Comparative Usability Analysis of University Department Websites: A Case Study of Industrial and Chemical Engineering Programs

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Abstract – This study aimed to compare the usability of websites for the Industrial Engineering and Chemical Engineering departments at a university. Since these sites are critical for new students seeking information, a user-friendly interface is essential for efficient and accurate information retrieval. To conduct the study, a user performance test was administered to 40 new students, all with less than a year of study. They were asked to complete three specific tasks: downloading a form, finding a "kaleidoscope" (a summary of activities), and locating information about oral exam registration. The researchers collected data on the time students took to complete the tasks (efficiency) and the number of errors they made. This data was then analyzed using a Two-Way ANOVA statistical method. The results showed significant differences in usability between the two websites, with a very strong interaction effect for both efficiency and error rates. The Industrial Engineering website was most efficient for downloading a form, but proved to be the least efficient for finding the kaleidoscope. Conversely, the Chemical Engineering website was most efficient for finding the kaleidoscope but was the least efficient for form downloads. Regarding errors, finding the kaleidoscope and downloading a form presented the most significant challenges, while registering for the oral exam was the least error-prone task. These findings highlight the importance of making specific, tailored improvements to academic web design to enhance the user experience on these platforms.

Keywords – Usability; University Website; User Experience; Efficiency; Error Rates

1. INTRODUCTION

Department websites are the primary digital hub for universities, offering critical information to both prospective and current students. They play a vital role in supporting academic processes and institutional communication [1]. However, the usability of these websites often falls short of user expectations, resulting in difficulties related to navigation [2], information retrieval, and user engagement [3]. These usability issues can make it hard for students, particularly newcomers unfamiliar with the university's digital systems, to find the academic information they need efficiently [4].

Despite the rapid development of web technologies and user interface standards, studies still identify persistent usability issues within academic and departmental websites [5], specifically within engineering faculties [6]. Recent studies point to common issues like a poor information architecture, confusing content, and awkward navigation. These problems make it difficult for students to access reliable information, which in turn hurts their satisfaction and efficiency [4]. Because these issues are so significant, researchers have developed various methods to evaluate university websites, such as the System Usability Scale (SUS) [7], user performance testing, heuristic evaluations, eye tracking, and comparative analysis [8].

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A comprehensive review of recent literature reveals several key themes and gaps relevant to this study. Akhtar et al. compared different usability evaluation techniques, emphasizing the importance of combining both quantitative and qualitative assessment for holistic website improvement [9]. Kravchenko et al. provided a framework based on content, design, ease of use, and reputation for evaluating the quality of university websites [4]. Their findings reveal that academic websites require continual refinement, particularly relating to structure and navigation, to meet evolving user needs. Other studies, such as those by authors analyzing the usability of department-specific websites, have adopted user-centered redesign approaches, such as Design Thinking [10] and iterative prototyping [11], which resulted in significant improvements in usability and user satisfaction [12]. Furthermore, accessibility, visual design, and mobile compatibility have also emerged as critical usability factors in recent works [13].

Given the diverse methodologies and focus areas in prior research, there is a lack of direct, performance-based comparative studies between similar academic department websites. Most studies address general usability or focus on isolated metrics, rather than executing side-by-side comparisons using controlled experiments with representative user groups, such as new students. This gap underscores the innovative value of the present study, which systematically contrasts the usability of Industrial Engineering and Chemical Engineering department websites with standardized performance metrics from real student users.

Building on the limitations of previous studies, the present research employs a performance-based experimental approach involving new undergraduate students. The study analyzes efficiency and error rates using user task performance data, advancing the discussion on comparative usability in academic web environments and providing institution-specific recommendations for improving digital platforms tailored to new student cohorts. This approach contributes original value to the literature by focusing directly on comparative usability and grounding findings in empirically measured user experience.

2. RESEARCH METHOD

This investigation employed a quantitative research framework, leveraging an empirical approach, specifically a user performance assessment to evaluate the usability of university department websites. The study unfolded through a series of structured chronological phases, ranging from the initial definition of the research scope to the subsequent data analysis and the formulation of actionable recommendations. The core aim was to gauge the user-friendliness and effectiveness of the websites for the Industrial Engineering and Chemical Engineering programs by comparatively analyzing their efficiency and error rates.

