

Toward Food Sovereignty for Coastal Communities of Eastern Québec: Co-designing A Website to Support Consumption of Edible Resources from the St. Lawrence River, Estuary, and Gulf

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Abstract

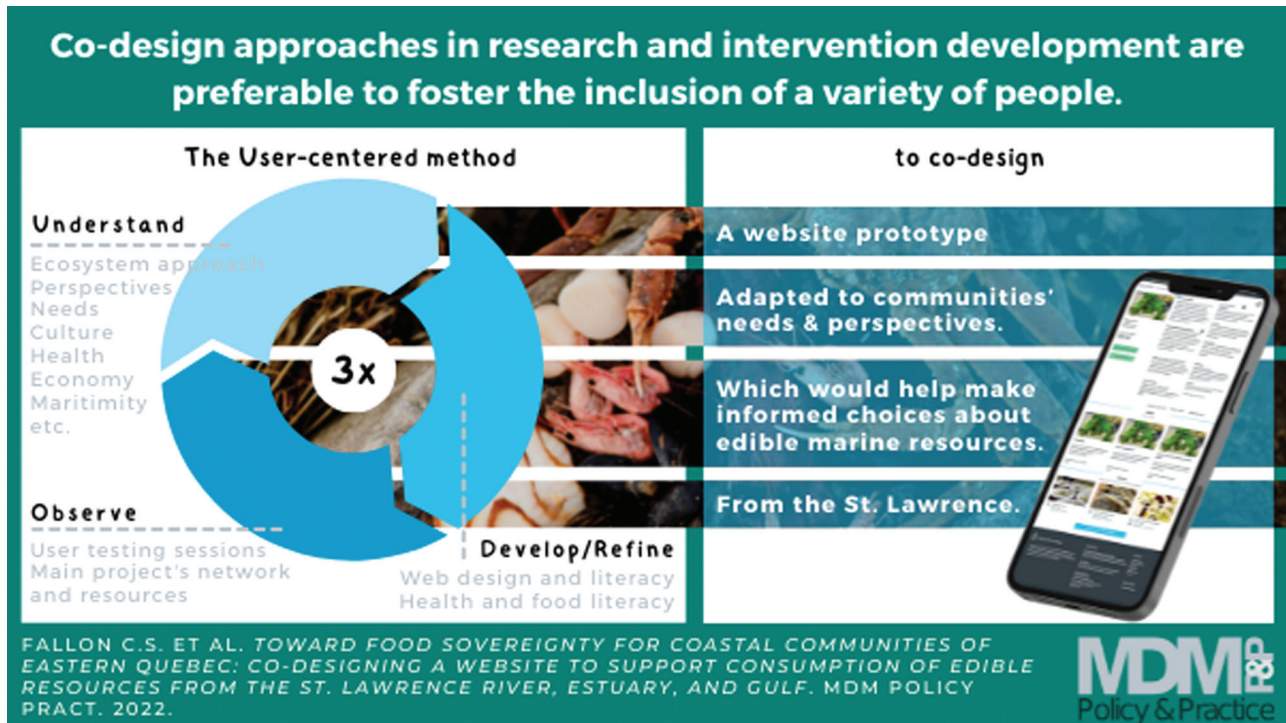
Background. Despite the abundance and proximity of edible marine resources, coastal communities along the St. Lawrence in Eastern Québec rarely consume these resources. Within a community-based food sovereignty project, Manger notre Saint-Laurent (“Sustenance from our St. Lawrence”), members of participating communities (3 non-Indigenous, 1 Indigenous) identified a need for a web-based decision tool to help make informed consumption choices. **Methods.** We thus aimed to co-design a prototype website that facilitates informed choices about consuming local edible marine resources based on seasonal and regional availability, food safety, nutrition, and sustainability, with community members, regional stakeholders, and experts in user experience design and web development. We conducted 48 interviews with a variety of people over 3 iterative cycles, assessing the prototype’s ease of use with a validated measure, the System Usability Scale. **Results.** Community members, regional stakeholders, and other experts identified problematic elements in initial versions of the website (e.g., confusing symbols). We resolved issues and added features people identified as useful. Usability scores reached “best imaginable” for both the second and the third versions and did not differ significantly between sociodemographic groups. The final prototype includes a tool to explore each species and index cards to regroup accurate evidence relevant to each species. **Conclusions.** Engaging co-designers with different sociodemographic characteristics brought together a variety of perspectives. Several components would not have been included without co-designers’ input; other components were greatly improved thanks to their feedback. Co-design approaches in research and intervention development are preferable to foster the inclusion of a variety of people. Once the prototype is programmed and available online, we hope to evaluate the website to determine its effects on food choices.

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Highlights

- Due to factors including cost, loss of traditional knowledge, and concerns about environmental contaminants, people living in coastal communities along the St. Lawrence River in Eastern Québec rarely consume local edible marine resources such as fish, seafood, plants, and mammals.
- Community members identified a need for a locally relevant website to support informed decision making about consuming local marine resources.
- By co-designing with community members, regional stakeholders, and other experts from the beginning of the process, we were able to integrate diverse perspectives into a website prototype adapted to community members' needs, with information about seasonal and regional availability, food safety, nutrition, and sustainability.

Keywords

food sovereignty, St. Lawrence, Eastern Québec, coastal communities, risk-benefit assessment, healthy eating, edible marine resources, web design, user-centered design, decision support technique.

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Background

Edible resources such as fish, seafood, plants, and mammals from the St. Lawrence River, Estuary, and Gulf used to figure prominently in the diets of coastal communities in Eastern Québec.¹ However, despite continued physical proximity, accessing edible resources from the St. Lawrence is no longer as easy in these communities for multiple reasons, including misconceptions about the benefits and risks of these resources.^{2,3}

When prepared and consumed safely, resources from the St. Lawrence have nutritional benefits² and contribute to healthy eating habits, namely, the consumption of fresh and minimally processed foods.^{4,5} People's preferences can include not only their own health but also the impact of their choices on their community. A more sustainable consumption of marine foods can also play a major role in the local economy and contribute to the sharing of culinary heritage with younger generations, supporting healthy communities.⁶⁻⁹ However, some of these resources accumulate environmental contaminants (for example, mercury),^{6,10} presenting a health risk, especially during pregnancy, infancy, and childhood.^{11,12} Because of these competing benefits and risks, people living on the shores of the St. Lawrence might benefit from decision support regarding the consumption of local marine resources.⁶

Previously, consultations with 50 coastal community members (Cap-chat, 13, Sainte-Thérèse-de-Gaspé, 10,

Îles-de-la-Madeleine, 14, Wolastoqiyik Wampanoag First Nation, 13; Figure 1) in 2018, conducted as part of the larger project *Manger notre Saint-Laurent* ("Sustenance from our St. Lawrence"), underlined communities' need for tailored information.¹³ This broader project encompassing the present study aims to promote sustainable, safe, and healthy consumption of the St. Lawrence's resources as well as the food sovereignty of the coastal communities of Eastern Québec.¹⁴⁻¹⁷ It uses an ecosystem approach to health, based on the principles of transdisciplinarity, sustainability, social justice, gender equity, and community participation from the outset of the project.¹⁸ The project draws from those principles to obtain a portrait of environmental, health, social, economic, and cultural challenges faced by the communities.

