could lead to a more happier, productive life after school (Asmar, Page, and Radloff 2011, Carini, Kuh, and Klein 2006, Willms 2003, Gunuc and Kuzu 2014). Therefore, educational leaders should use multifaceted pedagogy within the class room to acquire these student successes. Many studies support the idea that teachers and researchers play an intricate role in student engagement. Young et al. (Young, Uy, and Bell 2017) specify how faculty involvement in graduate student research, scholarship and creative activity had a very positive outcome for student engagement. The concept of positive outcomes due to engagement are not new, as Austin's (Austin 1993) theory indicates that the more a student is involved in their education the greater their learning outcomes, while Pace (Pace 1990) suggests that the more time and effort that a student puts into their education the more positive result. The research into student engagement suggests a number of strategies that may include; positive classroom culture, foster student centred learning, incorporating complex and engaging course embedded assessments (Akers 2017, Quin 2017, Everett 2017).

Further and more specific to our study, research has suggested that students will engage more when presented with real world connections (Akers 2017). In our research, we have investigated a third-year forensic science course that provided extensive study of real crime scene images, access to hands-on technology (both in lecture and laboratory environments) that is currently being used in the field of CSI, access to practitioner based knowledge and virtual/real mock crime scene attendance. These pedagogic approaches offer extensive real-life problem-solving tasks for students who also benefit from a collaborative peer assisted environment. It has been suggested that these student engagement techniques can encourage

student ownership of the course material and self-efficacy (Kamilah et al. 2016).

In 2015 a virtual crime scene was introduced to our course curriculum as an primer to an essay assignment on crime scene processing and as a technique to enhance engagement. Prior to 2015 the students would attend a mock crime scene at the university crime scene house and we considered the move to the virtual crime scene to be a solution for the increase in course enrollment. The course was growing from 60 to 120 students so a crime scene visit was replaced with the virtual scene. Simulation based training have proven to be useful within a number of disciplines to enhance or optimize classroom learning (Lehtinen and Viiri 2017). In particular, the medical field has been using simulations for training and for surgical or treatment optimization for many years (Jalalimanesh et al. 2017, Keskitalo, Ruokamo, and Gaba 2014, Khunger and Kathuria 2016, McGaghie et al. 2014). Hence simulations have been used for tertiary education and for field work applications.

Studies have suggested that inquiry based learning must be directed to deliver an optimized learning outcome and this need becomes even greater when using simulations (Lehtinen and Viiri 2017). With proper implementation and pedagogic innovation, simulations have provided successful results in education, improved field practices, end-user outcomes and other collateral effects (McGaghie et al. 2014). Having implemented a virtual crime scene within the curriculum it seemed appropriate to assess the student acceptance of this technology and their preference between "real space" against the virtual simulations.

We have conducted a study based on a general definition of engagement and from a review of methods within the literature. Engagement is generally studied from two perspectives; the psychological and behavioural. Researchers have developed many methods for teasing out this information and specific studies that relate to our research are summarized.

The Organization for Economic Co-operation and Development Programme for International Student Assessment used a two-dimensional approach to measure student engagement on a global level. In a 2003 study (Willms 2003) the researchers measured two criteria; if the students had experienced a sense of belonging and their school attendance. The students sense of belonging was measured using six questions on how they felt about being accepted by their peers. The attendance was measured quantitatively by keeping track of frequency of absence, being late and skipping class (Willms 2003). The results from the measurable of this mixed method research provided a robust data set that was used to understand how youth were prepared for life after school. It should be mentioned that multiple studies have been conducted suggesting that class attendance has a direct link to course performance across multiple course content (Bowman 2009, Louis et al. 2016, Van Blerkom 1992). A study by Vasalampi et al. (Vasalampi et al. 2016) assessed the behavioral engagement, emotional engagement, competence experiences, disaffection and help seeking of their student participants. This was completed by examining lesson-specific class room experiences using a survey composed of eighteen questions. The study found support for the use of these InSitu instruments. The support for assessing both behavioral and emotional

engagement continues in studies by Wilson et al. (Wilson et al. 2015), where they investigated science, technology, engineering and mathematics (STEM) undergraduate students in five US universities. The researchers used a survey that was set up to connect key links between behaviour of the students and their emotional involvement while in university. The survey results provided support for student engagement. The successfully approaches within the studies provided a framework for our research.

