APPROPRIATING DIGITAL COLLABORATION TOOLS FOR USABILITY EDUCATION AND RESEARCH

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Abstract. This paper investigates the appropriation of multi-user digital collaboration tools for use in an HCI-related educational context. Specifically, we assess the suitability of three specific tools for in-class heuristic evaluations in a small-scale study over two consecutive semesters. The goal of the in-class activity was not only to experience a heuristic evaluation first-hand, but also to foster active collaboration between participants and facilitate reflection about the process. Based on the results, we identify requirements for key functionalities of digital tools to support such group-based heuristic evaluation settings.

Keywords: usability education, heuristic evaluation, digital collaboration tools

1 INTRODUCTION

Even before the pandemic, digital collaboration tools such as *Miro* [9] and *Mural* [10] were actively used in research and educational contexts to facilitate the collaborative development of ideas [5][6][8]. The simplicity and convenience of creating, sharing and structuring ideas on a virtual whiteboard has attracted millions of active users, and the functionality of these tools continues to grow. The additional benefit that these applications can typically be utilized without the necessity of even installing them, using virtually any browser, makes them particularly popular amongst students, instructors, and researchers alike. Despite these advantages, such tools are not entirely suited for every purpose. As the number of users and amount of content increases, for example, the more unwieldy they typically become. While they may technically be able to support one hundred or more simultaneous participants in an individual session, it becomes significantly more challenging to maintain productive collaboration between so many active users. This shortcoming was one of the main motivations to develop our own collaborative brainstorming tool that aims to support the facilitation of collaboration sessions with a large number of participants. The resulting web-based system, *Spacehuddle* [14], provides moderators of such creative workflows with several customisable modules that enable the collection, structuring and evaluation of ideas from a scalable number of users, in addition to visualising these processes on a shared public screen.

Scalability is nonetheless not the only factor to consider. Although digital collaboration tools typically offer a fairly wide range of functions and templates [2][13], they were simply not designed for specific research-related activities, such as heuristic evaluations. On the surface, this may not seem a significant issue, as there are a number of custom tools for heuristic evaluations, and many experts already have their own preferred workflows and toolsets for conducting their evaluations [1], one common approach including the use of modern multipurpose software such as spreadsheets. However, in the context of a university HCI course, with limited class time and a large number of aspiring engineers, designers and researchers, finding a suitable collaboration tool remains a challenge [3][7].

This paper addresses the requirements of multi-user digital collaboration tools for use in an HCI-related educational context. Specifically, we investigate the suitability of three digital collaboration applications for in-class heuristic evaluations. The goal of this class activity was not only to experience a heuristic evaluation first-hand, but also to promote active collaboration between participants and facilitate reflection about the process. A small-scale study was performed over two consecutive semesters and serves as the basis for our analysis.

2 METHODOLOGY

Addressing the requirements of a multi-user digital collaboration tool for use in an HCI-related educational context, the digital collaboration applications *Excel 365* [4], *Miro* [9], and *Spacehuddle* [14] were each utilized as the main tool for a series of in-class, group-based heuristic evaluations. *Excel* and *Miro* were chosen due to their general popularity and frequent use in university settings, but also because they utilize two distinct approaches of structuring information (table vs. canvas). Both tools are also fairly representative, in terms of general functionality, for a variety of other spreadsheet and whiteboard applications. The third application, *Spacehuddle*, is currently in development as a scalable brainstorming tool and its general performance in this setting was one of the motivations for the study. The evaluation subject was the beta version of the Austrian Federal Railways (ÖBB) web app [12]. The evaluation was performed in a between-subjects study design over two consecutive semesters, with a total of six groups of 16 to 23 undergraduate students each (N = 97).

Prior to the evaluation, students attended a series of theoretical lectures over the course of several weeks, where they were introduced to basics of usability, the concept of heuristic evaluation, and underlying heuristics [11]. For each group, two students volunteered to take on the role of moderators guiding the group-based discussion and prioritization of identified usability issues, while the remaining students took on the role of evaluators identifying usability issues. This allowed us to understand which factors are important for support of group-based heuristic evaluation both from a content creation and content structuring perspective. The evaluation took place in-class and lasted approximately two hours per group. The workflow followed a common heuristic evaluation structure starting with (1) evaluators individually inspecting the user interface and collecting usability issues, followed up by (2) collective discussion and consolidation of the issues, and finally (3) rating of issues by severity and compilation into a prioritized list. After the evaluation, separate questionnaires were completed by moderators and participants, in which they were asked to indicate their familiarity with the digital tool, how helpful they perceived it for the evaluation process on a 6-point Likert scale, and provide comments on the perceived benefits and drawbacks. The responses were combined with content analysis and observation data from each session.

