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Creating inclusive UX: uncovering gender-bugs in higher education website through GenderMag'ing

Maria Isabel Milagroso Santos[1], Thelma Domingo Palaoag[2], Anazel Patricio Gamilla[3]
[1]Mobile and Cloud Computing Lab, Department of Information Technology, College of Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines
[2]College of Information Technology and Computer Science, University of the Cordilleras, Baguio City, Philippines
[3]Department of Information Technology, College of Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines

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ABSTRACT

Higher education websites serve as service-providing and information-disseminating platforms which may contain gender-related usability issues that affect how male and female users interact with digital platforms. This study applied the gender inclusiveness magnifier (GenderMag) method to identify and assess these gender-specific usability barriers. Researchers conducted cognitive walkthrough sessions using gendered personas, Abi (female) and Tim (male), uncovering key inclusivity bugs aligned to specific cognitive facets-motivation, information processing style, computer self-efficacy, risk aversion, and learning style. Insights from these walkthroughs guided the creation of a structured usability survey, administered to 200 respondents equally divided between males and females, comprising faculty and upper-year BS information technology students. Statistical analysis revealed significant gender differences specifically in information processing style (p=0.0003), emphasizing distinct preferences for content organization and navigation between genders. The integration of usability factors with GenderMag's cognitive facets effectively pinpointed areas requiring inclusive design adjustments, guiding future efforts to enhance equitable digital interactions in educational environments.

Corresponding Author:

Maria Isabel Milagroso Santos
Mobile and Cloud Computing Lab, Department of Information Technology, College of Engineering
Central Luzon State University
3120 Science City of Muñoz, Nueva Ecija, Philippines
Email: mamilagroso@clsu.edu.ph

1. INTRODUCTION

Higher education websites serve not only as informational gateways but also as essential platforms for user interaction and engagement [1]. Despite their critical role, these platforms often exhibit inherent design flaws that can impact user experience (UX) differently across genders [2]. Common issues such as complex navigation [3], inconsistent interfaces, and lack of personalized support not only impair usability [4], [5] but particularly disadvantage users who are less technologically proficient or access the web in varied contexts. This highlights the pressing need for technology in higher education to foster inclusive learning environments [6].

Recent studies highlight the significance of gender-inclusive software design, demonstrating how gender biases in digital interfaces can drastically affect user engagement and satisfaction [7], [8]. However, the integration of these gender-inclusive principles in higher education websites, where usability is crucial,

remains inconsistently applied [2]. The slow adoption of these necessary changes reveals a substantial gap in ensuring that higher education websites are truly inclusive [8], [9]. Moreover, most existing research lacks a combination of qualitative insights from cognitive walkthroughs and quantitative user data, crucial for a comprehensive understanding of usability issues and their implications for gender inclusivity [10].

Addressing this gap, this study employs the gender inclusiveness magnifier (GenderMag) toolkit [2] to not only theorize but actively apply and assess gender-inclusive design principles within dynamic educational environments. By integrating a mixed-methods approach, the research innovatively adapts GenderMag cognitive facets into usability factors, enhancing the analysis of how design impacts users across genders. This adaptation improves the understanding of gender-specific needs in website usability and uncovers design issues that can promote equitable access.

2. METHOD

This study employs the GenderMag method, as outlined in Figure 1, to assess the website's gender inclusivity, focusing on five key cognitive facets: motivation, information processing, self-efficacy, risk aversion, and learning style-that operationalize research into actionable strategies [8]. Utilizing two personas from the GenderMag toolkit [11], 'Abi' and 'Tim', the researchers conducted cognitive walkthrough to initially identify usability issues. To rigorously validate these issues, a quasi-experimental approach [12] is integrated, where qualitative insights from the cognitive walkthrough are systematically corroborated with quantitative data collected from real users through an online questionnaire.