In our study, we also used a mixed method survey approach. We have collected both quantitative and qualitative data from forensic science students to tease out information on how often they came to class, why they came to class and their assessment of level of engagement. This methodology is described in detail.

Methods

Background on the Course

The course consists of lectures and laboratory sessions on crime scene investigations. This is a third-year forensic science course with prerequisite requirement of; 60% or higher in a first-year Introduction to Forensic Science Course and an Introduction to Crime Scene Investigations Course. Beyond this the students enrolled in the course must be registered in the Bachelor of Science in Forensic Science Program or in the Forensic Science Joint Major Program. This ensured that our sample set only consisted of forensic science students. The core learning objectives were developed under the standards of the Higher Education Quality Council of Ontario, Canada (Illes 2016). The main learning objects are stipulated as follows:

1. A depth and breadth of knowledge of the basic principles of crime scene investigations and the most current scientific issues that are associated with forensic science such as; the NAS Report, Strengthening Forensic Science in the United States: A Path Forward, the Inquiry into Pediatric Forensic Pathology in Ontario and the paradigm shift for the comparison disciplines.
2. The knowledge of methodologies that are used within crime scene investigations such as; the use of hypothesis testing, the scientific method, scene and evidence processing fluid dynamics, mathematics and the comparison disciplines.
3. The application of knowledge that will include; basic scene processing, photography, evidence collection, fingerprinting and collection, footwear impression development and collection, bloodstain pattern analysis and comparison theory and law.
4. Communication skills in forensic science writing, specifically writing and referencing according to the Journal of Forensic Sciences.
5. The awareness of limits to knowledge for the comparison disciplines and the dynamic scientific paradigm shift that is occurring within CSI and forensic science.
6. The autonomy and professional capacity to understand the basic CSI principles and eventually influence scientific change within the discipline when considering the current issues.

A survey was developed to acquire those data that we considered vital in understanding student engagement in this class.

Data Collection and Analysis

A one-time online survey was administered to 114 university students within the third-year forensic science course. As state above, the sample set was controlled by only allowing forensic science student majors to take this course. The volunteer survey was launched within a lecture period and the students were provided time to complete it anonymously. Announcements within the Universities Online Learning Management System (LMS) were used to inform those students about the survey who had not attended the lecture. The survey was left open for one week with 88 (77.2%) out of 114 students completing the survey.

The survey was managed using Qulatrics software that was available through the university. It was comprised of both quantitative and qualitative questions. The quantitative questions focused on rankings of the various pedagogic methods used within the course and the student perceived impact or effectiveness of the methods, along with percent attendance to both labs and lectures, see table 1. Frequency distributions were analyzed using those quantitative data to support suggested conclusions. The qualitative questions teased out information on why the students came to the lectures and labs, their persistence, how they interacted and the general nature of the forensic science course environment. This information was analyzed to identify dominant themes and student attitudes on engagement in the course. Both data sets were compared to help show validation of the conclusions. The results of this study are discussed.

Table 1. Student engagement study survey questions.

Q2. Rank the following teaching techniques that were used within this course in order of preference, with 1 being best and 5 being the worst. (drag and drop)

- Interactive Lectures
- Collaborative Lab Sessions
- Virtual Crime Scene
- Crime Scene House
- Online Material

Q3. How did the active laboratory exercises that were used in this course impact your interest in the course?

No Impact	Minor Impact	Neutral	Moderate Impact	Major Impact
○	○	○	○	○

Q4. How did the interactive lectures that were used in this course impact your interest in the course?

