

# Usability Evaluation of the Faculty Research Experience and Expertise (FREE) Webpage

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## **Executive Summary**

This report includes the results from a detailed heuristic analysis of the Faculty Research Experience and Expertise (FREE) search tool and a formal usability test of the interface based on the results of the heuristic analysis. The FREE tool is meant to enable users to search an electronic database of faculty at CSULB based on their research experience and expertise. Its purpose is to foster research collaborations and partnerships among faculty at CSULB, colleagues at other educational institutions, industry partners, and government agencies. The target user groups of FREE are:

- CSULB students
- CSULB faculty
- Students outside of CSULB
- Faculty/academic professionals outside of CSULB
- Industry partners
- Government agencies

The purpose of this analysis is to inform iterative improvements to the usability and efficiency of use of the FREE tool.

### **Heuristic Analysis**

To inform the formal usability test, a heuristic evaluation of the FREE website was performed with 4 evaluators using Nielsen's (1994) Heuristics for User Interface Design. Over 22 violations were found, and the top 5 used as the focus of the usability test tasks. These 5 major violations, ranked from most severe to least severe, are:

1. When using Safari, users are unable to scroll to the bottom of the page.
2. Searching by keyword results in many seemingly irrelevant results.
3. No contact information is provided for users to seek help or report issues and inaccuracies with the website.
4. Faculty research interest pages provide inconsistent amounts of information.
5. Users are unable to search for specific departments without first specifying the college that the department is in.

### **Usability Test**

From the 5 major heuristic violations identified, a formal usability test was conducted to gain insight into the severity of these violations. 5 tasks were developed for the formal usability test.

Conceptually, the tasks are meant to test the system's usability of the following functions:

Task 1: Basic faculty search with name known beforehand

Task 2: Basic search using college/department search & keyword search

Task 3: challenging college/department combination + keyword search that yields different results from searching and college/department search + contact information not consistently available

Task 4: Test search function with multiple-word query + combined college/department & research interest search

Task 5: Another multiple-word research interest search query

From these tasks, data were collected from 6 participants using time-on-task, lostness, perceived system usability, and task success rate metrics, as well as verbal comments describing positive and negative user experiences with the interface.

The results showed are summarized as follows:

1. Lostness was significant for performing the tasks that involved using the faculty department search function (task 2), using the keyword search function using specific multiple-word queries (task 4), and searching for a faculty member with a specific research interest (task 5). Thus, users were lost when searching for faculty from a specific department or from specific research interests.
2. Task completion times were on average 40 to 146 seconds longer than the allotted optimal time calculated by the researchers.
3. The task success was a 100% completed for tasks 1, 2, and 3. However, for task 4 (specific multiple-word search), only 67% of the users completed the task. Also, for task 5 (specific research interest), 86% of the users completed the task. Thus, a more refined search algorithm is recommended.
4. The results from our verbal protocol analysis, supports our heuristic finding that the search function is dysfunctional in that each keyword search produces seemingly unrelated results.

From these results, the implementation of the following functionality is recommended:

1. Users should be able to scroll to the bottom of the page regardless of their browser.
2. Users should be able to searching by keyword results and exclude seemingly irrelevant results.
3. Provide contact information to the users to seek help or report issues and inaccuracies with the website.
4. The faculty research interest pages should provide consistent amounts of information.
5. Users should be able to search for specific departments without first specifying the college that the department is in.

# Introduction

A heuristic evaluation and user testing were performed to assess the usability of the Faculty Research Experience and Expertise (FREE) website. The heuristic evaluation was conducted first using four independent evaluators who identified heuristic violations that were later compiled together and ranked by level of severity. The top five most severe violations are described in detail in this document with photos from the website and recommendations for how to fix the problems are provided.

A usability study was conducted to validate the top issues that were found in the heuristic evaluation. This study was conducted using six participants that were each given five task scenarios intended to provide data on how the website's problems were affecting usability. Task performance was measured by task completion rate, task completion time, and lostness. User preference was also measured using the System Usability Scale (SUS). The results of the usability study are reported in this document, as well as recommendations for how to improve the usability of FREE.

## 1. Product Details

### 2.1 Product Description

FREE is a website where users may learn about the research experience and expertise of the faculty at California State University Long Beach (CSULB) through a searchable electronic database. The database uses a search algorithm that can be searched through keywords, names, college, or department. The purpose of the FREE website is to foster research collaborations and partnerships among:

1. Faculty at CSULB
2. Colleagues at other educational institutions
3. Industry partners
4. Government agencies
5. Students at CSULB

### 2.2 User Needs Analysis

The target user groups for the Faculty Research Experience and Expertise (FREE) website are:

- CSULB students
- CSULB faculty
- Students outside of CSULB
- Faculty/academic professionals outside of CSULB
- Industry partners
- Government agencies

All users shall:

1. Possess at least basic computer skills

2. Have obtained, or are currently pursuing, a bachelor's degree or higher
3. Possess an interest in research being conducted on the CSULB campus
4. Have access to a computer, phone, tablet, etc., with internet access

Previous research experience is not necessary in order to use the FREE website. Usage of the FREE website is voluntary unless required for a specific project or assignment.

All users desire a simple, fast, and efficient user interface, mobile compatibility, access to faculty contact information, and compatibility with a keyboard, mouse, and/or touchscreen. Users affiliated with CSULB (students, faculty) prefer the website to display a familiar CSULB layout that is consistent with the rest of the CSULB webpage. Users with disabilities require a website that is accessible and compatible with assistive technologies.

All tasks and procedures are specified and require sitting at a computer for 45-60 minutes. Task success is determined by measuring speed and accuracy

## **2.3 Customer Requirements Definition**

### **2.3.1 Problems Needing Testing/Validation**

1. Searching by keyword includes many irrelevant results, which makes it difficult to find what you are looking for.
2. Inconsistent research interest sections
3. Total number of results is not shown above the fold.
4. Users cannot search by department until they have chosen the corresponding college.

These 4 problems were determined from the user needs analysis and the heuristic evaluation found below in *Section 3*. These were problems with relatively high severity that could be validated through user testing.

### **2.3.2 Target Market**

The target market for FREE is CSULB faculty, as well as faculty outside of CSULB, students, industry partners, and government agencies.

### **2.3.3 Relevant Timelines**

The product is complete, so there only needs to be iterative improvements made to make it more efficient and useful. Using the information in this written report from the heuristic evaluations, user testing, and design recommendations, a new iteration of the website can be developed in the next 3 weeks. Further testing should be completed within 2 weeks after the new iteration has been implemented (5 weeks total) and a written report of the results and recommendations should be completed within 3 weeks (6 weeks total).

## **3. Heuristic Evaluation**

### 3.1 Methodology

Usability issues with the FREE website were uncovered through the employment of a thorough heuristic evaluation analysis. Four (3) evaluators conducted two (2) independent assessments each using Nielsen's (1995) Heuristics for User Interface Design of Interface Design in order to document potential usability violations. The initial assessment was conducted with a focus on overall flow of the device, and the second assessment was conducted with a focus on individual interface elements, and each violation was given a severity rating of 0 to 4, with 4 being the most severe. Once independent assessments were completed, the findings were combined and recommendations for resolving the violations were provided.

