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At the Edge of the Internet: Teaching Coding and Sustainability to Himalayan Girls

Aux confins d'Internet: Enseigner le codage et la durabilité aux filles himalayennes

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Abstract

This report introduces a two-week workshop on web coding and environmental sustainability at a school for girls in Northeastern India. Our discussion of this teaching project reviews issues that shaped the project's development, outlines resources required for implementation, and summarizes the workshop's curriculum. Highspeed Internet will soon arrive in the region of this recently-recognized UNESCO World Heritage Site. We believe that the training of girls in particular could help redistribute power and resources in regions where women are often poorer, less educated, and excluded from decision-making in institutional and public contexts. Relatively few code-teaching projects have grappled with the difficulty of working in offline environments at the "edge of the Internet," and yet moving skills and knowledge into these regions before the Internet becomes widely accessible might help mitigate some of the web's worst impacts on equity and justice.

Résumé

Ce rapport porte sur un atelier de deux semaines sur le codage Web et le développement durable environnementale dans une école pour filles du nord-est de l'Inde. Notre discussion sur ce projet d'enseignement passe en revue les préoccupations à la base du développement du projet, décrit les ressources nécessaires à sa mise en œuvre et résume le programme de l'atelier. L'Internet à haut débit arrivera bientôt dans la région de ce site récemment reconnu comme patrimoine mondial de l'UNESCO. Nous pensons que la formation des filles en particulier pourrait aider à redistribuer le pouvoir et les ressources dans les régions où les femmes sont souvent plus pauvres, moins

instruites et exclues de la prise de décision dans les contextes institutionnels et publics. Relativement peu de projets portant sur l'enseignement de code ont été confrontés à la difficulté de travailler dans des environnements hors ligne au «bord d'Internet», et pourtant le transfert de compétences et de connaissances dans ces régions avant que l'Internet ne devienne largement accessible pourrait aider à atténuer certains des pires impacts du Web sur l'équité et la justice.

Introduction

This report introduces a two-week workshop on coding and sustainability at a school for girls in Northeastern India. Our discussion of this teaching project will review issues that shaped the project's development, outline resources required for implementation, and summarize the workshop's curriculum. This project is part of a collaboration between a faculty and student team at the University of Toronto and two groups in India, the Khangchendzonga Conservation Committee (KCC) and the Kasturba Gandhi Balika Vidyalaya (KGBV) school for girls. The KCC is a small non-governmental organization based in Yuksom, a rural village that is the main access point to a UNESCO World Heritage Site in the Indian Himalaya, along the Nepal border. Located not far from Yuksom, about 30 minutes by car along winding mountain switchbacks or an hour's walk along a lushly forested footpath, the KGBV is a residential school for girls. Our Canadian-led workshop for KGBV girls in 2019 aimed to support the KCC's longstanding work to build capacity across the region in natural resource management and conservation, and their promotion of village-level economic growth through culturally and environmentally responsible modes of tourism.

Our interest in supporting the KCC's work with girls through developing this workshop was stimulated in part during a trip to Sikkim in 2018, when we noticed bright blue conduit for fiber optic cables emerging from the dirt alongside mountain roads. Highspeed Internet was soon to arrive in this UNESCO World Heritage Site. As the call for climate change adaptation becomes more urgent, women across the Himalaya are playing an increasingly important role in reconfiguring social development and resource management. How will young women living in this ecologically critical area become ready to participate in, and direct, the many changes that will soon flow through those fiberoptic cables?

Working for Sustainability in the Himalayan Foothills

Mount Khangchendzonga, a massif with five peaks and five massive glaciers, is the world's third highest mountain (8,586 metres; 28,169 feet), straddling Eastern Nepal and the Indian state of Sikkim, which is itself one of the world's 34 biodiversity hotspots (Tambe & Rawat, 2009). The Nepali government designates the entire Khangchendzonga massif as a conservation area, and India's Ganges and Brahmaputra rivers are fed by the mountain's glaciers. Seventy percent of Sikkim's Khangchendzonga National Park (KNP) lies above 4,000 metres, 34% is covered with ice, and the park contains over 150 glaciers and 73 glacial lakes (Tambe & Rawat, 2009, p. 443). In July 2016 the KNP, which covers 25% of the state of Sikkim, was recognized by UNESCO as a natural and cultural World Heritage Site for its extraordinary cultural diversity and range of sub-tropical to alpine eco-systems.

Drawing upon a mix of Buddhist, shamanic, and Hindu perspectives, the multi-ethnic communities living in the Khangchendzonga foothills understand the mountain variously as a

barrier to travel, a sacred body, a socio-political space, or the home of deities, and ritual practices dedicated to Himalayan mountains remain essential to the well-being of these communities (Denjongpa, 2002; Gorer, 1938; Sagant, 1996; Siiger, 1967). Further afield, stories of Khangchendzonga have been told by travelers from the Tibetan plateau for hundreds of years, and in times of social, political, and environmental distress, groups of Tibetans fled south to the lush forests and valleys of Sikkim, which they named the Land of Rice. For more than a century, Europeans too have been drawn to the region's botanical wealth, and mountaineers have told tales of dramatic ascents, capturing the imagination of global audiences. The Sikkimese prohibited early mountaineers from standing on Khangchendzonga's sacred summit, and in 2000 the government again banned expeditions to the summit, inciting conflict between international and local communities (Wangchuk & Zulca, 2007). In recent decades, trekking and mountaineering have had dramatic effects on the environment, economy, settlement patterns, and cultural and religious practices of communities living near Himalayan mountains (Bahuguna, 1998; Dearden, 1989; Draper & Kariel, 1995; Dutta & Singh, 1998; Price, 1995).