The research methodology began with crafting a detailed test plan, which delineated the specific usability attributes slated for measurement: user efficiency and the frequency of errors. Efficiency was conceptualized as the duration a user required to successfully complete a designated task on either website, whereas the error level pertained to the obstacles encountered during task execution [14]. The testing environment was meticulously set up, incorporating essential tools such as laptop computers, a reliable internet connection, screen recording software (e.g., Bandicam), and a stopwatch for precise timing.

Participants in this study included 40 new students, who were characterized as those who had attended the university for no more than a year and who had visited the designated department websites 0–3 times in the two months prior. In order to guarantee that any usability issues found appropriately represented the challenges faced by new students during their first encounters with university digital resources, this specific user profile was purposefully chosen. Every respondent's demographic information, including age, gender, and frequency of general website use, was meticulously recorded.

Because the study used a between-subjects design, only one of the two department websites was used to evaluate each responder [15]. In particular, 20 respondents were tasked with

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testing the Industrial Engineering website, and the other 20 respondents concentrated their assessments on the Chemical Engineering page. This intentional design decision was made in an effort to reduce any biases or learning effects that might result from users interacting with both platforms [16].

On their individual webpages, participants were given three different tasks to complete:

Task 1: Researching the department's history and accomplishments.

Task 2: Obtaining the Field Work Practice application form

Task 3: Finding details on how to sign up for an oral exam

To make sure participants understood their tasks completely and to reduce any unnecessary mistakes, each testing session started with meticulous time recording and a comprehensive briefing. To make sure participants understood their tasks completely and to reduce any unnecessary mistakes, each testing session started with meticulous time recording and a comprehensive briefing. Data collection included recording each task's completion time (efficiency) and recording any problems or difficulties encountered (error level). The correctness and precision of the usability test results were guaranteed by conducting the complete testing process under "real work" situations [17].

The Statistical Package for the Social Sciences (SPSS) software was used to process the quantitative data on user efficiency statistically and recorded errors in order to assess the information that was collected. The Two-Way ANOVA was used to determine the significance of any variations in efficiency and mistake rates seen among the various websites and jobs assigned, and this was then ascertained using a statistical approach. This analytical approach provided a robust framework for investigating the interaction effects between the specific website design and the user's tasks, thereby illuminating its influence on overall user performance [18].

By executing a detailed process of data collection and analysis, this study is able to ensure the scientific validity of our findings. This groundwork allowed us to form reliable conclusions and create actionable recommendations specifically aimed at improving the usability of academic websites. To provide a visual summary of the chronological flow of this research, the chronological and structured phases of the research methodology are visually summarized in the flowchart below.

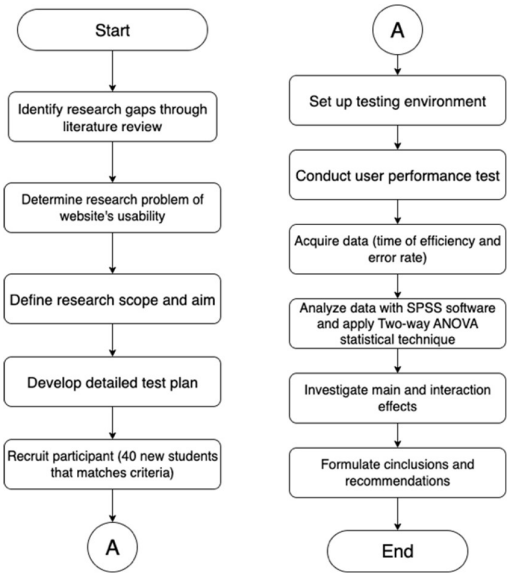

Figure 1. Flowchart of research methodology

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3. RESULTS AND DISCUSSION

This section presents the findings from the usability testing, followed by a comprehensive discussion of the results for both efficiency and error rates on the Industrial Engineering (TI) and Chemical Engineering (TK) department websites. The analysis aims to identify key usability challenges and provide actionable recommendations for improvement.

3.1. Efficiency Analysis

The Two-Way ANOVA was conducted to analyze the impact of the website and tasks on user efficiency. The results, as shown in Table 1, indicate that the Website factor has a significant effect on efficiency (Sig. = 0.000). Similarly, the Tasks factor also has a significant impact (Sig. = 0.000). Most notably, the Website * Tasks interaction effect is also highly significant (Sig. = 0.000), with a large F-value of 306,568. This significant interaction confirms that the effect of the website on user efficiency is not consistent across all tasks, and a more detailed examination of mean differences is warranted.