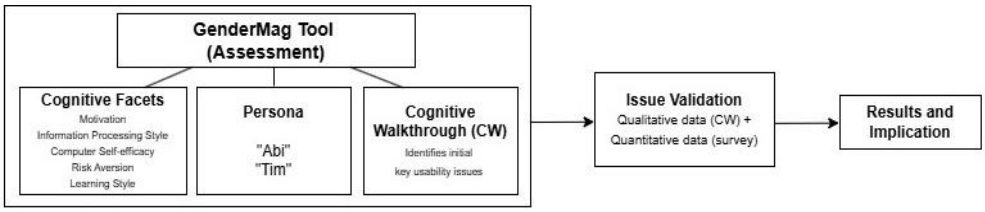
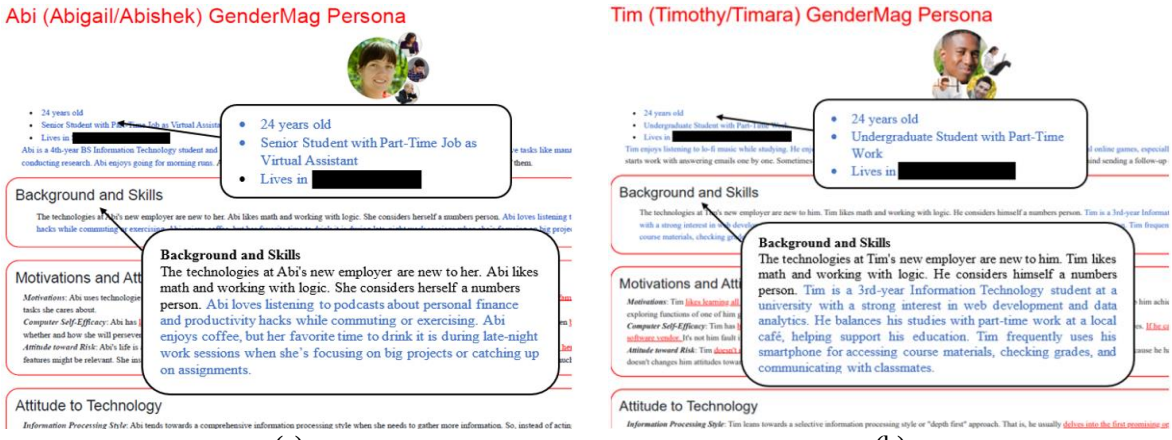


Figure 1. GenderMag assessment methodological framework

2.1. GenderMag persona

In this study, the researchers introduced two carefully crafted personas, as illustrated in Figure 2. Figure 2(a) presents 'Abi', representing female participants, while Figure 2(b) shows 'Tim', representing male participants. These personas reflect cognitive traits commonly associated with gender differences, as highlighted in prior research [8]. Each persona's characteristics were specifically designed to align with the needs and experiences of the target users [11].



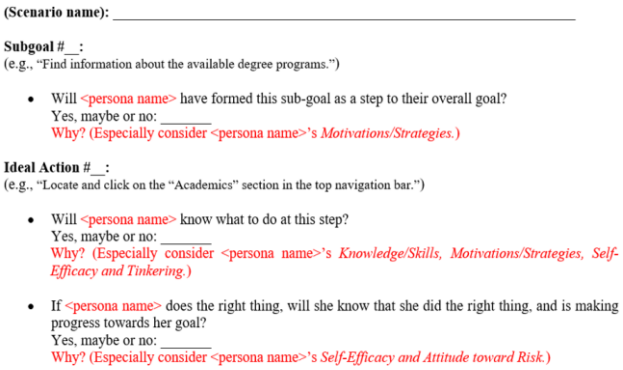
(a) (b)

Figure 2. GenderMag persona includes black text for fixed characteristics and blue text for customizable attributes (a) Abi and (b) Tim

Abi, a female in her early 20s, was depicted as having a basic understanding of technology, whereas Tim, a male also in his early 20s, was characterized as more tech-savvy and enthusiastic about technology. By tailoring their backgrounds, age, location, hobbies, and daily routines, this approach offered a glimpse into how various users might interact with the higher education website.

2.2. Cognitive walkthrough

This study addresses website usability issues through a gender-specialized cognitive walkthrough using modified GenderMag personas – Abi and Tim [7]. The participants, including faculty teaching HCI, software developers, and HCI students, engage in the walkthrough. Roles are clearly defined: a facilitator leads and evaluates, a recorder documents feedback, and a driver navigates the use case on a shared computer [2]. The participants carried out these walkthroughs by executing representative tasks that simulate real user interactions. A particularly focused scenario was the task to "find detailed information about available degree programs on the website". This goal was methodically divided into two subgoals, each of which was further broken down into actionable steps. Sub goal #1 was to locate the "academics" or "program" section on the homepage, and sub goal # 2 was to access and review specific details about a degree program. Each subgoal was achieved through specific steps and actions detailed in the cognitive walkthrough template as shown in Figure 3 [13], highlighting key GenderMag features in red for clarity. The form documents the features that raised concerns, the reasons behind these issues (through free-form explanations), and the specific aspects that render them issues of gender inclusiveness (by enumerating the relevant facets) [14].



