

# Heuristic Evaluation and Usability Testing

Saki Takizawa  
Earlham College  
Richmond, Indiana  
stakiz21@earlham.edu

## 1 ABSTRACT

User experience design (UX) is a critical approach to web design that emphasizes both the aesthetic and functional aspects of a website. However, not all websites possess well-designed UX. Heuristic evaluation and usability testing serve as two valuable methods to enhance it. The evaluations in this paper aim to identify usability issues on a college website and redesign based on the found issues.

This paper will employ two research methods, heuristic evaluation and user testing, to identify and sort out problems affecting the user experience of a college website. The heuristics evaluation will be conducted by referencing Nielsen Norman Group Heuristic Evaluation Workbook on specific user groups's tasks : current computer science major student, prospect computer science students[8]. It will uncover points where there might be potential usability issues. Following this step, the college website design will be revised based on the guidelines created by the Research-Based Web Design and Usability Guidelines provided by the US Department of Health and Human Services[6]. Comparing the original website and the new website, potential users will be asked to do tasks for the user testing. Ultimately, the results and analysis from the user testing will clarify if usability issues were resolved and specific areas of the website in need of improvement if there is more. The overarching goal is to enhance the website's usability, making it more user-friendly and enjoyable for users.

## 2 INTRODUCTION

User Experience (UX) has become a central paradigm within the field of Human-Computer Interaction (HCI). The demand for well-designed digital interfaces has been steadily increasing, necessitating designs that are not just highly functional but also intuitive, enjoyable, and effective in meeting the diverse needs of users. Within this context, the evaluation of user experience is important as it involves understanding the efficiency and user-friendliness of digital interfaces. One of the valuable methodologies for assessing the usability of a website is heuristic evaluation. According to Nielsen, "Heuristic evaluation is a usability inspection method for computer software that helps to identify usability problems in the user interface (UI) design. It involves having a small set of evaluators examine the interface and judge its compliance with recognized usability principles (heuristics) [8]."

In addition to heuristic evaluation, user testing engages actual users in interacting with a system and provides a holistic view of usability. This research explores the significant intersection of UX, heuristic evaluation, and user testing, specifically focusing on the usability of college department websites. College websites are vital information resources for college students, faculty, prospective students, and even more, so all the information needs to be the latest. Furthermore, the design should be something for the sake of those user groups given that users are a specific group, such

as current students and faculty. However, the computer science website at Earlham College is not operated by UX professionals, as is the Earlham College website. Therefore, there is a need for improvement in UX perspectives.

In this research, I will begin by applying heuristic evaluation to the Earlham Computer Science Department's web page, referencing Nielsen's heuristic evaluation principles and the Research-Based Web Design and Usability Guidelines provided by the US Department of Health and Human Services [6][8]. Subsequently, I will catalog the problems identified in the website and rank them based on the severity of the design issues [3].

The next step involves conducting user testing that will be implemented referring to the result of heuristic evaluation. Following this, user testing will be conducted for specific user groups, current computer science major students and students who are considering majoring in computer science in this research. Each user will be asked to perform some tasks on one of the two versions of the website, original and redesigned. Finally, the data and its analysis by incorporating Analysis of Variance (ANOVA) will identify if usability issues were resolved and specific areas of the website are in need of improvement.

This research stands out for its unique combination of several different evaluation methods, a focused analysis specialized on the domain of college websites, and a data-driven redesign strategy. All of them aimed at significantly enhancing the user experience for college website users.

## 3 BACKGROUND

Heuristic evaluation and user testing play key roles in UX design. UX design is an approach that aims to produce a better user experience. It encompasses the entire process of creating a product, including aspects of branding, design, usability, and function [1]. UX design involves two elements: how a person perceives and how a product is used. Both of these elements depend on each other in UX design.

Perception in UX design encompasses visual aspects, such as layout and the use of colors, emotional responses, such as how users rate their overall experience with the website, and comprehension, such as how easily users can understand the website's layout. Additionally, usage in UX design, focusing on how a product is used, includes navigation, such as how easily users can move from one section to another on the website, functionality, such as the performance of functions like buttons, and task efficiency, assessing how effectively users can find the information they were seeking.

These elements are intricately linked in UX design, highlighting the importance of designing products with UX principles that effectively capture and respond to human emotions and experiences.

