Developing a transdisciplinary citizen science tool for experiential learning in undergraduate education: Squirrel Life in a nutshell

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Abstract

Pre-existing challenges of inequitable access to inclusive and meaningful science and education experiences have been widely exposed and magnified during the COVID-19 pandemic. As the transition towards a post-COVID reality begins, it is critical to continue to actively address these challenges. However, these problems transcend disciplines and the traditional siloed approach to science creates inefficiencies in problem solving and developing solutions to address systemic problems. In this paper, we discuss the transdisciplinary approach we applied to address educational inequities, which allowed us to begin to solve problems and ask questions in other diverse disciplinary areas. Specifically, the Squirrel Life project draws from and provides solutions to problems spanning the disciplines of Higher Education, the Scholarship of Teaching and Learning, Ecology, Computer Science, Data Science, Software Engineering, and Graphic Design.

To demonstrate this approach, we present the Squirrel Life project as a case study for the usefulness of transdisciplinarity in addressing diverse and seemingly unrelated challenges while considering three key design priorities. These include 1) Active and Experiential Learning, 2) Accessibility and Inclusion, and 3) Usability. These key design priorities were informed by the needs of the various stakeholders, which were determined through collaboration with educators, students, and community members. While many of these needs were directly related to challenges created by the COVID-19 pandemic, these requirements resulted in an initiative and tool that is more inclusive, accessible, and overall superior to something we would have developed had these considerations not been made.

Throughout the development process, we discovered additional benefits to participants, including support of physical and mental wellbeing, and fostering a sense of community. Squirrel Life started as a collaborative Google Spreadsheet, transitioned to a Google Form to record field notes and data, then a free data collection app (EpiCollect5), and has finally evolved into the Squirrel Life citizen science mobile application for Android and iOS smartphones. The mobile app will expand the reach of the project beyond the Guelph community. The intentional design of the Squirrel Life project and mobile application supports the integration of experiential learning into undergraduate science curriculum, and the creation of a citizen science project that engages individuals in large-scale environmental monitoring research. The EpiCollect5 trial version of the Squirrel Life app is currently in use by community members and over 650 undergraduate students, and the public release of the official version of the Squirrel Life mobile app is imminent.

Keywords: Citizen science, higher education, experiential learning, transdisciplinary, active learning, accessibility, inclusion, digital tool, usability, app development

1 INTRODUCTION

Equitable access to high-quality educational experiences is a long-standing challenge, particularly in large first year undergraduate courses. In March, 2020, these challenges were further exposed by the COVID-19 pandemic and the need to quickly transition from in-person instruction to virtual learning

(Robertson et al. 2021, Thomsen et al. 2021). The hurried pivot meant that experiential learning was often abandoned (but see Jacobs et al. 2021 and Robertson et al. 2021) in favour of the more traditional lecture style forms of content delivery, thus further reducing accessibility to learning (Kuh 2008), especially for students from underserved communities (e.g. Haeger and Fresquez, 2016). The COVID-19 pandemic opened our pedagogy to more accessible ways for students to engage in class, but also challenged us to reduce the barriers to experiential learning.

To foster experiential learning and research opportunities at the undergraduate and graduate level in Canada, there has been a call to develop more transdisciplinary education and research opportunities (Schmitt 1960; Jantsch 1972; Rittel et al. 1973; Polk 2015; McPhee et al. 2018; Jacobs and Gillis, 2016; Gillis et al., 2017). These opportunities are purposefully designed around a 'real-world problem' (Thompson Klein et al. 2001) to build teams of students, community partners, researchers, and others to work collaboratively in ways that transcend disciplinary and interdisciplinary approaches to solve complex challenges. This has been particularly important during the COVID-19 pandemic, where these teams have developed solutions to slow the spread of the disease and to protect the lives of people around the world (Bernardo et al., 2021). Transdisciplinary team-based approaches have also been important in the development of numerous technology-based solutions that address, for example, the Digital Divide (Durish et al., 2021), the need for community-based environment and health monitoring (Sawatzky et al., 2020), and food insecurity (Korzun et al., 2014a and 2014b). In each of these examples, the development of technology-based solutions required the contributions, expertise, and lived experiences of many individuals from a diversity of backgrounds. This was necessary to ensure that the solutions served a diverse range of needs - from those of the researchers and community leaders, to the users of the various tools that were created. With this in mind, the Squirrel Life Project was developed with a transdisciplinary lens. That is, the research team worked to develop an experiential learning opportunity for first year undergraduate students by first building a transdisciplinary team.

