Outdoor Classroom Capstone; Trail Design

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Introduction

Paul Smith's College needs another outdoor classroom to fulfill the needs of faculty and students for outdoor learning. The current outdoor classroom is older and is normally reserved before the semester starts. There are also many educational and health benefits an outdoor classroom can provide. By adding another outdoor classroom, more students and faculty will be able to have class outside. Outdoor classrooms can result in the degradation of the nature the students are supposed to enjoy if mismanaged. Harming the natural landscape of the outdoor classroom is almost as if you're damaging an outdoor classroom itself. When designing, the outdoor classroom it is important to consider a sustainable design to reduce impacts on the landscape. This is especially true, because of the campus culture of sustainability and natural resource management. We want to determine what is the most sustainable outdoor classroom that would accomplish the needs of the users. My subject focus on the outdoor classroom design team is creating sustainable trails. Sustainable trails protect the environment, meet user needs and expectations, and require minimal maintenance.

Covid-19 Pandemic

During the coronavirus pandemic, there has shown an increased need for outdoor classroom spaces. Outdoor classrooms allow for appropriate social distancing outside of the confined classroom (Superville, 2020). It is a challenge for education institutions to provide safe learning space and continued experiential education within an indoor classroom. Professors have lectured classes completely over zoom because there was no available seating in classes. An outdoor classroom can allow for additional seating space, proper aeration, and social distancing during a pandemic (Superville, 2020). Outdoor classrooms can give students and teachers a

break from wearing masks. For this reason, the outdoor classroom format has become popular since 2020 nationwide.

Health Benefits

Research suggests there are other health benefits for students in outdoor spaces aside from pandemic prevention. Even young children that spend time outside have better health and learning outcomes than those who spend time inside (Largo-Wight et al., 2018). Health benefits include a decrease in myopia symptoms, better immune systems, and increased concentration (Largo-Wight et al., 2018). Nature is also stress-relieving. It stimulates less utilized areas of the brain and restores fatigued cognitive resources to cope and manage stress (Largo-Wight et al., 2018). Classes that utilize outdoor learning and nature study in conjunction with class materials showed these characteristics. Research also suggests that these benefits can extend past outdoor education, but also to core classes such as math or literacy (Largo-Wight et al., 2018). Outdoor classrooms are becoming more important as Americans are spending more time inside especially during the quarantines and restrictions. Americans are spending 90% of their waking hours inside (Samet & Spengler, 2003). An outdoor classroom can allow more students the opportunity to be in nature when they are otherwise required to spend a significant amount of time indoors.

Experiential Education

Providing spaces that allow for experiential education is one of the most important things about an outdoor classroom. Experiential education is a hands-on learning method that encourages students to use problem-solving skills and analysis in real-world applications (Association for Experiential Education, n.d.). Teachers can use the outdoor classroom as a field example in classes. In a college geoscience outdoor classroom, students rated the field learning

experience highly as very useful and essential (Waldron et al., 2016). The students had an overall positive rating for the use of their outdoor classroom (Waldron et al., 2016). Paul Smith's College has many classes that could use an outdoor classroom for similar field learning experiences. Some examples are environmental resource analysis, park and recreation design, dendrology, ornithology, and other environmental and natural resource courses.

Sustainable Design

The outdoor classroom design takes into account the impacts on the environment. One of the major long-term impacts is from trails. Foot traffic and social trails can affect the soils and plants of the area. When visitors are not constrained to formal trails, unsustainable informal trails could occur (Barros & Pickering, 2017). They can damage plant communities that are slow to recover when they are disturbed (Barros & Pickering, 2017). Aconcagua Park in the Andes struggles with having a large amount of informal social trails. A study done in the park found that only 10% of the vegetation in the park has not been damaged by visitor use (Barros & Pickering, 2017). Similarly in Hong Kong, they noticed trail degradation due to poor trail design, lack of maintenance, and a large number of visitors (Ng et al., 2018). Poor trail design can include improper trail grades. A sustainable trail grade should be on average a maximum of 10% grade (American Trails & Massachusetts Department of Conservation and Recreation, 2008; US Forest Service, 2007). Lack of maintenance can cause erosion and the decline of structures. Proper sustainable trail planning and maintenance are essential to prevent the degradation of the land surrounding the outdoor classroom.