Community members expressed a need for reliable information about St. Lawrence edible resources, their seasonal and regional availability (costs), food safety (risks), nutrition (individual-level benefits and risks), sustainability (community-level benefits and risks), and preparation instructions (implementation of decisions). As in other studies that have applied medical decision-making approaches outside the bounds of complete clinical equipoise (for example, reducing overuse of antibiotics,¹⁹ increasing uptake of vaccines,²⁰ or supporting people in choosing a health insurance plan²¹), we believed that decision support would be appropriate in this context. Informed decision making may help people consider the benefits and risks of their food options in a complicated landscape and then implement their decisions with confidence. Community members mentioned that the information should be centralized, easy to access, easy to understand, and adapted to the St. Lawrence, its species, and the sociocultural characteristics of its communities, such as language preferences, culinary heritage, and geography.¹⁴⁻¹⁷

We reviewed governmental and nongovernmental tools already available²²⁻²⁹ and found no existing web tools that met the aforementioned needs. We therefore aimed to co-design a website prototype to support informed decision making regarding the consumption of edible resources from the St. Lawrence in partnership with the 4 coastal Indigenous and non-Indigenous communities involved in Sustenance from our St. Lawrence and with the project stakeholders. In this article, we describe working with them from the start and throughout the co-design process.

Methods

Overall Co-design Process

Our overall process followed the typical steps of user-centered design (Figure 2). We conducted user research

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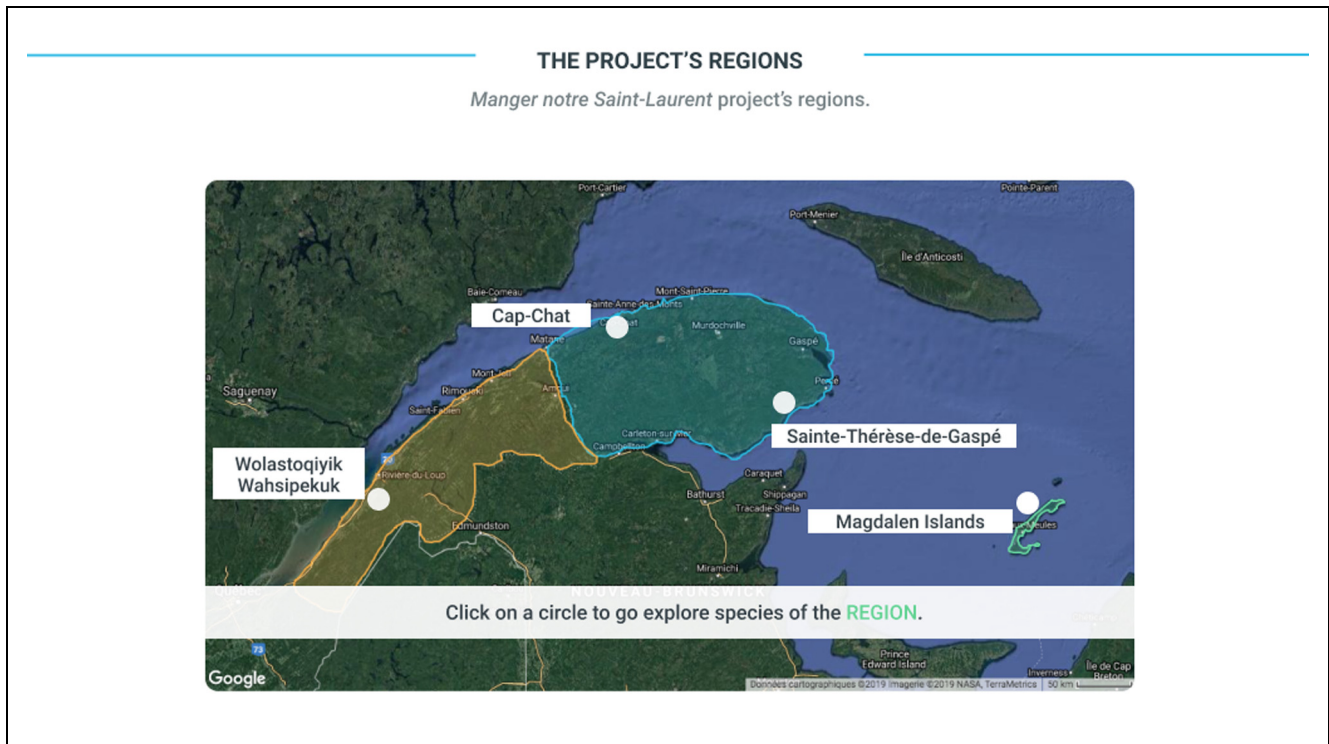


Figure 1 Screenshot of the hand-drafted map used for the last version of the prototype.

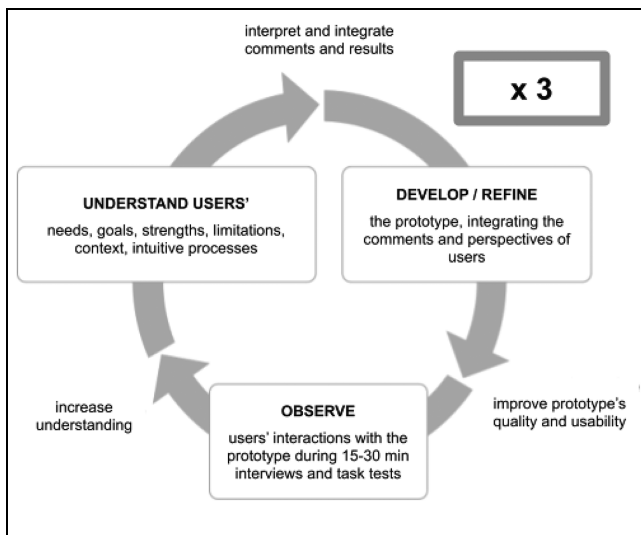


Figure 2 Adaptation of the user-centered design method from Witteman et al. (2015).³⁰

to understand community members and stakeholders' perspectives, developed a prototype, tested users' interactions with it, interpreted results, and iteratively refined

the prototype.³⁰ Under the umbrella of user-centered design, our process was one of co-design, in which community members and stakeholders had equal power to determine the type of content and design of the prototype.³¹ To develop a first prototype, the first author (C.F.) incorporated ideas from team members, community members, and stakeholders, keeping in mind ecosystem approaches to health and web design principles in public health and literacy synthesized from expert's guidelines for professionals (see Supplementary Appendix 1 for details).^{32–34} We collected and analyzed qualitative and quantitative data to improve the prototype with each of the 3 iterative cycles. In the third cycle, because of the confinement measures associated with the COVID-19 pandemic, we recruited among people comfortable with using video-conferencing software. The project was approved by the CHU de Québec Ethical Board (project MP-20-2019-4171/modification F1-42256).

Participants

Communities prioritized reaching current or future parents of children and also involving fishers in the broader project. Our inclusion criteria for user testing were

therefore adults >18 y old who belonged to the communities and their surroundings and/or who were stakeholders in the project (e.g., people working in the maritime food industry, people whose professional role includes promoting local food sustainability), who were able to understand at least one of French or English (although it need not be their mother tongue), and able to perceive images and text on paper or on a screen. We aimed to recruit a total sample size of 60 participants (about 5 participants per community per iterative design cycle, across 4 communities and 3 iterative cycles).³⁵ Across recruitment efforts, we sought to include community members and stakeholders (participants) with diverse sociodemographic characteristics, for example, people of different age groups, genders, occupations, and languages. While we aimed to consult across all adult ages, our groups of interest were people between the ages of 26 and 50 y, who were more likely to be parents or adults who might play a role in children's eating habits.

We recruited convenience samples over the 3 cycles. To enable in-depth feedback from repeated participation, we allowed people to participate in multiple cycles if they wished, but we primarily sought new participants in each cycle, as they would better represent potential users of the website encountering it for the first time.³⁶ We also aimed for a variety of occupational classes, approximately equal representation of users and stakeholders, and equal recruitment from the 4 communities. In addition, although French is the predominant language of Eastern Québec regions, we sought the perspectives of at least 1 English-speaking person.

