

# CS916: Evaluation of Redesigned WebApp

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## 1 Introduction

In the previous assignment, the team conducted an internal developer assessment of the original website E-Veg and undertook a targeted redesign based on issues identified during the evaluation. In this assignment, the team will conduct a user-based usability evaluation of the redesigned website to investigate whether the new site performs better than the prototype in terms of appearance and functionality and to assess its adaptability on different devices through user feedback.

The selected user-based usability evaluation methods by the team are Questionnaire and Laboratory study. The questionnaire, especially the online questionnaire, offers advantages such as ease of distribution, rapid data collection, and the ability to expand the test user group easily. Moreover, incorporating open-ended questions in the questionnaire can also gather personal feedback from highly engaged test users, somewhat substituting for interview evaluations, thus saving time and increasing efficiency. The laboratory study, a method conducted in a controlled setting, allows developers to directly observe test users' interactions with the website and listen to their opinions and suggestions. This approach tends to collect more detailed data and identify more potential issues compared to questionnaires and interviews.

This report will show the designed questions of the questionnaire and the conclusions of the quantitative evaluation based on the responses data. The implementation process of the laboratory study and the analysis of its final results will also be presented.

The original website can be viewed at: <https://www.dcs.warwick.ac.uk/u5525549/evveg0/>.

The redesigned website can be viewed at: <https://www.dcs.warwick.ac.uk/u5525549/evveg1/>.

## 2 Questionnaire

### 2.1 Design

The questionnaire is an online survey created using Google Forms [1], which facilitates the distribution of the questionnaire through social media by team members, thereby ensuring an ample number of samples. Comprised of multiple sections, the questionnaire features conditional jumps between sections based on the options selected by the respondents. This is one of the advantages of online surveys. The link of this questionnaire is: <https://forms.gle/maUHUGxobrhcdPYm9>.

#### 2.1.1 Introduction Section

In the first section of the questionnaire, there is a brief introduction clarifying the purpose of the survey and the estimated time required for completion. The specific content is as follows:

*E-Veg is an online shopping website that allows users to browse products, add items to a basket, and checkout. We are now testing for different interface versions of the site. Please complete the task below and fill out the form. Thank you for your time!*

*The questionnaire is expected to take no more than five minutes.*

Then, considering that this project involves a comparative performance evaluation of two versions of a website, the experiment is conducted using the *A/B Testing* method. Both the prototype and the redesigned website use the same questionnaire. Consequently, the team created a binary choice question following the introduction to divide the respondents into two groups. The content of the question is:

*Please choose a random version of the website to test on.*

This question offers two options, 0 and 1. Participants selecting 0 were assigned to test the original version of the website, while those choosing 1 were allocated to the new version. Since 0 and 1 represent abstract numerical concepts with no apparent bias in choice preference, this method ensures a random distribution of participants into the two groups. Upon completing this selection, participants can proceed to the second section.

### 2.1.2 Heuristic Tasks Section

The second section provides a conditional link to the website. Should a user select 0 in the question from section one, the link directs to E-Veg, which is the link for the original prototype. Alternatively, if a user selects 1, the link leads to E-Grocery, the redesigned website. Users can simply click this link to be directed to the testing website. Additionally, this section includes five suggested tasks to guide users participating in the test to interact with the website. Since developers are not present when users complete the survey, the team cannot know whether users have actually opened the webpage and engaged with it. This situation tests the enthusiasm and responsibility of the participants. Moreover, it is challenging for developers to objectively evaluate the website's performance based solely on the collected questionnaire scores. Therefore, the tasks proposed in section 2 are designed to encourage test users to spend more time on the webpage, engage in more activities, and help them think in preparation for the subsequent questions. The specific tasks and objectives are as follows:

Tasks	Objective
<i>Think of a kind of vegetable, fruit or other food (for example, spinach, strawberry, bread or milk).</i>	To guide users in contemplating and evaluating whether the website offers convenient browsing, filtering, and searching features.
<i>Try adding and removing items to and from the shopping basket.</i>	To guide users in contemplating and evaluating the convenience of adding and removing products.
<i>Can you keep track of the items in your basket and the total price?</i>	To guide users in contemplating and evaluating whether the website offers flexible interaction and responsiveness to actions.
<i>Try proceeding to the checkout page. Look at the navigation bar, floating windows and other components, what do you think of them?</i>	To guide users in attempting to navigate between different pages and operational stages.
<i>Look at the navigation bar, floating windows and other components, what do you think of them?</i>	To guide users to think and evaluate the features, appearance, design and layout of the web page.

Table 1: Tasks and objectives

### 2.1.3 Questions Section

The third section comprises all the usability testing questions used for website evaluation. The sequence of the questions is determined based on the timeline of the testers' familiarity with the website. The 14 closed mandatory questions are:

1. *I found the website visually appealing. (Satisfaction)*
2. *I found the website's design clear and straightforward. (Learnability)*
3. *I found it easy to get started with this website on my first use. (Learnability)*
4. *The website provided sufficient resources/help for me to learn how to use it. (Learnability)*
5. *I can easily find the features I'm looking for on this website. (Efficiency)*
6. *I found the website responsive. (Efficiency)*
7. *I found it easy to undo or redo an operation while using the website. (Efficiency)*
8. *I can perform a task or action in more than one way. (Efficiency)*
9. *The website can prevent me from making errors. (Errors)*
10. *I found it easy to correct errors and recover from mistakes. (Errors)*