Methodology

Faculty and Student Survey

The purpose of our study is twofold: determining if there is a need for an outdoor classroom and the best design features. We decided to use a self-administered online survey through Google Forms. These surveys were focused towards the two key user groups for the outdoor classroom: the Paul Smith's faculty and students. According to the Paul Smith's College website (2021), there are approximately 750 Paul Smith's students. There are 32 majors available to Paul Smith's students. There are approximately 70 faculty in the directory including adjunct professors at Paul Smith's College. The 5 departments that faculty are categorized into are business and hospitality, environment and society, forestry, and graduate studies.

We conducted a simple random sampling was conducted of the faculty and student bodies. All faculty and students were sent an email to the google forms survey. We did not do a stratified or clustered random sampling to ensure an equal representation across majors and departments, because of time limitations. Due to the title "Outdoor Classroom," certain majors and departments that may be less inclined to take the survey. This creates a bias towards outdoor and environmental majors. An incentive to take the survey was not given and was optional to faculty and students. A prize or incentive may also encourage other majors to participate. Given more time future surveys should consider utilizing a clustered random sampling to ensure all students and faculty are represented. Sampling our two user populations is easier than the larger surrounding community because we had email access. This saves time and resources by excluding individuals outside the Paul Smith's community. Due to this, there is a biased towards the Paul Smith's community. Other staff on campus were also excluded. This includes

individuals that may oversee the outdoor classroom such as administration, maintenance, and facilities.

We determined that faculty and students should be surveyed separately, because of the separate needs and perspectives. While there are some similar or the same questions there are a significant amount that are only applicable to either students or faculty. For example, students are asked, “what major are you in?” Where as faculty are asked, “what department(s) do you teach in?” The study utilized both qualitative and quantitative data. One example of quantitative data that we used was, “how many students do you need to accommodate in one class?” Faculty have the option to respond with 5-10, 11-20, 21-30, and more than 30. This question provides us with the normal class size that would have to be accommodated in our outdoor classroom. An example of a qualitative question is, “during the COVID pandemic (Spring 2020 to now), would you feel safer teaching outdoors?” One response to this question is “yes, but only if students could be socially distanced or still wore a mask.” This is one of the multiple-choice questions. We included multiple-choice questions, checkboxes, and short answer. Multiple-choice questions were used to find singular answers like in the previous question. Checkboxes allow the survey taker to select multiple options. These questions were mainly focused on design preference, needs, and what department they are in. Short answer questions were used when there were a significant amount of data that could be collected. Leaving these questions as short answer also allows time-saving for the survey taker and the researcher. One example of a short answer question for faculty is “what classes would teach in an outdoor classroom?” We also used a short answer question for the accommodation needs of the students, because they can be very specific

to the individual and varied. Accommodations for teachers were more likely to be education centered and similar, so we used checkboxes.

In many of the questions, we provided options such as no opinion, not applicable, or other. No opinion was used for design questions. If the participants are not concerned with certain roof materials then it gives the designer flexibility in design. Questions with answers that included other allowed for further input from the participants. This was in the form of a short answer box. There were only two questions in each of the surveys that required previous experience with the outdoor classroom. If the student or instructor was unfamiliar they could select the not applicable box.

Land Analysis

We conducted a land analysis of each of our proposed sites. We considered many factors for an outdoor classroom site, such as slope, convenience of location, trees, noise, wind, exposure, and moisture. These factors were determined based on design plans and survey results from faculty and students. We walked to each site and make considerations based on these factors. We also used GIS to provide more analysis. Some of the main use of GIS was to determine which locations were convenient for classes to walk to. We put a radius limit of 500’ from the three major academic buildings in GIS. We determined a 500’ buffer from the buildings was within a reasonable distance to walk from an indoor class without taking up class time. It also means that it is close enough for students to walk to the bathroom in these buildings. We then collected all of this information and excluded sites based on this data.

