

Experiential learning in forensic science at the University of Toronto Mississauga: The merits of a forensic crime scene house

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Abstract: The University of Toronto Mississauga (UTM) is a leading institution in Canada for forensic science education. An invaluable resource for both the Forensic Science Program and forensic outreach at UTM is the Forensic Crime Scene House. Located on the UTM campus, the house offers students and visitors with a unique experiential opportunity to expand their knowledge and skills in the areas of forensic investigation, including crime scene processing and critical thinking. The Forensic Crime Scene House (CSI House) supports various undergraduate courses, external training workshops as well as general outreach to local schools and community groups, with more than 1000 visitors annually. This article describes how the Forensic Crime Scene House is leveraged to serve the largest possible number of students and participants, as well as future directions for creating a virtual experiential opportunity for marginalized and underrepresented communities.

Keywords: forensic crime scene house; crime scene investigation; forensic science; experiential learning; forensic analysis, community outreach

Introduction

At the University of Toronto Mississauga (UTM), experiential learning is at the heart of both the undergraduate and public outreach curriculums. The Forensic Science Program at UTM is the oldest program in Canada (created in 1995), and currently offers four specialist degree plans (Forensic Anthropology; Forensic Biology; Forensic Chemistry; Forensic Psychology) as well as a Forensic Science Major and a Forensic Science Minor degree plan. The Forensic Science Major is part of a double major degree at UTM and is designed to provide students with a general foundation of all forensic science has to offer. The degree plan focuses on crime scene investigation, where students graduating from this degree program are typically planning a career as police officers, special constables, detectives, or first responders. Students interested in the identification of human remains, skeletons and bones, or body recovery and excavation, are likely to pursue the Forensic Anthropology Specialist Degree. Anthropology students have a variety of avenues after graduation, including anthropological consultation for police investigations, human rights and genocide work, graduate studies, or medical school with a focus in forensic pathology and pathology assistantships. The UTM Forensic Anthropology Lab is managed by one of Canada's leading anthropologists, Dr. Tracy Rogers, who has been a primary investigator on some of Canada's most famous homicide cases. The Forensic Biology Specialist Degree at UTM focuses on forensic DNA

typing and human identity applications involving genetic markers. Dr. Nicole Novroski runs the Novroski Forensic Genetics Laboratory, where students focus on collaborative research in areas of human pigmentation and ancestry, transfer and persistence of DNA, population genetics and novel marker exploration and massively parallel sequencing panel development. The Forensic Chemistry Specialist Degree prepares students for a career in the laboratory, focusing on a diversity of applications from chemical fingerprint enhancement, to gunshot residue identification, to toxicological analyses. The Forensic Psychology Specialist Degree is unique, where the focus is not only the study of criminal behavior, but also the behavior of the judge and jury, how society perceives criminals, and how bias may interfere with a fair trial. Courses in forensic psychology also examine the forensic scientists themselves, by examining the bias and subconscious prejudice that may influence the way of a scientist doing their work objectively.

Since 1995, the Forensic Science Program has fostered many important connections with forensic science institutions worldwide, resulting in the opportunity for UTM students to engage in research and real-world employment experience; valuable tools that not only emphasize the learning experience but also help students develop their curriculum vitae in their undergraduate career. Of note, the program course offerings remain extensive and diverse, where program educators are a complement of full-time faculty and external forensic professionals who contribute in adjunct

capacities. Consequently, the program offers a curriculum of courses designed and instructed by individuals diverse in experience, discipline expertise, and who can offer unique experiential opportunities. The Forensic Science Program curriculum has multiple offerings in research, fieldwork or capstone initiatives, as well as many laboratory-based offerings to ensure a well-rounded experience with practical, tangible experiential components. The diversity of learning experiences offered at UTM are what the majority of higher education students want, employers increasingly demand and governments expect (1).