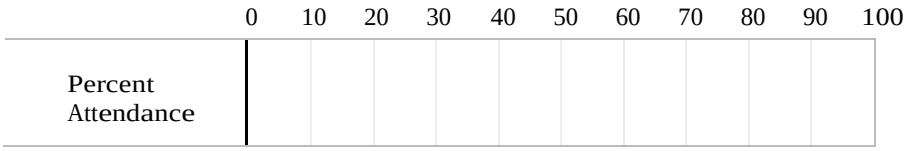
No Impact	Minor Impact	Neutral	Moderate Impact	Major Impact
○	○	○	○	○

Q5. Reflecting upon this course how did the collaborative classroom culture (hands-on work, group work, integration of research projects etc.) impact on your engagement?

No Impact	Minor Impact	Neutral	Moderate Impact	Major Impact
○	○	○	○	○

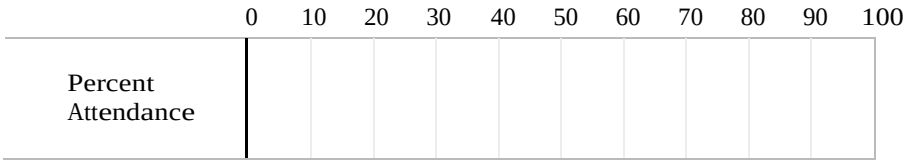
Q6. Why did you come to the lectures?

Q7. Approximately what percentage of lectures did you attend?



Q8. Why did you come to the labs?

Q9. Approximately what percentage of labs did you attend?



Q10. Rate yourself on a sliding scale of percent on the following statements:
0% (not at all) ….. 100% (absolutely)

	0 10 20 30 40 50 60 70 80 90 100
When I have a problem in class, I persist with the problem until I find a solution.	
When I have a question in class, I am not afraid to ask it.	
I enjoy working with others in the class.	
I find the interactive lectures really helpful for my learning.	
I find the interactive labs really helpful for my learning.	
I am a student who studies hard.	
I am a student who gets my work done on time.	
I am a student who likes going to class.	
I am a student who is curious about learning.	

Q11. Please provide additional information or comment.

Results and Discussion

Student Response Rate

This investigation focused on discovering information on why students in forensic science programs are so engaged in this field of study. Considering our research was about student engagement it is imperative that we start by talking about the resultant student response rate. Baruch and Holtom (Baruch and Holtom 2008) completed an extensive study on survey response rate levels analyzing 409 studies over 100,000 organizations and 400,000 individuals. They found that the average response rate on surveys by individuals was 52.7% with a standard deviation of 20.4%. This put our survey response rate at almost 25% above the researched derived average rate which is also significantly above and outside of the reported standard deviation. Comparing these numbers with our survey response rate of 77.2 % (88 students out of 114), in its self, is an indicator of the student engagement level within this forensic science course.

Quantitative Analysis on Student Engagement

The student response rate becomes more significant when correlated with those quantitative data from our survey. The survey questions can be reviewed within Table #1 and we start by discussing the frequency distribution results from Question #2, the ranking of teaching techniques that were used within the course.

Question #2 requested the students to rank the course teaching techniques, see Figure #1. These techniques included; interactive lectures, collaborative laboratory sessions, the use of virtual crime scenes, the crime scene house and the distributed online material within the LMS. The message from the students was clear, with 81.61% indicating that the collaborative laboratory sessions and crime scene house were the favorite teaching techniques. The lab sessions being the favorite at 59.77%. The online material and virtual crime scenes tied last at 1.51%. The lack of interest in the virtual scenes was surprising, considering the student age range (Generation Z) and todays digital environment, clearly showing that the students were more responsive hands-on and not digital experiences. The results from the next group of questions provide support for the discussion from question 2.