Field Survey

We used basic land surveying techniques to determine the existing slope of the project site. To accomplish this we had to obtain data on changes in elevation for the existing social trail to the current outdoor classroom and the proposed site of the new classroom. First, we measured distances between changes in grade using a measuring tape. Then using an engineer's level and a graduated level, we measured the differences in elevation. We started at the paved access road between Freer and Cantwell buildings to various grade break locations along the social trails to the existing classroom. Then we measured the grade from the path from Pickett and to the proposed new classroom site. Slope calculations were done to determine the changes in topography, using a simple "rise over run" formula. Once the percentage of the grade was calculated, the existing average grade was compared to recommended slopes for trails.

Results

Student and Faculty Survey

Student Survey

There was a total of 54 students that took the survey. Students that were familiar with the outdoor classroom favored the location and design (Figure 1.4). There were 38 students (73.1%) that liked the location of the outdoor classroom. Only 8 students (17.4%) said that they disliked the location (Figure 1.5). 34 students (63%) preferred to learning outside rather than inside (Figure 1.6). Only two students (2%) choose a preference for learning indoors. There were 11 students that had no opinion on learning indoors or outdoors. There were also 7 students that choose other, because they felt it depended on the subject and weather. When asked what accommodations students needed they had a variety of answers (Figure 1.8). Many students

wanted a desk and chairs. There were 5 students that requested no stairs or an accessible location. Many of the students would safer in an outdoor classroom during Covid-19 (Figure 1.10). There were 23 students (43.4%) that strongly agreed to the statement. Many students felt that they learned better in an outdoor classroom (Figure 1.11). There were 11 students (20.4%) that said they strongly agree that they learn better in an outdoor classroom. Fifteen students said that they agree (27.8%) that they learn better in an outdoor classroom. Only 6 students (11.1%) had said that they strongly disagreed with the statement. There was a similar response to the next question that asked if they felt more engaged in an outdoor classroom (Figure 1.12). There were 14 responses (25.9%) strongly agreed. Twelve students (22.2%) had agreed with the statement. The number that disagreed with the statement as the previous question.

Faculty Survey

There were 15 faculty that took our survey. Most of the faculty do use the outdoor classroom (Figure 2.2). There were 3 faculty that never use the outdoor classroom. The majority of faculty use the classroom seldomly. Four of the faculty utilize the classroom sometimes. There were 2 faculty that indicated they used the outdoor classroom often. Only one instructor indicated that they use the outdoor classroom frequently. There were 5 faculty (33.3%) that use the outdoor classroom, but do not make reservations (Figure 2.5). Only one instructor found it difficult to make reservations (Figure 2.5). Three of the faculty do not find it difficult to reserve the outdoor classroom (Figure 2.5). Four of the faculty (26.7%) take students to other locations, because of insufficient outdoor teaching facilities (Figure 2.6). A large number of teachers (9) take students to other locations, but not due to a lack in outdoor teaching facilities (Figure 2.6). Similarly to the students the faculty also liked the location of the outdoor classroom (Figure 2.8).

There were 9 faculty (69.2%) that liked the location. Only one instructor (7.1%) dislikes the current location.

Land Analysis

We initially found seven different possible locations for an additional outdoor classroom shown in figure 3.3. The 500' buffer excluded three of our possible sites. This included the rosta church, ice rink, and alumni park. Four sites fulfilled the 500' walking distance. These sites were behind the library, the labyrinth, hammock hill, and across from the current outdoor classroom. After looking for a more accessible location we also conducted a site analysis of the great lawn.