After hydro-electric power, tourism is now the second largest contributor to Sikkim's Gross Domestic Product (Mitra, Roy, & De). A dramatic increase in tourism to the state began in the early 1990s, and local residents and guides soon noticed a corresponding increase in waste around the trekking routes, as well as damage to sacred sites and unmanaged extraction of medicinal and other fragile plants. The Khangchendzonga Conservation Committee was formed in reaction to these concerns, with an initial focus on the increasingly popular West Sikkim trekking route, which climbs upwards departing from Yuksam, through Dzongri and to the Gochala pass at 4,940 metres, with magnificent views of the Khangchendzonga range when the weather is clear. In 2002, the KCC developed and began to promote the concept of homestay tourism in the region, where visitors stay in local homes rather than hotels. With this model, tourists experience local lifestyles, foods, and customs, and tourism revenue benefits village families.

The KCC has worked on a wide variety of environmental management and capacity-building projects in Sikkim (Jain, 2002). It was founded by a small group of community members in 1996 with the aim of promoting socially and ecologically responsible tourism, redesigning practices of waste management, and building capacity among local guides, porters, and homestay providers in West Sikkim and the Khangchendzonga National Park. Illegal collection of medicinal plants and other non-timber forest products has long been recognized to be a significant problem across the Khangchendzonga region in India and Nepal, and sustainable management and conservation has been challenging (Wang, Wu, Kunze, Long, & Perlik, 2019, p. 24). The KCC has been successful in implementing bans on the use of forest wood for fuel, on hunting, and on the collection of medicinal plants in the KNP. The KCC has also worked for two decades on zero waste practices throughout West Sikkim, implementing waste collection and recycling policies in collaboration with Sikkim's Rural Management and Development Department and with several local Buddhist monasteries. A leader across the Himalaya, the KCC has worked with similar environmental protection and eco-tourism organizations in Ladakh, Jammu, Kashmir, and Nepal to provide training and education.

The KCC's history opens a window to an important set of dynamics with global implications. Until its annexation into India in 1975, Sikkim was an independent kingdom, and so the KCC has negotiated its work within one of India's newest states, one that is moreover strategically positioned at the border of the global superpowers of India and China. The KCC has influenced tourism practices at a time when global tourism has risen to become a major economic

driver in Asia and especially the Himalaya. The group's work has also coincided with the acceleration of climate change and environmental degradation in the region, and with the deployment of environmentalism by local groups as a lever for both regional autonomy and global integration. The migration of peoples has complicated ethnic tensions in many Himalayan regions over the last two decades, some of which have directly addressed conflicting orientations toward environmental protection and economic development. The work of the KCC has also directly addressed conflicted relationships between international mountaineering cultures and local conceptions of sacred space, which has seen increasing attention in news media. Recent research has shown how the close links between poverty and resilience threaten rural mountain communities most directly (Barua, Katyaini, Mili, & Gooch, 2014, p. 269). The KCC's interventions have strategically aimed to address poverty in the region with a multidimensional approach relevant to mountain communities.

Sikkim's Kasturba Gandhi Balika Vidyalaya School for Girls

Located not far from the KCC's headquarters in Yuksom, the Kasturba Gandhi Balika Vidyalaya (KGBV) school for girls in Labing, West Sikkim, has roughly 200 students between the ages of 12 and 18. Most girls come to this residential school from poor families, and many are orphans. In 2004, the Government of India established the KGBV residential school project with the aim of serving girls belonging to minority and disadvantaged communities. According to the guidelines for the project, schools were to be established in regions where "rural female literacy is below the national average (46.13%: Census 2001) and gender gap in literacy is more than the national average (21.59%: Census 2001)", in areas with a high tribal population, and in other areas with low female literacy rates (India Development Gateway). There are now hundreds of KGBV schools across India but only one in the state of Sikkim. The KGBV school in Labing admits mostly girls from West Sikkim, and only those with legal Sikkimese status (which is inherited from the father's side).

The overall curriculum for the KGBV school is set by the Central Board of Secondary Education, and the school prides itself for rich programs in sports, music, and culture. Almost all students go on to further study after their years at KGBV. Those with the highest grades may do further training in science or math at the senior secondary level, those with mid-range grades go on to study humanities or the arts, and the lowest achieving students may obtain further training in household skills. Although most girls do continue to senior secondary education, some girls with heavy domestic responsibilities at home must return to their families without continuing their schooling. Beyond Grade 8, students must purchase their own books and paper; teachers at the KGBV school in Labing will often pay out of pocket for those girls who cannot afford supplies.

The Khangchendzonga Conservation Committee has both institutional and personal connections to the KGBV school in Labing. A dynamic and highly engaged science teacher with a degree in sustainable development, Sikshita Bhutia is married to one of the KCC founders and is a key participant in much of the KCC's work in environmental conservation and awareness. Environmental science is not taught as a distinct subject at the KGBV but is woven into the curriculum as much as possible. Sikshita Bhutia runs a "green club," bringing the KCC's emphasis on zero waste to the school community, as well as a garden for the girls, and she appoints girls to serve as environmental stewards of the school grounds.

Unlike other schools nearby, the KGBV has a dedicated computer lab with 10 computers and a part-time computer teacher. The lab was set up and networked by an IT service provider in Gangtok, Sikkim's largest city, which is roughly eight hours by car from Labing. Within the school, however, IT expertise is limited, meaning that if the network or its components lose functionality, they may simply be left out of use for a long time. Although the computers are networked to a modem, Internet access is unreliable. Computer classes for students therefore focus on "offline" computing skills, including touch typing and basic training in desktop applications. Computer programming skills are not taught. Although broadband Internet connectivity in West Sikkim was poor to nonexistent as of 2019, people access the web and social media platforms extensively with their cell phones. Girls at KGBV spoke about using YouTube, Facebook, Instagram, and WhatsApp in particular.