### 3.2 Heuristics Used

A set of 10 heuristics by Jakob Nielsen (1995) were used to evaluate the usability of the FREE website. These heuristics were developed to be used as general principles and guidelines for designing an effective user interface. These heuristics are listed in Table 1.

Number	Heuristic	Description
1	Visibility of System Status	The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2	Match Between System and the Real World	The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3	User Control and Freedom	Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4	Consistency and Standards	Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
5	Error Prevention	Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.
6	Recognition Rather Than Recall	Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
7	Flexibility and Efficiency of Use	Accelerators — unseen by the novice user — may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8	Aesthetic and Minimalist Design	Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
9	Help Users Recognize, Diagnose, and Recover from Errors	Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10	Help and Documentation	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

*Table 3.2.1. Heuristics for User Interface Design, Nielsen (1995)*

In combination with Nielsen’s (1995) heuristics, for Interface Design were also used to conduct the heuristic evaluation of the FREE website. These guidelines are listed below in Table 2.

### 3.3 Problem Prioritization

Each documented violation was given an averaged severity rating based on three factors: the frequency of the problem (common or rare), the impact of the problem on usability (easy or difficult for users to overcome), and persistence of the problem (one-time or recurring problem). The purpose of a severity rating is to assist in allocating resources toward the most serious usability problems (Nielsen, 1995). The severity rating scale is listed in Table 3 below. The scale for estimated amount of effort required to fix the problem is listed below in Table 3, and the scale for the estimated amount of effort required to fix each problem is listed below in Table 4.

Rating	Definition
0	Not a usability problem.
1	Cosmetic problem only: need not be fixed unless extra time is available on project.
2	Minor usability problem: fixing this should be given low priority.
3	Major usability problem: important to fix, so should be given high priority.
4	Usability catastrophe: imperative to fix this before product can be released.

*Table 3. Severity Ratings, Nielsen (1995)*

Rating	Definition
0	Problem would be extremely easy to fix. Could be completed by one team member before next release.
1	Problem would be easy to fix. Involves specific interface elements and solution is clear.
2	Problem would require some effort to fix. Involves multiple aspects of the interface or would require team of developers to implement changes before next release or solution is not clear.
3	Usability problem would be difficult to fix. Requires concentrated development effort to finish before next release, involves multiple aspects of interface. Solution may not be immediately obvious or may be disputed.

*Table 4. Ease of Fixing Rating, Olson (2004)*



### 3.4 Summary of Heuristic Evaluation Findings

#	Problem	Severity Ranking	Number of Identifying Evaluators	Ease of Fixing Rating	Heuristics Violated	Broad Heuristic
3.5.1	When using Safari, the page is unable to scroll past the fold	4.00	1 out of 4	1	Nielsen: #1, 4	Visibility of system status, Consistency and standards
3.5.2	Searching by keyword seems to include too many results that are not relevant to the keywords.	3.00	2 out of 4	2	Nielsen: #8	Aesthetic and minimalist design
3.5.3	No contact information is provided anywhere on the page for users that are having difficulty using the site, or for users to report issues/inaccuracies.	3.00	1 out of 4	1	Nielsen: #3, 10	User control and freedom, Help and documentation;
3.5.4	Some professors have nothing listed in their research interest portion. No links are provided to view most faculty members' pages or CVs. This isn't helpful when users are trying to find out more information about faculty research. The research interest descriptions are sometimes a list of topics and other times a mini-description. Some interests have pictures.	2.00	4 out of 4	2	Nielsen: #4	Consistency and standards
3.5.5	The search instructions indicate capabilities to search by name, college, or department, but there's no option to search by department unless college is selected first (Figure 5).	2.00	2 out of 4	1	Nielsen: #7	Flexibility and efficiency of use;

Table 3.4. Summary of most severe violations of the FREE website

## 3.5 Specific Findings

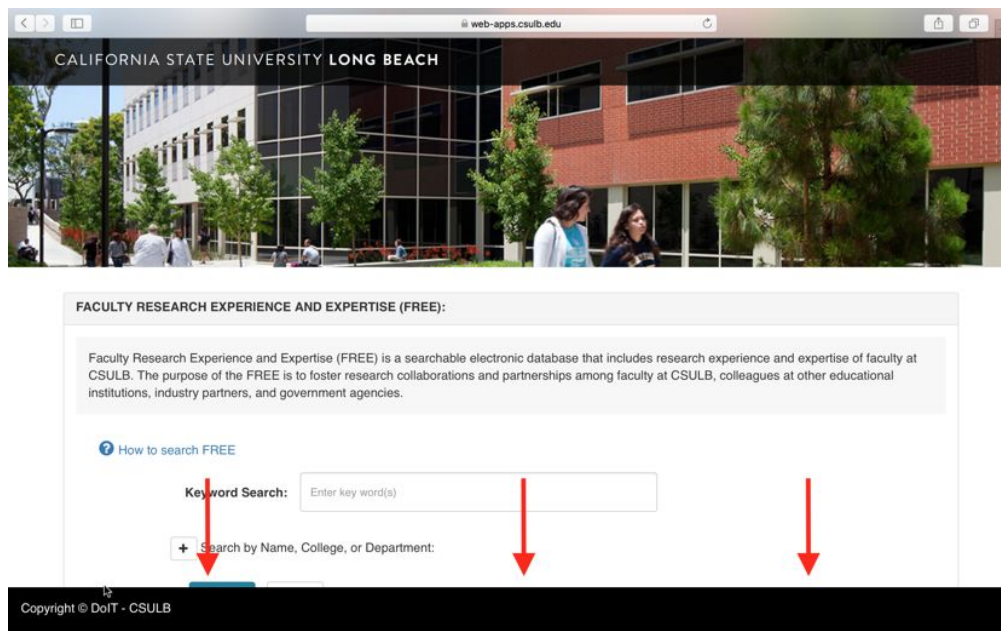
### 3.5.1 When using Safari, the page is unable to scroll past the fold.

#	Problem	Severity Ranking	Number of Identifying Evaluators	Ease of Fixing Rating	Heuristics Violated	Broad Heuristic
3.5.1	When using Safari, the page is unable to scroll past the fold	4.00	1 out of 4	1	Nielsen: #1, 4	Visibility of system status, consistency and standards

#### Problem

Users visiting the FREE webpage using the Apple Safari browser are unable to view or access content below the fold of the page. That is, the website is unable to scroll when using the Safari browser. Only content above the fold that is initially visible on the website can be accessed. If the user attempts to scroll, the page appears locked into position (*Figure 3.5.2*). Therefore, crucial information is inaccessible on Safari.

#### Evidence



*Figure 3.5.2.* For Safari users, the screen is frozen into position and unable to scroll past the fold.

#### Recommendation

To resolve this issue, the FREE website must be compatible with all web browsers.