The Forensic Crime Scene Investigation (CSI) House on the UTM campus was an inherited property acquired by the University in 1998, and later adopted by the Forensic Science Program in 2009 (**FIGURE 1**). Located on Principal's Road (an access road off the main campus circle), the house is operational year-round and is supported by campus Facilities Management & Planning. The house, estimated to be built between 1877- 1886, was a temporary residence, then art studio for the original landowner, Charlotte Schreiber, one of Canada's pioneer female artists. Schreiber painted during an era in which she challenged patriarchal attitudes regarding the role of women in the professional art world (2). Since the adoption of the house in 2009, The Forensic Science Program has been refining how to best utilize the space in a way that supports the forensic science curriculum and associated applied courses, as well as other non-academic functions. As the house has grown in popularity both on-campus and within the local community, the reputation of UTM's Forensic Science Program has consequently increased, with program enrollments rising steadily per annum (data not shown).



FIGURE 1 Situated within the woods of the UTM property, the CSI House offers students the opportunity to apply their skills in realistic simulations.

Purpose and Goals of the Forensic Crime Scene House

The concept of a crime scene recreation house is not unique to UTM. Educational institutions including Trent University (Peterborough, Ontario, Canada), Marshall University (Huntington, West Virginia, USA), Keele University (Keele, Newcastle, United Kingdom) and West Sydney University (Sydney, Australia) have similar facilities for forensic education. To visualize the space and the goals of the house, an educational video was created and can be accessed here: <https://www.youtube.com/watch?v=IDGR0J1zG70>.

Internal Educational Training

The Forensic Crime Scene House currently supports multiple courses in the Forensic Science Program (FSC300: Forensic Identification; FSC302: Advanced Forensic Identification; FSC303: Techniques of Crime Scene Investigation; FSC399: Research Opportunity Program; FSC407: Forensic Identification Field School in collaboration with FSC311: Forensic Chemistry; FSC481: Internship in Forensic Science; and ANT306: Forensic Anthropology Field School), where skills development include crime scene investigation, 3D crime scene reconstruction, resiliency training as well as critical thinking and reasoning (**FIGURE 2**). Further, the Forensic Crime Scene House fosters interdisciplinary collaborations between the Forensic Science Program and the departments of Chemistry, Psychology and Theatre & Drama. For example, the collaboration between FSC407 (Forensic Identification Field School) and FSC311 (Forensic Chemistry), allows for students in FSC407 to investigate the crime scene and collect evidence in the house, and then, passing on the evidence to those students enrolled in FSC311, forensic chemistry students then will analyze the collected evidence for traces of compounds, residues and chemicals. Both FSC407 and FSC311 courses come together at the end of the term for a mock trial, where students are questioned and cross-examined by real attorneys, allowing for all involved to understand and appreciate the value of evidence examination, evidence collection, chain of custody, and evidence processing and interpretation in the lab. Alternatively, members of the Psychology Department have worked in collaboration with local police to re-enact different crime scenes, hiring students from the Theatre and Drama Department as actors for each scenario. In this exercise, investigators can practice their protocol(s) with real people who can simulate real-life scenarios.



FIGURE 2 Top: A FSC407 student practicing crime scene photography in a staged scenario. Photo by Nick Iwanyshyn. Bottom: A CPR mannequin is used in lieu of a real victim, while a potential weapon is discovered close by. Photo by Murray Clayton.

During the COVID-19 Pandemic, in an effort to increase student engagement, the Forensic Science Program developed an interactive murder mystery that navigated the user through the Forensic Crime Scene House remotely. Led by the university undergraduate Forensic Student Society, and in collaboration with students from the Theatre and Drama Studies program, actors filmed interrogation videos in the house, while sweeping shots of the crime scene were provided by video to participants to view and analyze. Students then submit their theories and conclusions via the society's social media channels, and new clues and room perspectives were uncovered daily, until the final solution was revealed. The society, and Forensic Science Program, found great success in maintaining engagement and a sense of academic community among students, even while at a social distance.

Advanced Independent Research

In addition to an elective Research Opportunity Program (ROP) that the University of Toronto offers, fourth year specialist students in the Forensic Science Program are required to complete a capstone experience as part of their graduation requirements, one option of which is an independent research internship. Both the ROP and research internship may be performed utilizing the CSI House and its surrounding grounds. The CSI House offers unique environments outside of a controlled lab or classroom that will mimic the complications of real, unpredictable environments. Some examples of previous projects using the CSI House include:

- *Fungus growth rates in internal environments*

Within the CSI House, pig cadavers were stored in tubs, and located in several areas of the house to simulate clandestine bodies, including the refrigerator (cold and dry), the basement (cool, but damp), and upper floor (warm and humid). Fungus/mold growth rates were recorded and compared between the environments, emphasizing the taphonomic impact of climactic differences within the same property location.