11. *I feel that the website supports all the tasks I need to perform. (Satisfaction)*
12. *The website's operations are in line with my daily usage habits. (Learnability)*
13. *It is easy for me to remember how to use this website once I learned it. (Memorability)*
14. *I am satisfied with the overall experience on the website. (Satisfaction)*

For each question, five-point Likert scales are used to measure users' attitudes towards the websites: 1 represents Strongly Disagree, 2 for Disagree, 3 for Neutral, 4 for Agree, and 5 for Strongly Agree. This follows the format of the System Usability Scale (SUS) questionnaire proposed by John Brooke [2]. Each question is presented either in the first-person narrative or third-person objective description. At the same time, the use of professional jargon is avoided, making the questions more colloquial and accessible to the general public. This allows users with no computer background to understand the questions easily. Unlike the SUS, which mixes positive and negative questions, this survey is designed solely with positive questions. This slight modification minimizes confusion caused by shifts in respondents' thinking and enhances the accuracy and authenticity of the responses to some extent.

Regarding the content of the questions, the team referred to Nielsen's Attributes of Usability (NAU) [3], which includes Learnability, Efficiency, Memorability, Errors, and Satisfaction. Specifically, questions 2, 3, 4, and 12 are used to assess the Learnability attribute; questions 5, 6, 7, and 8 for the Efficiency attribute; question 13 for the Memorability attribute; questions 9 and 10 for the Errors attribute; and questions 1, 11, and 14 for the Satisfaction attribute.

Additionally, the third section includes one optional open-ended question:

*Do you have any extra comments on this website?*

This allows participants to provide personal opinions beyond the fixed questions, akin to a written interview.

At the end of Section three, there is a mandatory question surveying the device used for testing the website:

*The device you used for testing the website was:*

There are three options: Computer, Mobile phone, and Tablet and other. During the website's redesign phase, the team introduced responsive design to accommodate screens of varying sizes. By comparing evaluations of the website from users on different devices, conclusions can be drawn about the website's display and responsiveness.

#### 2.1.4 Remaining Sections

After answering all mandatory questions in Section three, the questionnaire will direct to different sections based on the last device question. If the respondent selects Computer, the following section will survey the browser used during the website test:

*What browser did you use to access the website?*

The five options are Firefox, Google Chrome, Microsoft Edge, Safari, and Other. This question aims to investigate the website's compatibility with different browsers. Upon completion, the questionnaire proceeds to the submission page, which is the end of this questionnaire.

If Mobile phone is chosen, the next question will be:

*What phone model did you use to access the website?*

The options are IOS, Android, and Other. This question seeks to gather information on the website's display and responsiveness across different mobile operating systems. After this question, the questionnaire advances to the submission page.

If the user selects Tablet and other, the questionnaire will directly proceed to the submission page, without additional questions like those for Computer and Mobile phone users.

## 2.2 Analysis of Results

In this survey, we received a total of 64 valid questionnaires, of which 31 were about the user experience with the redesigned version (11 from desktop users and 18 from mobile users); 33 were about the user experience with the prototype version (10 from desktop users and 23 from mobile users).

### 2.2.1 Overall Comparison Between Prototype and Redesigned Version

Questions of survey	1、Please choose a random version of the website to test on.(mean $\pm$ standard deviation)		<i>t</i>	<i>p</i>
	0.0( <i>n</i> =33)(prototype)	1.0( <i>n</i> =31)(redesigned)		
2、I found the website visually appealing.	2.03 $\pm$ 1.13	2.74 $\pm$ 1.00	-2.660	0.010**
3、I found the website's design clear and straightforward.	2.30 $\pm$ 1.19	3.16 $\pm$ 0.90	-3.249	0.002**
4、I found it easy to get started with this website on my first use.	2.61 $\pm$ 1.09	3.16 $\pm$ 0.97	-2.150	0.035*
5、The website provided sufficient resources/help for me to learn how to use it.	2.15 $\pm$ 1.20	2.90 $\pm$ 0.70	-3.079	0.003**
6、I can easily find the features I'm looking for on this website.	2.33 $\pm$ 1.02	3.39 $\pm$ 0.67	-4.917	0.000**
7、I found the website responsive.	2.24 $\pm$ 1.25	3.19 $\pm$ 0.98	-3.371	0.001**
8、I found it easy to undo or redo an operation while using the website.	2.12 $\pm$ 1.29	2.84 $\pm$ 1.10	-2.385	0.020*
9、I can perform a task or action in more than one way.	2.39 $\pm$ 1.12	3.10 $\pm$ 0.87	-2.797	0.007**
10、The website can prevent me from making errors.	2.06 $\pm$ 1.12	3.06 $\pm$ 0.85	-4.022	0.000**
11、I found it easy to correct errors and recover from mistakes.	2.42 $\pm$ 1.12	3.00 $\pm$ 0.82	-2.362	0.022*
12、I feel that the website supports all the tasks I need to perform.	2.27 $\pm$ 1.15	2.97 $\pm$ 0.84	-2.773	0.007**
13、The website's operations are in line with my daily usage habits.	2.36 $\pm$ 1.08	3.19 $\pm$ 0.95	-3.254	0.002**
14、It is easy for me to remember how to use this website once I learned it.	2.76 $\pm$ 1.25	3.39 $\pm$ 0.76	-2.449	0.018*
15、I am satisfied with the overall experience on the website.	2.39 $\pm$ 1.27	3.10 $\pm$ 0.87	-2.592	0.012*

\* $p < 0.05$  \*\* $p < 0.01$

Figure 1: t-test analysis results of the survey

From Figure 1, it can be observed that both types of samples (prototype version and redesigned version) show significance ( $p < 0.05$ ) for all survey questions, indicating that there are differences in responses to all survey questions between the two types of samples.