### 3.5.2 Searching by keyword includes too many results that are not relevant to the keywords.

#	Problem	Severity Ranking	Number of Identifying Evaluators	Ease of Fixing Rating	Heuristics Violated	Broad Heuristic
3.5.2	Searching by keyword includes too many results that are not relevant to the keywords.	3.00	2 out of 4	2	Nielsen: #8	Aesthetic and minimalist design

#### Problem

Searching by keyword seems to include too many results that are not relevant to the key words. When searching keywords, such as "probability theory", some of the professors that appear are unrelated to the searched keyword because there is nothing about the searched keyword in their interest page (*Figure 3.5.2.1*).

#### Evidence

*Figure 3.5.2.1.* When searching for “probability theory”, 132 professors appear to have interest in probability theory. However, there is only one professor that actually has probability theory listed under his or her research interests. The other professors (such as Rebekha Abbuhl) does not have anything about probability theory under their research.

The screenshot shows a search interface with a search bar containing "probability theory". Below the search bar, there is a table of 132 search results. The table has columns for Name, Department, Email, and Faculty Profile. The first row is for Rebekha Abbuhl, Linguistics. A red arrow points to the search input field. Another red arrow points to the profile of Rebekha Abbuhl, which shows her research interests do not include probability theory. A red question mark is placed at the bottom right of the profile view.

#### Recommendation

Fix the search algorithm of the website to. When a keyword is searched, make sure the

professors displayed are related to the keyword by having the keyword present on their interest page.

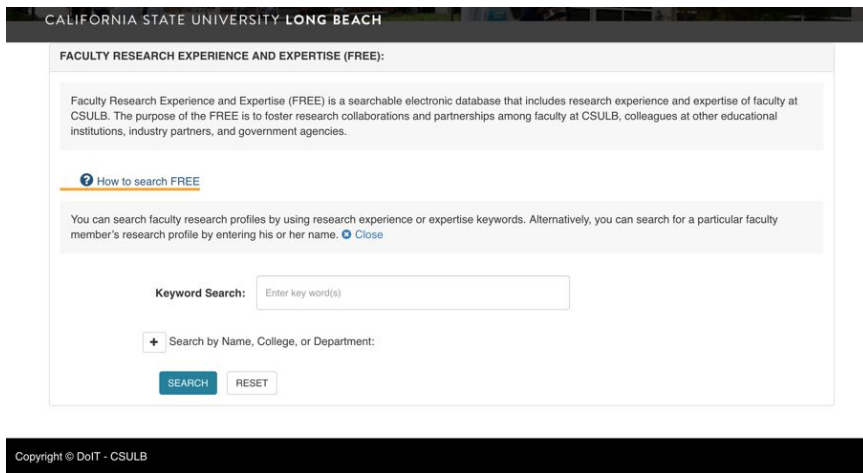
**3.5.3 No contact information is provided anywhere on the page for users that are having difficulty using the site, or for users to report issues/inaccuracies.**

#	Problem	Severity Ranking	Number of Identifying Evaluators	Ease of Fixing Rating	Heuristics Violated	Broad Heuristic
3.5.3	No contact information is provided anywhere on the page for users that are having difficulty using the site, or for users to report issues/inaccuracies.	3.00	1 out of 4	1	Nielsen: #3, 10	User control and freedom, Help and documentation;

**Problem**

The website includes brief “how to search FREE” instructions. However, no other help is available on the page. If the user does not understand the brief instructions provided, wants to report issues/inaccuracies, or is in need of additional help, they may be unsure of how to obtain additional help (*Figure 3.5.3*).

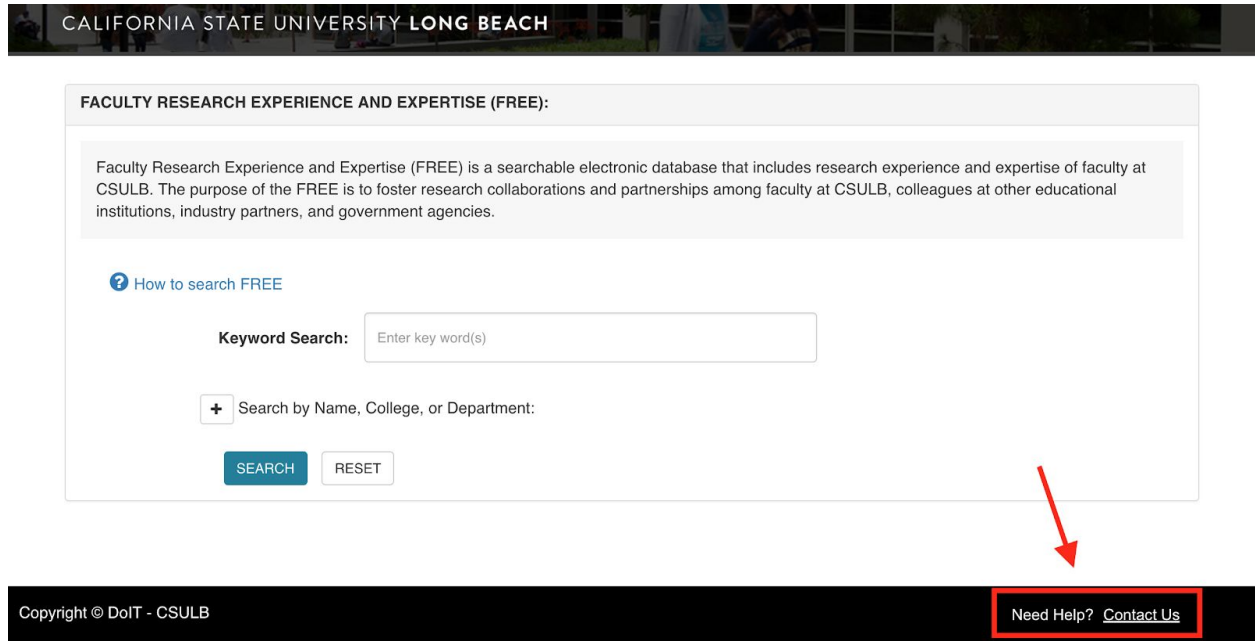
**Evidence**



*Figure 3.5.3.* Brief instructions are provided, but no additional contact information is included.

**Recommendation**

Provide contact information, such as a “contact us” link (Figure 3.5.3.1) for users to obtain additional help, or to provide feedback.



### 3.5.4 Faculty research interest pages provide inconsistent amounts of information.

#	Problem	Severity Ranking	Number of Identifying Evaluators	Ease of Fixing Rating	Heuristics Violated	Broad Heuristic
3.5.4	The information given in faculty profiles is inconsistent. Some faculty members have nothing listed in their research interest portion, while others have a small or large descriptions with or without a picture. Many profiles also do not include links to view faculty members' webpages or CVs.	2.00	4 out of 4	2	Nielsen: #4	Consistency and standards

#### Problem

The information given in faculty profiles is inconsistent. Many faculty profiles have nothing listed in the research interest portion (Figure 3.5.4.2). Some profiles have one-line descriptions of research areas, while others have large paragraph descriptions or pictures of the faculty member (Figure 3.5.4.2). Many profiles do not include links to view faculty members’ webpages or CVs, which is not helpful when users are trying to find out more information about faculty research.