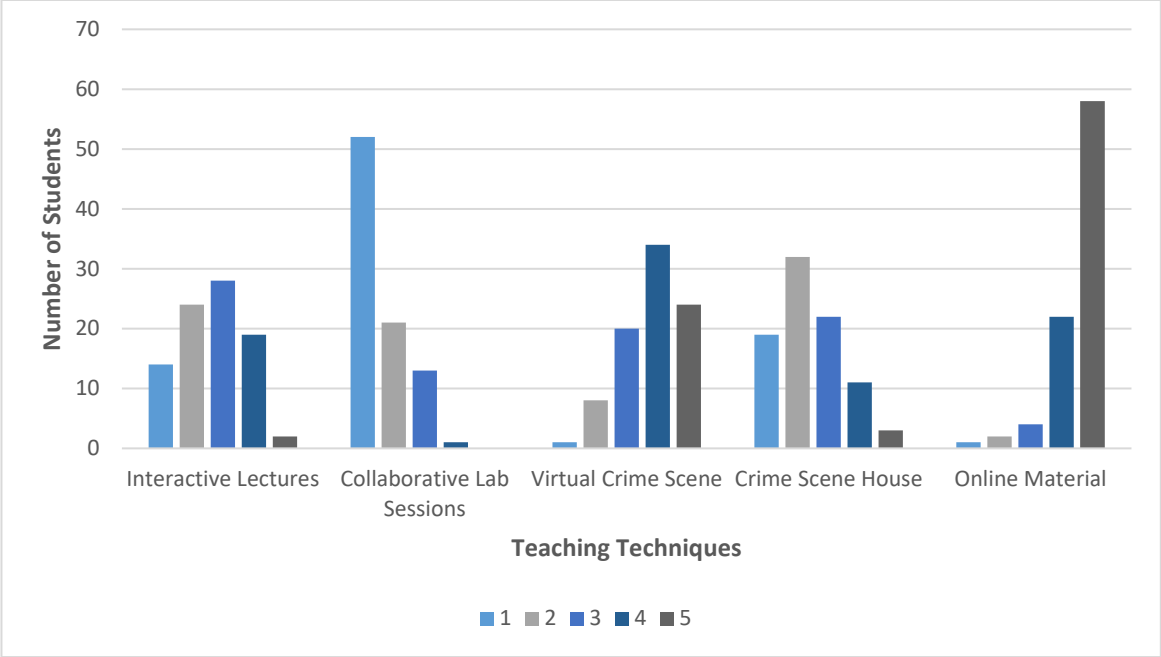


Figure 1. Frequency chart of ranking Question #2 data with 1 being the best, and 5 being the worst.

We combined questions 3,4 and 5 to develop a distribution chart for those quantitative data, see Figure # 2. These questions (Table 1) requested information from the students on how much the three teaching techniques, laboratory sessions, lectures and the collaborative work environment, impacted their engagement in the course. The students could choose from five levels; No Impact, Minor Impact, Neutral, Moderate Impact, Major Impact. The results from question #3 indicate that 96.59% of the students believed that the laboratory sessions had moderate (27.27%) and major impact (69.32%) on their course engagement. These results support those data from question #2 along with the 99.59 % mean percent results from question 9 that asked the students to approximate the percentage of labs that they attend. The interactive lectures contributed to an 80.68% combined moderate and major impact in engagement (question 4) with an attendance rate of 90.60% (question 7), while the collaborative learning environment provide a 77.27% engagement rating (question 5). We will syndicate this information with the following qualitative answers provided by the students.