Here we describe how we designed an experiential learning opportunity for first year undergraduate students in large classes by building a transdisciplinary design team to create a digital platform for the Squirrel Life citizen science project. The diverse perspectives represented in the Squirrel Life team helped to inform design priorities, laying the foundation for a more inclusive and robust tool. This project has now supported over 2,000 undergraduate students and is being scaled up to engage members of the public from all communities as citizen scientists.

1.1 Active and Experiential Learning

Experiential learning programs can provide high-quality, authentic experiences to undergraduate students and enhance transferable and discipline-specific skill development and knowledge acquisition (Kolb, Stains et al. 2018, Thiry et al. 2011, Wurdinger & Allison 2017), especially for students from poor and working-class backgrounds (Astin 1993; Owen et al. 2021). Experiential learning involves a cyclical process of having an experience, reflecting on the experience, learning from and connecting it to existing knowledge, and then applying what has been learned (Kolb 1984). Through this approach learning is viewed as a process where knowledge is continually formed and reformed through experiences and reflection (Bruner & Bruner, 1966, Kolb 1984). This process gives students the skills, knowledge, confidence, and opportunity to participate in higher order thinking (Sivalingam and Yunus, 2017) .

In most post-secondary programs, opportunities for experiential learning increase with the program stage, such that upper year students have more opportunities available to them than first year students. Offering experiential learning as capstone experiences does address the often considerable challenge of providing equitable access with limited resources. Though the cost of offering an experiential learning opportunity can be considerably higher than traditional lecture style lessons (e.g. Ellmann 2015), there is evidence to suggest that exposure to experiential learning in early program years provides an enhanced benefit to student learning (e.g. Aukes et al. 2008).

Training for an experiential learning opportunity can come in many forms, including passive learning modules, or even no training at all. A 2018 survey of STEM higher education in North America found that 'traditional lecturing' remains the dominant pedagogy (Stains et al. 2018) despite the significant evidence base supporting that other techniques are more effective and inclusive. Though active-learning teaching techniques are generally regarded as best-pedagogical practice (Freeman et al. 2014), high-intensity active learning can narrow learning gaps, especially for students from equity-seeking communities, and providing them within the core curriculum reduces barriers to access (Theobald et al. 2020). Given the clear benefits of active experiential learning, providing equitable access to opportunities should be prioritized.

1.2 Accessibility and Inclusion

Accessibility and inclusion can be considered from several perspectives including, but not limited to, equitable access to opportunities, data availability and access, and the accessibility of the tools themselves. From an educational viewpoint, achieving accessibility and inclusion in science education and experiential learning requires more than including a diversity of people. To provide truly equitable access, the principles of inclusion must extend to pedagogy, learning materials, physical spaces, digital tools, and technology, so that all participants are engaged and have equal opportunity to participate in high-quality learning experiences. Experiential learning opportunities are often offered outside of the required undergraduate curriculum, placing the responsibility on the individual student to seek out opportunities and overcome financial and other barriers (REF). Fortunately, connecting experiential learning with curriculum is becoming more common, as either a curricular component (experiential learning experiences completed for credit) or course-based (experiential learning used as a pedagogical technique and embedded within a course) (REF). Even still, the design of some opportunities creates barriers. For example, traditional field work courses (a popular type of experiential learning) are financially expensive, require students to take time away from prior responsibilities (e.g. family, work), and can have physical requirements that make them inaccessible (REF). In these situations, the onus is again placed on the individual student to self-advocate and find their own accommodations (Bingham, 2021).