## Evidence

Jane Dabel

Title:	Instructional Faculty AY
Department:	History
College:	College of Liberal Arts
Contact Information:	<a href="mailto:Jane.Dabel@csulb.edu">✉ Jane.Dabel@csulb.edu</a> <a href="tel:(562)985-2408">☎ (562) 985-2408</a>

Research, Scholarly, and Creative Activity:

*Figure 3.5.4.1.* This professor has no information under “Research, Scholarly, and Creative Activity.”

Andrew Jenks

Title:	Instructional Faculty AY
Department:	History
College:	College of Liberal Arts
Contact Information:	<a href="mailto:Andrew.Jenks@csulb.edu">✉ Andrew.Jenks@csulb.edu</a> <a href="tel:(562)985-8759">☎ (562) 985-8759</a>

Webpage: [View Webpage](#)

Research, Scholarly, and Creative Activity:

Modern Europe, Russia (politics, technology, environment)

Kim Vu

Title:	Professor
Department:	Psychology
College:	College of Liberal Arts
Contact Information:	<a href="mailto:Kim.Vu@csulb.edu">✉ Kim.Vu@csulb.edu</a> <a href="tel:(562)985-5021">☎ (562) 985-5021</a>

Research, Scholarly, and Creative Activity:

I have developed programs of research in three interrelated areas. The first area of my research focuses on the topic of action-selection. Action-selection refers to how a speeded decision is made regarding which action to take in response to perceptual events. My research in this area has implications for how displays and controls should be organized and mapped in order to achieve efficient performance, with minimal errors. The second area of my research focuses directly on human factors and human-computer interaction. Human factors is an interdisciplinary field of research, that includes applied cognitive psychology. It is concerned with improving interface designs or products for human use. The third area of my research is on the topic of aviation psychology. I have used human-in-the-loop simulations to investigate human factors issues associated with pilot performance using various cockpit interfaces, pilot and controller performance with different air traffic management concepts, and the human-automation interaction associated with new tools and technologies.

Dan Chiappe

Title:	Instructional Faculty AY
Department:	Psychology
College:	College of Liberal Arts
Contact Information:	<a href="mailto:Dan.Chiappe@csulb.edu">✉ Dan.Chiappe@csulb.edu</a> <a href="tel:(562)985-5024">☎ (562) 985-5024</a>



Research, Scholarly, and Creative Activity:

I do theoretical and empirical work on Situation Awareness, as well as research on offloading and embodied and extended cognitive systems. I am currently working on a phenomenological analysis of presence and its relation to situation awareness.

*Figure 3.5.4.2.* The 3 faculty profiles have inconsistent information: one has a link to the faculty member’s webpage and a small description under “Research, Scholarly, and Creative Activity,” one has a large block of text, and one has a photo of the faculty member.

## Recommendation

Be consistent with the information given under “Research, Scholarly, and Creative Activity” by having all descriptions be the same length and adding photos of all faculty members. Links to webpages or CVs should be added to all faculty profiles as shown in *Figure 3.5.4.3*.

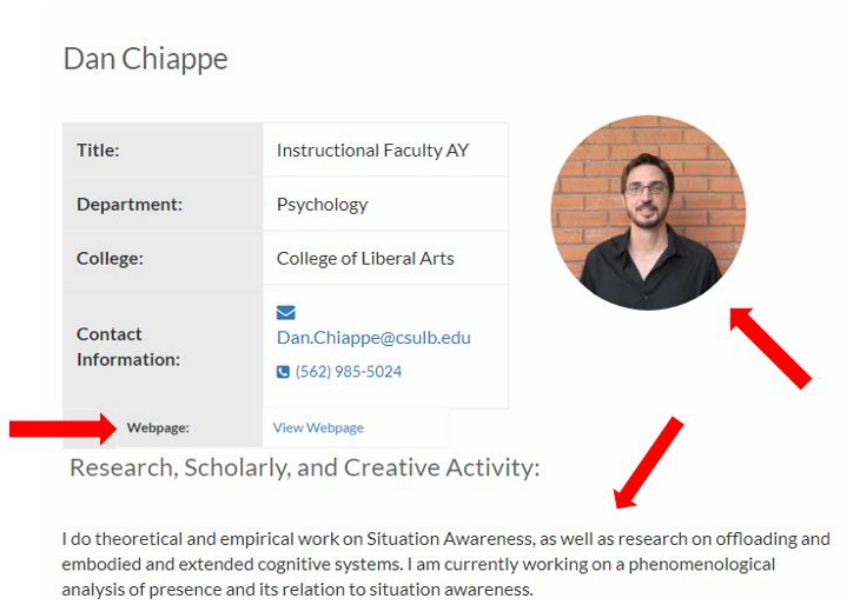


Figure 3.5.4.3. This faculty profile has a photo of the faculty member, a link to his website, and a medium-sized, two-sentence description of his research interests.

**3.5.5 The search instructions indicate capabilities to search by name, college, or department, but there's no option to search by department unless college is selected first.**

#	Problem	Severity Ranking	Number of Identifying Evaluators	Ease of Fixing Rating	Heuristics Violated	Broad Heuristic
3.5.5	The search instructions indicate capabilities to search by name, college, or department, but there's no option to search by department unless college is selected first.	2.00	2 out of 4	1	Nielsen: #6, 7	Recognition rather than recall; Flexibility and efficiency of use;

**Problem**

The instructions on the “+” button the search box on the FREE website is labeled “Search by Name, College, or Department:”, but in order to search for different departments on the website, users are required to enter the college to which the department belongs. Users may expect to be able to search with only the department name and find themselves lost without the college to which the department belongs.

**Evidence**

**+** Search by Name, College, or Department:

*Figure 3.5.5.1.* The search function indicates that it is possible to search the database using only a department name.

**-** Search by Name, College, or Department:

**Last Name:**

**First Name:**

**College:**

**-** Search by Name, College, or Department:

**Last Name:**

**First Name:**

**College:**

**Department:**

*Figure 3.5.5.2.* Users are unable to enter departments into the search without first entering a college.

### Recommendation

Users should be provided with an option to search the database by department without first entering a specific college, as shown in Figure 3.5.5.3.



Search by Name, College, or Department:

**Last Name:**

**First Name:**

**College:**

**Department:**

Figure 3.5.5.3. Mockup of user option to search database by department without first specifying a college.