Table 1. SPSS Efficiency Calculation Results

Tests of Between-Subjects Effects					
Dependent Variable: Efficiency					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	186301.442[a]	5	37260.288	138.765	,000
Intercept	673351.008	1	673351.008	2507.698	,000
Website	5810.208	1	5810.208	21.638	,000
Tasks	15856.017	2	7928.008	29.526	,000
Website * Tasks	164635.217	2	82317.608	306.568	,000
Error	30610.550	114	268.514		
Total	890263.000	120			
Corrected Total	216911.992	119			
a. R Squared = ,859 (Adjusted R Squared = ,853)					

The analysis results indicate that both the "Website" and "Task" variables have a significant effect on user efficiency. This suggests there is a tangible difference in the speed at which user complete tasks on the two websites, and that some tasks are inherently faster to complete than others.

However, the most crucial finding is the highly significant interaction effect between "Website" and "Task" (with a large F-value of 306,568). This strong interaction effect confirms that a website's impact on user efficiency is not consistent across all tasks. In other words, no single website is uniformly superior that a website's efficiency is highly dependent on the specific task being performed by the user. This complex pattern underscores that design improvements must be detailed and task-oriented, rather than being general enhancements for the entire website. This demands that designers specifically consider how each task is handled on each particular platform [17].

Table 2. Estimated Marginal Means for Efficiency

Website * Tasks					
Dependent Variable: Efficiency					
Website	Tasks	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Industrial Engineering	Task 1	112.650	3.664	105.391	119.909
	Task 2	31.700	3.664	24.441	38.959
	Task 3	59.500	3.664	52.241	66.759
Chemical Engineering	Task 1	43.600	3.664	36.341	50.859
	Task 2	142.500	3.664	135.241	149.759
	Task 3	59.500	3.664	52.241	66.759

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The Estimated Marginal Means for efficiency, shown in Table 2, provide a clearer picture of the interaction effect. The mean completion time for the Industrial Engineering website was highest for Task 1 (112,65 seconds), followed by Task 3 (59,5 seconds), and was most efficient for Task 2 (31,7 seconds). This indicates that Industrial Engineering website users spent the most time finding information on the department's track record and achievements compared to the other two tasks. In contrast, the Chemical Engineering website showed the highest mean completion time for Task 2 (142,5 seconds), which was significantly higher than for Task 3 (59,5 seconds) and Task 1 (43,6 seconds). Therefore, users of the Chemical Engineering website took considerably longer to download the Field Work Practice application form than to perform the other tasks.

The Industrial Engineering website's strength in handling form downloads (Task 2) suggests that its "Forms" or "Student Resources" section is well-structured and easily accessible. Conversely, its inefficiency in finding department achievements (Task 1) indicates potential issues with information architecture, labeling, or the organization of promotional content. This suggests that tasks completed quickly imply an intuitive path, while those that take a long time point to a hidden path, ambiguous labels, or fragmented information requiring extensive navigation [8]. This directs attention to specific areas of the website's design, such as the navigation menu, search functionality, and content hierarchy, that require further review [19].

On the other hand, the Chemical Engineering website's efficiency in finding department achievements (Task 1) demonstrates an effective presentation of its profile information. However, the severe inefficiency during form downloads (Task 2) points to major obstacles, likely due to hidden links or a convoluted navigation flow leading to these important student forms. The extremely high completion time for Task 2 on the Chemical Engineering website (142,5 seconds) compared to the Industrial Engineering website (31,7 seconds) highlights a significant difference in how this common administrative task is handled, indicating a profoundly different information architecture for forms.