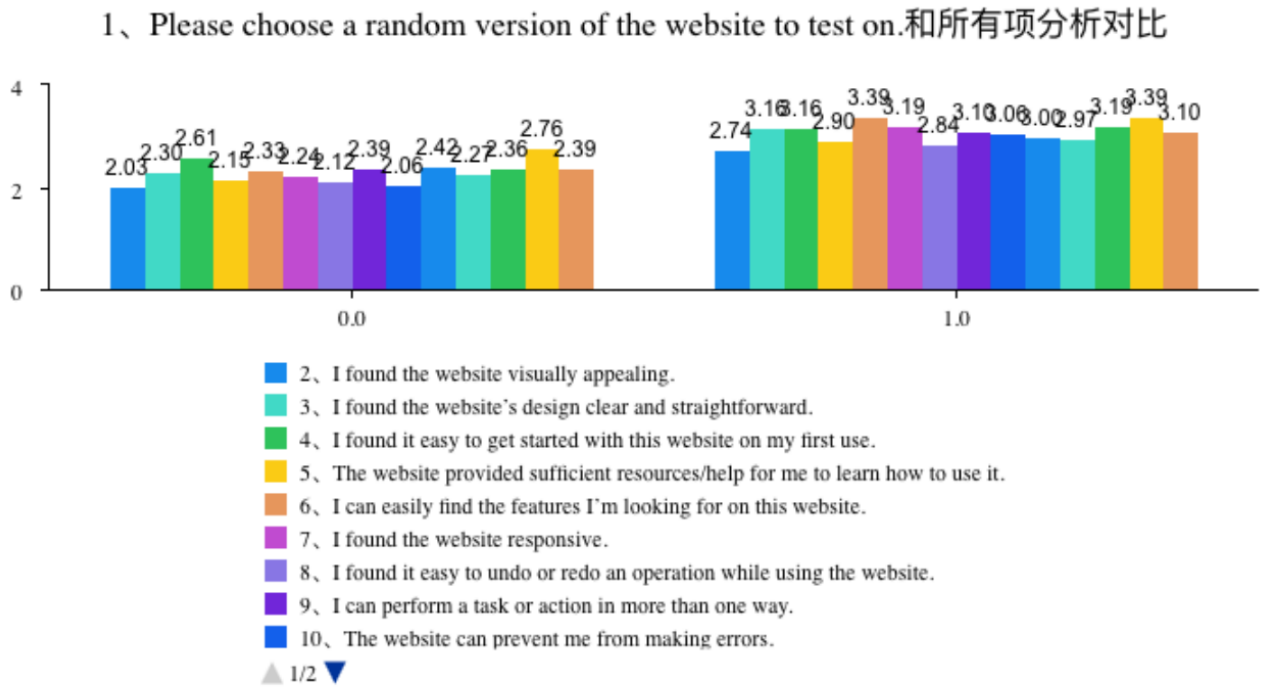


Figure 2: Comparison of average scores between prototype and redesigned version

From Figure 2, we can see that for all questions, the mean score of the first type of sample (prototype version) is significantly lower than that of the second type of sample (redesigned version), indicating higher user satisfaction with the redesigned version.

For questions 3 (I found the website's design clear and straightforward.), 6 (I can easily find the features I'm looking for on this website.), and 13 (The website's operations are in line with my daily usage habits.), the

average scores for the redesigned version have significantly improved ( $>0.8$ ) compared to the prototype version. This indicates that we have successfully optimized the website's design to better align with users' usage habits, making it more convenient for users. For question 7 (I found the website responsive.), users' average scores for the redesigned version have significantly improved ( $>0.9$ ) compared to the prototype version. This suggests that we have effectively optimized the website's responsiveness, enabling it to react quickly and appropriately according to users' devices and needs. For question 10 (The website can prevent me from making errors.), the average score for the redesigned version has increased by a full point compared to the prototype version( $=1$ ). This demonstrates that we have significantly optimized the website's error prevention, avoiding user errors during use.

### 2.2.2 Comparison Between Prototype and Redesigned Version on the desktop

Questions of survey	1、 Please choose a random version of the website to test on.(mean $\pm$ standard deviation)		<i>F</i>	<i>p</i>
	0.0( <i>n</i> =10)(prototype)	1.0( <i>n</i> =11)(redesigned)		
2、 I found the website visually appealing.	1.40 $\pm$ 1.07	3.36 $\pm$ 0.81	22.646	0.000**
3、 I found the website's design clear and straightforward.	2.40 $\pm$ 1.35	3.55 $\pm$ 0.69	6.181	0.022*
4、 I found it easy to get started with this website on my first use.	2.70 $\pm$ 1.25	3.45 $\pm$ 0.69	3.010	0.099
5、 The website provided sufficient resources/help for me to learn how to use it.	1.80 $\pm$ 1.48	2.91 $\pm$ 0.94	4.294	0.052
6、 I can easily find the features I'm looking for on this website.	2.10 $\pm$ 0.88	3.73 $\pm$ 0.47	29.018	0.000**
7、 I found the website responsive.	2.10 $\pm$ 1.20	3.55 $\pm$ 0.69	11.796	0.003**
8、 I found it easy to undo or redo an operation while using the website.	1.60 $\pm$ 1.26	3.55 $\pm$ 0.69	19.693	0.000**
9、 I can perform a task or action in more than one way.	2.60 $\pm$ 0.52	3.45 $\pm$ 0.69	10.197	0.005**
10、 The website can prevent me from making errors.	1.80 $\pm$ 1.23	3.45 $\pm$ 0.52	16.687	0.001**
11、 I found it easy to correct errors and recover from mistakes.	2.00 $\pm$ 1.41	3.27 $\pm$ 0.79	6.667	0.018*
12、 I feel that the website supports all the tasks I need to perform.	1.50 $\pm$ 0.97	3.18 $\pm$ 0.98	15.522	0.001**
13、 The website's operations are in line with my daily usage habits.	2.10 $\pm$ 0.99	3.55 $\pm$ 0.52	17.884	0.000**
14、 It is easy for me to remember how to use this website once I learned it.	2.70 $\pm$ 1.25	3.73 $\pm$ 0.47	6.451	0.020*
15、 I am satisfied with the overall experience on the website.	1.80 $\pm$ 1.32	3.55 $\pm$ 0.69	14.916	0.001**