A common sample size for this type of work is 5 people per cycle, which typically approaches saturation of usability problems identified within several cycles.^{35,37} We sought a somewhat larger sample size than usual to enable broad representation across communities, aiming for 5 participants per community (total 20 people per cycle) with a goal of reaching saturation in people's comments. We did not prespecify saturation criteria; rather, our limit was a function of achievable sample size in this context. We considered we had reached saturation when participants repeated similar comments between one another. Participants were not given any remuneration.

Recruitment

In the first cycle, we recruited participants by posting flyers in the communities and by reaching out through the networks of Sustenance from our St. Lawrence members (see Supplementary Appendix 2). We identified recruitment sites with the help of our local partners, affiliated both with

Université du Québec à Rimouski: CIRADD, a collegial research center, based in Gaspésie-Îles-de-la-Madeleine, that introduces postsecondary students to research and aims to support sustainable development, and with Centre de recherche sur les milieux insulaires et maritimes, a research center located on the Magdalen Islands, studying maritime and island environments. We visited markets and shopping centers, with the consent of their owners.

In the second cycle, we recruited new participants through project newsletters sent via email or posted on the project's Facebook page. We also recruited while participating in other activities of Sustenance from our St. Lawrence, for example, when we returned project results to the communities, and during the annual powwow of Wolastoqiyik Wahsipekuk First Nation. We also collaborated with the Nation's band office to communicate with community members and recruited employees of the office. User testing sessions were conducted on the spot of recruitment for the first and second cycles.

In the third cycle, because of restrictions during the COVID-19 pandemic, we conducted interviews through video conferencing. Our participants needed an internet connection and to be comfortable using video-conferencing software and shared-screen functions so we could observe the interactions with the prototype. We also recruited fewer participants because we made fewer and more minor modifications in this cycle. With our average System Usability Scale score already high and saturation reached in the comments noted in the second cycle (namely, we had no new usability issues raised [see details in the Supplementary Appendices]), the goal of the third cycle was mainly to confirm that the changes made improved the prototype. We therefore recruited multidisciplinary experts in web design, communication, infographics, and web marketing from our participating communities and networks to participate in a standalone critique.³⁸ This approach allows conversations between a presenter and critics toward a goal of improving a design. The critics were asked to discuss their perspectives on the prototype without following a particular set of heuristics or checklist.

Data Collection: Individual User Testing Sessions

We showed prospective users (participants) the prototypes and asked them to articulate their reactions in 15- to 30-min individual user testing sessions. For the first cycle, the first author (C.F., research student) created a first prototype (Figure 3) and printed the main pages of the first prototype (homepage, species list, 1 index card)

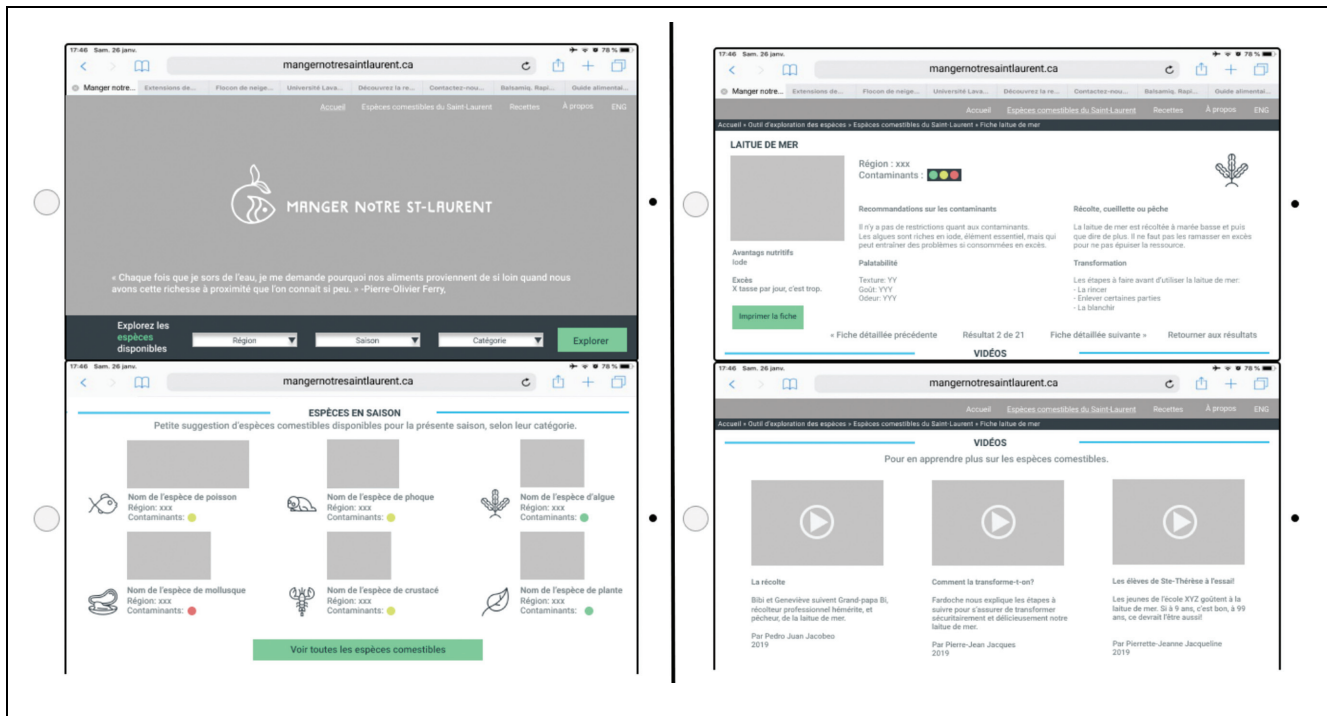


Figure 3 Selected screenshot of the first version of the prototype.

on legal-sized paper to facilitate a first round of user testing in rural areas in which we might have had difficulty with internet access. She presented the homepage first and then other pages according to which button the participant indicated.

In the second and third cycles, we used electronic tablets to present the prototypes, allowing participants to navigate a mocked-up draft website and comment freely. We also measured the usability of the prototype after each individual session, using a previously translated and validated French version³⁹ of the System Usability Scale⁴⁰ (Supplementary Appendix 3).

All user testing sessions took the form of semistructured interviews (interview guide: Supplementary Appendix 2) in French or English, the main languages in Eastern Québec.⁴¹ The first author (C.F.) collected comments, observed interactions as qualitative data regarding the components of the design and usability, and asked structured questions from a sociodemographic form. She audio-recorded and transcribed the interviews for qualitative analysis of the comments.

Prototype Creation

To design the first version of the prototype (Figure 3), we drew on ecosystem approaches to health^{18,42} and web

design principles in public health and literacy.^{32–34} In short, we considered text and font, using Sans Serif font with minimum size of 12 to 14 points, short paragraphs, explicit titles, as well as kerning and line spacing wide enough for pleasant reading. We used the color palette created for Sustenance from our St. Lawrence by an agency specialized in territorial marketing (Visages régionaux), including colors that fit well together and that are contrasted, constant, and simple. We also considered layout principles, dividing the webpage in 3 parts: the header, the footer, and the body. Lastly, we considered principles related to web browsing and usability. Namely, websites should be simple, organized, and easy to browse with strategic hyperlinks and a printing option to support potential offline activities.^{32–34} The ability to print for offline use may be especially important in rural areas or among people with lower incomes, who might have less internet access. We used a layout canvas within Figma software (San Francisco, CA, USA) for all of the designing and refining processes.