The challenge to teach coding in this girls' school was therefore of particular interest because of its location at "the edge of the Internet." Today in West Sikkim, the Internet travels only over cellular signals, and the lines of sight in the mountains are short and uncertain. Fiberoptic cable is being laid in the district, however, so over the next several years Internet access will expand dramatically. The district is replete with small businesses, many in the tourism trade, and with the 2016 World Heritage Site designation tourism is expected to increase. A substantial number of these businesses have no web presence at all, and web development expertise in the region is limited. Our goal for this project was therefore to create and teach a web development curriculum appropriate to the region, helping to prepare a group of girls to be tomorrow's web experts in West Sikkim. What might it mean if, when fiberoptic connectivity arrives there, the best-trained and most highly skilled web developers were a group of 18-year-old girls from the most economically disadvantaged families in the region? Recent research has addressed how Himalayan women "perform multiple roles: in the household, agriculture, natural resource management, communities, and the markets and other public spaces at higher scales, and particularly with the trend of large-scale male outmigration" (Resurrección et al., 2019, p. 494) and moreover how mountain women are "critical actors in mitigating and adapting to climate change" (Resurrección et al., 2019, p. 497) (Joshi, 2014; Leduc, 2009; Nellemann, Verma, & Hislop, 2011). With its close connections to the KCC, one of West Sikkim's best-established and influential non-governmental organizations, its relatively strong technology infrastructure, and its highly engaged and progressive staff of teachers and administrators, the KGBV was eager to welcome the development of our workshop on coding and sustainability.

Web Developers at the Edge of the Internet

After meetings in 2017 between KCC leaders Kinzong Bhutia, Uden Bhutia, and Pema Bhutia, and University of Toronto professors Frances Garrett and Matt Price, a collaboration between the two groups took shape in the context of Price's fourth-year undergraduate research seminar, called Hacking History. Over 2017-18, students in this course worked with the KCC on the creation of an archival website. The KCC was in need of a website and a digital archive to preserve more than twenty years of documents accumulating on the mildewed shelves of their Yuksom headquarters. For the university students, collaborating with the KCC accentuated some of the most interesting dynamics of public history: the relationships between experts and lay knowledge; power dynamics between historians and oral history subjects; and the potential for conflicts between the duties of a historian and those of a "contractor" working on behalf of an

organization. Each of these problem areas was presented as an opportunity for learning throughout this year-long course.

Taught yearly, Hacking History is an innovatively designed course exploring new media as tools for the transmission of historical knowledge, culminating in an intensive group project in which students build a historical website in close collaboration with a community partner. The community partnership is a key element of the course each year and a source of many of its pleasures and challenges. Students learn about the history of digital media and their place in the development of the public sphere, and they study the history and politics of "engaged" and "public" scholarship. They spend a substantial amount of time acquiring the technical skills needed for their project, including the fundamentals of HTML and Javascript, as well as enough PHP to work with WordPress, a popular Content Management System (CMS). No prior technical knowledge is required for this course, but students must be willing to challenge themselves to learn the basics of web programming.[1] The payoff for this effort gives students a rare chance to contribute in a meaningful way to historical discourse beyond the walls of the university, and to explore the frontiers of historical communication.

In May 2018, a month after Hacking History had concluded, six undergraduate students traveled to Sikkim with Matt Price and Frances Garrett to discuss their work in person with KCC staff and to offer a week-long web skills workshop at the KCC for staff and community members. The workshop had 12 participants, including four founding members of the KCC, a local entrepreneur interested in opening a homestay business, several local government officials, two members of the local forestry department, and a doctoral student from New Delhi doing research on pastoralism. Matt Price led the workshop, beginning with a presentation of basic information on the structure of the Internet, the global web, computer languages and how they communicate, and an overview of different kinds of digital communication and the differences between websites and social media platforms. Participants discussed how different kinds of digital communication might meet different needs, and they worked in pairs to articulate their own needs. Most participants were interested in new strategies for improving communication between federal and local governmental agencies, and between those agencies and local communities; some were also interested in advertising their businesses to tourists. As the workshop continued, Price taught participants how to create a basic website using a CMS with a locally networked Wordpress installation. Participants worked in small groups, assisted by the University of Toronto students, designing their site architecture and setting up sample pages.

Participants in this Yuksom web skills workshop were highly enthusiastic and motivated to learn how to create websites to meet their varied needs. *The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People*, a comprehensive 2019 report by International Centre for Integrated Mountain Development in Nepal, demonstrates that these interests are shared across mountain communities and felt with a sense of urgency by mountain peoples who witness the impacts of climate change directly. Increased access to "information and knowledge-sharing platforms" the report details, are "key to fostering socioeconomic development as well as enhancing environmental governance" (Wester, Mishra, Mukherji, & Shrestha, 2019, p. 36). Information technologies are also critical tools in spreading natural disaster risk warnings and increasing access to healthcare and education.

[1] The class syllabus is available at https://2017.hackinghistory.ca/.

On the final day of our 2018 visit to Sikkim, the KCC invited the Canadian group to present a brief web skills workshop at the Kasturba Gandhi Balika Vidyalaya girls' school near Yuksom. Matt Price set up an afternoon HTML and CSS workshop for two classes of girls, ages 12-18, and with a locally-networked intranet linking computers in the school lab, the girls quickly learned how to manipulate features of their webpages, happily changing text sizes and colours, resizing borders, and changing background colours. The reception was so enthusiastic that a seed was planted for returning to provide more in-depth training.