Finally, within the province of Ontario, Canada, software developers must consider the Accessibility for Ontarians with Disabilities Act (AODA, 2005) so that the software they develop is accessible to everyone. This involves considering accessibility design at all stages of software development to ensure access regardless of a person's status or accessibility needs. A key component of this is the usability of technology and digital tools

1.3 Usability

Usability encompasses how easily a user can navigate an interface, including intuitive design, that is, the ability of a user to accomplish a task using the interface (e.g. a website, a mobile application) without training. Ideally, the design of a mobile application should be simple enough that a user can execute basic functions (sign-up, log-in, navigation) without instruction. One approach to facilitate this is limiting the number of actions or tasks a user can do on each page, thus decreasing cognitive load as the user navigates through the app.

1.4 The Squirrel Life Project

The Squirrel Life Project combines the design priorities of active experiential learning, accessibility and inclusion, and usability in a citizen science project to offer an inclusive framework for engaging undergraduate students in meaningful science and authentic research, regardless of skill, experience, or access to resources. We achieve this by reaching beyond the boundaries of academia and disciplinary silos to actively engage students and the broader community in ecological citizen science research. This facilitates meaningful connections to science, reduces barriers to equitable science learning, and supports.

Citizen science engages untrained individuals and members of the general public in scientific research (Bonney et al, 2009), and is beginning to be recognized as a powerful tool for providing authentic opportunities for undergraduate students to build and practise research skills (Mitchell et al., 2017; Oberhauser & LeBuhn, 2012) and other discipline-specific and transferable skills (Kobori et al., 2016; Phillips, Ballard, Lewenstein, & Bonney, 2019; Phillips, Porticella, Constas, & Bonney, 2018). A combined framework of citizen science and experiential learning was used for Squirrel Life because of similarities they share in learning outcomes (Bruner & Bruner, 1966; Gilbert et al., 2014; Kobori et al., 2016; Kolb & Kolb, 2005; Phillips et al., 2018), and the capacity of citizen science programs to be highly scalable and support many participants. Additionally, citizen science invites communities to engage in science research, and therefore citizen science models and best-practices may naturally address accessibility and inclusivity (Heinisch, 2021), and many (but not all, for example those that require expensive or specialized equipment to participate) projects uphold these elements. In fact, the accessibility of a citizen science project influences how successful and long standing it is (Chase, 2016). Access to the data and information generated by these projects is an important consideration, and citizen science projects with web-based data portals (e.g. iNaturalist (https://www.inaturalist.org/), eBird (https://ebird.org), Marine Debris Tracker (https://debristracker.org/)) put the data back into the hands of the people who collected it.

In this paper, we present the transdisciplinary approach taken to create the Squirrel Life project and the development of an associated mobile app and web-portal, prioritizing the aforementioned three key design priorities: 1) Active and Experiential Learning, 2) Accessibility and Inclusion, and 3) Usability. These priorities were chosen through collaboration with educators, students, community members, computer scientists, software engineers, and data scientists. Complementary to our design priorities, we recognized that it was critical to design the project to flexibly support student learning while not overburdening instructors. An early version of the Squirrel Life project was successfully introduced as a pilot in a first-year undergraduate biology course during the Winter 2021 semester (January to April 2021) (see Robertson et al 2021), and lessons from this were implemented during the refinement of the project and app development.

2 METHODOLOGY

Designing Squirrel Life was a collaborative transdisciplinary process that required the expertise and contributions of team members from numerous disciplines, including biology, computer science, software engineering, pedagogy, and data science. This was necessary to ensure that the tools developed would support research questions from multiple domains, with a preliminary focus on biology and pedagogy.

Active and Experiential Learning

The initial design of the Squirrel Life project was designed based on institutional and evidence-based resources (REFs) criteria for a successful experiential learning activity. These criteria are briefly summarized in Table X. To participate in the Squirrel Life project, students go for walks on safe, well-marked, frequently travelled trails and observe and record the behaviours of the squirrels they see.