### 3.6 Other Problem Areas

#	Problem	Severity Ranking	Number of Identifying Evaluators	Ease of Fixing Rating	Heuristics Violated	Broad Heuristic
6.1	When you enter a college and department and search, if there are no results it deletes the college and department you had previously entered, which makes them have to remember what they just put in	2.00	1 out of 4	1	Nielsen: #6	Recognition rather than recall;
6.2	Cannot type keyboard shortcuts to lead to each specific college. When attempting to type "liberal" for the college of liberal arts, it jumps to library at the "b" even when the "b" is promptly followed by the "e" used for liberal arts.	2.00	1 out of 4	1	Nielsen: #4, 7	Consistency and Standards; Flexibility and Efficiency of Use
6.3	There is no navigation bar on the top of the page, which is inconsistent with the rest of the CSULB site	2.00	1 out of 4	0	Nielsen: #4	Consistency and Standards
6.4	No breadcrumbs are present to show the user the path they took to get to the individual faculty member's page.	2.00	1 out of 4	1	Nielsen: #1, 3, 4, 6, 7	Visibility of System Status, User Control and Freedom, Consistency and Standard, Recognition Rather than Recall, Flexibility and Efficiency of Use

6.5	When searching for professors that I know are present at CSULB, an error message appears that no results are found.	2.00	1 out of 4	1	Nielsen: #9	Help users recognize, diagnose, and recover from errors
6.6	Filter function has no instructions.	2.00	1 out of 4	0	Nielsen: #3, 5, 10	User Control and Freedom, Error Prevention, and Help and Documentation
6.7	The search function does not remember past profiles that the user viewed.	1.00	2 out of 4	2	Nielsen: #7	Flexibility and Efficiency of Use
6.8	When trying to search some departments, they have no professor listed in their department.	1.00	3 out of 4	1	Nielsen: #5	Error Prevention
6.9	Most faculty has the title of "Instructional Faculty AY" but there's no definition of what "AY" means. There is no option to save faculty profiles for later quick access; only search function, which may take additional steps for frequently viewed profiles.	1.00	2 out of 4	0	Nielsen: #2	Match Between the System and Real World
6.10	The faculty profile tab is clickable, but nothing happens.	1.00	1 out of 4	0	Nielsen: #1	Visibility of System Status
6.11	The page says "Displaying X Records" and right under it says "Show X entries," which uses records and entries to mean the same thing.	1.00	1 out of 4	0	Nielsen: #	Consistency and Standards
6.12	Hitting "enter" does not select "Ok" to dismiss the prompt. The user has to click "Ok" with the mouse.	1.00	1 out of 4	1	Nielsen: #4	Consistency and Standards, and Flexibility and Efficiency of Use
6.13	Search function does not allow for users to search for an exact phrase using "" around the phrase. The error message given states "Try again."	1.00	1 out of 4	2	Nielsen: #9	Help Users Recognize, Diagnose, and Recover from Errors
6.14	The text above the search results displays the number of results that are being displayed twice, but users must scroll to the bottom of the page to determine how many total results exist.	1.00	1 out of 4	0	Nielsen: #1, 4	Visibility of System Status, and Consistency and Standards
6.15	There's a big white space and it pushes the description down the page significantly, so users must scroll more to read the description,	1.00	1 out of 4	0	Nielsen: #8	Aesthetic and Minimalist Design

	and in cases of very long descriptions, the information box or faculty name may be out of frame.					
6.16	Adding a space after a faculty member's last name results in a "no records found: try again" prompt even if they are in the directory. Removing the space results in the correct faculty member profile appearing.	2.00	1 out of 4	0	Nielsen: #5	Error Prevention
6.17	If you choose and college and department and go back to the previous page and return to the page, the college that was previously selected remains selected and the department drop-down box does not appear if you search or choose the same college again. The only way to make it show up is to change the college in the dropdown menu and go back to that original college.	1.00	1 out of 4	1	Nielsen: #5	Error Prevention

*Table 3.6.1* Minor heuristic violations.

## 4. Usability Test

### 4.1 Usability Test Plan

The goal of the test is to be formative and improve the usability of the FREE tool with each iteration. The customer goal is to provide users with the functionality to search through a database of CSULB faculty to foster collaborations and partnerships for research. The purpose of FREE is to effectively search through the database of CSULB professors' research interest areas by keywords, names, college, or department.

The participant pool of the usability study includes CSULB students and faculty involved in research, students and faculty outside of CSULB, industry professionals, and government agency employees. Six participants were tested, including CSULB students (graduate and undergraduates) and industry professionals working in the field of computer science.

To conduct the usability study, two desktop computers running Windows 10 software were used. Participants accessed the FREE website using one of these computers, and the Morae recorder software was used to track their facial expressions, mouse and keyboard actions, and think-aloud verbalizations. Experimenters monitored and recorded participant video from the second computer. Participants and experimenters were in two rooms separated by a one-way viewing glass mirror. Google voice video calling was used so that participants could communicate with experimenters, and researchers could moderate the usability study.

Participants were given five task scenarios describing stories about the intended use of the FREE website. The task scenarios are intended to guide participant actions in the study and gain relevant responses and think-aloud verbalizations while they performed the tasks. These task scenarios stated specific goals for participants to achieve, provided information about the task, and specified details about the situational context in which the system was intended to be used.

#### **4.1.1 Tasks**

1. You are a student at CSULB who has participated in one of Dr. Kim Vu's research studies, and you are interested in learning more about her research areas. Find Dr. Kim Vu's faculty profile. Identify and read aloud only the three areas of her research interests. You do not need to read the entire paragraph aloud.
2. You are a kinesiology graduate student working on your thesis, and you are trying to find faculty members to serve as your thesis committee. You must find three faculty members to serve on your committee: Two must be from your department (kinesiology), and one can be from outside of your department. You are ambidextrous and are interested in including research on ambidexterity in your thesis, so you may need to search outside of your department for a faculty member specializing in ambidexterity research. First, find two faculty members from your department to serve on your committee. Next, find one instructional faculty member with ambidexterity research listed in their profile under research interests. This faculty member can be outside of your department.
3. You work for a government agency looking for professors at CSULB with which to create research partnerships. How many professors are listed under the department of Criminal Justice? Provide the contact information (name, email and phone number) of one criminal justice professor.
4. You are an industry professional working at a software startup. You want to find out what research is being done in the computer engineering/science department regarding digital signal processing. Find two professors who work in the computer engineering/science department that have digital signal processing listed in their research interests.
5. You are a faculty member currently working at CSULB. For one of your projects, you need help with probability of your data. You decide you need to contact another CSULB faculty member who is interested in and has more experience with probability theory. Find a professor that has 'probability theory' listed in his or her research interests.

#### **4.1.2 Task Procedure**

The estimated duration of each usability test is one hour.

<b>Time (min)</b>	<b>Activity</b>
<b>0-5</b>	<b>User enters lab, experimenter shows the user around the lab</b>
<b>6-10</b>	<b>User is given informed consent</b>
<b>11-15</b>	<b>User is informed about what will occur in the study</b>
<b>16-20</b>	<b>Ask the user to familiarize him/herself to the website</b>
<b>20-25</b>	<b>SUS</b>
<b>25-30</b>	<b>Counterbalanced Task 1</b>
<b>30-35</b>	<b>Counterbalanced Task 2</b>
<b>35-40</b>	<b>Counterbalanced Task 3</b>
<b>40-45</b>	<b>Counterbalanced Task 4</b>
<b>45-50</b>	<b>Counterbalanced Task 5</b>
<b>50-55</b>	<b>User is given a post-test questionnaire/SUS and Demographics</b>
<b>55-60</b>	<b>Debrief and thank participant</b>

*Table 4.1.2. Projected schedule and times of usability test events*

Experimenters provided any required clarification to participants for any task they found unclear. Task times were limited to 5 minutes, and any task exceeding that length was coded as a failure. Data was collected using Morae screen recording, think aloud protocols, performance times, and completion rates.