As we developed the first prototype, we incorporated the before-identified needs as well as ideas from team members, community members, and stakeholders (Table 1). We mapped the elements of Table 1 to the basic technology acceptance model (TAM),^{43–45} which offers a theoretical framework to describe intention to use and usage

Table 1 Considerations, Components, and Design Features (Grouping Guide)

Technology Acceptance Model	Need	Website Component Addressing the Need
Perceived ease of use	(A) Centralized information	Access to species' index cards centralizing information. List of species and species categories. "Details" button.
	(B) Adapted information	Species index cards. Print button. Expectations: Sections of the species index card answering what the participants are expecting in terms of information. Website purpose: Presentation of the homepage. Index cards will only be about St. Lawrence species. Reliability: Do participants view the information as reliable and science-based?
	(C) Information easily accessible	Language, French, English: Words in both French and English. Exploring (via research bar): Two research bars: bottom of the first picture of the homepage, and left column of the species list. Divided into: species category, season, region. Exploring (via images): Drawings representing 6 species categories: fish, molluscs, crustaceans, algae, seaside plants, and marine mammals.
	(D) Information easy to understand	Clarity: Is the presentation of the information clear, does it cause confusion or clashes? Clarity (3 colored points): Colored 3-point system (red, yellow, green) to emphasize species to consume with caution for their contamination risks. Design (font, colors, layout): Dark font adapted for on-screen reading (i.e., sans serif; here, Roboto). Limited color pallet (i.e., the 3 colors of the project, HEX codes: 33bce6, 73e0a2, 354047). Aerated layout on a white background. Logo and other drawings: Official logo of Sustenance from our St. Lawrence. Drawings (pictograms), 1 by species category. Pictures and videos: Pictures (i.e., species and recipes) and videos (i.e., steps of consumption) will be included to facilitate the comprehension. Title examples were put in the prototype.

(continued)

Table 1 (continued)

Technology Acceptance Model	Need	Website Component Addressing the Need
Perceived usefulness	(E) Information about risks and disadvantages	Contaminants: Section title on index cards: "Recommandations sur les contaminants/ Recommendation on contaminants." Sustainability: Section not created on the first prototype. Fishing, picking, hunting methods: section title on index cards: "Cueillette ou pêche/ Picking or fishing."
	(F) Information on benefits and healthy consumption	Excess: section title on index cards: "Excès/ Excess." Palatability: section title on index cards: "Palatabilité/Palatability." Nutritional values: section title on index cards: "Avantages nutritifs/Nutritional benefits."
	(G) Information on transformation and consumption	How to prepare: section not created on the first prototype. Recipes: section at the bottom of each index card: "Recettes valorisantes/ Recipes to appreciate." A button was included to suggest recipes. Transformation and conservation: Section title on index card: "Transformation."
	(H) Information on seasonal availability	Choosing a season with the search bar: Research bars are divided into: species categories, seasons, regions.
	(I) Other concerns identified (with prototype 1 interviews only)	Information gap
	(J) Available tools and references	Additional suggestions Shops and enterprises Entourage Government Books and writings Search engine Scientific organizations Organizations

behavior in terms of perceived usefulness and ease of use, social influence, and cognitive instrumental processes. While in this study we did not have control over the social and cognitive aspect of the framework, we did have control over the design components, which we consider to be predictors of the ease of use, and over the type of information, which may predict perceived usefulness. We also outlined more benefits than potential costs in the index cards because the health benefits of consuming seafood generally outweigh the few contaminant risks.¹²

Data Analyses

Qualitative data. In addition to considerations, components, and design features, we used Table 1 as a grouping guide for our qualitative analysis, seeing the needs and

considerations as main groupings and the components and features as subgroupings. We collected comments on this first version by transcribing interviews and grouping the comments according to which component of the prototype they were related.

We (C.F., H.W.) analyzed each grouping and addressed them in a second version of the prototype. We followed the same iterative process for the second and third versions. We evaluated which comments or problems needed to be addressed based on the severity of each usability problem with additional input from our web design specialist (E.P.).

Quantitative data. We obtained System Usability Scale scores for the second and third versions of the prototype by asking participants to indicate their agreement with 10

statements on a Likert-type scale rated from 1 (*strongly disagree*) to 5 (*strongly agree*) (see Supplementary Appendix 3 for details). We summed the scores to obtain a global score between 0 and 100 for each participant.

We assessed the validity of each global score by using an 11th statement, according to the method described by Bangor et al.⁴⁰“Overall, I would rate the user-friendliness of the product as [. . .]” with the following possible adjectives: “the worst imaginable,” “awful,” “poor,” “OK,” “good,” “excellent,” and “the best imaginable.” This allows researchers to compare a participant’s global score with their answer for this 11th statement. When a chosen adjective did not match the global score for a participant, we saw an inconsistency, and their global score was excluded from the statistical analyses.

Statistical analyses. We computed each participant’s global score to calculate the average score of the prototype for the second and third cycles. Scores ranged from 0 to 100: between 0 and 25 (worst usability score imaginable), 26 to 39 (awful), 40 to 52 (poor), 53 to 73 (good), 74 to 86 (excellent), and 87 to 100 (best imaginable).⁴⁰ We then ran descriptive analyses with R, version 3.6.3 (Vienna, Austria) to assess the distribution of the average scores. We used nonparametric tests to assess differences in global scores by sociodemographic variables ($\alpha = 0.05$). We conducted analyses when we had a minimum of 5 participants ($n = 5$) in each group.^{46,47} We used Wilcoxon-Mann-Whitney tests to compare between roles in Sustenance from our St. Lawrence (community members and stakeholders), genders (women and men), citizenship categories (Indigenous and non-Indigenous), and age groups (≤ 50 y and >50 y). We used a Kruskal-Wallis test to analyze possible differences between communities.

Results

Participants

Sociodemographic data are presented in Table 2. Overall, we met our predetermined inclusivity goals. We had to exclude 1 participant’s score from the analyses (community member from cycle 2) because their global score for the first 10 statements (0, worst imaginable) did not align with their answer to the 11th statement (excellent) nor with their qualitative comments, which were positive about the prototype.

Iterative Cycle 1 ($n = 20$)

We summarized participants’ comments and grouped them according to which component of the prototype it

referred, then made modifications to refine the prototype accordingly (see Supplementary Appendix 4 for details).

The type of comments provided differed somewhat by sociodemographic characteristics (age and occupation). Older community members had a different understanding of the purpose of the website in general. Participants with a background in marketing or web design had more specific comments. For instance, regarding the purpose of the website:

I’m with the impression that there are, that this website will tell us if fishes are endangered, or those who are mistreated, those to avoid. I don’t know. Pollution. Problem with water. Water, we don’t know what we eat. (Translation, retired participant, 65 y old, section “(D) Information easy to understand” in Table 1)

Only to contextualize where you are, at first glance. Because a person will spend 3 seconds. The first 3 seconds are decisive to stay on a website or not. (Translation, stakeholder participant, 29 y old, section “(D) Information easy to understand” in Table 1)

We noted various severe problems regarding comprehension and usability of the first version of the prototype (section D in Table 1). Participants understood the pictograms representing the 6 species categories, but the section’s name and titles were not well understood. We changed those titles from “species in season” to “species categories.” More importantly, the 3-color point system (red, yellow, green) to emphasize contamination risks was not understood or the red had too strong a meaning. Consulting with experts in environmental health, we understood that contamination challenges are complex and sensitive and do not answer well to a simple red, yellow, and green scale. Thus, from the 3 suggestions offered by the participants, we chose to move the color system from the homepage to the species’ information for index cards to not emphasize only the risks. Then, to avoid the unnecessarily alarming red colors and the use of a 3-colored scale, we considered other symbols that would bring attention to information that is of special importance in each index card: a magnifying glass or yellow triangle with an exclamation point (see Figure 4).