\*  $p < 0.05$  \*\*  $p < 0.01$

Figure 3: t-test analysis results of the survey on the desktop

From Figure 3, it can be observed that the two types of samples do not show significance ( $p > 0.05$ ) for questions 4 (I found it easy to get started with this website on my first use.) and question 5 (The website provided sufficient resources/help for me to learn how to use it.), meaning that the two types of samples performed consistently for questions 4 and 5 without any differences. However, the two types of samples show significance ( $p < 0.05$ ) for the remaining questions, indicating that there are differences between the two types of samples regarding these questions.

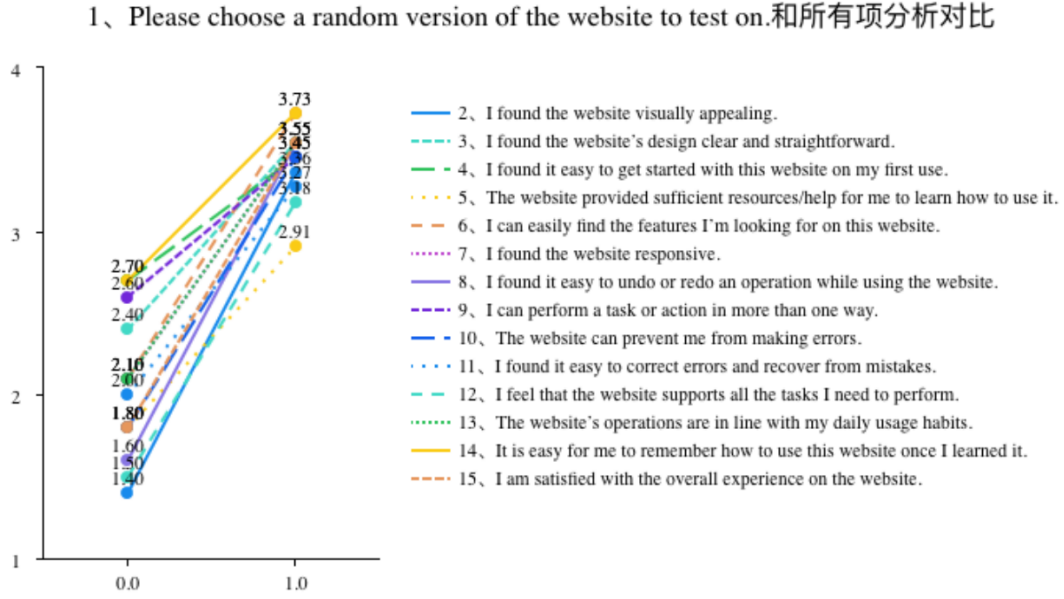


Figure 4: Comparison of average scores between prototype and redesigned version

From Figure 4, we can see that for all questions, the mean score of the first type of sample (prototype version) is significantly lower than that of the second type of sample (redesigned version), indicating higher user satisfaction with the redesigned version on desktop.

For questions 2 (I found the website visually appealing.), the average scores for the redesigned version have significantly improved ( $>1.9$ ) compared to the prototype version. This indicates that we have significantly optimized the website's aesthetic design, making its appearance more in line with user aesthetics. For question 8 (I found it easy to undo or redo an operation while using the website.), users' average scores for the redesigned version have significantly improved ( $>1.6$ ) compared to the prototype version. This suggests that we have effectively optimized the "user control and freedom." aspect, and the redesigned website has effectively implemented features that give users the flexibility and control they need to manage their interactions confidently. For question 10 (The website can prevent me from making errors.), the average score for the redesigned version has increased by a full point compared to the prototype version ( $>1.6$ ). This demonstrates that we have significantly optimized the website's error prevention, avoiding user errors during use. For question 12 (I feel that the website supports all the tasks I need to perform.), the average score for the redesigned version has increased by a full point compared to the prototype version ( $>2$ ). This demonstrates that we have significantly optimized the website, making it aligning with users' expectations and needs effectively. For question 15 (I am satisfied with the overall experience on the website.), the average score for the redesigned version has increased by a full point compared to the prototype version ( $>1.7$ ). This demonstrates that we have significantly optimized the website to meet the users' requirements on the desktop, providing a better user experience.