The data was analyzed in terms of user preferences and task performance. User preference data was calculated using verbal protocol analysis, positive comments (“the design of this website is simple to use”), and negative comments (“this search is not working how I want it to”). Participant perceived usability of the FREE website was measured using the SUS. This measure was taken initially after familiarization with the website and again after completing all five tasks. The change in participants’ perceived usability of the system was calculated using these two measurements. A demographic questionnaire was also administered to measure participants’ age, highest academic degree, enrollment as a CSULB student, school/work status, and other feedback comments. Task performance was measured by completion rate, completion time, and “lostness”. The completion time measure was calculated by subtracting participants’ actual completion time for each task by that task’s ideal expert completion time. Lostness was

calculated using the formula,  $L = \sqrt{((N/S) - 1)^2 + ((R/N) - 1)^2}$

Task success rate confidence intervals were calculated using the adjusted Wald method.

## **4.2 Usability Test Results**

### **4.2.1 Demographics**

The six participants were aged from 20-31. Five participants had normal to corrected vision, with one without claiming to be “slightly short-sighted.” For highest degree achieved, four had Bachelor’s degrees, one had a Master’s degree, and one is still pursuing a Bachelor’s degree. Four participants are CSULB students, of whom there are three graduate students and one undergraduate student. Three of the CSULB students are majoring in industrial organizational psychology and one is majoring in psychology. Three of the CSULB students have been at CSULB for one year, and one student has been there for three years. One of the participants is a student outside of CSULB and is pursuing a PhD at University of Southern California. Two participants are working in industry as software engineers. One participant is working for a lab at CSULB, specifically the Center for Usability in Design and Accessibility. One participant has used FREE prior to participating in this study. All six participants have research experience, two in human factors psychology, one in developmental cognition, one in the semantic web, one in software and virtual reality, and one on scale development and validation. In the space on the demographics questionnaire for additional comments, three of the participants expressed concerns with the functionality of the search bar (“Seems like the search returns unrelated results”).

### **4.2.2 Lostness**

Lostness was significant for tasks 2, 4, and 5, with means greater than .5 (Smith, 1996). Over half of the participants for each of those tasks had lostness scores over 0.5.

#### **4.2.2.2 Lostness by Task**

Task 1: All participants had below 0.5 lostness ( $M = 0.23$ ,  $SD = 0$ ). Application of the tool was straightforward.

Task 2: Participant scores were borderline in terms of lostness ( $M = 0.52$ ,  $SD = 0.22$ ). Participants had to use the keyword search, which caused them to take more steps to find the correct results when the first results of the searches did not contain the correct answer. This task also introduces college/department search, which does not require extra steps to be taken. For this component of the task, completion time is a better measure.

Task 3: Only one participant had over 0.5 lostness (0.61) – for this task, participants searched through the college/departments, which is considered to be the same page and not a new page visited. Thus, completion time is a better measure of the challenges participants faced completing this task.

Task 4: Overall, lostness was much worse for this task. The mean lostness score was relatively low ( $M = 0.64$ ,  $SD = 0.29$ ) considering the high individual lostness scores, but that was because participant 1 had an exceptionally low score. Participants 1 and 3 were the only ones with scores below 0.5, and participants 2, 5, and 6 all had scores above 0.75. This supports our heuristic finding that the search function is defunct in that each keyword search produces seemingly unrelated results. By including more than one word in the keyword search, the amount of unrelated results appears to be multiplicative of the words used in the search.

Task 5: Lostness scores were very high for this task as well ( $M = 0.78$ ,  $SD = 0.19$ ). All scores were over 0.5. Although the correct result is on the first page of the intuitive search, there are 132 results for “probability theory,” even though very few have “probability theory” specifically listed as research interests. In addition, the quotation marks “” function is not available in FREE, even though some participants tried to use it. This made it so participants had to go one by one through the search results.

#### 4.2.3 Task completion times

- Task 1 had an average completion time of 53 seconds, compared to the optimal time of 17 seconds.
- Task 2 had an average completion time of 115 seconds, compared to the optimal time of 25 seconds.
- Task 3 had an average completion time of 94 seconds, compared to the optimal time of 19 seconds.
- Task 4 had an average completion time of 170 seconds, compared to the optimal time of 24 seconds.
- Task 5 had an average completion time of 107 seconds, compared to the optimal time of 12 seconds.

Overall, the task completion times were approximately 40 to 146 seconds greater than the optimal times of the tasks. The longer average task completion times, may cause the user to be frustrated with the website and lower the system usability scores.

Task completion times may be improved once the heuristic violations are fixed to the recommendations. A better search algorithm will most likely decrease the task completion times by not searching professors unrelated to their intended search.

#### 4.2.4 Task success

- Tasks 1-3 had a 6/6 (100%) completion rate, so their adjusted wald CI is 0.64 to 1.00.
- Task 4 had a 4/6 (67%) completion rate, so its adjusted wald is 0.30 to 0.91.
- Task 5 had 5/6 (83%) completion rate, so its adjusted wald is 0.42 to 0.99.

Two participants failed to complete task 4 task within the 5 minute requirement. One participant passed over the correct answer and continued searching through the extensive results pages. Another participant initially used only the search bar without any filters or advanced search items selected, which produced far more results than what would be found by filtering. The participant

also paired the keyword with a department, which produced additional irrelevant results. For task 5, one participant failed for similar reasons in that the participant passed over the correct answer and continued to search through the extensive results pages. Overall, failure to complete a task resulted from an extensive search results section saturated with irrelevant, distracting items, causing the participants to feel frustrated.

Task 1: Basic faculty search with name known beforehand

Task 2: Basic search using college/department search & keyword search

Task 3: challenging college/department combination + keyword search that yields different results from searching and college/department search + contact information not consistently available

Task 4: Test search function with multiple-word query + combined college/department & research interest search

Task 5: Another multiple-word research interest search query

#### **4.2.5 Verbal Information**

##### Task 1

Participants were asked to find the three primary research interests for Dr. Kim Vu. Three participants (50%) chose to search for her by name, while the remaining three (50%) chose to first search for her by keyword. Searching for her by name produced a single result, while searching for her by keyword produced 75 results, which all of those participants found overwhelming. One participant exclaimed “What the heck?” in response to the 75 results, and then decided to search by name instead: “First I searched Kim Vu and I got a lot of options that were not Kim Vu.” Another stated, “There’s a lot of items,” while the third participant remarked, “It didn’t take me straight to her when I searched for her.”