As for the need for information that is adapted (section B in Table 1), many participants made negative comments about the word *palatability*, bringing the language level to our attention. Some suggested the phrase *taste properties* instead. We also changed the first sentence seen on the homepage to better describe the website’s purpose. Many also used *resource quality* to talk about the safety of the edible resources, more than the word *contaminants*.

Table 2 Sociodemographic Data and Mean System Usability Scale (SUS) Scores by Iterative Cycle

	Cycle 1 (User Testing; <i>n</i> = 20)		Cycle 2 (User Testing; <i>n</i> = 21 ^a)			Cycle 3 (Standalone Critique; <i>n</i> = 7)		
	<i>n</i>	%	<i>n</i>	%	Mean SUS	<i>n</i>	%	Mean SUS
Mean ± SD and Median [IQR] out of 100	—	—	—	—	89 ± 10 93 [13]	—	—	92 ± 4 93 [4]
Gender								
Women	14	70%	14	67%	88 ± 10	6	86%	92 ± 4
Men	6	30%	7	33%	92 ± 8	1	14%	95
Nonbinary and other	0	0%	0	0%	—	0	0%	—
Age, y								
18–25	2	10%	4	19%	91 ± 4	2	29%	90 ± 7
26–35	7	35%	3	14%	90 ± 13	2	29%	93 ± 0
36–50	5	25%	8	38%	91 ± 12	2	29%	95 ± 0
51–65	5	25%	5	24%	86 ± 9	1	14%	90
≥66	1	5%	1	5%	83	0	0%	—
Role ^b								
Community members	12	60%	13	62%	89 ± 9	0	0%	—
Stakeholders	8	40%	8	38%	89 ± 11	7	100%	92 ± 4
Occupation ^c								
Retired, student, etc.	4	20%	3	14%	93 ± 3	0	0%	—
Manager	3	15%	4	19%	89 ± 12	1	14%	95
Professionals	5	25%	8	38%	90 ± 8	6	86%	92 ± 4
Technicians and associate professionals	3	15%	2	10%	83 ± 0	0	0%	—
Clerical support workers	2	10%	2	10%	83 ± 21	0	0%	—
Service and sales workers	3	15%	2	10%	100	0	0%	—
Others	0	0%	0	0%	—	0	0%	—
Language								
French	20	100%	20	95%	89 ± 10	7	100%	92 ± 4
English	0	0%	1	5%	95	0	0%	—
Communities ^d								
Gaspésie (Cap-Chat)	4	20%	5	24%	78 ± 13	1	20%	95
Gaspésie (Ste-Thérèse-de-Gaspé)	4	20%	5	24%	94 ± 7	0	0%	—
Magdalen Islands	6	30%	4	19%	91 ± 4	2	40%	89 ± 5
Bas-St-Laurent	6	30%	7	33%	91 ± 7	2	40%	91 ± 2
Other	0	0%	0	0%	—	2	40%	95 ± 0
Citizenship category ^e								
Indigenous	5	25%	5	24%	89 ± 6	1	14%	90
Non-Indigenous	15	75%	16	76%	89 ± 11	6	86%	93 ± 4

IQR, interquartile range; SD, standard deviation. We conducted nonparametric statistical analysis using Wilcoxon-Mann-Whitney or Kruskal-Wallis tests when $n \geq 5$ in each group: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

^aWe excluded 1 participant from the analysis because of an invalid rating.

^bUsers (meaning community members who might use the web-based decision support) and stakeholders (meaning people with a specific interest or input in the project).

^cClasses of the International Standard Classification of Occupations.⁴⁸

^dPart of 3 Eastern Québec regions: Gaspésie (Cap-Chat and surroundings or Sainte-Thérèse-de-Gaspé and surroundings), Magdalen Islands, or Bas-Saint-Laurent (Wolastoqiyik Wahsipekuk First Nation). Participants might also represent other regions since members of the Wolastoqiyik Wahsipekuk First Nation are spread across various regions of Québec and Ontario Provinces, as well as Maine in the United States.⁴⁹

^eWe also considered citizenship categories when collecting the sociodemographic data: Indigenous origins (Wolastoqiyik Wahsipekuk First Nation) or other non-Indigenous origins.

We changed the section on contaminants for *resource quality and contaminants*. We kept the word *contaminants* because we noted that public health departments, researchers, and communities are concerned by food safety and health risks of environmental contaminants.

Although they expressed it (sections E–H in Table 1) in various ways, all participants had concerns regarding resources and environmental sustainability, many pointing out the importance of considering resources' status and environmental impacts for responsible fishing,

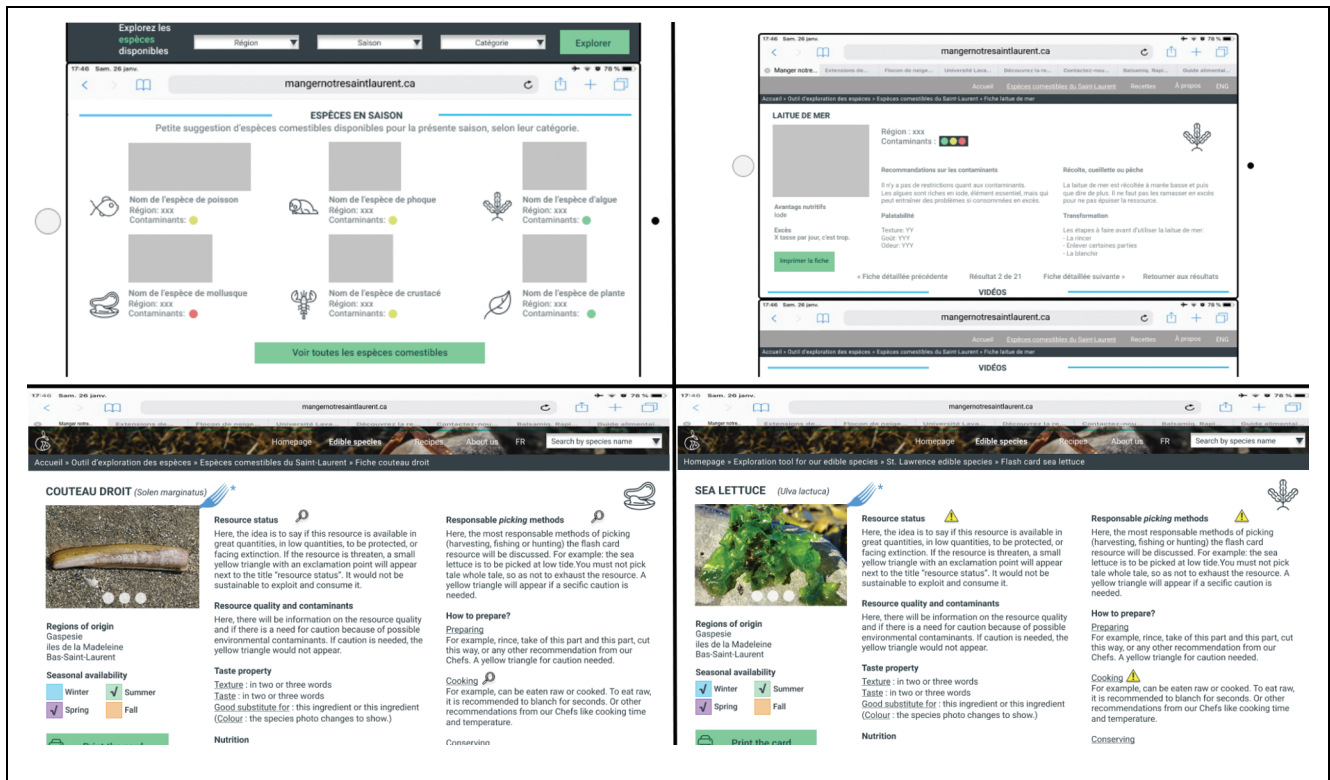


Figure 4 Selected screenshot of the first and second versions of the prototype. Top right: Homepage version 1, with colored points for contaminant information. Top left: Index card version 1, with colored points for contaminant information. Bottom right: Index card version 2, with magnifying glass for precaution information. Bottom left: Index card version 2 with triangle for precaution information.

picking, and hunting methods. Some also mentioned the resource status as being an economic preoccupation. We created a new section to discuss resource status, and we added the word *responsible* to the section on fishing, picking, and hunting methods to reflect the importance of sustainability.