(Scenario name): _____

Subgoal #__:
(e.g., "Find information about the available degree programs.")

- Will <persona name> have formed this sub-goal as a step to their overall goal?
  Yes, maybe or no: _____
  Why? (Especially consider <persona name>'s *Motivations/Strategies.*)

Ideal Action #__:
(e.g., "Locate and click on the "Academics" section in the top navigation bar.")

- Will <persona name> know what to do at this step?
  Yes, maybe or no: _____
  Why? (Especially consider <persona name>'s *Knowledge/Skills, Motivations/Strategies, Self-Efficacy and Tinkering.*)
- If <persona name> does the right thing, will she know that she did the right thing, and is making progress towards her goal?
  Yes, maybe or no: _____
  Why? (Especially consider <persona name>'s *Self-Efficacy and Attitude toward Risk.*)

Figure 3. Cognitive walkthrough template for GenderMag analysis of the website

After the 3.5-hour session, researchers identified inclusivity bugs by reviewing issues linked directly to each persona. An issue was marked as an inclusivity bug if it matched at least one cognitive facet value from the persona used [15]. Findings from this session were then used to develop relevant survey questions.

2.3. Survey question creation and respondent selection

From the identified key inclusivity bugs in the cognitive walkthrough, survey questions were crafted to assess how well the website meets the specific needs of both genders. These questions were informed by GenderMag cognitive facets [7] – motivation, information processing, self-efficacy, risk aversion, and learning style – and key usability factors such as effectiveness [16], efficiency [17], satisfaction [16], learnability [16], responsiveness [18], accessibility [17], navigation [19], user control and freedom [20], help and support [21], and engagement [22], resulting in 35 survey questions.

To effectively assess the website's usability on a broader scale, the researchers selected 200 respondents, evenly divided between 100 males (persona "Tim") and 100 females (persona "Abi"), consisting of faculty and upper-year BS in information technology students. These participants completed the survey using a 3-point Likert scale (1-agree, 2-neutral, 3-disagree).

2.4. Statistical data analysis

The study employed an independent t-test to analyze the differences in website usability experiences between male and female respondents, pinpointing gender-based disparities crucial for crafting more accessible and inclusive web designs [23]. This analysis highlights the importance of considering gender in usability evaluations, as supported by prior research [24]. The independent variable in the study is gender, while the dependent variables are the user experience scores across each GenderMag cognitive facet [7], which correspond to key usability factors. This approach sheds light on how different genders interact with the website, providing essential insights for enhancing the inclusivity of the online environment.

3. RESULTS AND DISCUSSION

This section presents the research findings, detailing the outcomes of the cognitive walkthrough (subsection 3.1), analyzing user demographics (subsection 3.2), and examining the impact of cognitive facets on personas (subsection 3.3).

3.1. Cognitive walkthrough outcomes

This section presents the results of the cognitive walkthrough sessions and explains how these insights informed the development of survey questions.

3.1.1. Website's bias findings

Table 1 presents inclusivity bugs found during the cognitive walkthrough sessions, showing their impact on the personas "Abi" and "Tim" and linking them to specific GenderMag cognitive facets. The impact severity for each persona was estimated based on the inclusivity bugs discovered (i.e., the count of "steps" with either a "maybe" or "no" response) associated with each facet. Abi encountered significant difficulty with scattered resources, limited course information accessibility, and insufficient guidance – issues particularly challenging for users needing structured, supportive designs. Tim, on the other hand, struggled more with missing search features and slow page loads, reflecting his preference for quick and direct navigation. These results confirm that gendered personas effectively reveal distinct usability issues, aligning with prior research [25]. In addition, the results highlight that most usability issues primarily affected Abi, although Tim also encountered certain problems, since issues tied to specific cognitive facets disproportionately impact users who strongly exhibit those facets [8].