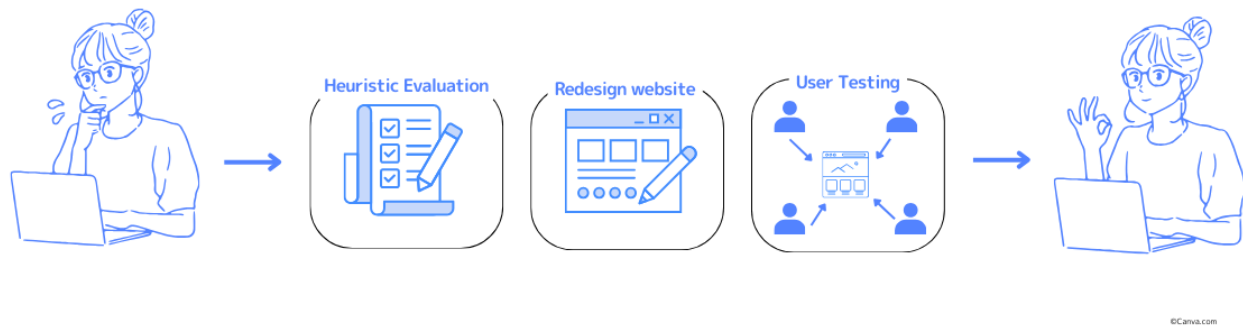


Figure 1: Graphical Abstract

Adhering to these principles is essential for creating products that meet user's needs and preferences.

### 3.1 Heuristic Evaluation

Heuristic evaluation is a usability evaluation method that involves a systematic inspection of a user interface by usability experts against a set of predefined usability principles. The evaluators identify usability problems, such as violations of these principles, and provide recommendations for improving the interface's overall usability. The aim of heuristic evaluation is to uncover usability issues quickly and cost-effectively, ensuring that the interface is more user-friendly and efficient in meeting the needs of its intended users. Thus, heuristic evaluation is a way to test a user interface for usability problems by comparing it to a set of best practices.

Heuristic evaluation is a useful method for identifying usability problems, but it is important to be aware of its limitations [5]. Experts may identify problems that users do not encounter, or they may miss problems that users are having. This is because heuristic evaluation is based on experts' knowledge and experience, which may not always be aligned with the needs of the target users. In addition, heuristic evaluations are typically performed in a laboratory setting, which may not be representative of how users interact with the product in the real world. Finally, heuristic evaluations can be subjective, and different experts can identify different problems. To mitigate these limitations, it is important to use heuristic evaluation in conjunction with other usability testing methods, such as user testing.

### 3.2 Usability Testing

Usability testing, particularly in the realm of UX (User Experience), is a method used to assess the ease of use of a web application. This assessment is carried out by instructing users to perform specific tasks with the application. Usability testing can take various forms, including in-person sessions in which a researcher observes users completing tasks, and remote testing, which offers a more accurate perspective on real-world user experiences [4].

Compared to heuristic evaluation, usability testing tends to find out more significant issues. One distinct advantage of usability testing is its ability to pinpoint problems that could affect actual users of the application, without the need for presorting or filtering these issues based on their perceived impact. The test itself helps in assessing the impact of identified problems. This has been consistently demonstrated in the Jeffries and Desurvire studies[7], where nearly all problems identified through usability testing proved to be of above-average severity. In addition, the problems that usability tests find are usually not found in other methods, such as heuristic evaluation, because the variation of the actual user's actions from users exceed the level of expectation of experts in most of the cases [7].

In the case study at Boğaziçi University, one of the user groups that the researchers carried out the users test on the undergraduates at Boğaziçi University. The ten tasks were like following:

- (1) Explore the website of the laboratory related to Flexible Automation. Guideline 10.4: Avoid misleading cues to click [6].
- (2) Locate the contact number for the chairman of the Industrial Engineering(IE) department. Guideline 2.5: Design for working memory limitations [6].
- (3) Find the webpage for the Office of International Relations to gather information about Erasmus or Exchange programs. Guideline 10.4: Avoid misleading cues to click [6].
- (4) Search for the courses taught by IE Professor Prof. Dr. Barbarosoğlu. Guideline 10.4: Avoid misleading cues to click [6].
- (5) Navigate to the webpage of the "Quantitative Finance Research Group" within the Boğaziçi University Industrial Engineering Dept. Guideline 10.4: Avoid misleading cues to click [6].
- (6) Locate the information page to determine if PSY 101 is available as an HSS elective. Guideline 16.2: Structure each content page to facilitate scanning [6].
- (7) Find the Alumni list of the IE Department to connect with fellow graduates after completing your studies. Guideline 10.4: Avoid misleading cues to click [6].

