

Insertion of HCI Practices in a Usability Engineering Course

Luiz Felipe Cirqueira dos Santos¹^a, Mariano Florencio Mendonça¹^b, Edmir Queiroz²^c,
Elisrenan Barbosa da Silva²^d, Shexmo Richarlison Ribeiro dos Santos¹^e,
Marcus Vinicius Santana Silva¹^f, Alberto Luciano de Souza Bastos¹^g,
Marcos Cesar Barbosa dos Santos¹^h, Marcos Venicius Santos¹ⁱ and
Marckson Fábio da Silva Santos¹^j

¹Federal University of Sergipe, São Cristóvão, Sergipe, Brazil

²IT Courses, Estacio University Center, R. Teixeira de Freitas, Salgado Filho, 10, Aracaju, Brazil

Keywords: Human-Computer Interaction, Usability Engineering, Flipped Classroom, User Experience, HCI Education.

Abstract: Including Human-Computer Interaction (HCI) practices is crucial for preparing future professionals to design systems that effectively meet users' needs. HCI encompasses methods and techniques to improve interactive systems' usability, user experience, and effectiveness. This article presents an experience report on teaching HCI techniques to a Usability Engineering class using the Flipped Classroom methodology. Through these techniques, it was possible to explore practically and offer a critical and analytical perspective on developing practical, efficient, and satisfactory user interfaces.

1 INTRODUCTION

Usability is an essential attribute of software quality, crucial for accepting interactive systems, especially on the web (Hitz et al., 2006). In Human-Computer Interaction (HCI), usability combines user experience with technology, hardware efficiency, task nature, and the environment in which the task is performed (Schneider, 2008). The perspective of software designers regarding the problem to be modeled often differs from the user's perspective on the solution to the same problem, which can hinder the interaction between the user and the system interface (Schneider, 2008).

Recent studies emphasize that Human-Computer

Interaction (HCI) practices must evolve to include contemporary approaches that reflect technological advancements and changes in user behavior (Padua, 2019; Jacko, 2012; Stephanidis et al., 2019).

HCI educators must be aware of their role in conveying that user experience and experience design are cross-cutting concepts that should influence all other areas involved in designing and developing innovative digital products and services (Barbosa et al., 2014).

The HCI community has undertaken various initiatives to address this challenge. There are examples of such initiatives in Boscaroli et al. (Boscaroli et al., 2013; Boscaroli et al., 2014b; Boscaroli et al., 2014a). However, when considering the constant evolution of technology and the different interaction forms it enables, reflecting more deeply on all significant HCI challenges for the 2012-2022 period (Pereira et al., 2024), one can identify a considerable challenge in HCI education: preparing students to balance research and practice in HCI, integrating accessibility, human values, and digital inclusion into the development of innovative and ethical solutions for smart and sustainable cities (Barbosa et al., 2014).

Given this complexity, Usability Engineering emerges as a fundamental approach for developing computational interfaces, aiming to promote ease of

^a <https://orcid.org/0000-0003-4538-5410>

^b <https://orcid.org/0000-0003-0732-3980>

^c <https://orcid.org/0009-0004-6930-3031>

^d <https://orcid.org/0000-0001-8890-9718>

^e <https://orcid.org/0000-0003-0287-8055>

^f <https://orcid.org/0009-0000-9211-5259>

^g <https://orcid.org/0009-0002-3911-9757>

^h <https://orcid.org/0000-0002-7929-3904>

ⁱ <https://orcid.org/0009-0006-1645-6127>

^j <https://orcid.org/0009-0001-6479-1900>

use, learning, and user satisfaction when interacting with system interfaces (Vieira and Baranauskas, 2003). Furthermore, Usability Engineering seeks to align the mental model of the developer or designer with the user's mental model, thus reducing vision conflicts and facilitating more intuitive and efficient interaction (Schneider, 2008).

This article reports on teaching usability evaluation techniques in HCI within the Usability Engineering course. Heuristic evaluation, interaction testing, and checklist-based interface inspection covered the methods covered. These techniques were used during the 2024/1 semester in live remote classes on Microsoft Teams. The adoption of usability practices in HCI provided an opportunity to teach and prepare students to explore and apply evaluation techniques, encouraging a critical and analytical approach to designing interfaces that enhance effectiveness, efficiency, and user satisfaction.

2 EXPERIENCE REPORT

This section presents an experience report describing the application of usability evaluation techniques in the Usability Engineering course during the 2024/1 semester for students from various technology programs. The course delivered remotely via Microsoft Teams, employed the Flipped Classroom methodology to teach ergonomics, usability, and human-computer interaction principles. The focus was on interface evaluation, including techniques such as heuristic evaluation, checklist inspection, and interaction tests, with practical activities documented by the students.