Table 1. Key inclusivity bugs derived from cognitive walkthrough sessions

Summary of key inclusivity bugs identified	Persona impact severity		Facets that found *
	Abi	Tim	
Scattered resources	High	Low	IP, LS, SE
Course information accessibility	High	Medium	M, IP, LS
Guidance for new users	High	Low	LS, M, RA, SE
Menu grouping	High	Low	IP, LS
Missing search functionality	Medium	High	SE, IP, M
Long loading times on certain pages	Medium	High	M, RA, IP

* Information processing style (IP); learning style (LS); computer self-efficacy (SE); motivation (M); risk aversion (RA)

3.1.2. Survey question development from inclusivity bugs and usability factors

From the identified inclusivity bugs, the researchers created targeted survey questions for a broader audience. Recent literature [26] confirms that incorporating cognitive facets into survey items effectively captures the real users' facet values. Figure 4 illustrates how survey questions align with cognitive facets. "Learning Style" is the most prominent facet (25.7%), reflecting its high impact on Abi and lower-to-medium impact on Tim, as identified in Table 1. "Motivation" and "Information Processing Style" each account for 22.9%, significantly affecting both personas. These facets clearly connect to critical usability issues such as scattered resources, course information accessibility, and menu organization. "Risk Aversion" and "Computer Self-efficacy" have the lowest shares, indicating fewer associated survey items.

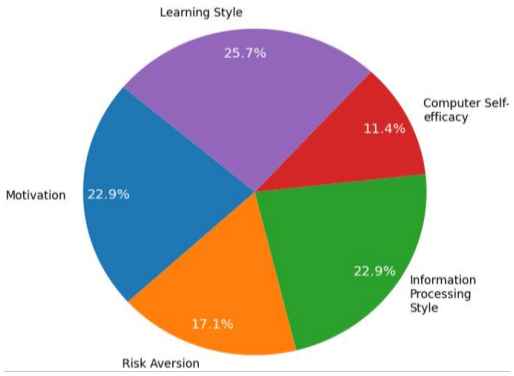


Figure 4. Distribution of survey questions by cognitive facets

Integrating cognitive facets into the survey questions as shown in Figure 4 highlights critical usability concerns identified during the walkthrough. Figure 5, a heatmap, further illustrates how these cognitive facets directly connect with specific usability factors, emphasizing that evaluating usability through cognitive dimensions effectively identifies which design aspects most influence user interactions [27], [28]. This heatmap illustrates how frequently each GenderMag cognitive facet aligns with specific usability factors. "Learning Style" strongly influences the usability factor "Help and Support," as indicated by the darkest color (value 3.0), emphasizing the need for structured guidance. Other facets, including "Motivation," "Information Processing Style," and "Computer Self-efficacy," connect consistently but less intensely (rated at 1.0) across multiple usability factors. This visual representation clearly highlights which cognitive facets have the strongest impact on usability, providing targeted areas for design improvement. This suggests that usability needs can vary significantly based on user characteristics, an insight echoed in recent studies [29], [30].