- (8) Find the contact number for Instructor Dr. Yasemin Aksoy to inquire about a specific elective course. Guideline 2.5: Design for working memory limitations [6].
- (9) Check if Dr. Suat Genç offers any undergraduate courses as elective options due to his reputed success as an instructor. Guideline 16.4: Group related elements [6].
- (10) Discover the list and descriptions of IE-Elective courses available for undergraduate education. Guideline 16.2: Structure each content page to facilitate scanning [6].

Addition to the tasks above, users would be asked about demographics and the frequency of internet usage to see if there is any significant difference in those categories as the case study at Boğaziçi University did.

### 3.3 Analysis of Variance

After collecting the data from usability testing, Analysis of Variance (ANOVA) will be introduced to investigate the results. ANOVA is used to determine if there is a statistically significant difference between user groups.

In simpler terms, ANOVA is a statistical test that can be used to compare the means of three or more groups. It is a powerful tool, but it is important to note that it has three key assumptions: the samples must be independent, the variances of the groups must be equal, and the data must be normally distributed.

In the case study, Mahmut Ekşioglu and colleagues conducted additional comparison tests alongside ANOVA to ensure that their results were reliable [3]. This is a good practice to follow, as it helps to minimize the risk of making false conclusions.

This research will use ANOVA, a statistical tool, to dig deeper into how different groups of users interact with the college website. It aims to compare how well different groups perform specific tasks and assess their overall experience. For example, we'll see if there are significant differences in how well different groups, like prospective students, faculty, and current students, complete tasks. Finding these differences can help us identify areas of the website that need to be improved for specific user groups. For instance, if prospective students have much lower success rates in navigating or finding information, it suggests that the website might not be meeting their needs. By using ANOVA to pinpoint these differences, we can make targeted improvements to better address the needs of specific user groups and improve the overall user experience of the college website.

## 4 METHODOLOGY

This research will involve four main steps. First, a guideline will be created to evaluate the Earlham College Computer Science Department website. This guideline will be based on Nielsen's heuristic evaluation principles [9] and Research-Based Web Design and Usability Guidelines. To ensure that the website's integrity is not affected by any updates during the research, the current version of the website will be cloned. These references will identify potential usability issues from a human perspective. Using these guidelines, areas of the website that require improvement or potential redesigns in terms of usability will be identified.

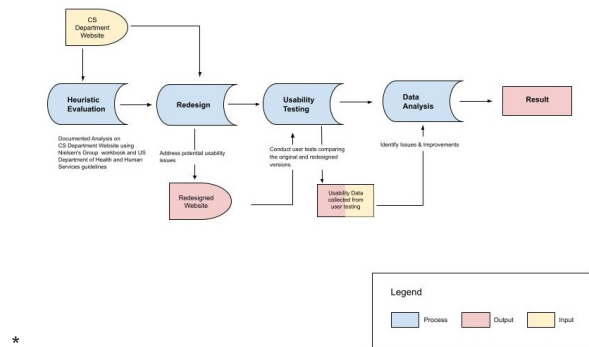


Figure 2: My Research Plan

### 4.1 Heuristic Evaluation Principles

This research carefully selects key principles and guidelines to evaluate the website's usability. These come from two well-respected sources: Nielsen's Heuristic Evaluation Principles and the Research-Based Web Design and Usability Guidelines. To pick the most important ones, we looked for elements marked with stars in these resources. These starred points are considered especially important because they are based on fundamental principles of user-centered design and have a big impact on how people experience the website. By focusing on these crucial points, our evaluation will primarily identify the areas with the biggest potential for improvement. The evaluation guideline will look like the following.

- (1) Understand and Establish User's Expectation
  - If the website provides contents that are appropriate.
  - Make sure that the website includes what is user's requirement
- (2) Avoid having unwanted windows and graphs
  - Unsolicited windows and graphs are not necessary.
- (3) Avoid using color alone to convey call-to-action
  - Consider that all people can recognize colors in the same way so only changing color to convey the critical actions is not effective.
- (4) Enable to have easy access to the homepage
  - Make sure that user can access to the homepage from any page in the website
- (5) Display all the major options on the homepage
  - Show the major options that users take should be easily accessible
- (6) Create positive impression at a first sight/ homepage
  - The homepage is a key for users to know the quality of the website so it needs to make a good impression.
- (7) Cluttered layout is unwanted
  - Create pages that are not considered cluttered by users, such as cramped design.
- (8) Place critical items consistently
  - The Important Information needs to be display all the time at the top center
- (9) Avoid horizontal scroll
  - Designing appropriate not to have a horizontal scroll.
- (10) Clear category labels