3 RESULTS

Analysis of the questionnaire results (see Table 1–2) revealed that, despite being the most familiar tool for both moderators and participants, *Excel 365* was actually rated the least suitable for this task (*M* = 3.93, *SD* = 1.37). *Miro*, with its infinite canvas style whiteboard concept, received the best ratings overall (*M* = 4.29, *SD* = 1.30), but with two major caveats: moderators had difficulty managing the ideas of all participants and rating them in a collaborative setting. These two aspects were perhaps the strongest features for *Spacehuddle* (*M* = 4.42, *SD* = 1.35), employing a column-based layout structure, which was generally well-received despite some limitations (due to its active development status).

For *Excel 365* (see Figure 1), the most cited advantages included ease of navigation and overall handling due to students' familiarity with the tool. Further advantages that were mentioned included the possibility of highlighting cells via formatting (e.g., color, font weight), the capability to perform basic arithmetic operations, as well as the possibility of applying sorting and filtering on a large number of issues. Another interesting aspect was the option of structuring the Excel file into separate tabs – which participants described as beneficial for separating the individual inspection and issue collection from the collaborative discussion on the one hand, but which also led to less copy-pasting and re-use of collected data on the other hand. The table-based structure turned out to be a major restriction during issue creation, especially in connection with longer texts (e.g., overflow, wrapping) and image content (e.g., arrangement, scaling, positioning in relation to text). This was accompanied by the major drawback of a perceived lack of structure and overview when dealing with larger numbers of issues, which was particularly relevant in the collective discussion and consolidation phase.

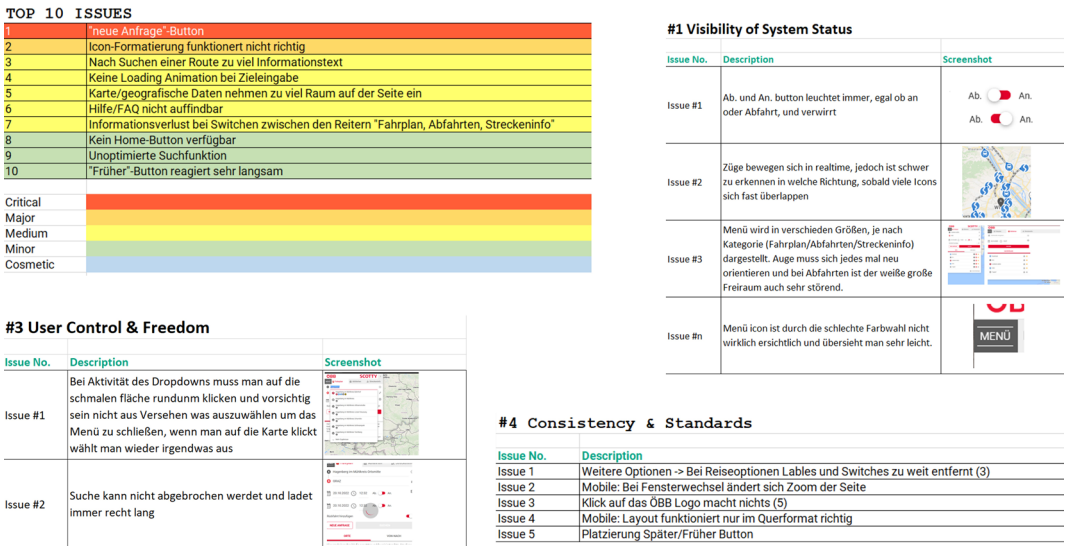

Figure 1: Artefacts from group-based heuristic evaluation using Excel 365 [4]. Text and color formatting, sorting and tabs were all utilized to maintain a better overview of the issues and heuristics.

For *Miro* (see Figure 2), participants highlighted the flexibility provided by the free-form canvas format, as well as the perceived ease of use in creation and handling of issues represented as sticky notes (e.g., drag-and-drop positioning, color-coding, auto-adjustment of text size). Another advantage included the possibility of pasting content directly onto the canvas (e.g., images, annotations). Given that, both evaluators and moderators applied diverse strategies of arranging content items on the canvas to structure them during the issue creation and consolidation phases (e.g., positioning related items close to each other, grouping items into larger-scale regions distant from each other). On the other hand, the canvas format was also perceived as a limitation, particularly from a moderator perspective, in regard to navigation (i.e., combined panning and zooming) and collection of large numbers of issues in an effort to consolidate them. Furthermore, evaluators raised concerns regarding user privileges and "territoriality", as all participants were equally able to view and modify others' content at all times.