Rosta Church

The first excluded location is the gazebo also known as the rosta church. We determined this location to be too steep for sustainable trails. The gazebo also has a large slope making it challenging for people with disabilities or injuries. The site also did not have enough room to fit the average class size that would use the outdoor classroom. This would require additional clearing and leveling to make the site suitable for the needs of the users.

Ice Rink

Our next site was across from the tennis court/ice rink. This location had readily available trails and an isolated location. We still found the tennis court to be too far from academic buildings making it inconvenient for teachers. This is we think that the VIC amphitheater is generally unused. It is a far distance away from the classrooms possibly causing an outdoor classroom to be underutilized if located across from the ice rink. The ice rink/tennis court may also be loud when in use which could be bothersome to instructors. The ice rink is near the gym

so that students would be able to have bathroom access. It also has a brick walkway that would be sufficient for student use. It is preexisting so there is no major trail building necessary.

Alumni Park

The alumni park was also considered as a site of the outdoor classroom. During site, assessment freshmen dorms were loud. This could disrupt teachers and students. The alumni park There was still 42.9% of instructors and 45.3% of students that want an isolated location. This disqualified the alumni park for being neither convenient nor isolated. It also is in the open exposed to the elements. This site is close to the administration building but does not have other close bathrooms.

Joan Weil Library

Putting a classroom behind the Joan Weil Library would be convenient for students and teachers. It has quick access to the academic buildings. It is also close to the library which also has some classrooms. The library also would provide a wind protection from the wind that comes from the lake. One of the issues with the site is that it is on the living roof of the classrooms. Building a classroom in this location could conflict with the construction parameters of the library. The site is next to a frisbee golf basket which could interfere with classes if someone is playing a game. Frisbees can propose a hazard to students. The library also has heating systems and generators near the hill that are loud when turned on. When they turn on they would be a major distraction for users.

The Labyrinth

Another location that met our 500' requirement was the labyrinth. This location is across the street from the academic building. The ground is flat at the labyrinth making it easier to walk. It is sheltered with trees providing an isolated location, barrier for noise, and protection from the wind. The labyrinth already is a popular feature on campus. The labyrinth has bird feeders and a rock circle/maze. Building an outdoor classroom would likely mean the removal of these features. The labyrinth is in a wet area, especially during the spring. This makes it less suitable for users, electronics, and trails.

Hammock Hill

Hammock Hill was another location we considered. This location has no trails but is directly across the road from Pickett Hall. This spot is in a small woodlot. This makes it quieter and isolated. It is also close to the student center, LMS, a parking lot and lake making it a central location with access to bathrooms. The downside to this location is the steep slopes and soil. There is already a pit on the parking lot side of the hill. It is unknown what has caused this hole, but it brings concern for development on the site. It is a steep slope to major access points like the student center and library where students may develop social trails.

Outdoor Classroom Hill

Our last initial site was on the opposite side of the hill to the current outdoor classroom near campus safety and Pickett Hall. This location already had one designated trail that transects the hill. This trail has two staircases up each side of the hill and has a paved section on the flat top section. There are also two unmaintained social trails from Freer Hall to the current outdoor

classroom. There is less tree cover at this location than at the current outdoor classroom, but still has trees to provide a noise and wind barrier.

Great Lawn

One of the outdoor classroom locations we did not initially consider was on the great lawn. There is a smaller lawn by Clinton and Franklin that is partially used for student orientation and graduation. This location would be accessible to people with disabilities rather than the other locations. It is openly exposed to the lake. A lake view can be beneficial for teaching especially with classes that discuss water sources. However, water bodies like lakes allow for easier wind and sound travel. Wind can dampen sound and also make it feel colder. When there is no wind sound can easily travel across the lake. Either scenario can cause the outdoor classroom to go unused.