- *Limitations found in exemplar fingerprints versus simulated crime scene fingerprints*

In order to determine if AI training in fingerprint recognition was impacted between controlled versus simulated crime scene prints, items in the CSI House (incl. high-touch areas) were used as a simulation sample set, given the high traffic in the house for many years, leaving ample anonymized print samples to lift and catalogue.

- *Decomposition processes on winter-exposed remains*

Pig cadavers, used as proxies for human remains, were immolated and left exposed to the elements from January-April on the back lawn of the CSI House in order to observe and record decomposition rates in a Canadian winter climate (Southern Ontario specific) (3). Motion cameras were rigged to the house, to observe animal and insect activity throughout the season's snowfall and thaw.

- *Wear effects of water velocity on chop marks on bone*

The basement of the CSI House was used as a private, low traffic area in which to create a sub-pump system that could slowly erode bone samples across a semester in a controlled environment. While not dependent on the house to successful research, this

emphasizes a different use just as a designated space for forensic research.

External Agency Training

In addition to undergraduate classes, the CSI House serves the local community by supporting a variety of training opportunities to forensic and legal professionals, including officer resiliency training, blood spatter analysis certification, and unique experiential learning for the Scenes of Crime Officer (SOCO) program. These partnerships offer a reciprocal benefit to both the program and its students, as the relationships fostered through the use of the house contribute toward student internship placements and experiential opportunities offered by partnering institutions. As an example, the SOCO parent agency, Toronto Police Services, offers placements and research opportunities for fourth year students in the program who are interested in IDENT work. As such, it is common to see forensic alumni return to the UTM campus during SOCO training, having been successfully hired as a SOCO constable.

These fostered relationships also grant more opportunities for our students to engage in the forensic and policing community. The law of the CSI House has been used for special demonstrations of canine unit training, and subsequently students obtaining their research internship training with the unit officers, conducting the research on the CSI House property because of this connection.

Public Outreach and Potential Student Recruitment

While the Forensic Crime Scene House was initially acquired for the expansion of course offerings and experiential learning outcomes to undergraduate students, the house also attracted the attention of public interest groups, secondary schools and heritage tour groups. As a result, the Forensic Science Outreach Program was created, with a solid mandate of bringing accessible and transparent forensic science education to a wider audience, and to clarify misinformation that popular entertainment shows such as CSI and Law & Order may be presenting to a general audience. Prior to the COVID-19 pandemic, school tours to the UTM campus and Forensic Science Program exceeded 1500 visitors annually, where student groups from local secondary schools were exposed to demonstrations and activities that provided students with the opportunity to gain practical (tangible) experience within the environment for which they may one day be investigating. Due to the priority use of the house still being university education and training, the Outreach Program is typically limited to 1-2 tours a week during the academic year, with secondary schools often booking outreach reservations up to two years in advance to secure their opportunity to visit

the campus. Priority is always given to schools who have not previously attended. Target audiences are students in eleventh and twelfth grade, who visit for day-long field trips during the academic year. Mock cases are prepared in the CSI House that allow for students to identify blood on physical items using presumptive chemical tests, assess and collect potential evidence, learn techniques of crime scene photography, and understand the importance of proper record keeping and documentation. By mimicking real scenarios, students appreciate the authentic feel of the experience, and by reflective accounts of the teachers and chaperones, are often discussing the experience long after their departure from the UTM campus.

In keeping with the original mandate of accessibility, these outreach field trips remain free of charge for all visitors, fully funded by the Forensic Science Program. Equally as important to recruitment and public engagement is the opportunity that the Forensic Outreach Program provides undergraduate forensic students to demonstrate leadership, teamwork, and community service by volunteering as workshop and investigation facilitators. Outreach volunteers for the CSI House investigations are stationed at a ratio of one volunteer per four visitors, to give forensic students a smaller audience to whom they can practice their presentation and communication skills as they guide guests through investigation methods. In this way, the benefit of public outreach serves more than just the public itself, providing fantastic pre-employment experience to forensic students. Police recruitment staff are often interested in a candidate's ability to engage positively with the public, and the outreach program is an effective way of being competitive.