"Interconnection:" Designing Curriculum for a Himalayan Context

In consultation with the KCC and KGBV, Price and Garrett began to develop a plan to return to Labing to deliver a two-week workshop on coding and sustainability, comprised of two interwoven curricular programs united under the theme of "interconnection." Drawing on a concept that is core to both Buddhist communities and popular environmental protection rhetoric, this theme highlighted both the Internet's capacity to connect global communities and the nature of sustainable engagement with the environment. Price and Garrett assembled a team of students in Toronto to develop curricular materials in advance of a scheduled trip in February 2019, including Faraz Khoshbakhtian, an undergraduate student in Computer Science and Philosophy; Laila Strazds, a graduate student in Adult Education and Community Development with a specialization in Environmental Studies; and Dawn Walker, a graduate student in the Faculty of Information with specialization in emerging alternative and decentralized web and Internet infrastructures. Four members of the team (excluding Faraz) were able to go to Sikkim in February to lead the workshop.

Over a period of several months, our team worked to develop this double-stranded workshop. The technical challenges of teaching coding in an environment where Internet access was limited or absent were especially daunting. We needed a system that could work independent of access to the web or Internet; work in a web browser without having to install additional applications; allow for export and import of saved work; and provide Uniform Resource Identifiers (URIs) that are shareable and persistent over the course of a workshop and across devices. Using the system, we wanted students to be able to check the results of their work in real-time, save their work and return to it at a later date, and view teaching materials for each specific lesson. The system should also allow teachers to view facilitation material for each specific lesson, as well as an overview for all available materials, find documentation to support setting up the system, and easily configure and modify the system over time. Developers likewise should be able to write easily maintainable lessons using widely-available tools and programming languages (i.e., HTML, CSS, JavaScript, and Markdown, using text editor applications and version controlled with Git), support local instructors seeking to improve the system for a given environment, and iterate rapidly on both the software and the curricular materials.

Before we began creating workshop materials, we wanted to better understand the landscape of teaching web development around the world, and we began with a review of technology teaching projects targeting girls. For example, Girls Coding in Lagos, Nigeria is a project of Pearls Africa Foundation that is "passionate about increasing the number of females in STEM, training the girls in underserved community and improving the resourcefulness of young girls and women." Its curriculum includes HTML, CSS, JS, Python, Android, and Microsoft. The ReDI School of Digital Integration is a non-profit free digital school for tech-interested newcomers

in Germany that offers multiple courses and a women-focused track on topics including front-end web development, HTML, JS, and CSS. Some useful materials from this project were available on Github. Girl Develop It is a non-profit that provides technology programs for women from diverse backgrounds. All materials are available on Github, as are the materials of Codebar, which aims to enable underrepresented people to learn programming through workshops and self-guided tutorials.[2] These well-established programs were for the most part larger in scope than our own, and yet it was helpful and inspiring to see others doing similar work around the world.

We also looked more broadly at openly licensed and open source projects and curricula. In order to find a suitable platform for teaching in Sikkim, we studied the benefits and deficits of code playgrounds such as Code Pan, Web-Maker, HTML House, Thimble, and JS Bin. It was difficult to find a well-developed environment that met our needs. Code Pan runs locally and offline, but it does not allow for saving work without external authentication. Web-Maker, an offline-first code playground designed originally for personal use by a developer in New Delhi, uses local storage to save projects locally, while also maintaining a centralized store of project files. It works offline as a web-app, can be served on HTTPS, and allows for saving projects into local .json file. However, it does not allow persistent URLs, so it would be difficult to get assignments and exercises to students, and its database runs via Google Firebase, which operates in the cloud, so while machine-local projects and cloud-based projects are easy, there is no notion of a "classroom" or other middle level or organization. HTML House uses localStorage for offline editing, has permanent URLs and project milestones, and offers a Chrome extension version, but there are no separate CSS and JS panes, and it requires Go. Thimble, a teaching tool from Mozilla's old open web promotion team, is nicely oriented towards young learners, with simple interface features that can be revealed one-by-one as skill level advances, and there are lots of curriculum materials already available. However, it is oriented towards a Scratch-like centralized community publishing model, and there is no immediately obvious route to ingest HTML/JS/CSS materials. Although each platform offers potential advantages, we settled on JS Bin, which is full-featured and provides a local SQL account and project data storage, so that no cloud access is required.

We undertook a similar research process in developing the sustainability-focused lessons for our workshop. Best practice environmental education is contextualized and culturally responsive. Wanting to narrow our scope and also target an area in which Himalayan girls and women might most readily see themselves to hold decision-making power, we decided to focus on food as a window into larger issues involved in creating sustainable environments. To better understand how environmental sustainability is taught in Indian schools, we first reviewed India's *Towards a Green School* resource book (National Council of Educational Research and Training, 2015). We also looked beyond India for existing projects and resources to help guide our lesson plans. We reviewed and drew from a range of online materials for teaching food systems and the environment (Center for Ecoliteracy, 2014; United Nations Children Fund, 2015; United Nations Food and Agriculture Organization, 2019; World Food Programme, 2018; Yukon First Nations Curriculum Working Group). Lesson plans created by Johns Hopkins' FoodSpan project ("FoodSpan," 2016) were especially helpful to our project design, although all materials had to be considerably modified to fit the context of Sikkim. In general, we took a critical perspective on food studies, going beyond a sole focus on nutrition and taking an interdisciplinary approach that highlighted the many connections food has in our lives. Within every lesson we emphasized

[2] For more on these programs, see http://www.girlscoding.com.ng/; https://www.redi-school.org/; https://www.girldevelopit.com/; https://codebar.io/.

students' rights and capacity for choice in the foods they eat, with an overarching message about the many considerations that go into such food decisions. Issues addressed included marketing and advertising, taste, culture, affordability, environmental impact, and food waste.