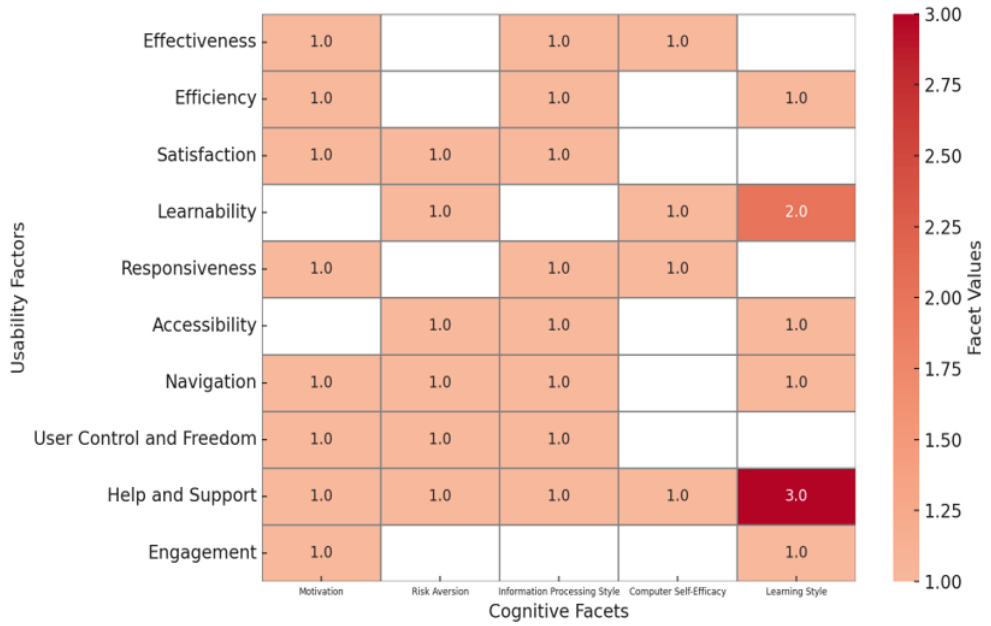


Figure 5. Heatmap of cognitive facets frequency across usability factors

3.2. User demographics

The study involved 200 respondents, evenly split into 100 males (represented by persona 'Tim') and 100 females (persona 'Abi'). Most respondents (91.5%) were aged 18-24. The majority (68%) had used the website for 1-3 years, while others had less than a year (15.5%) or 4-5 years (16.5%) of experience. Smartphones (91%) were the most common devices used, with laptops (70%), desktops (18%), and tablets (7%) also noted. Most respondents accessed the site from home (78%), through mobile data (76%), or the university network (73%). Regarding technology skills, 74.5% rated themselves intermediate, 18.5% advanced, and 7% beginner.

3.3. Facets impact on persona

The researchers assess the impact of each GenderMag cognitive facet on personas Abi (representative of female users) and Tim (male users), highlighting key differences in their usability experiences. The analysis uses statistical comparisons to reveal which cognitive facets significantly influence each persona's interaction with the website. Table 2 compares mean scores of GenderMag cognitive facets between personas Abi and Tim, including standard deviations, t-statistics, and p-values. Most facets (motivation, risk aversion, computer self-efficacy, learning style) showed no significant differences ($p>0.05$). However, information processing style differed significantly ($p=0.0003$), clearly highlighting how Abi and Tim process information differently. This finding is crucial because recognizing these cognitive distinctions allows designers to better structure website content, ensuring improved usability, inclusivity, and engagement for users with diverse information-processing preferences.

Table 2. Comparison of GenderMag cognitive facets between personas: mean, standard deviation, t-statistic, and p-value analysis

Facet		Persona		T-statistic	P-value
		Abi	Tim		
Motivation	Mean	1.2600	1.3250	1.5690	0.1184
	Standard deviation	0.2460	0.3333		
Risk aversion	Mean	1.5383	1.5183	-0.4534	0.6508
	Standard deviation	0.3069	0.3168		
Information processing style	Mean	1.6063	1.4575	-3.6554	0.0003
	Standard deviation	0.2720	0.3027		
Computer self-efficacy	Mean	1.6400	1.6600	0.3240	0.7463
	Standard deviation	0.4637	0. 4075		
Learning style	Mean	1.3800	1.4022	0.4647	0.6427
	Standard deviation	0.3175	0.3576		

Histograms in Figure 6 reveal distinct gender differences across cognitive facets, impacting website interactions. Figure 6(a) illustrates that both groups cluster around moderate scores (1.5 to 2.0), indicating generally moderate confidence when interacting with the website. However, males display slightly more variability, with some users showing notably lower motivation scores compared to females. While existing research [8] suggests that females are typically more task-oriented and males engage more through curiosity or enjoyment, this research finding indicate that in an academic website context, males exhibit greater variability in motivation, suggesting that their engagement may depend more on external incentives, while females remain consistently task-driven.

Figure 6(b) shows males maintaining a consistent and moderate level of risk aversion (1.4 to 1.8), indicating steady caution in their website interactions. Females, however, display a wider range of behaviors – some remain highly cautious, while others are more inclined to explore new features. This observation does not contradict existing literature [31], which generally identifies females as more risk-averse; instead, it enriches these findings by highlighting that female risk-taking varies significantly within digital contexts. Designers should, therefore, provide flexible interfaces that combine supportive guidance for cautious users and exploratory opportunities for more risk-tolerant individuals.