3.2. Error Rate Analysis

A Two-Way ANOVA was also performed on the log-transformed error data (natlog_error) to assess the impact of the website and tasks on error rates. As shown in Table 3, the Website * Tasks interaction effect is highly significant (Sig. = 0.000). This indicates that the influence of the website on error rates is dependent on the specific task being performed. The Tasks factor also has a significant effect on errors (Sig. = 0.041), whereas the Website factor alone does not show a significant effect (Sig. = 0.751)

Table 3. SPSS Error Calculation Results

Tests of Between-Subjects Effects						
Dependent Variable: natlog_Errors						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	32.829 [a]	5	6.566	37.826	.000	.663
Intercept	96.334	1	96.334	554.995	.000	.853
Website	.018	1	.018	.101	.751	.001
Tasks	1.148	2	.574	3.307	.041	.064
Website * Tasks	30.040	2	15.020	86.534	.000	.643
Error	16.663	96	.174			
Total	161.859	102				
Corrected Total	49.492	101				
a. R Squared = ,663 (Adjusted R Squared = ,646)						

The analysis results indicate that while there was no significant overall difference in the number of errors made by users across both websites (due to a Sig. value of 0.751 for the 'Website'

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factor), a significant difference was caused by the type of task assigned (a Sig. value of 0.041 for the 'Task' factor). This suggests that some tasks are inherently more difficult than others, regardless of the website used. The most crucial finding, however, was the highly significant interaction effect between the 'Website' and 'Task' factors (Sig. = 0.000). This demonstrates that the error rate a user experiences on a particular website is highly dependent on the specific task they are performing. In other words, no single website is consistently better or worse in terms of avoiding errors. Instead, the design issues that lead to errors are specific to certain tasks, rather than being systemic problems throughout the entire website. This complex error pattern affirms that to improve usability, highly detailed and task-focused improvements are necessary [9].

Table 4. Estimated Marginal Means for Errors

Multiple Comparisons						
Dependent Variable: natlog_error						
Tukey HSD						
(I) task	(J) task	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Task 1	Task 2	-,0967	.09937	.595	-.3333	.1398
	Task 3	,2653 [a]	.10025	.025	.0267	.5040
Task 2	Task 1	.0967	.09937	.595	-.1398	.3333
	Task 3	.3621 [a]	.10499	.002	.1121	.6120
Task 3	Task 1	-,2653 [a]	.10025	.025	-.5040	-.0267
	Task 2	.3621 [a]	.10499	.002	-.6120	-.1121

To determine which specific tasks had significant differences in error rates, a Tukey HSD *post-hoc* test was performed. As shown in Table 4, a significant difference was found between Task 1 and Task 3 (Sig. = 0.025), and also between Task 2 and Task 3 (Sig. = 0.002). In contrast, no significant difference in error rates was found between Task 1 and Task 2 (Sig. = 0.595). This suggests that Task 3, which involves locating information for oral exam registration, was the most error-prone task and was significantly different from the other two tasks.

A re-evaluation of specific task error rates revealed significant usability challenges across both the Industrial Engineering and Chemical Engineering websites. Notably, Task 2 (downloading the form) emerged as the most error-prone task, particularly on the Chemical Engineering website, where it also showed highly inefficient performance. This points to a serious design flaw impacting both user efficiency and accuracy. Meanwhile, Task 1 (finding achievements) also demonstrated a high error rate, especially on the Industrial Engineering website, which proved to be very inefficient at helping users find and comprehend this information. This highlights significant challenges in navigation and content interpretation. As for Task 3 (oral exam registration), while it was initially identified as the most error-prone task, the data showed it actually resulted in the fewest errors. However, its moderate efficiency on both websites still reflects room for improvement in instruction clarity and speed, to enhance the overall user experience.

3.3. Discussion

The most crucial finding from this study is that a website's usability cannot be assessed in its entirety rather, it is highly dependent on the specific tasks performed by the user. The presence of a significant interaction between the website and the task demonstrates that no single website is unilaterally superior to the other. Instead, each platform's effectiveness is characterized by distinct strengths and weaknesses that vary with the task flow. Consequently, design improvements cannot be approached with a one-size-fits-all strategy. The necessary approach is, instead, to optimize the user flow for each specific objective on each website, with a meticulous focus on interaction details and information cues. This affirms that effective website design is not merely about aesthetics and overall structure, but also about ensuring that every critical task

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features a clear path, consistent labeling, and information that is easily comprehensible to the user [20].

The Industrial Engineering website was found to be highly efficient for Task 2, which involves downloading a specific form. However, it was least efficient for Task 1, which required navigating to find information on track records and achievements. Conversely, the Chemical Engineering website was very efficient for Task 1 but was the least efficient and most error-prone for Task 2. The significant differences in error rates between Task 3 and the other two tasks suggest that finding information on how to register for an oral exam is a more complex task than simply downloading a form or finding a department's profile, leading to higher levels of user difficulty and error. This could be due to a less-intuitive menu structure or a more complex navigation path required for that specific task. The findings suggest that both websites have unique usability strengths and weaknesses that are directly tied to their specific information architecture and content organization for different user needs.