Table X: Experiential Learning Criteria in the Context of Squirrel Life

Experiential Learning Criteria (MCU, 2017)	Squirrel Life
The student is in a workplace or simulated workplace.	Students are expected to: ● Follow a structured data collection and reporting protocol ● Use the skills a scientist or biologist would use while doing fieldwork (observation, safety, attention to detail, communication, [others]) ● Manage their time to complete the project (plan proactively, use organizational and time management skills)
The student is exposed to authentic demands that improve their job-ready skills, interpersonal skills, and transition to the workforce.	Students must make judgement calls (what type of squirrel they see, how to describe the behaviours they observe, etc) and deal with messy data while they are out doing Observation Activities

The experience is structured with purposeful and meaningful activities.	Students contribute to a real dataset that will be used by the general public and scientists for research. *Real projects, not make work projects*. Data for ecology, pedagogy, [other] projects
The student applies university or college program knowledge and/or essential employability skills.	Students are asked to familiarize themselves with the squirrels in their area so they can identify the species Students learn about basic animal behaviour and had to apply this knowledge while in the field to report on what the squirrels are doing
The experience includes student self-assessment and evaluation of the student's performance and learning outcomes by the employer and/or university/college.	At the end of each Observation Activity, the student must evaluate how confident they are in their observations The culminating project for Squirrel Life is a worksheet where students reflect on their experience and share their favourite/least favourite parts of the activity, what they learned, their favourite nature experiences, and anything else important to them Student participation is formally evaluated by a Teaching Assistant who reviews their data collection reports and worksheet.
The experience counts towards course credit or credential completion or is formally recognized by the college or university as meeting the five criteria above.	The Squirrel Life project is worth 5% of the final course grade in a first-year undergraduate biology course.

Mobile Application Development

Prior to beginning the design of the mobile application, the biology team collaborated with a group of students, community members, researchers, and naturalists to understand what each stakeholder would want in the project and a digital tool. Based on the early versions of Squirrel Life (a Google Sheet and a Google Form), the recurrent themes in the feedback were: 1) a more user-friendly interface, 2) the ability to easily record more detailed observations (beyond just a point-count), 3) GPS tracking to automatically record walking route and location of squirrel observations, and 4) a platform to easily explore the data.

To support the design of the Squirrel Life tools, an Agile software design process was used (Beck 2001, Cockburn 2006). We began with the identification of a set of requirements over the period of several weeks at the beginning of May, 2021. Specifically, several virtual team meetings were held where we: 1) discussed the overarching goals and needs of the software, 2) identified the different types of users, and 3) worked to describe the specific functionality required to support active and experiential learning, accessibility and inclusion, and usability. Requirements were documented using a shared Google Sheet to allow for easy access and editing. The process of identifying requirements also involved describing specific actions and functionality that each type of user would require. While the list of requirements would not be considered exhaustive, they provided sufficient detail for the design team to understand the minimal viable product, as well as functionality that might be developed for future versions of the tools. Once the team was satisfied that the requirements adequately described the intended tool, the team categorized each requirement as a *must, should, could, or won't.* This was initially done independently, before the team gathered virtually to finalize the categorization of each requirement. In the event that team members categorized the requirement differently, a discussion was had before a consensus on the categorization label was reached.

Table X Design priority considerations

Design Priority	Key Considerations	Design Elements
Active and Experiential Learning	• Criteria for experiential learning based off of University of Guelph requirements MCU 2017 [others?] summarized in table X	• University of Guelph requirements for experiential learning • Best practice documents (MCU 2017)
Accessibility & Inclusion	• Participate anywhere, anytime, regardless of abilities and access to resources • Flexible time constraints/ requirements • Flexible options to participate	• AODA • Students in different parts of the world (different time zones, different levels of access to safe spaces, different species of animals) • Students with different responsibilities (have to work) • Using a citizen science framework
Usability		• AODA, PIPEDA, CASL

One take away from the first group run through of the wireframe was noticing how complex the mobile app would be. Originally it was planned to have different interfaces for each user type on the app. Once it was laid out on a wireframe however it was clear that it was much more complex to build than how it appeared on paper so the team had to agree on how to reduce the project scope. It was decided to move the admin account to just the website to reduce development time. We also decided to merge the citizen scientist and student user pages, opting to make some elements on the pages dynamically change depending on the account type. This would allow the team to build the app in a shorter time frame and reduce complexity.