Notably, Figure 6(c) clearly illustrates significant gender differences in information processing style. Females show a narrower and more concentrated distribution around moderate-to-high scores, indicating a preference for structured and systematic ways of accessing information – this aligns with the recent findings [26] that females often engage more thoroughly with digital content. In contrast, males display a wide range of preferences, from structured to more flexible or exploratory styles, as evidenced in the previous research findings [32]. This distinction is important because it suggests that website designs should accommodate both structured navigation for users who prefer clarity and organization, and adaptable features for those who favor flexibility and exploration. Integrating both approaches can help cater to the diverse cognitive styles, thereby enhancing the overall user experience on digital platforms.

Figure 6(d) highlights differences in computer self-efficacy between genders. Most respondents from both groups cluster around moderate scores (1.5 to 2.0), indicating generally moderate confidence when interacting with the website. Though, females show varied confidence levels, suggesting some may require additional support when using the website, while males generally exhibit higher confidence in navigating new technologies – this aligns to existing studies [31], [33]. Recognizing these differences helps designers create supportive and inclusive features tailored to varying technological abilities, improving usability for all users.

Finally, Figure 6(e) demonstrates gender differences in learning style scores. Both males and females tend to cluster around lower scores (1.0–1.5), indicating a general preference for structured, step-by-step guidance when using the website. However, females display a slightly more concentrated pattern at lower scores, reinforcing their stronger preference for structured and systematic learning support compared to males, this supports the claims from the previous studies [15], [31], [34]. This implies that designing clear and organized support resources can significantly enhance the usability for both groups, particularly benefiting users who heavily rely on structured information.

The results highlight the importance of gender-inclusive design on higher education websites, emphasizing improved usability for diverse users. The GenderMag method effectively identified inclusivity bugs by aligning cognitive facets with specific usability factors. Combining qualitative cognitive walkthrough insights with quantitative survey data using a mixed-methods approach strengthened the findings. Integrating usability factors with GenderMag's cognitive facets also provided practical strategies to address user differences, particularly those related to information processing style, preventing potential navigation barriers.