### 2.2.3 Comparison Between the Desktop and Mobile Versions of the Redesigned Website

Questions of survey	17、The device you used for testing the website was:(mean ± standard deviation)		F	p
	Computer(n=11)	Mobile phone(n=18)		
2、I found the website visually appealing.	3.36±0.81	2.33±0.91	9.525	0.005**
3、I found the website's design clear and straightforward.	3.55±0.69	2.89±0.96	3.875	0.059
4、I found it easy to get started with this website on my first use.	3.45±0.69	2.89±1.08	2.407	0.132
5、The website provided sufficient resources/help for me to learn how to use it.	2.91±0.94	2.89±0.58	0.005	0.943
6、I can easily find the features I'm looking for on this website.	3.73±0.47	3.11±0.68	7.027	0.013*
7、I found the website responsive.	3.55±0.69	2.89±1.08	3.243	0.083
8、I found it easy to undo or redo an operation while using the website.	3.55±0.69	2.56±0.98	8.532	0.007**
9、I can perform a task or action in more than one way.	3.45±0.69	2.89±0.96	2.877	0.101
10、The website can prevent me from making errors.	3.45±0.52	2.83±0.92	4.129	0.052
11、I found it easy to correct errors and recover from mistakes.	3.27±0.79	2.78±0.81	2.611	0.118
12、I feel that the website supports all the tasks I need to perform.	3.18±0.98	2.78±0.73	1.605	0.216
13、The website's operations are in line with my daily usage habits.	3.55±0.52	2.94±1.11	2.813	0.105
14、It is easy for me to remember how to use this website once I learned it.	3.73±0.47	3.11±0.83	5.014	0.034*
15、I am satisfied with the overall experience on the website.	3.55±0.69	2.78±0.88	6.090	0.020*

\*  $p < 0.05$  \*\*  $p < 0.01$

Figure 5: t-test analysis results of the survey of the redesigned version on the desktop and mobile phone

From Figure 5, it can be observed that the two types of samples do not show significance ( $p > 0.05$ ) for questions 3, 4, 5, 7, 9, 10, 11, 12, 13, meaning that the two types of samples performed consistently for those nine questions without any differences. However, the two types of samples show significance ( $p < 0.05$ ) for the remaining four questions, indicating that there are differences between the two types of samples regarding these questions.

For questions 2 (I found the website visually appealing.), the average score for the desktop is significantly higher ( $>1.9$ ) than that for the mobile phone. This indicates that users found the website's visual appeal to be significantly better when viewed on a desktop compared to a mobile phone, which suggests that the website's design, layout, and visual elements may be better optimized for larger screens or that certain aspects of the website's visual presentation do not translate as effectively on the smaller screens of mobile phones. It also implies that users have higher expectations for visual aesthetics when browsing on desktops, and that the website's responsiveness and adaptation to mobile devices need improvement. This feedback reminds us to enhance the website's visual appeal and user experience across different devices.

For question 8 (I found it easy to undo or redo an operation while using the website.), users' average score for the desktop is significantly higher ( $>1.9$ ) than that for the mobile phone. The significant difference suggests that the website's functionality for undoing or redoing actions is better optimized or more accessible on desktop platforms, possibly due to larger screen size, different interface design, or more intuitive navigation controls. The significant difference suggests that the website's functionality for undoing or redoing actions is better optimized or more accessible on desktop platforms, possibly due to larger screen size, different interface design, or more intuitive navigation controls. This disparity highlights the need for improving the mobile user experience, particularly in making it easier for mobile users to correct actions, which is a critical aspect of user control and freedom in usability design.

Among 29 questionnaires collected, 18 participants indicated using a mobile phone for testing and 11 indicated using a computer, this will have the some impacts on analyzing the differences in user experience between computers and mobile phones: with more users testing on mobile phones than on computers, the analysis results might lean more towards reflecting the experience of mobile users. This imbalance could affect the representativeness of the results. A smaller sample of computer users might not adequately represent the views of all computer users. This may be the reason why the user experience on desktop is generally better than on mobile. Since most users accessed it through mobile, the results suggest that more optimization and improvements are needed for the mobile version of the website.

### 2.2.4 Analysis of User Comments

For the original version of the website, we received the following user comments:

1. *"The page appears very crowded and items are not neatly arranged when opened on a mobile phone; the layout is a bit dense."*
2. *"Some embellishments could be made to make the website more aesthetically pleasing."*
3. *"I can't find the useful information immediately. The visual hierarchy for the words, images, and the different blocks for functions is poor."*
4. *"There's no 'total price' displayed."*
5. *"The box asking about the use of cookies cannot be dismissed."*
6. *"The setup of the search box is not very convenient."*
7. *"The cookies popup at the bottom cannot be closed."*
8. *"No further adjustment in the basket or checkout page."/ "It'd be better if there is a button on the checkout page to go back to and recheck the store page... maybe i just wanna check what ive got so far."*
9. *"The help and contact labels are listed but no response when clicking."*
10. *"Hard to find the category of product."*
11. *"Bad user experience, there was no feedback on some actions, nor was there feedback on some actions when expected."*
12. *"The font size for 'checkout' is too small."*

Our improvements to the website have successfully addressed all the feedback above. As a result, we can see that there are much fewer comments from users about the redesigned website, including the following points:

1. *"The checkout interface could be placed in a more prominent position."*
2. *"Maybe use fresh colors in the background."*
3. *"The browsing zoom interface lags on mobile."*
4. *"I don't find the plus and minus buttons very appealing."*
5. *"As a mobile user, I feel that there is too little information on a single page." / "Only 2-3 products can be viewed on a mobile page at the same time, requiring frequent scrolling when searching for products. I think the product boxes could be made smaller, allowing about 8 products to be viewed on a page at the same time, and providing the functionality to enlarge product images."*