Participants were also interested in learning about health issues related to some nutrients found in the resources. We created a “nutrition” section to cover both health benefits and what constitutes an excessive intake. We planned on using claims such as “rich in” or “poor in” (based on the Canadian Food Inspection Agency’s regulation) and not the actual nutritional facts table, which requires higher numeracy and literacy skills.³³

Participants showed interest in seeing a section on safe ways to handle, preserve, and cook the resources, other than simply providing recipes. We changed the title of the transformation section of the index card from “how to prepare?” and added 3 subtitles: “preparing,” “cooking,” “conserving.”

Iterative Cycle 2 (n = 21)

In addition to the modifications described above, we modified the prototype to make it more usable on an electronic tablet. Based on comments made during the first cycle, we refined the prototype to create a second version (see Figure 5).

We summarized participants’ comments and grouped them according to which component of the prototype it referred, then made modifications to refine the prototype (see Supplementary Appendix 5 for details).

Again, the type of comment did not differ by most sociodemographic characteristics, with the exception of age and background in marketing or web design. Older community members were more hesitant but still able to access the information and understand the sections:

Easy to use, yes, it’s relatively easy. I would not need any technical support, I don’t think. Even despite my great ignorance. (Translation, participant, 72 y old, section “(C) Information easily accessible” in Table 1)

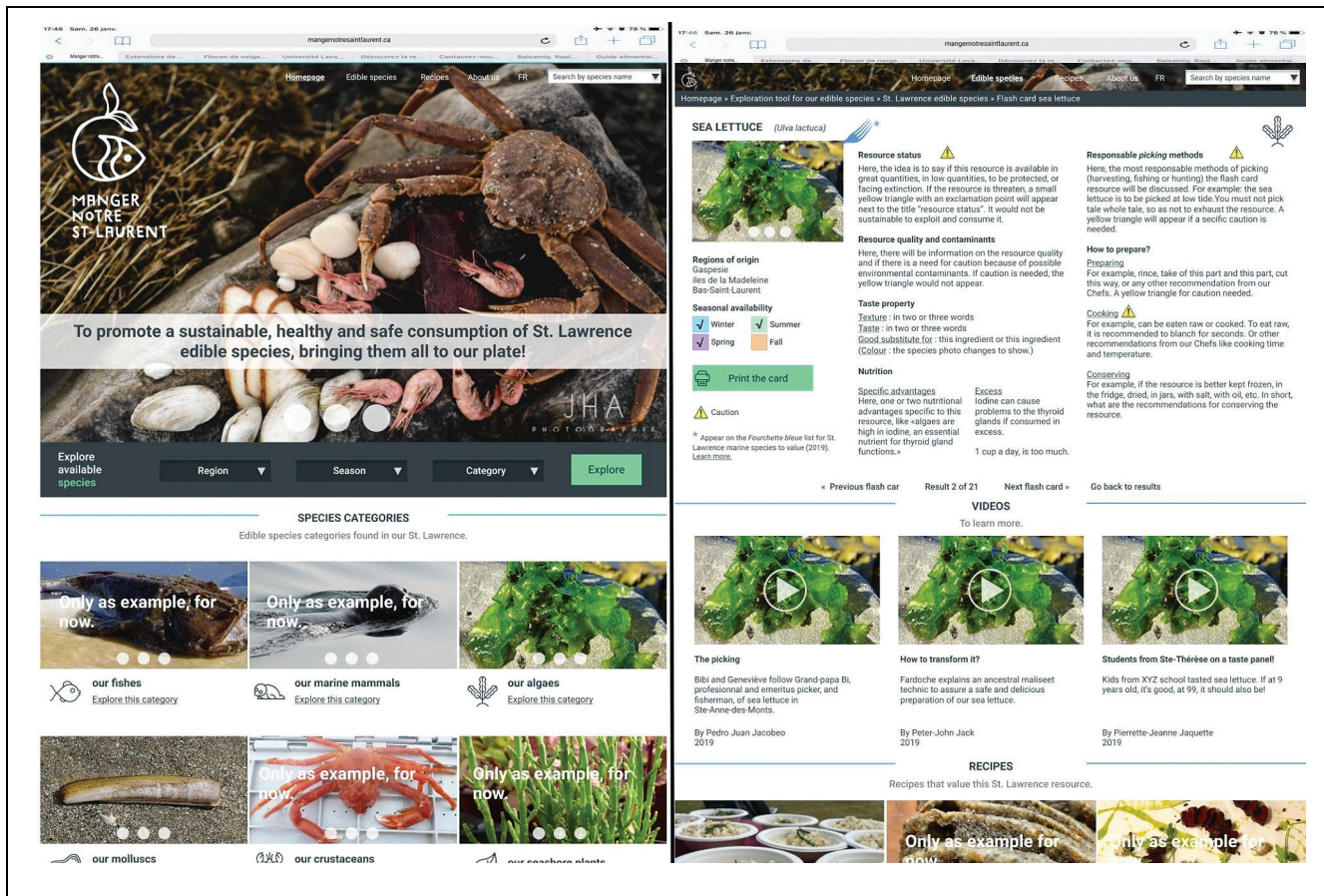


Figure 5 Selected screenshot of the second version of the prototype.

Compared with the first cycle, community members offered fewer comments and we observed fewer critical issues needing to be addressed to improve the comprehension and usability of the second prototype.

All participants preferred the yellow triangle with the exclamation point to the magnifying glass to represent precaution. However, the understanding of the word *precaution* varied slightly from one person to another, and some participants found the word threatening. With the advice of our web design specialist (E.P.), we changed the symbol to a black circle with a white exclamation point and changed the legend to a pop-up bubble reading, "Pay special attention to this section for healthy, sustainable, and safe consumption of the resource."

Most participants did not understand that they could scroll down the page, although nobody had a problem accessing the index cards or browsing the prototype by other means. We moved the exploration tool a little

higher on the page to allow users to notice the lower section at first glance.

Participants needed time to understand the colors and 1-letter abbreviations for the seasonality indication. We therefore changed the letters and colors to black and white symbols more commonly representing the seasons in Québec: a snowflake (winter), a flower (spring), a sun (summer), and a leaf (fall).

We calculated System Usability Scale scores, for an average of 89.1 (best imaginable, $n = 21$, $s = 10$) for this second version, varying from 72.5 (good) to 100 (best imaginable). We examined score differences between sociodemographic groups. We ran Wilcoxon-Mann-Whitney tests for gender ($P = 0.42$), role in the project ($P = 0.61$), citizenship category ($P = 0.60$), and age groups ($P = 0.15$) and Kruskal-Wallis rank sum test for communities ($P = 0.25$), although it should be used with caution. We did not find significant differences or stochastically dominant scores.