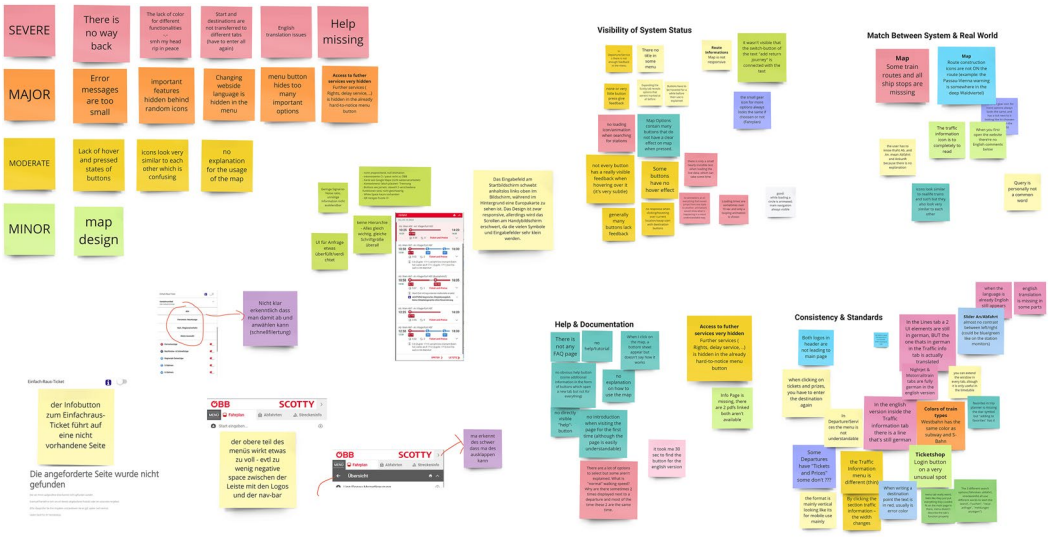

Figure 2: Artefacts from group-based heuristic evaluation using Miro [9]. Post-it notes and spatial placement were used extensively, but screenshots were not as frequently employed.

For *Spacehuddle* (see Figure 3), the main advantages pointed out by participants included the possibility of structuring content into a combined workflow of individual activities for the individual issue collection, collaborative discussion, and final prioritization phases. In particular, the card-based representation was highlighted as beneficial for combining text-based and image-based content to describe and visualise issues. The arrangement of cards in a column-based layout, on the other hand, was simultaneously regarded as both helpful and limiting to the evaluation process (e.g., helpful in the final phase of prioritizing issues by severity, whereas limiting when re-arranging issues in the discussion phase). The functionality of both a personal and public view of the content in *Spacehuddle* was leveraged by participants for contributing and discussing issues, respectively. Limitations included the navigation of large numbers of issues within the column-based layout, especially with varying length and numbers of content items.