##### Task 2

Participants were tasked with finding two faculty from the kinesiology department, as well as one faculty member outside of the department who specializes in ambidexterity research. All participants were sure of searching for the kinesiology department. However, all participants were unsure of the college to which kinesiology belongs: “I’m going to assume it’s health and human services.”

##### Task 3

Participants were to search for criminal justice faculty. Similar to task 2, participants were sure of the department, but unsure of the college to which criminal justice belongs: “I have to figure out what college criminal justice is under. I’m going to guess it’s health and human services?” Additionally, three (50%) of the participants searched by department and received 12 results, and subsequently came to the conclusion that there are 12 criminal justice faculty. “It shows 1 to 10 of 12 entries, so it sounds like 12 professors.”

##### Task 4

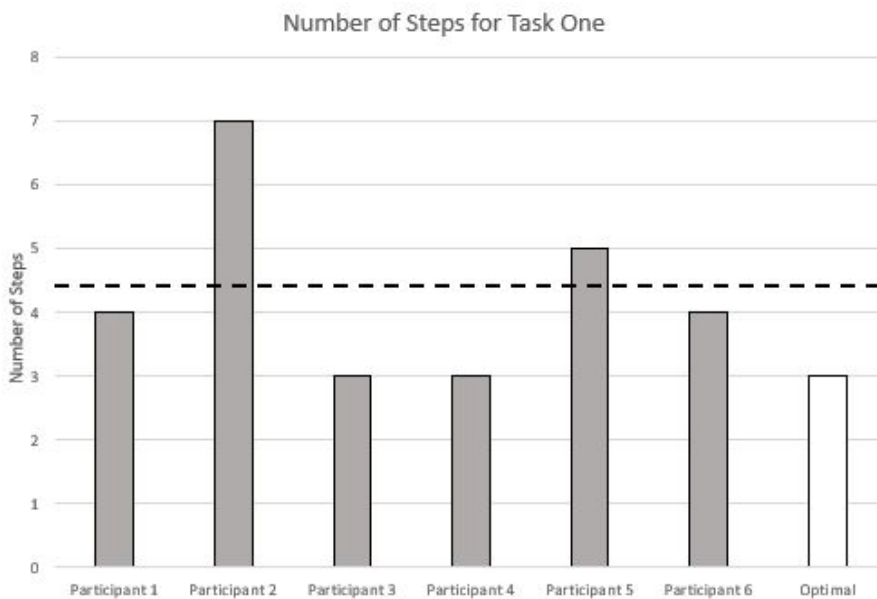


Participants were asked to find two faculty members specializing in digital signal processing in the computer engineering/science department. All participants initially typed “digital signal processing” or “signal processing” into the keyword search box, which produced 48 and 24 results, respectively. One participant narrowed the search results by next searching for a more narrow keyword: “Since it looks like the keyword search is an or, I’m just going to type processing.” Another participant filtered the results: "I'm going to try filtering. Since digital signal processing is in the keyword search, I'm not sure what the filter would apply to, but I'm going to try it," but found that the filter was unsuccessful, saying, “It's not there... so much for keyword search.” Participants all found the filtering to be unhelpful, with one showing frustration and asking, “Why is it not filtering?”

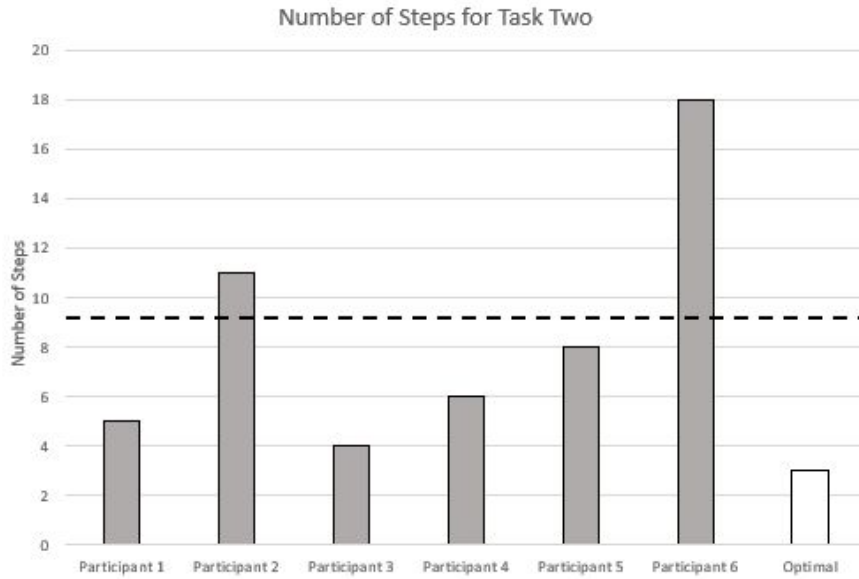
### Task 5

Participants were tasked with finding a faculty member with experience in probability theory. Three (50%) of the participants searched “probability theory” in the keyword search bar. One participant chose to search only for probability: “I’m just going to type probability because it’s an ‘or’, and I don’t want to get everyone who lists theory in their research interests.” Those who searched for probability theory in full were dismayed to see the number of results produced: "There are 132 entries, which is a lot to sort through.”

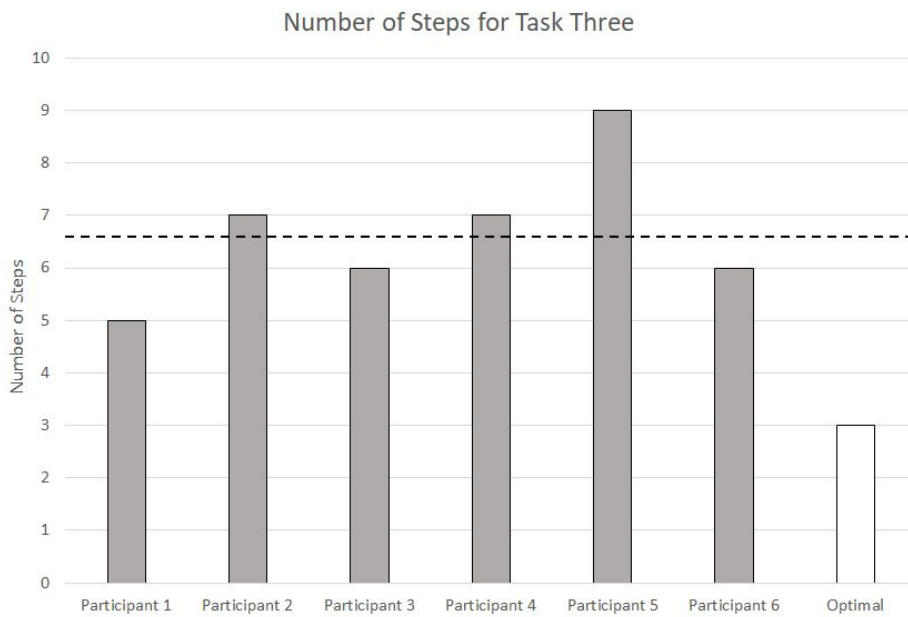
### 4.2.6 Results for number of steps taken per task