Field Survey

Social Trail

As expected from visual observations, the existing grade along the trail to the existing classroom is fairly steep (Photo 11). There was an average grade of 17.29 percent on the suggested trail from freer to the current outdoor classroom (Figure 4.2). We determined this by dividing the rise 26.8 feet by the run of 155 feet. The first section had a rise of 11.4 feet with a run of 50 feet with a grade of 22.8 percent. The second section had a rise of 5.1 feet and a run of 37 feet with a grade of 13.8 percent. The third section had a rise of 2.6 feet and a run of 13 feet with a grade of 20 percent. The fourth grade had a rise of 7.7 feet and a run of 55 feet with a 14 percent grade.

New Trail

The new trail measurement we took was from the paved path to the planned outdoor classroom site (Figure 4.1). The new trail survey section had an average grade of 12.04 percent. We found this by dividing the rise of 10 feet by the run of 83 feet to get the average of the entire grade. The first slope of the new trail had a rise of 2 feet and a run of 25 feet with a grade of 4 percent. The second grade had a rise of 5.1 feet with a run of 27 feet with an 18.9 percent grade. Our third and last section had a rise of 3 feet with a run of 30 feet with a percent grade change of 10 percent.

Accessibility and Sustainability

Both trail sections are over the maximum of 10% average trail grade for building sustainable trails as suggested by the US Forest Service. It is also unable to fit the design criteria for American Disabilities Act (ADA) standards of a 1:12 ratio maximum (U.S. Access Board, n.d.). This means that any trails built on the outdoor classroom hill will be unaccessible and require structures.

Recommendations

Outdoor Classroom Location

Two sites would fit our needs for an outdoor classroom. Our primary recommended location is across from the existing outdoor classroom. This site has a cleared area and already has preexisting trails. It will also have less of an environmental impact than other locations because they require more trail construction. The outdoor classroom hill is secluded while also being a convenient distance from the academic buildings. This location is also centrally located as many faculty requested. It is also surrounded by trees that provide protection from the wind. It

is near the main road so as much of the noise The downside to this location is that it will not be accessible. This is why our second recommendation is the great lawn. The great lawn is further away from the academic buildings, but has a flat brick walkway. So does not require much trail work. This is why my paper focuses on trails for our primary location suggestion.

Trail locations

Due to the small area of the outdoor classroom hill it is unfeasible to make a bench cut trail. This is where the trail is cut out of the side of the slope to form the trail. There are two major social trails that are from Freer Hall. Due to this there is a reduction on the amount of vegetation on these hills. It would be both challenging due to the geography of the location and the additional removal of trees and vegetation that would be required. The two current social trails from Freer Hall are fall line trails (Figure 5.4). Fall line trails can increase erosion, because they give a path for the water to flow freely. Water flows down the path with the least resistance which would be our trails. This proposes a challenge, but there are ways to accommodate such steep inclines.

Social Trail One

The first social trail is to the right of the hill (Photo 7). It goes to the front of the outdoor classroom. Maintenance has put up rip rap and a retaining wall to the right to prevent erosion. It has not been able to fully protect this trail as it has started to erode on both sides of the retaining wall (Photos 7 & 8). The retaining wall has also created more of a berm on this trail (Figure 5.1). This causes the water to be sent onto the trail and erodes the soil from the sides of the trail. I do not recommend further use of this trail. This trail can be closed to allow for growth of plants to stop the erosion. Revegetation and adding signs is one way to ensure closure. Revegetation can

include putting logs and sticks over the trail to prohibit use and encourage plant growth. I do not advise turning up the soil, because it could be eroded. I would also recommend a sign that says trail closed for environmental restoration to deter users from taking this route.

Social Trail Two

The second social trail is our preferred site (Photo 11). The second social trail is established, but does not have a sustainable design. It is used for accessing the power lines behind the academic buildings. It is closer to Freer Hall than the first social trail. It also goes behind the first outdoor classroom. This makes it so it is less of a distraction to the first outdoor classroom. This trail is steep, but it is not as steep as other trail approaches (Figure 3.1, 3.2, and 3.4). Making it the preferred site for a trail from Freer. This site is more suitable, because it already has a precut trail corridor. There is no needed vegetation removal to make this trail, because the trail is wide to accommodate vehicles. The second social trail is 155 feet in length to the current outdoor classroom.