We arrived in West Sikkim with several suitcases of teaching supplies, understanding that the school would have limited art supplies, that a computer shop would be a day's drive away, that the Internet would not be reliably available, and that even consistent electricity could not be guaranteed. For our coding sessions, we carried a travel router, ethernet cables, HMDI cables, power strips, and micro-USB devices, plus three Raspberry Pi 3 B+ single-board computers. The USB devices were loaded with Adobe Acrobat Reader, PuTTY, Chrome, Notepad++, Segoe System Font, and an HTML reference and Raspberry Pi library. Our web development curriculum and teaching materials were loaded on the pre-configured Raspberry Pi, which ran hosted software that both teachers and students could access. This meant that student computers could be networked to shared materials hosted on the Pi materials even without live Internet access. For our sustainability sessions, we filled a suitcase with crayons, markers, sticky note pads, old cooking magazines, scissors, glue, tape, stickers, and string, and we also brought three large rolls of butcher paper.

Anticipating power outages, we prepared a series of group games relevant to our curricular themes, which we could start up whenever needed. For example, the "human knot" game aimed to teach about interconnection and teamwork: small groups of approximately six students entangled themselves by holding hands and then competing against other groups to unravel their human knot into a circle. The "broken messenger" game taught about potential implications of online communication by demonstrating how meaning may be misunderstood when messages are rapidly passed from one to another, as may often happen online. In this game a message is whispered from one person to another around a circle until the last person says aloud what they heard, and the group finds that the message has changed significantly. Other games presented in our more extensive curriculum documents include the "food web" game and the "werewolf" game, which teach about food chains and cyber security, respectively. Not only would these games allow us to quickly shift focus in the event of a power outage, but they would also help us raise a group's energy level, enhance learning and memory through fun physical activity, and model a variety of teaching styles for KGBV teachers who observed or participated in our workshop.

Teaching Coding and Sustainability

We designed our workshop to take place in nine two-hour sessions with two strands, delivered over two weeks at the KGBV school. The first session, with all four instructors present, was meant to introduce the theme of interconnection. (Logistical challenges prevented us from implementing this plan, and the theme was instead introduced to the two groups separately.) Sessions two through five separated the girls into two groups, with Price and Walker leading lessons on coding in the computer lab, and Garrett and Strazds teaching about sustainability in a large hall elsewhere in the school (see Figure 1). For the second week of the workshop, sessions six through nine, Price and Garrett had to return to Canada while Strazds and Walker continued to lead the students through lessons and group work aimed at producing a final project website that united both curricular strands.

With four two-hour sessions in a computer lab, our aims for the coding strand of the workshop were to teach students enough HTML and CSS to build a simple web page with assets;

to introduce web literacy issues (including privacy and trust); and to teach staff enough about the system to enable them to replicate and expand on the workshop themselves. At the end of the second week, our goal was that every student would have built a web page with HTML and CSS, understand the use of tags, elements, layout tags such as div and how nesting works, be able to modify text (e.g., manipulating headers, using bold, italics, and font face), and add images and links. We also wanted each student to feel pride and excitement about their coding skills and confidence that they could learn more.

Our coding lessons began with an overview of basic questions: What is a computer? How do computers work, and how are instructions are given to a computer? What is the Internet? We combined active physical games with lecture-style content delivery for this initial lesson. In our next lesson, students began to practice making web pages using a "code playground" on a locally installed version of JS Bin, a tool that allows students to experiment with source code while seeing its output in real-time. They began to learn about webpages and computer languages, and about the building blocks of HTML by creating a simple page in the code playground. Lessons about tags allowed students to change the look of text on their pages by altering the tags (see Figure 2). They then learned about the main parts of a webpage and adding style using CSS. The next lesson was about making links and adding images. The final lesson continued with more advanced instruction on layout, including more instruction about the parts of a web page, practice with making borders and creating space around text and elements on a page, and putting text and images together (see Figure 3).[3]

The second strand of our workshop aimed to introduce sustainability through a focus on food, using a series of art-based exercises. The first session primed students on the concept of sustainability and explored their existing understanding of the topic, and the following three sessions used the theme of food to guide their learning. Reviewing the literature for a meaningful but simple way to present the concept, we defined sustainability as the ability for everyone to live well now and for generations to come (Drew & Gurung, 2014; East, Inmann, & Luger, 1998; Liu et al., 2015; Meadows & Rome, 1972; Robinson & Cole, 2015; World Commission on Environment and Development, 1987). We wanted the girls to develop a level of food literacy that could empower them to make positive food choices derived from an understanding of nutrition, environmental impact, and the food system at large. With its widely publicized environmental initiatives and commitment to organic farming, environmental sustainability is a prominent part of public discourse in Sikkim, and so it was our hope that these lessons would build on and extend students' existing knowledge and allow them to feel pride in and ownership of their region's leadership in the area.

Our first lesson introduced the concept of sustainability, highlighting the theme of "interconnection" and introducing three components of sustainability (economic, social, and environmental), with an art project allowing students to create a diagram of how these components manifest in their own lives. We then led small group discussions about food and nutrition, aiming to assess the level of their knowledge, followed by a circle game on food systems using a ball of string (see Figure 4), based on the lesson plans Teaching the Food System from Farm to Fork.[4]

[3] Lessons are online at https://code-at-the-edge.github.io/curriculum-materials/

[4] This game can be found at http://www.foodspanlearning.org/lesson-plans/unit-1-meet-the-food-system/index.html .