With the development of a list of categorized requirements, the design team began building paper and wireframe prototypes using both Google Drawings on Chrome (version 96.0.4664.55), and Adobe XD (version 21.0.12). These were used so that the entire research team could visualize the process flow of the mobile applications and the web-portal while remaining virtual, and to ensure that the design team completely understood the pedagogical and research needs of the tools being developed. The prototypes were presented to the research team during virtual meetings over several weeks during May and June of 2021 to collect as much feedback as possible. The design was also shared with non-research team members (specifically students and community members) to collect informal feedback from the end-users. Feedback was then used to refine or extend the list of requirements, and to update and improve the design of the prototype.

Once the research team was satisfied with the design of the prototype, the design team began to implement the Squirrel Life mobile application and web-portal using React Native (version 0.66 https://reactnative.dev/). React Native was selected to allow for ease of development for both iOS and Android devices and for the web-portal. This choice also allowed for the development of responsive tools. A PostgreSQL (12.8) database was created to house data collected via the apps. To protect the integrity of the database, an Application Programming Interface (API) was also created. Code was shared and managed by the design team through the use of a GitHub repository.

The testing methods used during this project were user testing, acceptance testing, and end-to-end testing[1]. Since the Squirrel Life app was mostly functional GUI components, much of the testing was done by hand simulating how a user would interact with the app and edge cases on what the user could input. That is why the team used acceptance testing and end-to-end testing, so we could test how the user would interact with the app and simulate the entire flow of the app. We also used user acceptance testing. This is when we give the app to the users and watch and see how they use the app. From that we can watch and listen to them to see where they get stuck, confusing points they might find, and promptly solve problems they face. This allowed the app to fast track through development because we could get user feedback early and not waste time polishing off parts to only need them changed due to user feedback.

We collected user feedback using Apple TestFlight and testing groups on the Google Playstore. This allowed us to put the incomplete app on testers phones and allow them to test the app as it was incrementally updated. We could get feedback at each development step and receive constant input from our users on what they did and did not like about the app. For example, users wanted bigger buttons for the home page and higher contrasting colours for the app. This let them see the interface better at different lighting levels and on a greater variety of screens than the developers could test on. These tools allowed continuous acceptance testing during the app development phase.

To improve the usability and accessibility of the mobile applications and the web-portal, special considerations were made to accommodate several legal requirements within Canada and the province of Ontario. These included the AODA, the Personal Information Protection & Electronic Documents Act (PIPEDA 2000, https://www.priv.gc.ca/en/), and the Canadian Anti-Spam Legislation (CASL 2010, https://fightspam.gc.ca/eic/site/030.nsf/eng/home). In particular, this involved designing to improve accessibility for visually impaired users. For example, multiple visual aids indicating choices made by the user, options to undo steps and reverse accidental actions, and pictures and labeled texts to help people who have trouble seeing colour, encryption and permissions and defaulting to opting out of future contact by the research team. When the user selects a squirrel image, a coloured box appears around the picture and a check mark appears beside the species name to show the user that it had been selected.

To test the Squirrel Life tools before release to the Android and iOS App Stores, the research team conducted extensive testing. This involved the creation of multiple test accounts and the submission of various observations representing all possible features to the back end. This allowed the design team to narrow in on any specific issue, such as crashes, or other user-interface malfunctions, that would impair user experience. This form of testing was done in the field with real data in order to ensure the pathway through the various stages of signing in, logging observations, and submitting data were seamless and accessible in all the relevant settings. When issues were discovered, they were communicated to the design team via a shared Google Sheet, and categorized by importance in collaboration with the end-users, ensuring the most significant issues were addressed first.

To account for the lack of familiarity first time users will have working through the app, a group of students from the University of Guelph and city of Guelph community members were given access to the suite of Squirrel Life tools to informally test and provide feedback on them. The testers went on Squirrel Walks and navigated through the app without prior knowledge of the design process, and provided verbal and/or written feedback detailing any issues they experienced and any suggested improvements. Perhaps most importantly, we also involved testers who had no prior connection or experience with the Squirrel Life project. This simulated a brand new user navigating the app without knowledge of what exactly the app was supposed to do. This provided the most informative feedback.