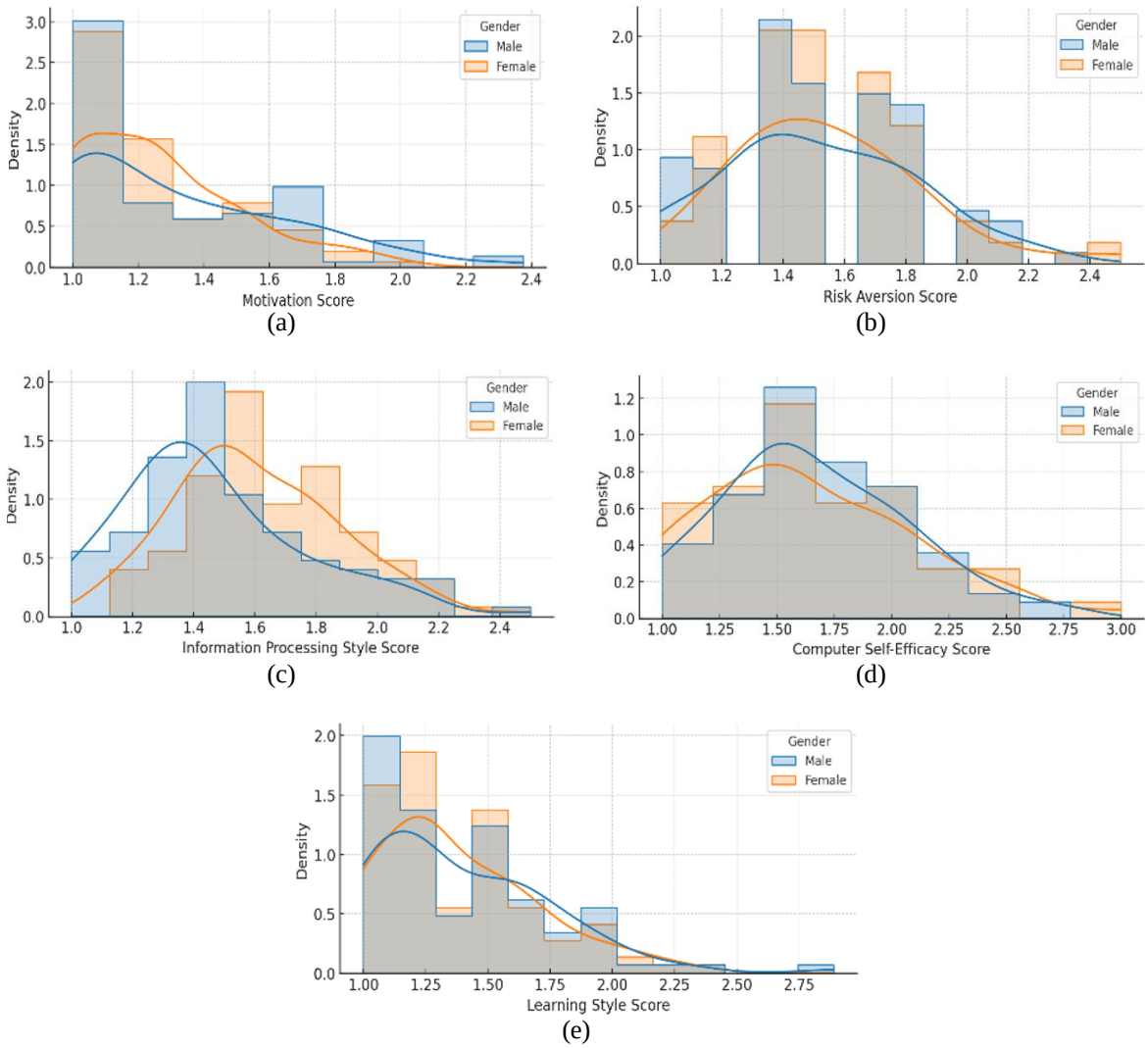


Figure 6. Histograms of individual facet scores by gender; (a) motivation, (b) risk aversion, (c) information processing style, (d) computer self-efficacy, and (e) learning style

4. CONCLUSION

This study brings attention to the importance of gender-inclusive design in enhancing the usability of higher education websites, particularly addressing differences in users' cognitive preferences. Using the GenderMag method, the researchers identified key areas needing improvements, notably content organization and clear navigation, to support diverse cognitive styles effectively. These insights can guide higher education institutions in optimizing their digital platforms, promoting more inclusive and equitable user experiences. Future research can further apply GenderMag to other digital platforms, expanding insights on gender-sensitive design and supporting diverse user interactions.

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AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Maria Isabel Milagroso Santos	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Thelma Domingo Palaoag	✓	✓		✓	✓				✓	✓	✓	✓	✓	
Anazel Patricio Gamilla		✓	✓	✓		✓			✓	✓	✓			

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, M.I.M.S. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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BIOGRAPHIES OF AUTHORS

Maria Isabel Milagroso Santos is an Assistant Professor at the Department of Information Technology, College of Engineering, Central Luzon State University in the Science City of Munoz, Nueva Ecija, Philippines. She holds a Master in information technology from Tarlac State University, Tarlac City, Philippines, and is currently pursuing a Doctor in information technology at the University of the Cordilleras, Baguio City, Philippines. Her expertise spans computer programming, web application development, systems analysis and design, and human-computer interaction. Her research focuses on the application of IT to high-value crops in agriculture, environmental and biodiversity studies, and the promotion of gender inclusivity in software. She can be contacted at email: mamilagroso@clsu.edu.ph.

Thelma Domingo Palaoag is the Graduate Program Coordinator of the College of Information Technology and Computer Science at the University of the Cordilleras. She is also the Director of the UC Innovation and Graduate Program Coordinator of the College of Information Technology and Computer Science Technology Transfer Office. She is passionate about writing and publishing researches in various disciplines. Her research interests focus on game-based learning, e-learning, machine learning, data analytics, intelligent systems, and artificial intelligence. Her involvement and exposure to various research projects and publication make her a notable academic researcher. She can be contacted at email: tdpalaoag@uc-bcf.edu.ph.

Anazel Patricio Gamilla holds a Master's degree in Information Technology (MIT) from Tarlac State University (TSU), Philippines. An Instructor of the Information Technology Department, College of Engineering, former Chief of Management Information Systems Office at Central Luzon State University (CLSU) and a Department of Information Technology and Communications Technology (DICT-ILCDB) trainer. Her current research interests include computer networks, SDN, and cyber security. She can be contacted at email: apgamilla@clsu.edu.ph.