Lessons two and three focused on how food connects us with our environments. The heart of these lessons was a body tracing art activity that asked students to illustrate connections between their own health and the health of their environment, such that when they take care of themselves, they are also taking care of their environment. Students traced an outline of their own bodies on large pieces of butcher paper (see Figure 5). We reviewed the concept of sustainability and students were encouraged to draw things related to food on the outer portion of their body tracing, including the environments they live in, where and how food is grown, their favourite foods, their family and friends, and so on. The next lesson focused on nutrition and the digestive system, and the girls were then given time to draw on the insides of their body tracings (see Figure 6).[5] Lesson four addressed nutrition guidelines from around the world by studying food guides from various countries. Students were asked to discuss how other countries' food guides compared to India's. Next, they studied pictures and data presented in Peter Menzel and Faith D'Aluiso's book, *Hungry Planet*, two copies of which we had brought, and they made charts of the cost of food for a week for families from around the world.

The second week of the workshop was devoted to creating websites that would be presented in a final day celebration. Through project-based learning, students integrated concepts from the sustainability and coding curricular strands and practiced skills such as time management and teamwork as they worked in groups to create a web page about a recipe. The design of this project was influenced by the "Recipes for Change" project (International Fund for Agricultural Development) and by materials available from the Global Sustainable Food Project (Penniman, 2015). The week began with a lesson on food miles and carbon emissions, aiming to show how food choices have environmental impact (see Figure 7). Girls in small groups studied world maps and recipes (recipes included sushi, fish tacos, butter tarts, mushroom risotto, or Pad Thai), and they were asked to estimate the weight of each ingredient and the distance it would travel to reach Sikkim. After that exercise, we gave students time to plan their recipes for their own web page recipe projects, with the requirement that the recipe must include a title, an ingredient list, steps on how to make it, and a paragraph on cultural, nutritional, and environmental factors. The remaining days of the week were devoted to creating these websites. Occasional power outages throughout the week were distracting but allowed us to take breaks for games, which the girls greatly enjoyed. On the final day, students shared their work in a celebratory assembly for the entire school.

Conclusion

In this brief report we have summarized a teaching project implemented in 2018-19 as a collaboration between Canadian university faculty and students and two small but influential organizations in the northeast Himalayan state of Sikkim. As Canadian researchers and educators, it was our aim in this project to support the interests of our partners in Sikkim, who have themselves been working successfully to build capacity and effect practical development outcomes for their communities. Although the majority of Sikkim's mountain population is rural and engages in subsistence farming and animal husbandry, climate disasters make this a precarious living; the mountain topography likewise complicates the likelihood of significant industrial development in the region. But tourism is increasing rapidly, and the natural environment may soon be the state's

[5] These lessons drew on the Dietary Guidelines for Indians (*Dietary Guidelines for Indians – A Manual* 2011, pp. 13-15) and infographics published by National Geographic and the Australian Academy of Science.

most valuable resource (Choudhury, 2001). Without carefully developed village-based ecotourism ventures that preserve ecological and cultural resources and raise environmental awareness in communities, the growing influx of visitors will only place further stress on this fragile mountain region (Datta & Banerji, 2015). As Internet access further increases the tourism industry's growth rate, web development skills combined with an understanding of sustainable environments could have substantial impact on the economic welfare of girls graduating from the KGBV. Beyond its potential economic impact, however, the training of girls in particular could help redistribute power and resources in a region where women are often poorer, less educated, and excluded from decision-making in institutional and public contexts (Karan, 1989, p. 270). In this project, we have followed an approach to development interventions that supports human wellbeing, not just economic growth (Resurrección et al., 2019). In our preliminary work for this project we found many inspiring code teaching projects in operation around the world, but few of them have grappled with the difficulty of working in offline environments at the "edge of the Internet." Moving skills and knowledge into these regions before the Internet arrives in full force might help mitigate some of the web's worst impacts on equity and justice.