Once the Squirrel Life tools were updated to correct any user identified issues or other bugs, the mobile application was compiled for both iOS and Android platforms. These were uploaded for processing and review by the respective online stores. While the official Squirrel Life app is under review by the App and Play Stores, we use EpiCollect5 (https://five.epicollect.net/) to collect and store data in a similar way to what the Squirrel Life app would. The temporary use of EpiCollect5 makes it possible for us to further test our data collection protocols, and start building excitement in the community for the official launch of

[1] https://www.atlassian.com/continuous-delivery/software-testing/types-of-software-testing

the Squirrel Life app. The design team also made any necessary upgrades or corrections to the mobile applications based on feedback from both the Android and iOS stores.

Accessibility and Inclusion

Accessibility and inclusion were considered from both a computer science/design perspective (covered in the "Usability" element), and in the context of how people can access and participate in the Squirrel Life project. To support students in equitable access to the experiential learning opportunity, we acknowledge that each student is an individual with unique priorities, class and work schedules, family responsibilities, extra-curricular commitments, etc. Therefore, we prioritize flexibility in three ways: time, location, and participation method. Time: The Squirrel Life project and assignment submission was open for 9 weeks of the 12 week semester so students could plan around their other deadlines and commitments, and complete the project at a time that best suited them. Location: Squirrels are the focal species because they are found almost all over the world (REF). To support students who could not find squirrels or who live somewhere without squirrels, we included an "Other" option so they could choose a different species (e.g. pigeons, cats, dogs) and observe it using the same observation protocols and collect data with the same tools. Participation method: students participate in Squirrel Life by either going for a walk to observe squirrels, or completing a stationary (point count) observation. The stationary observation can be done from inside (looking out a window), or by sitting in an outdoor spot. We provide a fully virtual option to students who cannot participate in these options, which currently involves having them watch a livestream animal cam of their choice. In the future we hope to set up a dedicated fully virtual "Squirrel Cam" option.

Usability

When designing the app usability was considered as one of the most important aspects of the app and website. A number of things were considered in order to help streamline use of the app for all possible participants, specifically the accessibility, learnability, memorability and the overall user satisfaction in order to improve the apps usability.

From an accessibility perspective; taking into account the colours used in the app's design was to make sure that no feature was reliant on colours that could cause issues to anyone with any type of colour blindness. This ensured that the user interface would be as simple and easy to use regardless of the colours chosen. The tech-literacy of the users was also taken into account, by making the user interface as intuitive to use as possible with minimal excess menus, pop-ups and distractions, it was possible to ensure that anyone with any experience in technology could use the Squirrel Life app and website. The previous point ties into the learnability of the app, which was addressed by streamlining the process that a user would have to go through in order to create and submit data to the database. Furthermore, we limited the number of tasks a user can do on each page in the app to decrease the cognitive load on users and prevent overwhelming them. For example, when a user records a squirrel observation the first page is to select the species of squirrel (represented pictorially and textually), and the second page requires the user to select the behaviours the squirrel was performing, then the user ends the individual squirrel observation and can continue their walk. Breaking up the observation into multiple smaller steps and using visual aids, such as pictures, is how the app was kept simple and intuitive to any user at any technological skill level. We also ensured the user could reverse as many actions as possible (by clicking a back button), and those that could not be undone had an additional pop-up to confirm the choice.

The learnability was increased by doing this making it easier for any user to get used to how to successfully use the app and website. The memorability of the overall user flow (the order and way a user uses the application to complete their objective) was also taken into account by having specific symbols and clear labelling on certain buttons and tabs. This ensured that no matter how long between any two instances of a user using the application, they would be able to remember or easily relearn how to go through and successfully use the applications. The final aspect that was taken into account was how satisfied the users would be after using the applications. By making sure the user could feel like their contributions mattered via an easy to use feedback system, it reminds the user that their thoughts and data are important, helping to improve their satisfaction with the app. By also making sure the overall system was simple and intuitive as covered by the accessibility and learnability elements, the overall user satisfaction was taken into account as well.