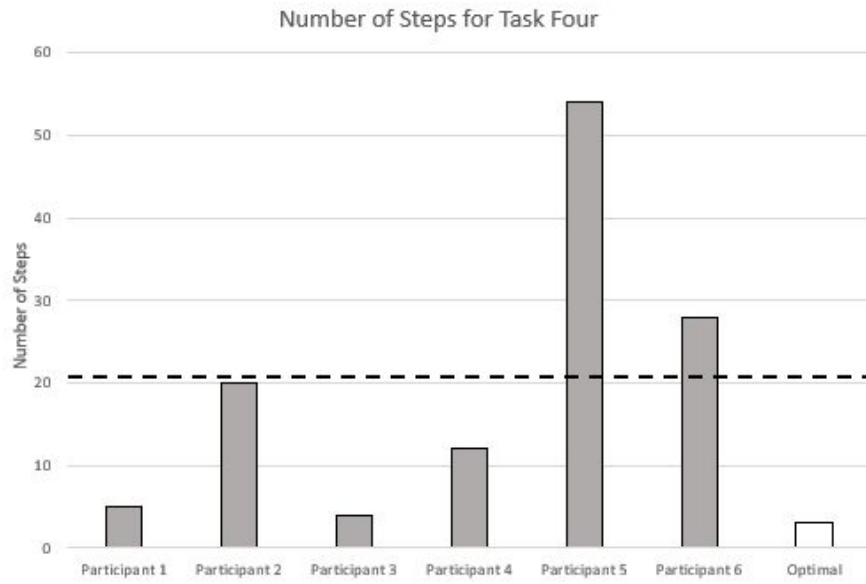
Graph 4.2.6.1. The average number of steps for Task One is 1.33 steps more than the optimal number of steps.



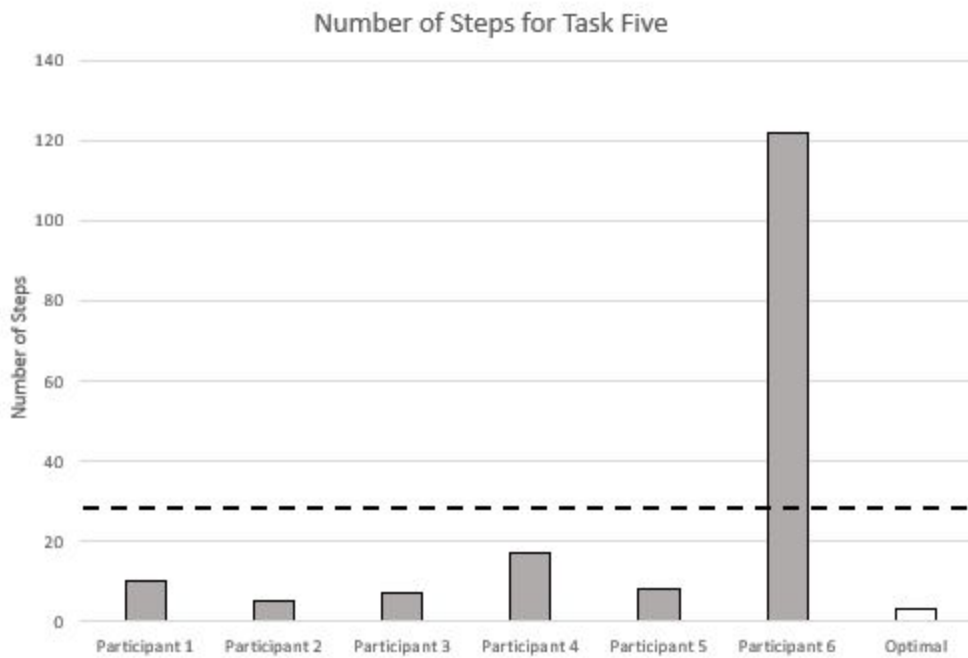
*Graph 4.2.6.2.* The average number of steps for Task Two is 5.67 steps more than the optimal number of steps.



*Graph 4.2.6.3.* The average number of steps for Task Three is 3.67 steps more than the optimal number of steps.



Graph 4.2.6.4. The average number of steps for Task Four is 16.5 steps more than the optimal number of steps.



Graph 4.2.6.5. The average number of steps for Task Five is 26.17 steps more than the optimal number of steps.

#### 4.2.7 System Usability Scale

The system usability scale (SUS) is a 10 item questionnaire with a five point likert-scale ranging from strongly agree to strongly disagree (Brooke, 1986). The participants completed an SUS scale after familiarizing themselves with the FREE website for five minutes and another SUS scale after completing all five tasks. The more usable the product is, the higher rated the score would be on the SUS.

In our results, the initial SUS score (after the familiarization) was scored on average, 78.5. According to Tullis and Albert (2008), a score of 78.5 on the SUS means the system is usable to the users because it has a score of over 70 and passes. However, after the participants performed all five tasks, the SUS score decreased by an average of 10.5%. The SUS score calculated to an average score of 68.3 which according to Tullis and Albert (2008) has poor usability.

The decrease score of 10.5 most likely occurred because the participants were given actually tasks that users of the site will perform. Once a realistic scenario was given with a specific task, they had to find the correct answers instead of familiarizing themselves with the website.

## **7. Discussion**

This technical report provides a throughout heuristic evaluation and usability test of the FREE (faculty research experience and expertise) website in order to decrease lostness, completion times, and confusion of related tasks, while also increasing task success and the SUS score. The two part-heuristic evaluation was completed by first reviewing the flow of the website, followed by assessing the usability of the website. The website was evaluated using Nielsen's (1994) Heuristics for User Interface Design. There were five major heuristic issues and our recommendations are to:

1. Users should be able to scroll to the bottom of the page regardless of their browser.
2. Users should be able to search by keyword results and exclude seemingly irrelevant results.
3. Provide contact information to the users to seek help or report issues and inaccuracies with the website.
4. The faculty research interest pages should provide consistent amounts of information.
5. Users should be able to search for specific departments without first specifying the college that the department is in.

The usability test was completed by having six participants perform five tasks related to the intended use of the FREE website. The following main points were concluded from the usability test:

1. Lostness was significant for performing the tasks that involved using the faculty department search function (task 2), using the keyword search function using specific multiple-word queries (task 4), and searching for a faculty member with a specific research interest (task 5). Thus, users were lost when searching for faculty from a specific department or from specific research interests.
2. Task completion times were on average 40 to 146 seconds longer than the allotted optimal time calculated by the researchers.

3. The task success was a 100% completed for tasks 1, 2, and 3. However, for task 4 (specific multiple-word search), only 67% of the users completed the task. Also, for task 5 (specific research interest), 86% of the users completed the task. Thus, a more refined search algorithm is recommended.
4. The results from our verbal protocol analysis, supports our heuristic finding that the search function is dysfunctional in that each keyword search produces seemingly unrelated results.

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