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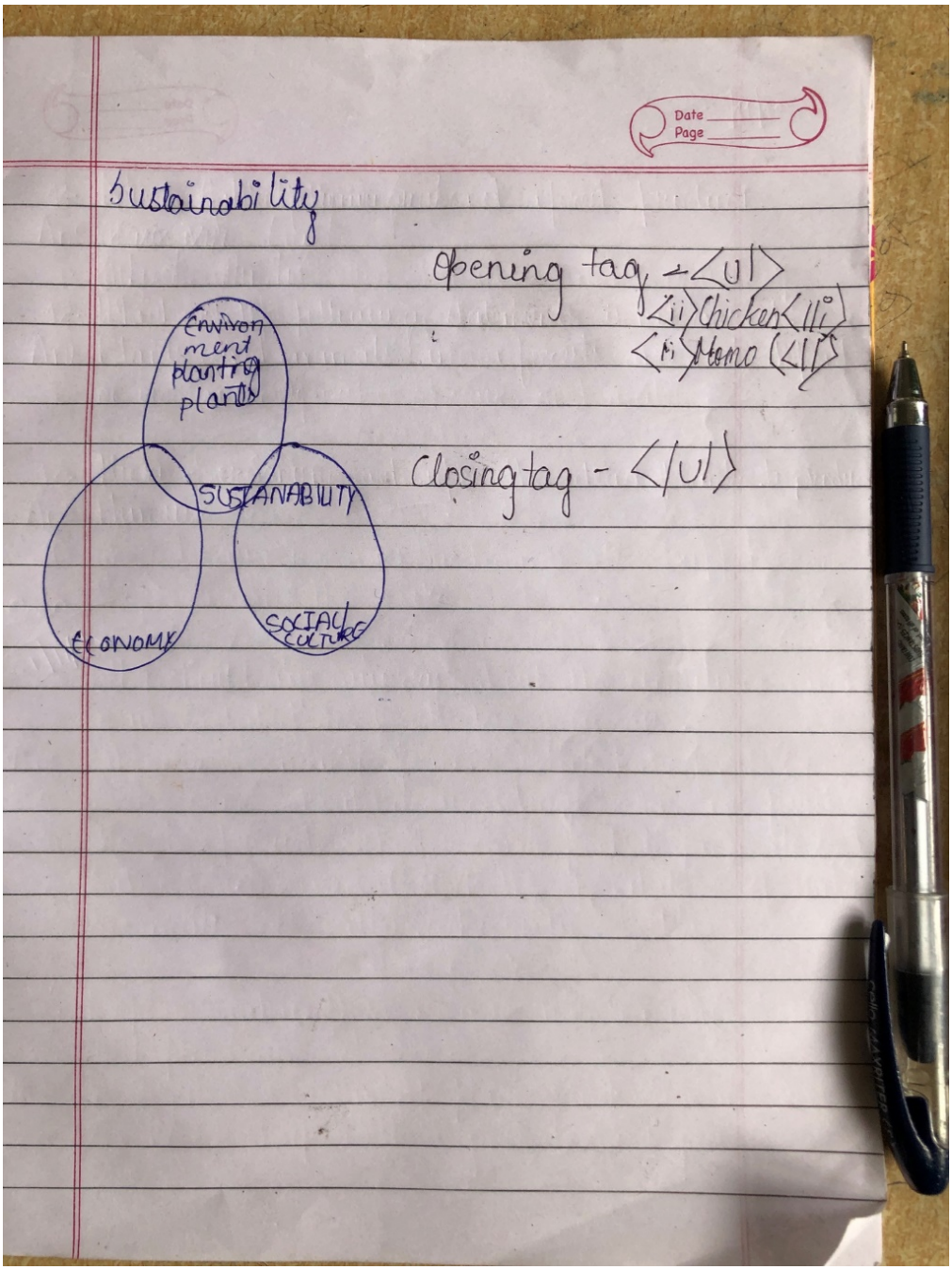

Figure 1. A student's notebook.

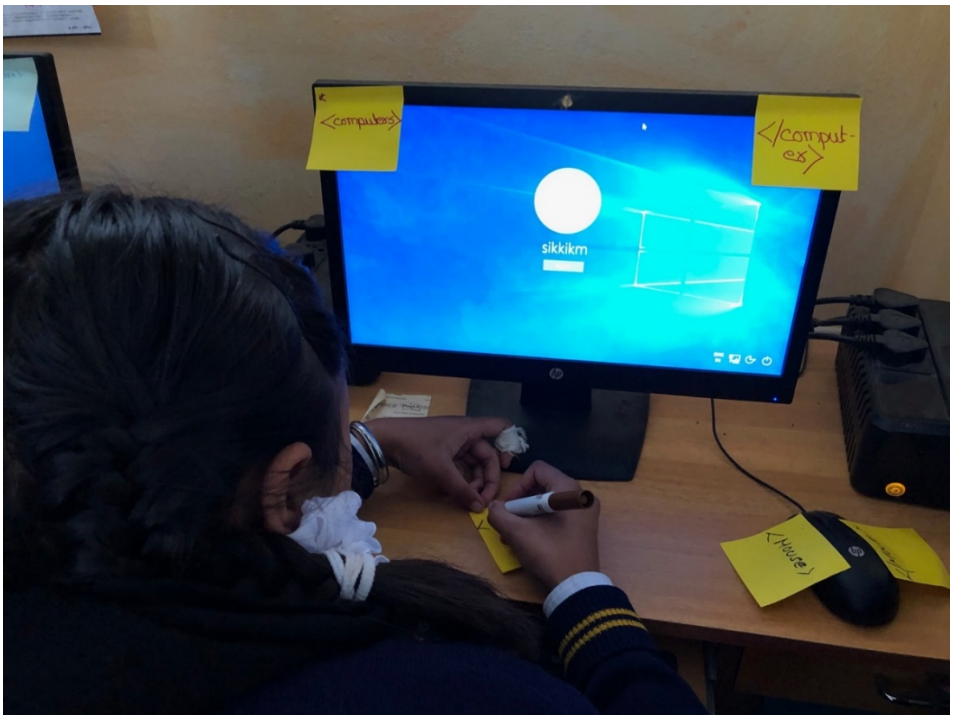

Figure 2. Lessons about tags allowed students to change the look of text on their pages by altering the tags.