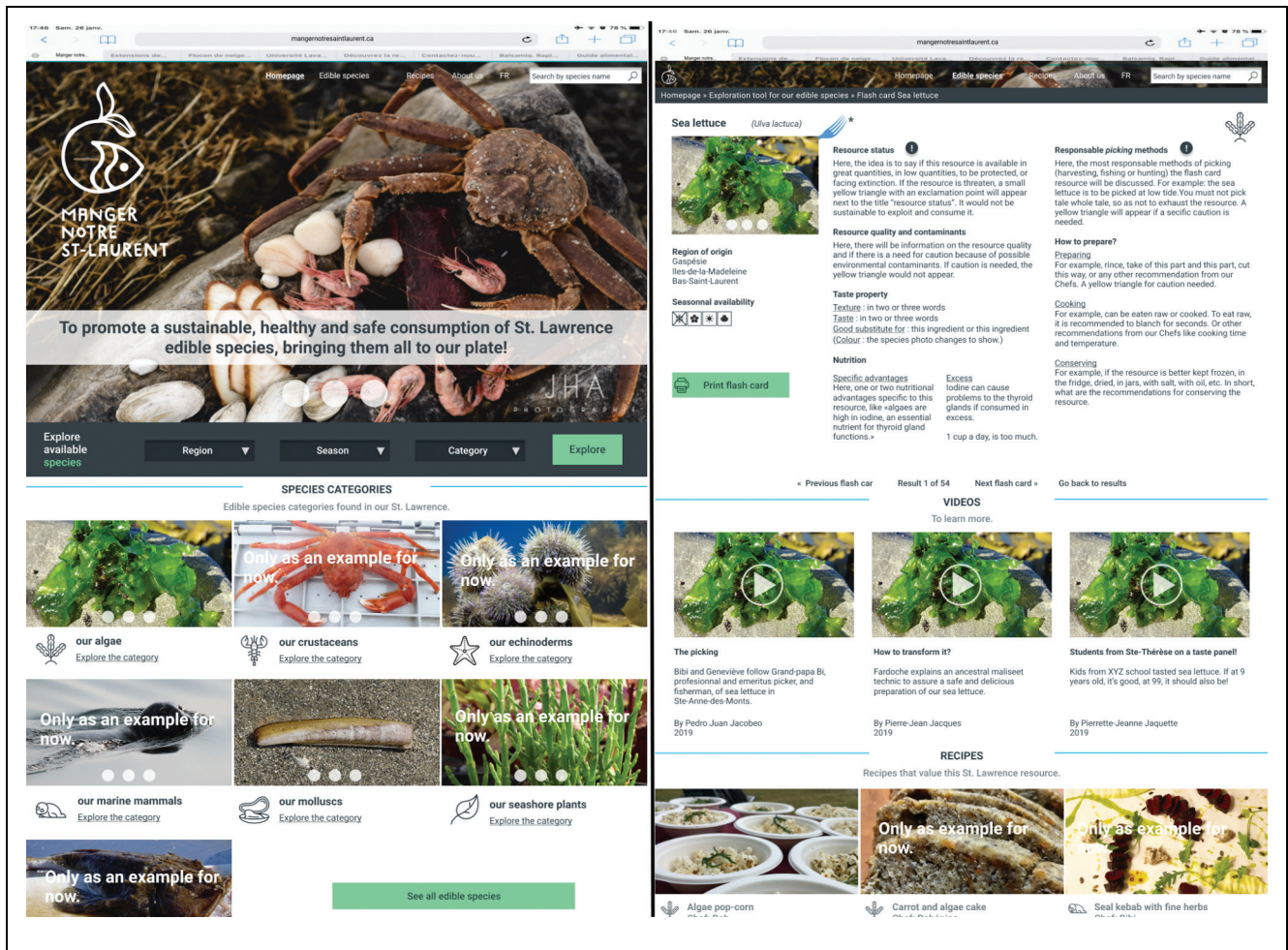


Figure 6 Selected screenshot of the third version of the prototype.

Iterative Cycle 3 (n = 7)

Based on comments from the second cycle, we refined the prototype to create a third version (see Figure 6).

In this standalone critique cycle, we again summarized participants' comments and grouped them according to which component of the prototype it referred, then made last modifications to refine the prototype (see Supplementary Appendix 6 for details). As in other iterative cycles, the first author (C.F.) identified participants' desired modifications and reviewed them with other team members. Given the small sample of participants recruited, we did not evaluate whether the type of comments differed according to the sociodemographic characteristics.

We found only minor issues for this version. Mainly, the symbols for season identification in the species list were not quickly understood by all. Three people also thought

the symbols should not be next to the picture because it overloads the webpage. We moved the symbols under the regions in the species list and added a pop-up legend.

Like, not on the [species] picture, but maybe underneath [the regions]. But not in the picture. It looks like it's hiding the product. (Translation, professional participant, 25 y old, section "(D) Information easy to understand" in Table 1)

We noted comments regarding the layout and some wording as well. Two participants suggested using action verbs. On the homepage, participants suggested using more space for the layout and using buttons as big as the species categories' images. The menu bar was not seen immediately, and 1 participant suggested having it floating when the user scrolls down the page. We made this