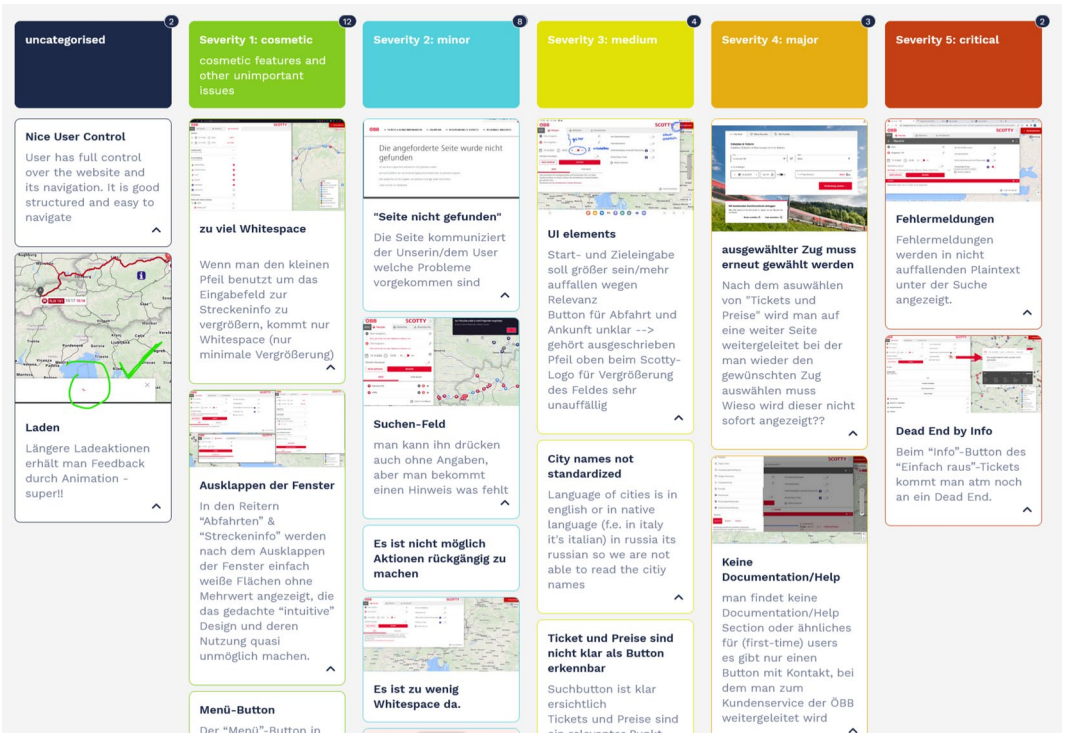

Figure 3: Screenshot from a group-based heuristic evaluation using Spacehuddle [14]. The severity categories provide a good overview of the total number of issues, with both text and screenshots, but require scrolling to view the entire list. The issues from each category can however be imported into other activities that would allow more focus (e.g., selection, rating or voting modules).

Statement	Excel 365	Miro	Spacehuddle
I am familiar with the digital tool used for heuristic evaluation.	4.03 ± 1.21	2.88 ± 1.28	1.95 ± 1.13
Using the tool generally simplified the heuristic evaluation.	3.75 ± 1.35	4.32 ± 1.05	4.63 ± 1.27
The tool provides a good overview of the entire evaluation process.	4.14 ± 1.33	4.40 ± 1.17	4.59 ± 1.14
The use of the tool for this purpose was intuitive.	3.82 ± 1.39	4.68 ± 0.97	3.94 ± 1.39
It was easy to manage my collected usability issues with the tool.	4.29 ± 1.51	4.76 ± 1.18	3.97 ± 1.57
The tool simplified the process of rating the severity of individual issues.	4.00 ± 1.20	3.84 ± 1.38	4.75 ± 1.30

Table 1: Mean ratings ± SD from evaluators for Excel 365 (N = 28), Miro (N = 25) and Spacehuddle (N = 32); ratings based on Likert scales ranging from 1 = "strongly disagree" to 6 = "strongly agree"

Statement	Excel 365	Miro	Spacehuddle
I am familiar with the digital tool used for heuristic evaluation.	3.00 ± 1.04	5.10 ± 0.99	2.70 ± 0.71
Using the tool generally simplified the heuristic evaluation.	3.50 ± 0.87	3.75 ± 1.64	4.50 ± 0.50
The tool provides a good overview of the entire evaluation process.	3.00 ± 0.71	3.75 ± 1.64	5.50 ± 0.50
The use of the tool for this purpose was intuitive.	3.50 ± 0.50	3.50 ± 1.50	3.75 ± 0.34
It was easy to manage the usability issues of all participants with the tool.	3.25 ± 1.64	3.50 ± 1.66	4.50 ± 0.87
The tool simplified the process of rating the severity of individual issues.	3.75 ± 1.48	3.50 ± 1.66	5.75 ± 0.43

Table 2: Mean ratings ± SD from moderators for Excel 365 (N = 4), Miro (N = 4) and Spacehuddle (N = 4); ratings based on Likert scales ranging from 1 = "strongly disagree" to 6 = "strongly agree"

4 CONCLUSION

In summary, multiple digital collaboration tools are available for in-class activities in a university setting. Although none of the selected tools were specifically designed for heuristic evaluations, each offered sufficient functionality when appropriated for in-class evaluation sessions. Identified key requirements include the combination of text-based and image-based content to represent issues during the issue creation process (e.g., by attaching screenshots to visualise issues and foster discussion), the navigation and flexible structuring of issues during the consolidation and prioritization phases (e.g., via color-coding or spatial arrangement to support navigation and orientation), as well as high-level separation yet flexible combination of content items within the individual and collaborative phases. Additional factors worth considering when appropriating digital tools in an educational context specifically include the difficulties faced by usability newcomers [3], the inherent time limit of in-class situations, and the influence of social dynamics on the overall process and outcome. As with practically any group-based activity, the individual personalities of the participants can play a significant role in the overall productivity of a session, regardless of which tools are utilized. As such, further investigation with a larger sample of participants and a consideration of personality types would be required to limit the influence of this factor on each tools' performance. As *Spacehuddle* was initially designed to compensate for varying personality types and related preferences within a larger group, it would be beneficial to examine these aspects specifically in a future study.

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