These comments provide valuable insights into areas where the website could be further improved to enhance user experience:

1. **Improving Visibility of the Checkout Interface:** Making the checkout button or section more visible and accessible could reduce friction in the purchasing process, potentially increasing conversion rates. Consider placing the checkout button in a fixed position on the screen or using contrasting colors to make it stand out.
2. **Redesigning Plus and Minus Buttons:** Users finding the plus and minus buttons unappealing indicates a need for a UI redesign. These buttons are often used for adjusting quantities, so making them more visually attractive and intuitive could improve the user interaction experience. Experimenting with different shapes, colors, or even animations could make these buttons more engaging.
3. **Refreshing the Background Colors:** The suggestion to use fresh colors in the background points to an opportunity to revitalize the website's visual appeal. It's important to choose colors that align with the brand identity and enhance readability and usability.
4. **Optimizing Mobile Browsing and Zoom:** Improving the website's responsiveness and speed, especially for interactive elements like image zoom, can significantly enhance the mobile browsing experience. Techniques such as lazy loading, image compression, and efficient JavaScript can help achieve smoother interactions.
5. **Revising Product Display on Mobile Pages:** Redesigning product boxes to be smaller and allowing more products to be viewed simultaneously can make browsing more efficient. Additionally, implementing a feature to enlarge product images can help users get a better view of the products without overcrowding the page. Pagination should also be added to the product display to facilitate browsing for mobile users.



## 3 Laboratory Study

### 3.1 Design

Apart from the questionnaire, the team also conducted laboratory study. Tasks in the questionnaire are relatively simple, with a small number of tasks, short time, broad description, and a high degree of freedom because these tasks are inspirational, aiming at enabling users to try more operations so that users can learn more about effectiveness. Contrastingly, tasks in the lab study tend to be more complex, time-intensive, specialized, and offer limited flexibility, comprising a combination of the following activities:

- Position goods
- Add/remove shopping basket
- Check whether the operations succeeds in real-time
- Check of correction addition of the items and number of copies
- Jump to the checkout page

The experimenter can observe the operation of the subject on the participates and make video recordings, timing, inspection results, etc. At the same time, they can talk to the participates. Compared with questionnaires, lab studies make a more objective and comprehensive evaluation of effectiveness, efficiency, and satisfaction. The lab study task is as below:

*Using the website provided, please add the items (with specified quantity) to the basket and proceed to the checkout page:*

1. Bread \* 1
2. Eggs \* 4
3. Milk \* 8
4. Orange juice \* 3
5. Sausages \* 1
6. Strawberries \* 2
7. Blueberries \* 2
8. Cherries \* 2
9. Potatoes \* 1
10. Carrots \* 1
11. Mushrooms \* 2
12. Spinach \* 5

The video recordings made by the team members during the laboratory study can be viewed at this link: OneDrive link.

#### 3.1.1 Hypothesis

The team uses a one-tailed hypothesis assuming that the performance of the redesigned website is always better than the prototype:

- More usable on the desktop than the prototype.
- It is well usable on a mobile phone.

#### 3.1.2 Experimental Design

**Choice of subjects** Participants are asked to perform a series of tasks that mirror real-world usage scenarios on the E-Veg website, including:

- **Product Search:** Finding specific items such as vegetables, fruits, or other groceries to test the search function and product availability.
- **Basket Management:** Adding and removing items from the shopping basket to evaluate the interface's intuitiveness and the visibility of crucial information like item count and total price.

- **Checkout Process:** Proceeding to the checkout page to assess the purchasing process’s simplicity and security. Interface and Navigation: Reviewing the website’s navigation bar, floating windows, and other interface elements for usability and design effectiveness.

**Independent variable** To control for variables, all participants used the same phone (iPhone 8 Plus, Safari browser) or the same laptop (ThinkPad, Google Chrome browser).

- **Time/effort to learn:** In the first phase of the experiment, participants are free to explore the features of the website for a maximum of five minutes. participants can terminate the process early if they think they have learned it. In this process, the observer observes what the participant does, chooses whether or not to ask the user a question, and they are free to choose what question to ask.
- **Time to perform tasks:** In the second stage, according to the shopping list, the participants will add the specified items to the shopping basket and checkout, and the time spent by the participants to complete the task will be recorded.
- **Errors committed:** Participants errors committed during operations are observed. The completion of the final task is also checked, that is, whether the goods and the number of copies added to the basket are correct. In general, observers intervene as little as possible. If a participant is having trouble performing a task, he first explore possible solutions on their own, and will only be alerted if the operation cannot be performed at all.
- **User satisfaction:** At the end of the two-stage experiment, participants rated their satisfaction with the website.

**Organization and the problem of training** Due to space and time constraints, we brought equipment to the test subjects and let them complete the experiment at home. In order to assess the site’s own Learnability, in the first phase, participants were not taught how to use the website but instead explored its use on their own.

**Between subjects allocates subjects to different conditions** A diverse group of participants was recruited to represent the E-Veg website’s target demographic, ensuring a mix of genders, ages, technological proficiencies, and dietary preferences. The selection process included screening participants for regular internet usage and familiarity with online shopping. Ethical guidelines were strictly followed, with informed consent obtained from all participants, ensuring they were aware of their rights and the study’s voluntary nature. The process of the participants exploring the site on their own will be noticed.

- Which buttons or links are they interested in?
- Which functions will they try out? For example, will they try clicking on “Contact” or “About” for the old website?
- Will they try “Help” and “About & Contact” for the new one? If so, how long will they spend on the pop-up windows before closing them? Will they actually read the content?
- Will anyone actually read the privacy policy, or will they all just close the window directly?