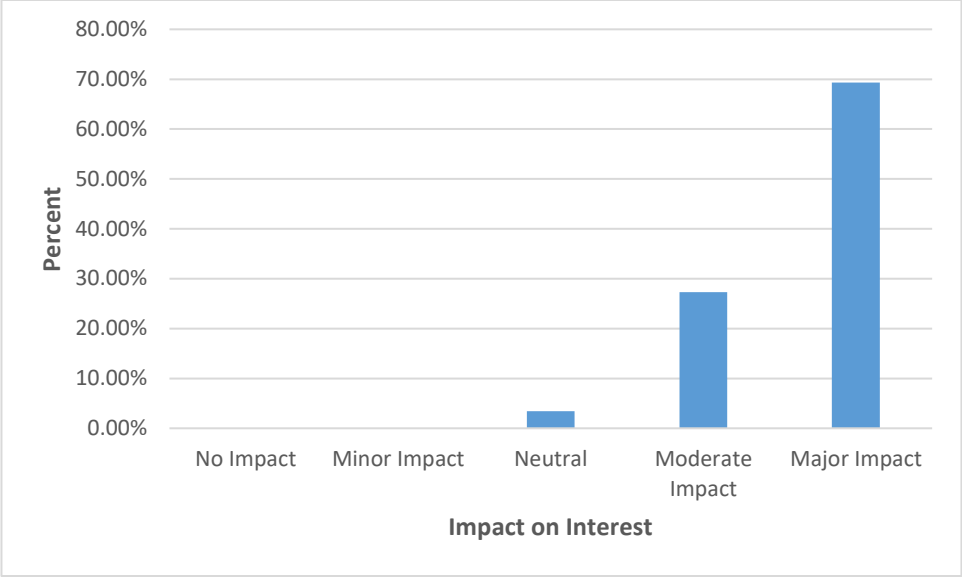


Figure 2. The laboratory exercises impact on course interest.

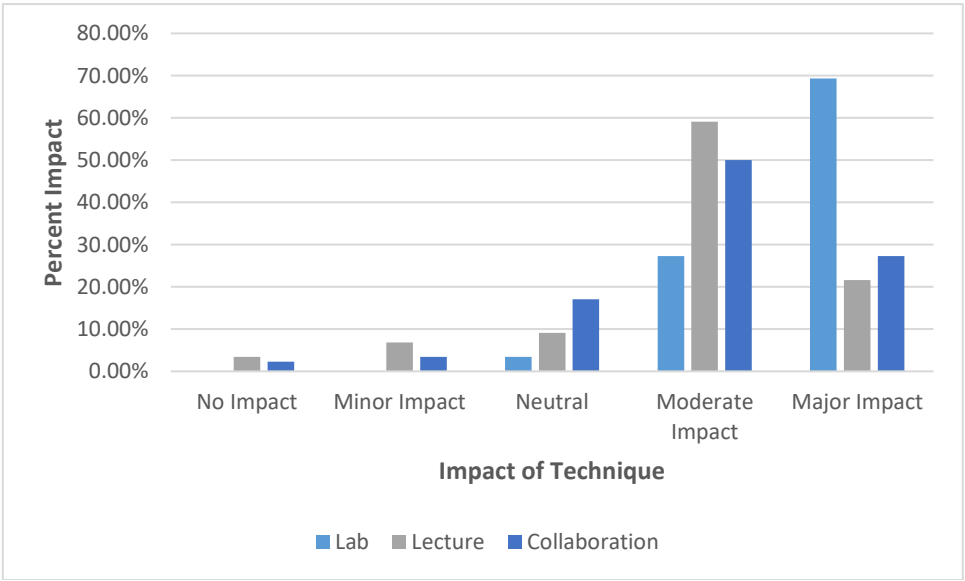


Figure 3. Combined results of question 3, 4 and 5 on the teaching technique impact on students.

Student Responses to Engagement Level

Our survey questions 6, 8 and 11 provided the students the opportunity to say why they attended the lectures, laboratory sessions and to add in any other comment. The student comments end up focusing on three main themes; that the material was interesting, that the classes were enjoyable and that they were eager to learn about the topic. These themes were consistent throughout when reviewing comments from the three questions. Upon analysis of

those data we found that the comments support those quantitative data collected. Here we provide a sample of student responses that clearly align with the high engagement response rate, percent attendance and frequency distribution charts. The following samples were selected from responses to the three questions;

I came to lectures to increase my knowledge about Crime scene investigating. I also, really enjoyed the course content.