- Make sure that all the category labels and their links reflect the information and items in the category.
- (11) Buttons need to be distinct
    - Ensure that push buttons are indicated distinctively.
  - (12) Clear category labels
    - Make sure that all the category labels and their links reflect the information and items in the category.
  - (13) Text color and Background
    - Text color needs to be distinct from the background color. The ideal color is to use black text on the white background.
  - (14) Speak the users' language
    - The wording on the web page needs to be expressed clearly
    - Words, phrases, concepts on the website should be familiar to users
  - (15) Minimize the user's memory load
    - The information that people do not need to memorize in longer term, such as instructions to show how to use the page, should be simple.
    - Those information needs to be retrievable easily.
  - (16) Consistency
    - Users never need to wonder if the different actions, situations, words mean the same.
    - Consistency also needs to be kept between the main page and sub pages.
  - (17) Provide clear exit pathways
    - All the situations that are possible on the web page have to have a clear exit pathway, so that users can leave the unwanted state while using the web page.
  - (18) Provide shortcuts
    - To avoid making users feel troublesome because it takes so many steps to get information, there needs to be some shortcuts to lead users to get what they need relatively easy and fast.

Using the list above, an evaluation will be conducted on the Earlham College CS Department Website [2]. For instance, the homepage contains a section where the text color and background color is not sufficiently contrasted. An item from the list, Text color and Background [6], can be applied to this case.

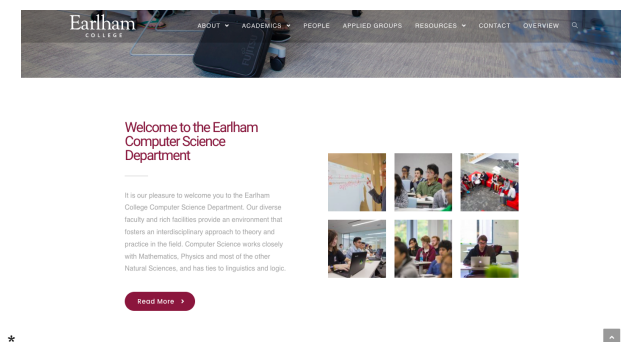


Figure 3: Original Screen

- Text color and Background

- Text color needs to be distinct from the background color. The ideal choice is to use black text on a white background.

The presence of light gray text on a white background hampers readability for users, particularly for those with color blindness. As recommended in the item, employing black text on a white background is optimal. Since the website's background is already set to white and the title appears in maroon and a larger font size, using black for the body text would be appropriate. The change can be implemented as follows:

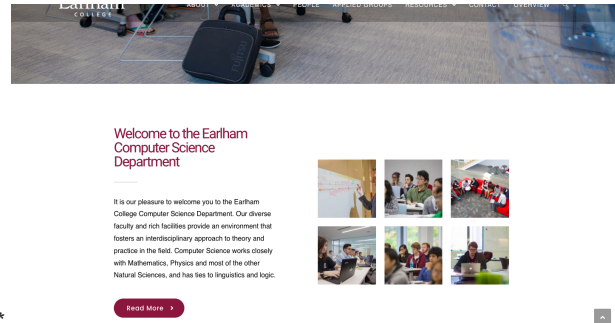


Figure 4: Revised Screen

Next, tasks will be created for different user groups to test the usability of the CS department website. These user groups will include current Earlham undergraduate students, prospective high school students, and faculty members of the CS department. The usability test will be conducted remotely in a survey-like format. The goal is to collect data on task completion, time taken for completion, as well as demographic information such as gender and ethnicity.

One of the risks in the usability testing phase is that maybe not enough data will be collected within the set time frame for the research, especially concerning high school students. Another risk is the wording in the usability testing. To avoid users confusion, it will be better to conduct a pre-survey with similar questions and smaller groups from the user pool to identify any potential ambiguities or challenges in the wording of the tasks.

The collected data will then be analyzed using the analysis of variances method. This analysis will identify which user group and tasks had the most significant impact on usability. Finally, a guideline for redesigning the website will be created based on the findings.

## 5 RESULT AND ANALYSIS

The heuristic evaluation was conducted on the specific tasks: "How many classes are there, and can I complete them in the remaining 2.5 years?", "What extracurricular activities are available beyond classes?", "What kinds of career paths are available to CS major graduates?", and overall page performance. The process discovered 52 potential usability issues in 10 different sections of the Earlham College computer science department website.

- (1) Visibility of System Status
  - Page loading took 8 seconds.