**Supplement to the first stage of the experiment** Based on the goal of enriching lab study through cooperative evaluation, participants are encouraged to “think aloud” during the experiment. If they can not find an item or can not close pop-ups because words are too small to read, they should speak out. In the process, the experimenters observe what difficulties they will encounter, which difficulties can be solved by themselves, which need to be prompted, and which need to be manipulated by the experimenter. The experimenter must faithfully record these contexts, as these are the most authentic, concrete feedback on the web experience. The feedback of the participants who encounter frustration in the process of performing the task can more honestly reflect the defects and vulnerabilities at the most detailed of the web page. However, in an effort to affect normal behavior as little as possible, the experimenter typically doesn’t answer questions during the experiment, such as “Where is this button?” “Why is there no response when I click on this link?”. The participant will not be helped unless the problem is already severely impeding the continuation of the experiment.

## 3.2 Experimental Results

### 3.2.1 Quantitative Analysis

**Participant** For each web version and each device, there were 10 participants, for a total of 40 people.

Condition	Prototype + Computer	Prototype + Mobile Phone	Our Version + Computer	Our Version + Mobile Phone
Average Time	2 min 35 s	2 min 59 s	2 min 4 s	2 min 21 s

Table 2: Time to perform tasks (Efficiency)

On the different versions, it takes slightly longer to complete a task on a phone than on a computer. The possible reason is that the mobile phone screen is small, and the goods that can be displayed at one time are less, so the up and down operation is frequent, and the finger click is easy to touch by mistake. For the same device, the time required to use the improved version is significantly shorter than the prototype.

Condition	Prototype + Computer	Prototype + Mobile Phone	Our Version + Computer	Our Version + Mobile Phone
No Error	6	4	8	7
Minor Error	3	4	2	3
Major Error	1	2	0	0

Table 3: Errors committed (Effectiveness)

#### Definition of error

**No Error:** The subject successfully added the specified number of products according to the shopping list provided.

#### Minor Error:

1. A participate misses an item.
2. A participate adds in an item that does not exist on your shopping list.
3. A participate does not add one item in the shopping basket.

**Major Error** (a combination of two or more minor errors, or any of the following):

1. A participate misses two or more items.
2. A participate adds two items that do not exist on the shopping list.
3. A participate can not add in two or more items in the shopping basket.

**Common Minor Error:** A single item is missing or the number of goods added is incorrect. The main reason is that the participant is careless and does not check the goods in the shopping list and basket one by one, which is caused by the participant clicking the add button without clicking it or clicking it repeatedly. It is caused by the fact that it is easier to touch mobile phones by mistake.

**Common Major errors:** A participate follows the habit of the old website, clicking the plus sign to add the product to the specified number and clicking "Add Basket" again to complete the purchase. The resulting error is that one more item per item is added to the basket than the shopping list.

Condition	Prototype + Computer	Prototype + Mobile Phone	Our Version + Computer	Our Version + Mobile Phone
Excellent	6	4	9	10
Acceptable	3	6	1	0
Unacceptable	1	0	0	0

Table 4: Summary of Evaluation Results

**User satisfaction** When asked about the overall experience, the vast majority of participants, whether using computers or mobile phones, consider the experience of using the new version of the website to be excellent. Only half of the participants rated the old version of the site as excellent, with slightly more positive comments for using computers than for using mobile phones. In addition, most participants chose 'acceptable', only one person chose 'unacceptable'.

### 3.2.2 Case Study

A representative number of participants (those whose time to complete the task was closest to the mean) were selected from each group to be analyzed.

#### Participant A (Prototype + Computer)

##### Experiment Phase 1:

1. A tried to press “+” and “-” to add and remove products, complaining that the buttons overlapped.
2. A clicked the “Contact” link three times and asked why there was no response.
3. A clicked the “About” link three consecutive times, but nothing happened.
4. A continued to try to click “Welcome, Test User” and “Checkout”.
5. A went to the Checkout page, clicked the “Name” input box, and asked why he could not enter it.
6. After clicking “Pay by Credit Card” to enter the payment interface, A stopped for a few seconds and then clicked the “back” button at the top of the browser twice to return to the main page of the website.
7. A tried to search for “apple”, saw the product, and then tried to search by clicking “Search” again.
8. A cancelled the search, the search box disappeared, A said: “Why can’t I return to the original page?”

##### Experiment Phase 2:

1. A searched for each item in turn through the search box, and clicked “+” to add to the cart. However, A was not clear about the purpose of the “Add Basket” button, and always clicked “Add Basket” after “+”, so that each item was one more than the specified amount.
2. After searching for the product name, only this one product was displayed on the entire page. However, the Cookie Message blocked most of the page, and no other content could be displayed even if he dragged it to the bottom of the page. In this version of the web page, the “Accept” of the Cookie Message was the same color as the background, so it could not be closed.

##### Summary:

1. Some functions of the website will cause trouble to users, such as clicking on unresponsive “About” and “Contact”.
2. The “+” and “-” of adjacent products on the website overlap, making it difficult for users to click the button.
3. The website lacks a good return mechanism between checkout and payment pages.
4. The search box function of the website is more confusing. Participants were not always clear on how to make it appear, hide, cancel the search after the search was completed to redisplay all products.
5. The function of the “Add Basket” button on the website is repeated with “+”, which is easy for misunderstanding.
6. The participants cannot find the Accept button of the Cookie Message, so the Cookie Message cannot be closed. It is very likely to prevent users from performing basic operations and have a serious impact on the usability of the website.