New Trail

A new trail will have to be created from the paved path to the outdoor classroom. This trail will go straight from the middle of the paved path to the new outdoor classroom. This section of trail has a more moderate slope. Moderate slopes are better for trail design. The new trail is only 83’ long.

Trail design and construction

With such steep slopes over 10% average grade there is a limitation on the options available for trail building sustainably. The most common solution to building trails in steep locations is steps and staircases. There are two materials that staircases The most sustainable

option for stairs is using rock. Rock stairs last longer than the other alternative medium of wood. Wooden staircases will rot over time. Wood may be used, because it is a difficult to find and move the rocks needed to build a staircase.

Stair Design

Rock steps could be made out of large rocks or an entrenched tombstone design. Large rocks are used as the entire step with two flat faces (Photo 18). The large stones are placed directly behind each other. The large rocks have two smaller rocks that are on the sides called gargoyles to prevent erosion. This requires finding rocks that match the dimensions needed for the staircase. Entrenched tombstone staircases can utilize thinner rocks and uses gravel, crush and mineral soil to fill-in the step landing (Photo 19). The tombstone design is not as erosion resistant as the tuck behind method.

The Paul Smith's area does not have the readily available rock that other locations have. This makes the wooden staircase the best option for trail construction. There are three ways to build staircases on trails. The least sustainable is the current construction used where the staircase is built up using pillars and cribbing. The current stair case design does prevent the wood from touching the ground and rotting faster, but it uses significantly more wood than other trail constructions (Photo 10). The box stairs and the entrenched log stairs are both set into the ground. The entrenched log is very similar to the tombstone design. A log is dug into the ground then backfilled with dirt and gravel. This is the easiest design to implement, but it is also the most likely to wash out. It does not last very long especially without regular maintenance. The trail to the point next to LMS has this style steps. It has washed out over time and it is presumable that this would also occur if used for this trail. The last design in the box step

(Photos 14 & 15). Box steps are U-shaped box that is dug partially into the ground and then filled with soil and gravel. The boxes are overlapped to make a step. This allows for a step landing pad that is flat. These types of stairs do not wash out as easily as others, because the soil is trapped on three sides. Lumber for constructing the trails can be made at the Paul Smith's lumber mill to reduce costs. It is significantly less lumber than the original staircases on the hill. I recommend this style of step, for this trail construction.

Stair Dimensions

Although our trail is unable to accommodate standard accessibility we wanted to design with people with disabilities or injuries in mind. We recommend steps of 6 inches so that it is more accommodating to people in crutches rather than regular 7.5 inch step height. We took the rise and divided it by 6 inches to find how many steps we needed. We found that the run or tread of each step was also larger than a normal step that is generally 9 inches. The longer treads of this construction will allow more time for people to walk on a flat grade and prepare for the next step.

We found that 54 steps throughout the second social trail would be needed. After determining the number of steps you're able to find the run of the step. The run for the 6" step is an average 34.4 inches for this location. I recommend further breaking down the overall trail into the different grade changes to match the geography. The first grade on there will be 23 steps that have a run of 26 inches. The second grade had 10 steps with a run of 44.4 inches. The third grade will have 5 steps and a run of 31.2 inches. The fourth grade will have 15 steps with a run of 44 inches. Our new trail has only one section of grade with a high grade percentage of 18% (Figure 4.1). This smaller section only needs 5 steps with a 60 inch run. I would advise making

entrenched log steps for this section, because the steps are spaced out and a box step would be difficult.

Conclusion

Outdoor classrooms are a fundamental part of experiential learning. Many of the courses offered at Paul Smith's College revolve around the natural world and its protection. The outdoor classroom can be used as a case study for sustainable design and also outdoor education. Sustainable trails can be a learning tool while functioning in its traditional role to protect the environment and users. By adding trail infrastructure it will be putting the college one step closer to its mission and vision.

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