## Heuristic Evaluation and Usability Testing

Evaluator	Saki Takizawa
Date	2/28
Product	Earlham CS Department Webpage
Question	"How many classes are there, and can I complete them in the remaining 2.5 years?"
Task	<ul style="list-style-type: none"> <li>Check the CS major curriculum and determine which courses need to be taken in the remaining 2.5 years.</li> <li>Review the required and elective courses, and create a study plan suited to your current year.</li> <li>Research the order and prerequisites of courses needed to complete in the fall semester of the second year and beyond.</li> </ul>
Evaluation Criteria	<ul style="list-style-type: none"> <li>Is the course information clear and well-organized?</li> <li>Are the required and elective courses listed in an easily understandable format?</li> <li>Can the student plan their coursework effectively based on their current academic progress?</li> </ul>
<b>Visibility of System Status</b> The design should always keep users informed about what is going on, through appropriate feedback within a reasonable amount of time.	
✓ Does the design clearly communicate its state? ✓ Is feedback presented quickly after user actions?	
Issues	Recommendations
- Might be the networking, but loading to the page took 8 seconds to show the change of the page - When clicking title of the courses in the course list, the color change is very slight	- Find why the website takes time to load pages (Too much data, cash, network) - Change color or make the hover change more drastically
<b>Match Between System and the Real World</b> The design should speak the users' language. Use words, phrases, and concepts familiar to the user, rather than internal jargon. Follow real-world conventions, making information appear in a natural and logical order.	
✓ Will user be familiar with the terminology used in the design? ✓ Do the design's controls follow real-world conventions?	
Issues	Recommendations
- Which class is required and selectives is difficult to distinguish at a sight	- Add an attribute, "Required/Selective" to the course list.

Figure 5: Heuristic Evaluation Result

- Course title color change is too slight, making it hard to see interactions.
  - "For further navigation, click on the menu on top" is vague.
  - Iceland Field Study video appears abruptly with no explanation.
  - No clear way to contact the Iceland Field Study.
  - Contact page only lists the school's phone number, lacking a direct contact form.
  - No navigation link from the main CS website to the alumni stories page.
  - The application process and contact details for GDSC are unclear.
  - CodePath.org is mentioned but lacks a link for access.
- (2) Match Between System and the Real World
- Difficult to distinguish between required and elective courses at a glance.
  - No clear attribute marking courses as "Required" or "Selective."
  - The link "Our Computer Science program has evolved..." leads to the Academic page, and the "wiki" is not prominent.
  - Applied Group information is placed on the Academic page, making it hard to find.
  - No explanation of how to engage with ACM-W, Girls Who Code, or AWM at Earlham.
  - Career support is only linked to an external source, lacking Earlham-specific guidance.
- (3) User Control and Freedom
- "Our Story" section is too long (three paragraphs) without clear navigation or emphasis.
  - Students cannot find contact information for Applied Groups, GDSC, or other organizations.

- No clear exit links or ways to go back a step in some processes.
- (4) Consistency and Standards
- About and Academic pages have a consistent design, but other pages do not.
  - Dark mode inconsistencies (some elements stay white or turn red).
  - Course title color change is inconsistent (some are blue with an underline, others are not).
  - Buttons have different hover effects (some enlarge, others change color).
  - Only the top 4 courses in the list are linked to course details.
  - Faculty photos have inconsistent aspect ratios.
  - Student representative section layout differs from the rest of the page.
  - The pink underline under faculty names is misplaced on the student representative's name.
  - "Back to Top" button is hidden and unclear due to light/dark mode inconsistencies.
  - Some internal links are missing, causing inconsistencies in navigation.
  - Resource page links are not standardized.
- (5) Error Prevention
- Users are redirected to Earlham's external page without being informed.
  - Incomplete links on the homepage (e.g., "Our Story" leads to unfinished content).
  - GDSC and Girls Who Code information is available but lacks contact details.
  - CodePath.org is mentioned without a link, making access difficult.
- (6) Recognition Rather Than Recall
- The concentration information does not lead to the courses needed for a specific concentration.
  - No FAQ section for frequently asked questions.
  - Information on required courses for graduation is confusingly placed.
  - The "Load Courses" button placement suggests additional courses are available when there are none.
  - Two different locations provide almost identical degree completion advice, causing confusion.
  - "Our Story" paragraph lacks visual emphasis, making key information hard to find.
  - Applied Group details are only available on the Academic page, making them hard to locate.
- (7) Flexibility and Efficiency of Use
- Course information is presented as large blocks of text with no headings or emphasis.
  - No visual aids (charts, diagrams) to explain course sequences or prerequisites.
  - No personalization for students with different needs (e.g., double majors, late starters, study abroad).
  - No interactive features (course planning tools, course filtering, links to course details).
  - Career-related information is only available via an external link, lacking Earlham-specific content.



