

Usability Evaluation of a Digital Teleradiology Case Study Using the System Usability Scale in the WFDT Project

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Abstract

Background: The global pandemic has significantly increased the use of e-learning. In the project “Knowledge modules and case studies in the digital transformation” (Wissensbausteine und Fallstudien in der digitalen Transformation – WFDT), digital learning content is created in H5P and integrated into the Learning Management System (LMS) to be made available as Open Source Material. The teleradiology content is presented through case studies oriented towards case-based learning. **Aim:** The objective of usability testing is to identify potential areas for improvement and ensure these are incorporated into subsequent development and quality assurance processes. **Methods:** The usability test is carried out with the SUS to obtain an overview of usability within 10 items, complemented by questions on font size and qualitative feedback on the presentation. In an asynchronous setting, students work on the case study, model a teleradiology process with software, and answer the SUS and additional questions. **Results:** A total of 20 students from the Health Care Management and Medical Informatics degree programme participated in the usability test. The case study usability was rated as $M = 59.63$. Eleven students rated the font size as exactly right. The tasks, examples, and clarity of the presentation were positively rated. Further criticism was made of the task elements and the design of the presentation. **Conclusions:** The content structure, integration of tasks, and examples will be retained for this and other case studies. The design of the case studies will be fundamentally transformed into an H5P-proprietary format.

Keywords: Healthcare Education; Case-based Learning; System Usability Scale; Health Care Management

Introduction

E-Learning is the utilisation of digital media in a variety of educational settings. In recent years, due to the coronavirus pandemic, there has been a marked increase in the use of this technology [1]. To transform learning content into a digital format that is both appealing and freely accessible, the “Knowledge modules and case studies in the digital transformation” (German title: *Wissensbausteine und Fallstudien in der digitalen Transformation – WFDT*) project is developing digital case studies and learning modules utilizing H5P within a learning management system (LMS).

The case studies are based on the case-based learning approach, an active learning method focused on solving cases or problems under the guidance of a lecturer [2, 3]. The WFDT project deals with a case study in teleradiology. All necessary data for process modelling is provided within the case study. The findings of the usability tests will inform the indication of potential improvements to facilitate the development and quality assurance processes.

Materials and Methods

The System Usability Scale (SUS) is used to measure usability and was selected because it is an established and standardised tool providing a good overview of a system’s usability. The SUS is designed so that positive and negative items are presented alternately to reduce response bias. The ten items request information regarding utilisation, technical support, integration of functions, structure, and learnability of the system [4]. A five-point Likert scale is used, with responses ranging from 0 (*complete rejection*) to 4 (*complete agreement*). The total score is calculated using the formula: $SUS = ((X-5) + (25-Y)) * 2.5$. X is the sum of all odd-numbered items, Y is the sum of all even-numbered items. The total score (SUS value) ranges from 0 to 100. Scores are defined as follows: scores >80.3 indicate excellent usability, 68-80.3 good usability, 68 acceptable usability, 51-68 poor usability and scores <51 terrible usability [5, 6]. The survey was supplemented with additional questions about font size, degree programme, age of the students and the time in minutes needed to complete the presentation and process modelling. Qualitative criteria were requested via free text: *What did you particularly like? What did you not like at all?*

In a blended learning setting, the case study is completed by students using a laptop, tablet, or smartphone. Students are asked to download the modelling software used for the teleradiology process modelling. They will work on this and then complete the SUS and additional questions. All steps, except downloading the modelling software, can be implemented in the LMS and are available to students asynchronously.

Results

Of 91 students enrolled in the Health Care Management and Medical Informatics degree programmes within the Process Management LMS course, 23 students completed the H5P teleradiology presentation, and 20 students participated in the evaluation.

The overall usability score is $M_1 = 59.63$. The *figure 1(a)* illustrates the SUS by end devices. The analysis by categories (*see figure 1(b)*) demonstrates that the utilisation, integration of functions, and learnability of the system are in the neutral range with a median and mean value close to 2. The categories of technical support and lack of structure have a median value of 1, indicating a near-complete rejection of these categories.

The font size appears to be optimal for 11 students, while 6 students find the font size rather too small. The mean processing time for the presentation is $M_2 = 50$ minutes, with a $SD_1 = 30$ minutes. The mean processing time for process modelling using EPC is $M_3 = 56$ minutes, with a $SD_2 = 31$ minutes. Due to technical constraints, the process model can only be processed on a laptop. Sixteen students provided a free text response to the question of what they particularly liked about the presentation (+ in Table 2), while nine students provided a free text response to the question of what they did not like about it (- in Table 2).