2.1 The Usability Engineering Course

The course focuses on information presentation and user interaction principles, covering interaction, interface, ergonomics, usability, and HCI in software development. It emphasizes applying ergonomics and usability to ensure tasks are performed effectively, efficiently, and satisfactorily, considering users' capabilities and limitations. The course also explores creating scenarios, personas, and conceptual models, using design and modeling techniques to enhance user communication. It includes evaluating interface projects based on user needs and goals, aiming for high-quality, usable designs. Additionally, it promotes the development of accessible web solutions for people with disabilities, ensuring flexible and widely usable interfaces. Table 1 summarizes the topics covered.

Table 1: Human-Computer Interaction Topics.

Content
Ergonomics in Human-Computer Interaction
Human-Computer Interface Development
Human-Computer Interface Evaluation
Web Accessibility

2.2 Context and Class Profile

This experience report refers to the 2024/1 semester of a live remote Usability Engineering course delivered via Microsoft Teams. The class included 26 undergraduate students from various computing-related programs: 12 from Systems Analysis and Development, nine from Software Engineering, two from Information Systems, and three from Computer Science. The students ranged from 18 to 45 years old, representing a diverse cohort regarding academic maturity and prior experience. Most students were in their 3rd or 4th semester, with varying levels of familiarity with HCI concepts.

2.3 Teaching Usability Evaluation Techniques in the Usability Engineering Course

The content on usability evaluation techniques was addressed in Topic 3 of the course syllabus, which focuses on human-computer interface evaluation. This content initially requires theoretical knowledge of the methods to enable their practical application during assessments. Thus, it was necessary to provide students with adequate resources to acquire the foundational theoretical knowledge before applying the usability evaluation techniques outlined in the syllabus.

The Flipped Classroom (FC) methodology was utilized even in the live remote model. This methodology proposes a shift from the traditional teaching paradigm, allowing students to access theoretical content at home through materials provided by the instructor. During live classes, students practice what they have learned, participating in practical activities led by the instructor (Silveira et al., 2018). The FC model makes classes more productive, transforming the instructor from a content expositor to a learning process mediator. Classes become more practical, featuring significant activities such as discussions, problem-solving, and debates (Martins and Villega, 2021).

Table 2 describes the practical activities related to each technique applied during the learning of usability evaluation in HCI. Students completed three practical assignments, documenting and applying the con-

cepts studied while accessing theoretical content.

Table 2: Evaluation and Practical Activity.

Evaluation	Practical Activity
Heuristic Evaluation of Human-Computer Interfaces	Choose an application and conduct a usability evaluation using Nielsen's heuristics
Inspection Evaluation Using a Human-Computer Interface Checklist	Four teams of five and one team of six students chose a prototype and evaluated its usability using a checklist
Interaction Testing of Human-Computer Interfaces	The same groups selected some applications among themselves and, through interface interaction, reported usability improvement points

2.4 Assessment and Evaluation Criteria

Students were evaluated by completing three practical assignments on usability evaluation techniques: heuristic evaluation, checklist-based inspection, and interaction testing. Each activity had defined objectives and a corresponding evaluation rubric. The criteria included: (1) correct application of the technique, (2) clarity and depth in reporting usability issues, (3) appropriateness of suggested improvements, and (4) teamwork and collaboration. While no summative grade was assigned, qualitative feedback was provided to each group. Future course iterations will incorporate pre- and post-intervention surveys to assess learning gains and gather student perspectives.

3 RESULTS AND DISCUSSION

It was observed that, through these activities, the Usability Engineering students could gain a practical and in-depth understanding of usability principles and Nielsen's heuristics (Nielsen, 2005). By evaluating different applications, students learned to identify common usability issues and recommend implementing effective solutions, thereby improving user-system interaction. The analysis using checklists al-

lowed students to acquire critical skills in the structured evaluation of interfaces, fostering a detailed and analytical perspective.

Direct interaction with applications and the subsequent reporting of improvement points allowed students to experience usability in practice, understanding design elements and how their variations influence user-system interaction. This collaborative evaluation exercise also encouraged teamwork and fostered effective student communication. Across all these activities, students were able to build a solid foundation of knowledge and practical skills, preparing them for future challenges in the usability and interface design domains.

Table 3 shows the number of assignments submitted, highlighting students' progress in identifying usability issues and proposing improvements based on principles like Nielsen's heuristics (Nielsen, 2005), fostering a critical and analytical perspective. The Accessibility assignment raised awareness of inclusion issues, addressing the needs of users with diverse abilities and promoting digital equity. The Design Processes in HCI assignments provided insights into the user-centered development cycle, encouraging creativity and methodology application for innovative solutions. These assignments equipped students with technical, ethical, and collaborative skills to tackle real-world challenges.

Table 3: Completed Assignments and Quantities.