#### Participant B (Prototype + Mobile Phone)

##### Experiment Phase 1:

1. B repeatedly tried to click “Contact” and “About”.
2. B searched for “strawberry”, but because the product name on the website was “strawberries”, the search did not succeed. B changed the search to “potato” and this time successfully displayed the product.
3. B’s screen often zoomed in automatically when buttons were clicked and input boxes were opened, causing the user to have to drag the finger to zoom back to normal size to continue browsing. B complained “What a hassle”.

##### Experiment Phase 2:

1. B swiped up and down the page and looked for each item with the naked eye, complaining that the words were too small and made the eyes tired. After finding each item, B continuously pressed "+" to add the specified number of copies to the shopping basket, and the page was still often partially scaled when clicked. Furthermore, when B wanted to add the commodity cherries on the last line, the button below the commodity was again obscured and could not be clicked, and B had to seek help to turn off the Cookie Message.

**Summary:**

1. The search function of the website does not support the unified treatment of the singular and plural forms of the same product. Likewise, the site does not support fuzzy searches or typos, which can be troublesome, as the user may mistakenly believe that the website does not have the item.
2. The font on the website is too small, which is not conducive to reading. Moreover, scaling during interaction reduces the user experience.

**Participant C (Redesigned Version + Computer)**

**Experiment Phase 1:**

1. C clicked "Accept & Close" to close the Cookie Message. C entered the input box under "Pumpkins" and tried to enter "1000", but was notified of insufficient stock: only 90 left. C then entered 90.
2. C clicked the "Basket" and clicked the "X" on the right of the Pumpkins to delete the product.

**Experiment Phase 2:**

1. C entered only the first few letters of the word, searched for each item, and entered the number of items through the input box below the item. C pressed Enter, but "Add to basket successfully" prompt did not appear. Before entering the Checkout page, C checked that the items and copies in the Basket matched the shopping list provided by the task. C noted: The items in the Basket are arranged in an irregular order, neither in the order they were spelled nor in the order they were added, making it difficult to check them all.

**Summary:**

1. The first thing most users do when using a new version of a webpage is to close the Cookie Message. Removing the occlusion of floating windows is an important improvement.
2. It is necessary to pop up a prompt message when the number of copies entered by the user is illegal. However, when the input is legitimate, in addition to the number change in the upper right corner of the Basket, the user needs more feedback to ensure that the purchase is confirmed.
3. Before entering the Checkout page, users can easily check and modify the purchased products in the Basket pop-up window, which is helpful for the execution of tasks. However, the order of goods in the Basket lacks regularity.

**Participant D (Redesigned Version + Mobile Phone)**

**Experiment Phase 1:**

1. After clicking 'Help' to open the popup window, D did not read all the content but tried to close the popup window by clicking 'Help' again, but failed, and finally had to click close at the bottom of the popup window.

**Experiment Phase 2:**

1. D screened the three categories successively, looked for products, and added products to the shopping basket by pressing "+" continuously; When D checked the Basket, he found that the milk was missing. D searched for the product and added it.

**Summary:**

1. The new version of the webpage realizes adaptive font, button size, etc., to provide a more smooth user experience.
2. Users don't always have the patience to read all the content and then click close at the bottom to close the popup window.
3. When using computers to perform tasks, users are more inclined to use the search box to find goods, and use their hands. Computer users are more willing to drag web pages up and down and look for them with

the naked eye, for two possible reasons: First, the mobile phone input box is small, the keyboard is small, so input is troublesome. Second, the mobile phone can accommodate a small number of goods per page. Users in the browsing process back to the top of the page to use the search box requires to slide a large number of pages.

## 4 Conclusion

The user-based usability study incorporating both questionnaires and laboratory studies has provided insightful feedback on the new site's performance compared to its predecessor. The methodology, carefully chosen to balance rapid data collection with in-depth user interaction analysis, has enabled the team to gather a wide range of user experiences and perspectives.

The questionnaire's design, leveraging the A/B testing method, effectively segmented users to test either the original or the redesigned version of the website, allowing for a direct comparison of user experiences. This approach, combined with targeted tasks, encouraged users to engage deeply with the website's functionalities, offering a comprehensive understanding of its usability aspects. The use of Google Forms facilitated an efficient distribution and collection of user feedback, which was instrumental in identifying both strengths and areas for improvement.

Feedback from the laboratory study, which provided a more controlled environment for observing user interactions, has been invaluable. Direct observation and interaction with participants have highlighted specific usability challenges and preferences that might not have been fully captured through questionnaires alone.

The redesigned WebApp, as shown through user feedback, has demonstrated significant improvements in terms of appearance and functionality. Notably, enhancements in navigation, the shopping basket feature, and overall site responsiveness have contributed to a more user-friendly experience. These improvements have addressed many of the issues identified in the original website, indicating a successful redesign process.

However, the evaluation also uncovered areas where the redesigned website could further enhance its usability. For instance, some users encountered difficulties with specific interface elements and suggested improvements for search functionality and handling of singular and plural product names. Addressing these concerns would likely result in an even more intuitive and efficient user experience.

In conclusion, the evaluation of the redesigned WebApp through a combined approach of questionnaires and laboratory studies has confirmed the effectiveness of the redesign in enhancing user experience. The study not only validated the improvements made but also provided a clear direction for further refinement. The team looks forward to implementing the suggested improvements and conducting future evaluations to continue improving the WebApp's usability and user satisfaction.

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