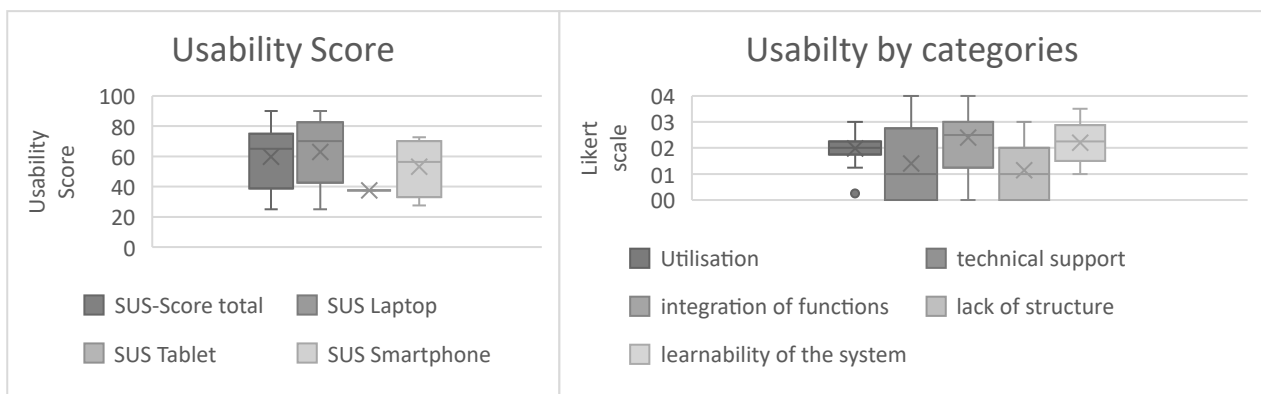


Figure 1. (a) SUS-Scores overall and end devices **(b)** Usability described in categories according

Table 2. Free text responses summarized in categories

categories	feedback	end devices
tasks	+ tasks in the presentation	6 laptop; 1 tablet
	+ examples	2 laptop; 1 smartphone
	- control	1 laptop; 2 smartphone
presentation	+ clear arrangement	3 laptop; 1 smartphone
	- design (font colour)	1 laptop

Discussion

The results of the usability test yielded an overall score of $M_T = 59.63$, with a range of 25 to 90. According to the SUS rating scale (see [5,6]), the overall is rated as poor usability. The free text responses indicate that the students found the clear arrangement, the tasks, and examples in the presentation satisfactory. This will therefore be adapted for this and other case studies, also emphasized by the almost complete rejection of the category structureless. The control of the task elements and the design of the presentation are perceived as negative aspects.

The results of the free text responses are used to further development and customisation. A fundamental change is the transition from a presentation-based format to an H5P-proprietary format. Another modification is the adaptation of the navigation elements for the drag-and-drop task type. Font size and colour will be implemented directly in H5P to support different scenarios. One limitation of the survey is the low response rate, with only 22% of enrolled students providing answers. Nevertheless, 86% of the students who completed the tasks are also rated the usability, so the results are valid and useful for further development. Moreover, the usability test is based on a single case study. As the project progresses, the usability of further content and changes to existing content will be re-evaluated. Another limitation is the asynchronous realisation. It would be beneficial to conduct further usability tests in a synchronous matter, as this would facilitate the prompt resolution of any queries.

Conclusions

Although the usability score is generally considered poor, the students' ratings of the case study in H5P are notably positive, particularly in the free text statements. The tasks and examples presented in the presentation are particularly noteworthy. Potential improvement is evident in the design of the presentation. These will be revised in the future to reassess usability and compare the results presented here with those of subsequent assessments. As a further research question, it should be critically examined whether the SUS method is suitable and which other methods could provide even more detailed findings.

List of Abbreviations: WFDT: Wissensbausteine und Fallstudien in der digitalen Transformation; LMS: Learning Management System; SUS: System Usability Scale; M: Mean; SD: Standard Deviation

Author Contributions: AB planned/performed usability test; TL research objective, coordinated, approved manuscript

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Conflict of Interest: The authors declare no conflict of interest.

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