3 RESULTS

Following an Agile design process, a non-exhaustive set of requirements were identified for each of the various users of the system. User labels included: *student, citizen scientist, instructor, researcher, and administrator.* Each user was assigned specific roles within the Squirrel Life tools. Specifically [insert roles of each of the users].

Squirrel Life was written using React Native (Version 0.66). To encourage future development and participation from the broader community of users, the application code and documentation is available for review at [Git Info]. The tool has been released with [Open source licencing details]. The app can be found on the Apple and Android App Stores.

Squirrel Life will be released as both an iOS and Android mobile application with a responsive web-portal for students and citizen scientists to review, edit, and analyze the data they have collected, as well as the data collected and released for the general public. The mobile applications are supported on devices with Andriod version XXXX and iOS version XXXX. The web-portal can be found here: [Insert URL]

The continued success of the Squirrel Life project is best demonstrated by the feedback from students who participated. In a previous offering of Squirrel Life (Winter 2021), students reported that participating in the project benefited their mental health, and gave them a greater appreciation for their natural surroundings (Robertson et al., 2021). This, and other themes, were echoed again by students during the Fall 2021 offering:

QUOTE (theme: mental health)
QUOTE (theme: exercise/ activity)
QUOTE (theme: connecting with nature)
QUOTE (theme: break from school)
QUOTE (theme: overall enjoyment/ fun)

The Squirrel Life project also supported instructors in providing active experiential learning to students, located around the world, without increasing their workload. Once the materials were created, the Squirrel Life project took less than 1 hour to set-up on the Learning Management System (LMS). Over the 12 week long semester, less than 5% of the class requested help, and after being directed to the instructions provided on the LMS most were able to resolve the issue independently. Facilitating this took less than 2 hours, and was handled by a Teaching Assistant as part of their regularly contracted hours. Overall students did very well on the assignment, with an average grade of 96%. To date, students have participated in the Squirrel Life project from 5 continents: North and South America, Africa, Asia, and Europe.

While providing high-quality experiential learning for students, the Squirrel Life project is also the beginning of a long-term research project which will generate a large dataset for ecology (squirrel data), pedagogy (participant data), community-engaged, and computer science (participatory-design, open source) research. Uniquely, most ecological citizen science data is presence-only data (ref), but the Squirrel Life project collects presence-absence data. That is, participants can complete and submit an observation activity whether or not they actually observe any squirrels.

- [STILL TO ADD?] Set of images of design process
    - Original idea (find chart from the start of my MSc?)
    - Next stage (Adobe XD stuff? Pictures in drive?)
    - Final product

4 CONCLUSIONS

Our integration of citizen science and experiential learning comes at a time when the need for systems approaches, inclusive education, and barrier-reduced access is more broadly realised. The benefit is that now we are better able to identify outcomes; where in the past, these learning opportunities may very well have supported student mental health, now we hear our students say it directly to us. We are grateful to our students for their careful feedback, which has allowed us to expedite our efforts. We have been able to respond to feedback about access with small modifications such that students living in urban mega-city centers are able to engage at the same levels as those living in rural desert communities. Further, our transdisciplinary design approach has resulted in a program that can serve many needs and our users have become inspired to share their visions for what we might do next. An important next step to ensure Squirrel Life is fully accessible will be to set-up a “Squirrel Cam” livestream to support fully virtual participation. Necessary modifications will be made to the Squirrel Life app to support data collection for this participation option. To the app itself, these future developments include expanding the preset species options, allowing for customization, adding photo functionality, view map functionality, and other features. To the database, we intend to design a researcher portal as the data accumulate, to make the data easily accessible for future research.

Ultimately, the Squirrel Life Project will be used to reimagine citizen science and experiential learning to support inclusive and accessible high-quality experiences for students and the broader community. This will facilitate learning and engagement with nature to empower people to make a difference in their local communities to protect the natural world.