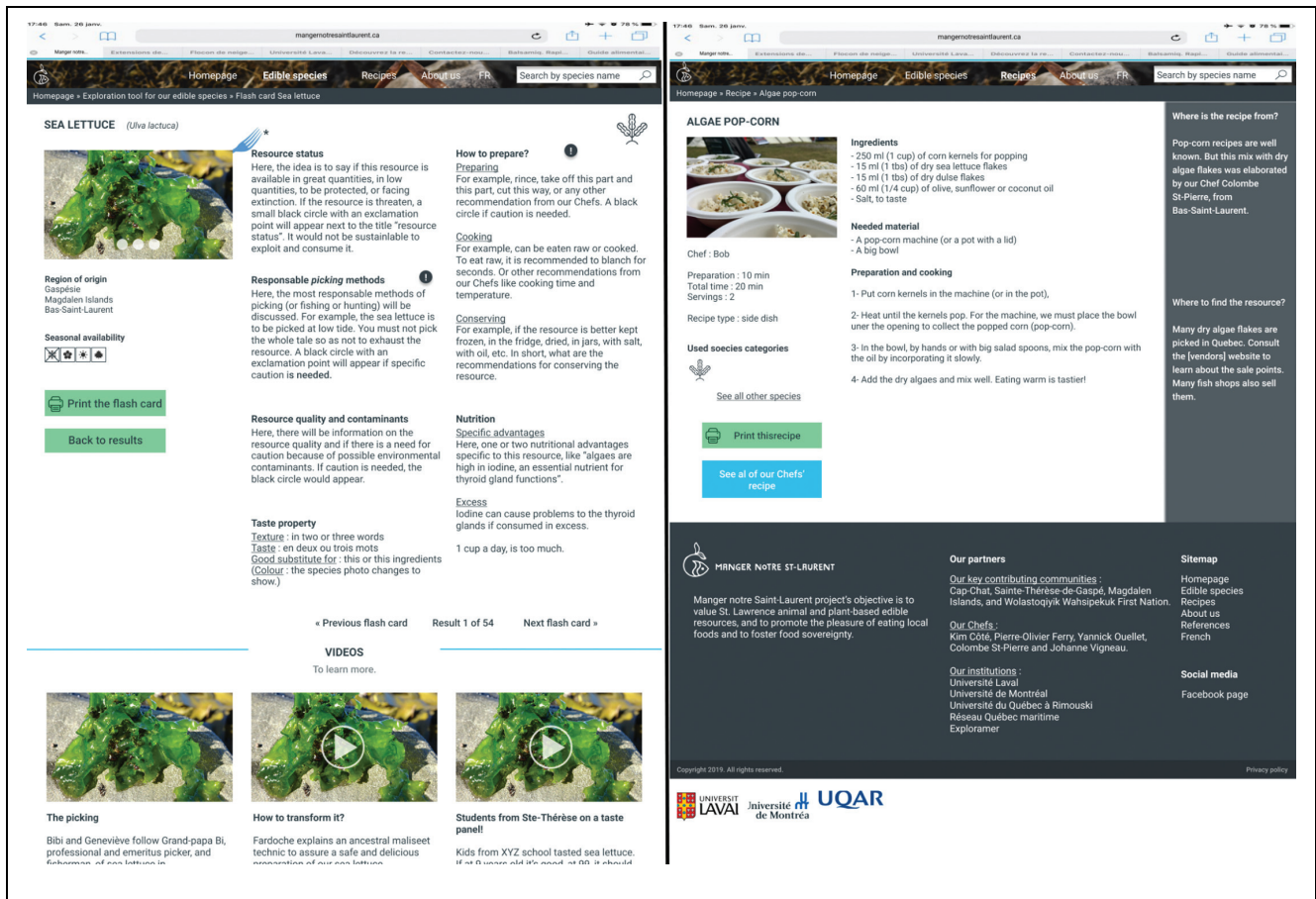


Figure 7 Selected screenshot of the final version of the prototype.

change, noting that such functionality helps usability and allows the menu bar to be more visible.

We calculated System Usability Scale scores to explore whether the changes made after the second cycle improved the prototype. We calculated an average of 92.1 (best imaginable, $n = 7$, $s = 4$), which varied from 85.0 to 95.0. We noticed that 1 participant had an incongruent answer to the second affirmation of the scale, a double-negative sentence, but it did not invalidate the rating as the 11th statement (excellent) still matched the calculated score (best imaginable).

Final Version of the Prototype

From those comments obtained during the third cycle, we finished the final version of the prototype, with minor modifications (see Figure 7).

Discussion

Main Takeaways: Co-design and Communities' Involvement

We co-designed a user-friendly prototype website about consuming edible resources from the St. Lawrence. Our work contributes to the body of literature regarding TAM because we worked in partnership with members of 4 coastal communities in Eastern Québec and stakeholders to create the prototype. Also, health decisions are not only about one's personal health but also about the impact of individual choices on all communities. We argue that our website could help make safe, sustainable, and healthy choices about the consumption of edible resources from the St. Lawrence, integrating health, environment, cooking skills, and taste appreciation. It also aligns with the suggestion of Fraser et al.⁶ and Richard and Pivarnik⁵⁰ to

develop a tool to meet community members' information needs about consuming marine resources.

We started our co-design process with an ecosystem approach to health,¹⁸ including the perspectives of a variety of sociodemographic groups and a portrait of environmental, health, social, economic, and cultural challenges drawn by Sustenance from our St. Lawrence with the communities involved and available references,⁵¹ while also considering web design principles and public health issues.³⁴ We aimed to ensure we were promoting food system sustainability, meaning having little impact on the environment; contributing to food and nutrition security as well as healthy living for present and future generations; protecting and respecting biodiversity and ecosystems while being culturally acceptable, economically fair, and accessible; and encouraging local production and distribution networks.^{53–55}

Co-design processes can be explained as efforts to facilitate creative cooperation between people with a variety of abilities and challenges: researchers, users, and designers. Everyone brings their expert point of view based on their experience and perspectives as well as an equal power to determine the design and the type of content the tool should have.³¹ In our co-design process, the cooperation of community members, project's stakeholders, and design experts was essential to better meet the needs of community members. By including every participant, we can capture a diversity of point of views and address their comments appropriately.⁵² By sharing power over the final product with participants, we achieved an end product that is likely different from what we might have produced reflecting researchers' views on what is important. We acknowledge that this meant deviating from some principles of decision support, such as providing information that users will perceive as completely balanced; the health benefits of consuming seafood generally outweigh the risks of contaminants.¹² Therefore, our product is similar to other medical decision-making contexts in which there is a preferable option, yet decision support can still help people make evidence-informed choices that align with their values and contexts.²⁰

We involved people from different age and occupation groups to ensure a variety of perspectives. Despite differences across these sociodemographic groups, we did not observe significant between-group differences in global System Usability Scale scores, which we interpreted as an indication that our prototype may be suited for users of different backgrounds, at least in our study regions. However, with the low power of our statistical analysis and it being subject to type 2 error, we ought to be prudent with our interpretation.

Limitations

This study had 3 main limitations. First, although we achieved our recruitment goals regarding inclusivity and recruited more participants than are typically necessary for a website usability study,^{35,37,56} we may still have missed key differences. Our sample sizes were smaller than might be required to detect differences in System Usability Scale scores between sociodemographic groups. Second, although during the planning and design, we explicitly considered the needs of users who might have lower levels of education, literacy, and numeracy, we did not formally assess these characteristics during testing sessions. Measuring education and ability may cause people to feel like they are being tested, rather than evaluating a prototype website. Further studies could determine the extent to which the final website is usable by people with lower levels of education, literacy, and numeracy and whether features such as videos help to increase accessibility. Third and finally, we did not aim to directly address food insecurity in Eastern Québec. In addition to the barriers regarding the consumption of marine resources, food insecurity remains an important health and social issue in the geographic area of our study.^{57–61} We hope that our website can help promote the consumption of local marine foods to support food sovereignty in the communities, which may promote healthier food environments and enhance food accessibility and availability, which are key pillars of food security.^{62,63}

Conclusion

The ecosystem approach and the user-centered method require a great deal of thinking, time, and flexibility. By working as part of a broader project, Sustenance from our St. Lawrence, and participating in its research activities, we were able to capitalize on the financial and human resources available and better understand environmental, health, social, economic, and cultural challenges. We were able to build on our collaborations with the 4 coastal communities of Eastern Québec from the beginning, integrating our common understanding of those challenges with their comments and web design principles throughout the co-design process to propose a prototype website that better fits their perspectives for an informed consumption of edible resources from the St. Lawrence.

Project members and stakeholders' involvement in an ecosystem approach helps to achieve a global understanding and to see how a tool can be used for initiatives aiming to reduce inequalities and strengthen local capacities.^{18,53} In future work, we aim to mobilize and transfer the knowledge to a publicly accessible online interface,

as part of the Sustenance from our St. Lawrence project. The challenge will also reside in balancing access, quality, and precision; understandable information for the overall population; and up-to-date information of good quality and reliability. Further work should determine to what extent this resource might encourage healthy, sustainable consumption of maritime resources. With this interface, we hope to contribute to a better-informed consumption of St. Lawrence resources and, ultimately, to foster food sovereignty, food security, coastal communities' health, and marine food system sustainability.

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Authors' Contributions

CF, ML, and HOW contributed to the design of the study by CF. Sustenance from our St. Lawrence contributed to data collection. CF conducted data analysis and interpretation, with the help of HOW's professional team members. CF and HOW drafted the first version of the article with early revision by ML. All coauthors (in alphabetical order: DD, EP, EF, IC, JB, MM, NP, SP) critically revised the article and approved the final version for submission for publication. CF, ML, and HOW had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Ethics Approval and Consent to Participate

This study was approved by CHU de Québec-Laval University's research ethics committee (approval number No. 2018-4171).

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Supplemental Material

Supplementary material for this article is available on the *MDM Policy & Practice* website at <https://journals.sagepub.com/home/mpp>.

Availability of Data and Materials

The data sets supporting the conclusions of this article are included within the article. Raw data are unavailable to share due to ethics committee regulations.

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