Camp UTM

Camp UTM is a series of weeklong programming that takes place on the UTM property in the summer, offering thematic sub-groups that caters to youth aged 9 to 13, including a Forensic Science Summer Camp. The forensic camp teaches children about investigation techniques through hands-on activities like dusting for fingerprints, basic DNA extraction, footwear analysis, and more. A major component of this camp is utilizing the CSI House as a part of applied experiential learning throughout the camp modules, to see these methods in a simulated environment. At the end of the week, participants get to apply these techniques for the ultimate test: investigating and solving a full case at the house and surrounding grounds. To simplify the educational experience and to be mindful of the audience, the "crimes" are designed to be appropriate for the age group and generally involve thefts, missing animals, arguments and mild assaults without a weapon. The camp counselors, or leaders, are upper-year students in the

Forensic Science Program and, similar to the Outreach volunteers, they are given the opportunity to take what they've learned throughout their undergraduate journey and teach it at a rudimentary level to interested, and often very excited, children. These camp leaders will have also had extensive experience in the CSI House as a part of their own courses.

The revenue from this camp program funds many of the outreach initiatives that take place throughout the academic year, including the purchase of supplies and the wages for Outreach Assistant Work-Study students-undergraduates that are paid to assist in events, drive student engagement, and design new outreach program modules. The use of the house provides a unique experience that few other camps can offer.

Success in the Forensic Science Summer Camp program has been overwhelming, with reservations filling months in advance, often within the first week of opening. Staff and Faculty of the Forensic Science Program have been told by several current undergraduate students in the program that they attended the camp as youth, and it redirected their focus into forensic science, ultimately deciding on UTM's Forensic Science Program as their top choice for post-secondary education. One student, who had attended the camp, became a camp leader herself, eight years later. This is accurately representative of our students' cycle of 'giving back' to the university and the community that has fostered their passion in the field.

Outcomes

Forensic Science Alumni

When the Government of Canada *Future Skills Council* published their 2020 recommendation guide for building a skilled and successful workforce, among their priorities was a need for expansion of experiential learning. Graduates are increasingly expected to stand out from a growing pool of competition, and thus being able to demonstrate proficiency and comprehension of techniques, often before employment, is what sets a candidate apart from other applicants. The paradox of employers requiring an applicant to have experience, yet an applicant not being able to gather experience without being hired first, is mitigated through the unique experiential education that an institution with a crime house provides. Forensic science, as a discipline anchored by the idea of *application*, requires students to train by means of experiential opportunities as a graduation requirement. In 2015, Statistics Canada released a National Graduates Survey, which demonstrated that bachelor's level graduates with workplace experience not only earn more, paying off student debt within two years of graduation, but also reported a better match between education and their job, subsequently returning to school at a lesser rate (4).

The employment rate of graduates of the Forensic Science Program at UTM is typically high, with most students who gain employment after graduation finding those positions within 1-2 years after graduation. Often, employment information is relayed when the alumni, having had experiential research mentors in their final year, return to the program to become mentors themselves, contributing to the cycle of experiential education and public engagement.

Forensic Science Outreach

Success of the Forensic Science Outreach Program is quantified through the popularity of the program, as well as the rise in enrollment. Undergraduate students within the program have identified their decision to study forensic science as a direct result of the outreach program, as well as the forensic summer camp. The following testimonials serve as a tribute to the success of providing a meaningful experience in the career directions of our high school participants:

"The CSI house was awesome. The students loved it and were very engaged during the activity, and they've been talking about it since. It was also great for them to do the chemistry workshop in a university lab and get a feel for that environment. The upper year students who were leading the workshops were fabulous, and they answered a lot of questions about university and were able to share some of their experiences with the students. The entire experience was valuable. We loved the experience, and Bramalea would bring students again in a heartbeat! If there is an opening next year, please let us know."

- Bramalea Secondary School, Ontario
30 Students, Grade 11

"The entire day is very valuable to the experiential learning for students. Students always enjoy all aspects of the day and very much appreciate hearing from Dr. Rogers and all of the volunteers - your program is unique, meaningful and provides a rare opportunity for high school students. My Grade 12 Law classes have thoroughly enjoyed visiting your campus and I have repeatedly heard from them that it is the best trip of their high school experience. Hopefully you will continue the Outreach Program next year. North Park can't wait to visit again. Thanks for all of the time, energy and passion that you put into this educational opportunity."