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Squirrel Life was founded and is based in Guelph, Ontario, on the traditional lands of the Attawandaron, Hodinöhsö:ni', and Anishinaabeg peoples, on the treaty lands of the Mississaugas of the Credit. Within the jurisdiction of the Two Row Wampum and the Dish with One Spoon Covenant, we are reminded that as inhabitants of Turtle Island (the ancestral name of what is referred to as North America) we are also responsible for protecting and caring for this land, living sustainably, and respecting diverse ways of living, learning, and knowing. We are grateful to live and work here and are committed to continuing to learn how to be better stewards of this land, and pass this on to others. Our priority is to address local and global challenges to our changing planet with an integrated approach by interweaving Indigenous Knowledge and Scientific Knowledge, such that all voices and perspectives are meaningfully represented and respected. Take a moment to connect with the land you are currently on and think about what you will do to protect and respect it. We encourage you to visit these resources to learn more about the land you live on: https://native-land.ca/ and https://www.whose.land/en/.

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OTHER BITS- removed/not used (paper)

Many 'traditional' organizations and institutions (for example, universities) are slow to replace outdated exclusionary policies and practices, and may not prioritize universal accessibility upon creating new ones (REF). From conception, projects and experiences should be intentionally designed to be accessible for all people, regardless of circumstance or ability. Additionally, challenges related to institutional and instructor resource availability (financial, time, materials, learning spaces, etc) that may degrade the quality of the experience must be considered and mitigated.

Probably remove: [To be considered an effective experiential learning activity, the student must engage in an activity that reflects real work experience, be presented with authentic demands that strengthen transferable skills with real-world applications, engage in purposeful and meaningful activities that are aligned with program learning outcomes, apply their knowledge and skills, complete a self-assessment and be formally evaluated, and the experience should count towards course credit.]

These skills are directly relevant to students' future careers, and closely aligned with first-year biology course program learning outcomes. The Squirrel Life activity puts these skills into use with purpose and meaning: to contribute to a real dataset that can be accessed and used by the general public and researchers. This eliminates "doing work just for the sake of doing work".

The reflection element of experiential learning was filled in 2 ways. To fulfill the reflection element of experiential learning, students were asked to complete a worksheet where they shared their favourite and least favourite parts of the activity, anything they learned, and/or their favourite nature sightings.

Info

https://iated.org/inted/call_for_papers

- Submit online (need account): https://iated.org/concrete2/login.php?event_id=42
- No graphics in abstract
- Final paper: 4-10 pages (including refs)
- Ref style: https://iated.org/citation_guide

Timeline

- [ ] Abstract due: November 18th **Abstract submission EXTENDED TO DEC 2ND**
- [ ] Notice of acceptance/rejection: Dec 20th
- [ ] Paper submission: Jan 13 2022
- [ ] Registration deadline: Jan 13 2022

Brainstorming

- Case study, here's what we did, how we worked together, etc

- Interdisciplinary aspect
- Here's a set of the things we need the tool to do in education during a pandemic…
- Pedagogical buzzwords
  - Experiential learning component
  - Mental health
  - Active learning
- Uses/ outcomes
- Evolution from Google forms to NOW
- Intro paper to the tool, how to use it
- Front load the important goals, what were the big things that everyone needed ("pillars"): Pedagogy, Learning, Digital Tools, …

OTHER BITS- removed/not used (abstract)

There is often resistance to the use of novel methods of providing these experiences and exploring methods that differ from those that are widely accepted.

Opportunity to interact and explore data
Community forming – working towards common goals

authentic engagement in science and nature.

From GIER proposal: The Squirrel Life project draws from best practices for Scholarship of Teaching and Learning, and ecology, for integrating experiential learning into undergraduate science curriculum and developing citizen science programs that engage individuals from multiple disciplines to contribute to large-scale environmental monitoring research. It will encourage students to participate in community-engaged learning to develop an understanding of the needs and knowledge gaps most relevant to the
community. An issue faced by all higher education institutions is the challenge of providing high-quality,
meaningful experiential learning in large classes.

Provide opportunities for authentic engagement in science education, forming meaningful connections with nature,

In this paper, we introduce X pillars of "what do we call this framework?": Pedagogy, Community, Software Development

Paper Draft Outline

- [ ] Liz- MOVE INTO WORD DOC TEMPLATE once finished draft
- [ ] 4-10 pages including refs

- [ ] Schedule work session times