Assignment	Quantity
Heuristic Evaluation	10
Accessibility	6
Design Processes in HCI	18

4 CONCLUSION AND FUTURE WORK

Adopting the Flipped Classroom in teaching HCI proved to be a practical approach to engage students and promote critical skills in the field of usability. The experience described in this paper reinforces the importance of aligning pedagogical practices with contemporary guidelines, contributing to the development of well-trained professionals who are sensitive to users' needs.

The analysis of student submissions, as shown in Table 3, highlights significant engagement with the Usability Engineering course practices. The 18 submissions on Design Processes in HCI demonstrate a strong interest in creative and complex tasks. The 10 Heuristic Evaluation submissions show that students

developed critical skills in identifying usability issues and proposing solutions. The six submissions on Accessibility mark an essential step in raising awareness of digital inclusion, though further reinforcement is needed to boost engagement. Overall, the methodology sparked student interest and promoted a diverse education that was aligned to prepare reflective and efficient professionals for the job market.

Future work includes adopting complementary approaches to expand the scope of pedagogical practices. One approach is **participatory design**, which engages students in developing solutions with real users, fostering a deeper understanding of the target audience's needs. Additionally, a greater focus on **accessibility** is proposed, aiming for more thorough evaluations of interfaces to promote digital inclusion and accommodate users with diverse abilities. Finally, **longitudinal studies** are recommended to assess the long-term impact of the methodology on professional training, providing a broader view of teaching effectiveness in terms of skills and competencies developed.

REFERENCES

- Barbosa, S. D., Bim, S. A., Boscarioli, C., and Silveira, M. S. (2014). Desafios do ensinar para enfrentar os desafios de ihc. *Anais do XIII Simpósio Brasileiro sobre Fatores Humanos em Sistemas Computacionais, 2014, Brasil*.
- Boscarioli, C., Bim, S. A., Silveira, M. S., Prates, R. O., and Barbosa, S. D. J. (2013). Hci education in brazil: challenges and opportunities. In *Human-Computer Interaction. Human-Centred Design Approaches, Methods, Tools, and Environments: 15th International Conference, HCI International 2013, Las Vegas, NV, USA, July 21-26, 2013, Proceedings, Part I 15*, pages 3–12. Springer.
- Boscarioli, C., Silveira, M., Prates, R., Bim, S., and Barbosa, S. (2014a). Currículos de ihc no brasil: panorama atual e perspectivas. In *Workshop sobre Educação em Computação (WEI)*, pages 40–49. SBC.
- Boscarioli, C., Silveira, M. S., Prates, R. O., Bim, S. A., and Barbosa, S. D. J. (2014b). Charting the landscape of hci education in brazil. In *Human-Computer Interaction. Theories, Methods, and Tools: 16th International Conference, HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014, Proceedings, Part I 16*, pages 177–186. Springer.
- Hitz, M., Leitner, G., and Melcher, R. (2006). Usability of web applications. *Web engineering: The discipline of systematic development of web applications*.
- Jacko, J. A. (2012). Human computer interaction handbook: Fundamentals, evolving technologies, and emerging applications.
- Martins, D. S. and Villela, M. L. B. (2021). Panorama do ensino de ihc no brasil: uma análise dos anais do weihc de 2016 a 2020. In *Anais Estendidos do XX Simpósio Brasileiro de Fatores Humanos em Sistemas Computacionais*, pages 79–84. SBC.
- Nielsen, J. (2005). Ten usability heuristics.
- Padua, M. C. (2019). Design da informação e interação: compartilhamento de informações em ambientes digitais de museus.
- Pereira, R., Darin, T., and Silveira, M. S. (2024). Reflexões da comunidade brasileira de ihc. *Anais Estendidos do XXIII Simpósio Brasileiro de Fatores Humanos em Sistemas Computacionais*.
- Schneider, H. N. (2008). Interface de software educacional: a questão da usabilidade. *CRUZ, MHS Pluralidade dos saberes e territórios de pesquisa em educação sob múltiplos olhares dos sujeitos investigadores. Araçaju: Editora UFS*, pages 199–231.
- Silveira, S. R., Pereira, A. S., Bertolini, C., Parreira, F., and Bigolin, N. (2018). Educação a distância, sala de aula invertida e aprendizagem baseada em problemas: possibilidades para o ensino de programação de computadores. In *Anais dos Workshops do Congresso Brasileiro de Informática na Educação*, volume 7, page 1052.
- Stephanidis, C., Salvendy, G., Antona, M., Chen, J. Y., Dong, J., Duffy, V. G., Fang, X., Fidopiastis, C., Fragomeni, G., Fu, L. P., et al. (2019). Seven hci grand challenges. *International Journal of Human-Computer Interaction*, 35(14):1229–1269.
- Vieira, H. and Baranauskas, M. C. C. (2003). Design e avaliação de interfaces humano-computador. *Campinas: Unicamp*.