Differentiating between low efficiency and high error rates is key to prioritizing design improvements. Low efficiency typically stems from navigation issues or a lack of clear cues, which causes users to struggle in finding what they need quickly. Conversely, a high error rate is often caused by ambiguity or a confusing design, where users may find the information but use it incorrectly. A task that is both time-consuming and error-prone, such as Task 2 on the Chemical Engineering website, reflects a very serious and complex usability problem. If a task is completed slowly but without errors, the problem likely lies in a lengthy navigation path or difficulty in locating information. If a task is completed quickly but with many errors, the issue points to a lack of clarity in instructions or the interface display [21]. However, when a task is both slow and error-prone, it signals a complete design failure that requires immediate attention, as users are unable to find, comprehend, or complete the task effectively [22].

The websites for Industrial Engineering and Chemical Engineering have complementary usability strengths and weaknesses. The Industrial Engineering website demonstrated good efficiency for form-related tasks but was less effective in presenting information such as program achievements. Conversely, the Chemical Engineering website excelled at displaying achievement information but encountered significant difficulties with form-related tasks. This finding confirms that each website requires specific improvements based on the type of task. The strengths of one site can therefore serve as a reference or inspiration to address the weaknesses present in the other.

3.4. Recommendation

To enhance the overall user experience, both websites need to adopt a uniform information structure [23]. Crucial content, such as “Student Resources” and “Forms,” should be organized with a consistent pattern across the entire university. Navigation must be designed based on how users think and behave [24], not on the department's internal organizational structure, which can be determined through methods like card sorting or tree testing [25]. In addition, a reliable global search feature should be provided to allow users to quickly find specific documents or information. This consistency will reduce the cognitive load on students who frequently need to access various departmental and faculty sites, making the experience smoother and more efficient [26].

An effective website requires a process of continuous improvement that is driven by data and user feedback. It is advisable to provide a feedback form or conduct simple, periodic usability tests to gain direct insights into the user experience [27]. The use of site analytics is also essential for identifying which pages are most visited, what terms are being searched for, and where users often exit the site. A/B testing can also be implemented to compare two design versions and see which one is more effective [28]. This flexible and data-driven process ensures that the website remains relevant as user needs and technology continue to evolve.

Usability also heavily relies on easily understandable content. All information on the site should be written in a simple, clear language, free of confusing technical jargon [29]. Use

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headings, subheadings, bullet points, and short paragraphs to make the content scannable and easy for users to comprehend. Crucial content, such as forms and deadlines, must always be kept up to date to maintain accuracy. Unclear or outdated information can lead to errors, slow down users, and damage their trust in the site, even if the navigation is well-designed [30].

4. CONCLUSION

This study set out to comparatively evaluate the usability of Tokopedia and Bukalapak, focusing on user efficiency and error rates when performing specific tasks for novice users (new students with a maximum of one year of study), with the aim of providing data-driven insights and recommendations for interface improvement. As demonstrated in the "Results and Discussion" section, it was found that the interaction between the "Website" and "Task" plays a crucial role in determining usability. Each website possesses unique strengths and weaknesses that are highly dependent on the task being performed. The error analysis results indicate that Task 3 (oral exam registration) was the task that generated the fewest errors. Conversely, Task 2 (form download) and Task 1 (finding achievements) presented more significant error challenges.

The insights from this data-driven analysis are highly important for formulating effective design improvements. By implementing specific recommendations, both departments can significantly increase their website's efficiency and reduce user errors. This will lead to improved user satisfaction, streamlined administrative processes, and a stronger digital image for the university. Continuous usability improvement is a strategic investment in the student experience and the operational excellence of the academic departments.

For future research, it is recommended to expand this study by including a larger and more diverse sample of respondents to enhance the generalizability of the findings. Future work could also incorporate a qualitative approach, such as in-depth interviews or focus groups, to gain a deeper understanding of the "why" behind the observed efficiency and error patterns. Furthermore, a follow-up study could be conducted after implementing the design recommendations to validate their effectiveness and measure their long-term impact on the user experience and administrative efficiency.

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