Love how interesting this course is, it the one class I always come to because it's fun material, is interactive and I learn a lot.

The material is interesting, this is probably the only class where I learn more by listening than frantically typing out notes. Seeing real crime scene photos is also really fascinating.

This class is my absolute favourite class so far. I love Forensics and the really enjoyed working with the professor and assistants in this course--especially with how interactive and "hands on" this particular course was. It is fantastic to actually perform the procedures and to process a crime at the crime scene house.

Student reports of benefits of an active collaborative work environment that has extensive hands-on course content supports the quantitative information in this study. This mixed method data suggests the use of experiential learning and how important it is to the student participation and their engagement.

Finally, in question 10 we asked the students to rate themselves by percentage (0% not at all and 100% absolutely) while assessing against nine learning traits. Many of these questions supported the information already collected. Specifically, the average for the student's response from the question, "I find the interactive labs really helpful for my learning." was 96.31%, while on average 80.07% indicated that the interactive lectures were really helpful for their learning. Other questions focused on self assessments on curiosity, working with others, persistence, asking questions in class and work habits with robust means between 54.77 and 96.52%. These results support the quantitative evidence within this study while also suggesting a student participation level and sense of belonging within the course.

Conclusion

The research literature that has been presented supports both the need for student engagement within education and how to assess it with a mixed method survey approach. In our study, we used two comprehensive approaches of assessment, the students sense of belonging and their attendance to laboratory and lecture sessions. Beyond this we have offered qualitative information, the student comments, that support the quantitative evidence. Those combined data present a clear image of what the students found to be most important to their learning and school engagement specific to a third-year level university forensic science course. The obvious being that experiential learning such as examining a scene at the crime scene house and conducting laboratory experiments were the most important to the students for learning and their engagement. Surprisingly the use of a virtual crime scene received a negative response which in turn supports the more hands-on crime scenes and exercises approach.

The virtual crime scene was the lowest on the list at 1.51% when comparing the other course teaching techniques. Knowing that technology is impacting the field of instructional design, with many instructors and institutions implementing technology in the classroom (Amirault 2015, Butler et al. 2014), we consider the following outcome of this part of our research. At the time of implementation, the virtual crime scene was a novel technological approach to a course problem. The course was growing from 60 to 120 students so a crime scene visit was replaced with the virtual scene. The evidence from the student survey, that the virtual crime scene was ineffective, makes us re-think the use of technology in this situation. In fact, we believe now that when technology is considered, appropriate measures should be taken to examine its usefulness within a specific course and to the students. This statement is redolent within the literature that was reviewed on the use of simulations (Lehtinen and Viiri 2017). This information was a supplemental observation from our main research objective on student engagement.

In our study, student attendance was not taken due to university policy and we felt that taking attendance could remove the thought of free choice for the students. However, the literature proposes that class attendance can influence performance and can be a measurable of engagement (Louis et al. 2016, Willms 2003). Intuitively we knew that students were coming to class and we wanted to know why. The survey results provided clear information that the students came to class because of the collaborative environment, hands-on exercises and the course material was interesting and enjoyable. The comments received on how the students enjoyed a collaborative environment and the fact that the course was highly social in nature supported a strong sense of belonging for a high percentage of the students.

The strong student opinion and participation levels suggest that a hands-on, collaborative environment will engage students within a forensic science course. This research also supports the current paradigm shift within tertiary education, which is to supply students with a more experiential experience and multi-modalities of instruction at the undergraduate level.

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Author Contributions

PhD candidate/Professor Mike Illes developed, composed, executed and analyzed the survey. He was the main author of the manuscript which was the final product of a graduate reading course for his PhD. Dr. Cathy Bruce, Dr. Theresa Stotesbury and Professor Robyne Hanley-Dafoe provided expertise in the development of the survey and edits within the manuscript.

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