- North Park Collegiate & Vocational
School, Ontario
23 Students, Ages 16-18

The return on investment of the Forensic Crime Scene House has been multifold for the Forensic Science Program through increased enrolment, an increase in experience throughout the undergraduate program, increased employability (due to increased technical skills, critical thinking and resiliency), high reputation (as a consequence of high caliber graduates) and the ability to offer non-academic educational training and experience to the local and broader community.

Future Directions

As the Forensic Science Program continues to expand on the UTM campus, the offerings for both enrolled students and community members will continue to expand.

The Forensic Science Program at UTM currently resides within the Department of Anthropology, a supportive department, but a department that is not totally in line with the vision of the interdisciplinary nature of the program. Given the importance of experiential education at UTM, the goal of the Forensic Crime Scene House is to create an environment of shared investment from all stakeholders (i.e., students, instructors, mentors and supervisors, staff and university executives).

Previous research has shown that university – high school collaborations that provide opportunities for high school students to learn in a university environment encourages them to consider potential careers in science and help their transition to university (5). Opportunities for on-campus education are not readily available for many students from marginalized communities, especially for specific science disciplines (6). In addition, it has been shown that interaction between high school students and university instructors can have a positive influence on student identities as emerging forensic scientists. (7, 8). We aim to deliver this experience and promote forensic science as a possible career option to all students by re-creating experiential learning that can be done without traveling to our campus yet still provide the experience of the crime scene house with hands-on activities.

Finally, a long-term goal is the development of a virtual Forensic Crime Scene House experience that can be disseminated to vulnerable, underrepresented and/or marginalized communities whose students may not have the opportunity nor the ability to visit the UTM campus in person. The virtual tool may utilize undergraduate students and/or faculty whose research involves crime scene reconstruction (for example, students of FSC406H5: 3D Crime Scene Mapping and Reconstruction). Rudimentary 3D walk-throughs of the house have already been created utilizing digital software

used in real case investigation (an example may be accessed here: <https://youtu.be/c5lDnMHx-U0>). The Forensic Science Outreach Program partners with many different community groups that often experience barriers to STEM education, and this initiative is one instance of barrier reduction. Once again, mutually beneficial arrangements are formed between the communities in need of access, and the program's own members to be able to refine their skills in communication, public engagement, and leadership.

Support from programs such as the NSERC PromoScience and internal funding will allow the Forensic Science Program to leverage current outreach offerings to a larger, more diverse audience and to promote the forensic sciences to students of all ages.

Conclusions

The Forensic Science Program at the University of Toronto Mississauga acknowledges the great asset and fortune in having been able to adopt the Schreiber cottage as its Crime Scene Recreation House. While universities may acquire property in several different means, from inheritance to new construction to external estate purchases, the investment in these properties are returned in significant ways.

Creating an experiential educational opportunity for both students and community members has demonstrably expanded overall interest in forensic science, as well as interest in UTM as a priority choice for post-secondary education. Undergraduate students and internal researchers benefit from having simulated spaces in which to apply skills, demonstrate knowledge, and test new or unique hypotheses and the CSI House provides employment opportunities for a large number of graduates as forensic practitioners. External partnerships are strengthened not only by allowing agencies and institutions to use the house for their new hire training, but also offers opportunities for reciprocal engagement with undergraduate students looking for connections and mentorship. Outside of practical training, the Forensic Science Outreach Program bridges the gap between the public and the often exclusive, misrepresented world of forensic science depicted in the media. The increased interest drives corrective education and, as an added bonus, increased enrolment. The CSI House has allowed the Forensic Science Program to emphasize a uniquely experiential education for university students, which is in more demand than ever before. Being one of the first programs of its kind in Canada, alumni are associated with an exemplary reputation for applied learning that surpasses theory-based academia- not only have they *heard* and *seen* how the work is performed; they have performed it themselves.

As the Program continues to expand, the possibilities for how to maximize the use of the house are limitless. New opportunities are being presented continually, as new students, agencies, and community groups are introduced to the valuable experiences that the house can provide.

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