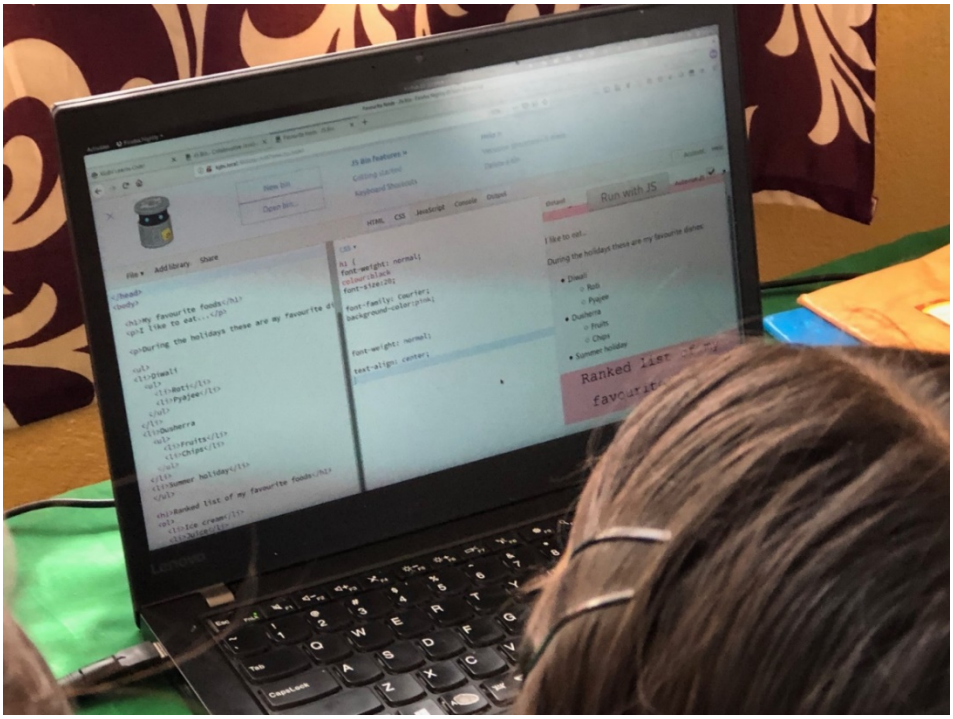

Figure 3. More advanced instructions on page layout.

Figure 4. Students traced an outline of their own bodies on large pieces of butcher paper.

Figure 5. A student's completed body tracing on display.

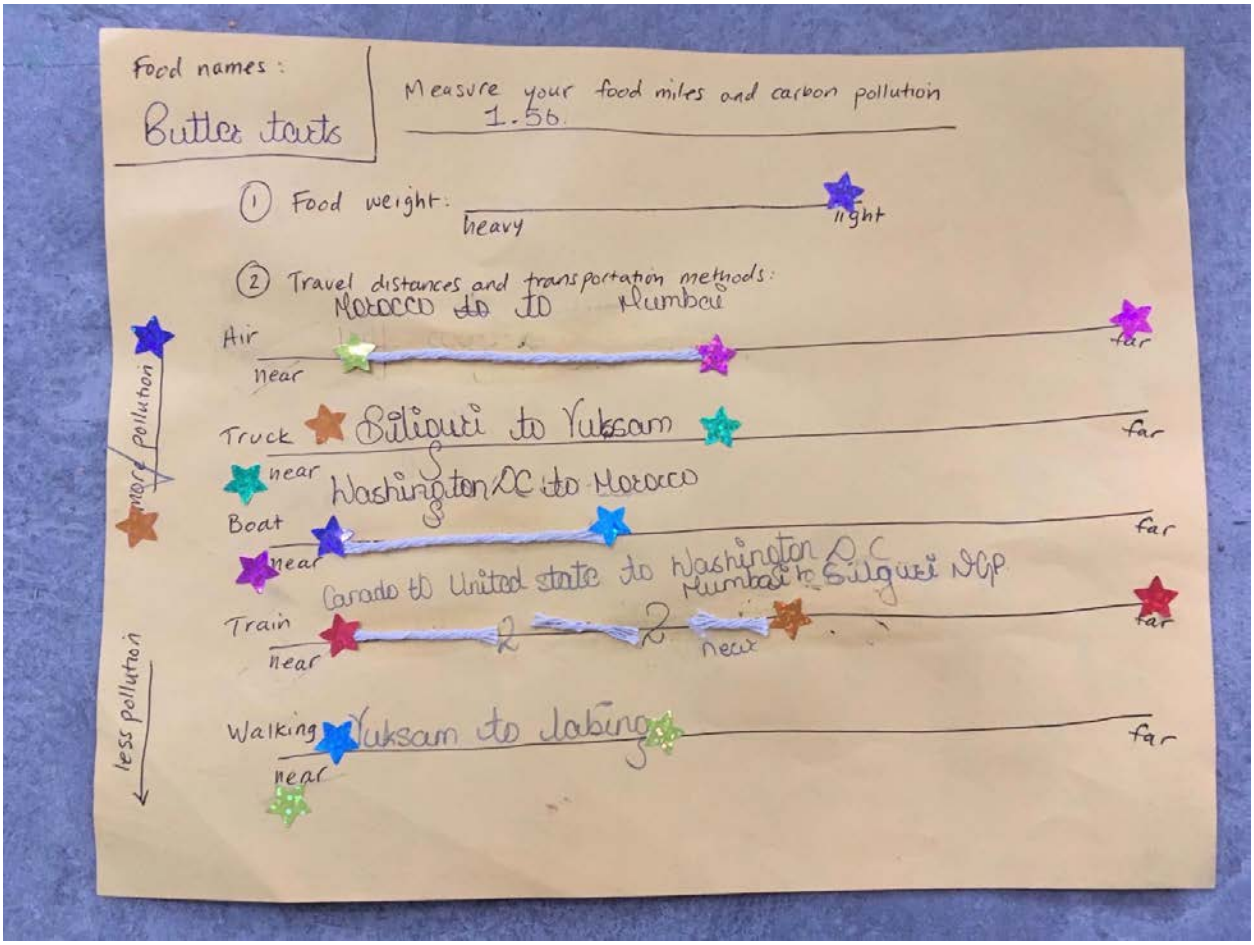

Figure 6. A lesson on food miles and carbon emissions, aiming to show how food choices have environmental impact.

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