

Usability Evaluation of a Modern Multilingual MeSH Browser

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Abstract. Medical Subject Headings (MeSH) is one of the most important vocabularies for information retrieval in medical research. It enables fast and reliable retrieval of research on PubMed/MEDLINE, the world's largest body of medical literature. The original English version of the thesaurus can be accessed via a MeSH Browser developed by the NLM. Recently, a multilingual MeSH Browser was proposed to enable usage across languages. To improve upon the original system, a new user interface (UI) was developed using contemporary web design frameworks in combination with principles from cognitive science. It aims to simplify access for medical professionals and increase overall usability. Evaluating such design improvements continually is necessary to quantify the possible positive impact for online systems in medical research. This study therefore directly compares the resulting system to the NLM Browser, using an established online questionnaire. Results show significant improvements in content and navigation as well as overall user satisfaction, while offering feedback for future improvements. This underlines the benefits of employing contemporary web design in terms of usability and user satisfaction.

Keywords. Medical Subject Headings, User-Computer Interface, Medical Informatics Applications

1. Introduction

User Interface design is constantly evolving, and the amount of research published in the field has been rising in recent years. User Interfaces (UI) for medical websites and applications are often lacking in terms of usability [1]. Employing modern design approaches based on principles from cognitive science has been shown to improve usability over legacy systems [2–4]. The present work aims to expand recent positive findings in the context of medical information retrieval systems. Specifically, retrieval of Medical Subject Headings (MeSH), one of the most important and established

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collections of medical terminology, will be evaluated. MeSH is a controlled thesaurus published by the National Library of Medicine (NLM) and serves as the main index for PubMed/Medline. As such, MeSH terms are used as labels and keywords for medical research and MeSH browsers are used for their retrieval. The current official browser for MeSH was published by the NLM in 2016 [6]. In 2022, Scheible et al. [5] published an alternative multilingual MeSH browser, adding multi-language support. In its present version, it allows the retrieval of English and German MeSH terms.

The multilingual MeSH browser uses modern open-source web technologies. It uses a fuzzy full text search with autocomplete and Material Design as its design language, which both represent state-of-the-art concepts in modern web development. To evaluate the multilingual MeSH browser in terms of usability, this study compares it to the official MeSH browser using an online survey based on an established questionnaire. Thereby, the possible impact of employing modern usability concepts for medical information retrieval systems is shown.

2. Methods

2.1. Experiment design

In order to compare the usability of the official and multilingual MeSH browser, an unsupervised online questionnaire in a cross-sectional comparative study was conducted. For the comparison, an english-only version of the multilingual browser was published to prevent bias due to participants' language preference. Participants were asked for medical background, interest in medical terms and prior experience with MeSH. No additional personal information was collected. For the evaluation of the websites, the Website Evaluation Questionnaire (WEQ) by Elling et al. [7] was used and expanded with the possibility to give qualitative feedback. Participants were sampled from the Institute of Medical Biometry and Statistics of the University Medical Center Freiburg and Students from Life Sciences and Medicine at the University of Freiburg. They were familiarized with one of the MeSH browsers assigned to them via a small set of tasks. To control for the resulting bias, three sets of tasks were used at random. Overall, this resulted in two website groups with three task sub-groups. The questionnaire was implemented using Google Forms, while the task assignment was realized by a randomized routing mechanism.

2.2. Statistical analysis

The questionnaire used provides Likert scale results for three dimensions containing sub-dimensions: Navigation with 3, Content with 3 and Layout with 1 sub-dimension(s). Each sub-dimension contains 3-4 Likert type questions. Results for the dimensions were calculated by taking the mean of the sub-dimensions' means.

To test whether the multilingual MeSH browser offers better usability, the results for both MeSH browsers were compared. The results in the Layout dimension were compared using a Mann-Whitney-U test since insufficient Likert type data was offered by the questionnaire to assume central tendency. For the other dimensions Navigation and Content, as well as the overall average rating across all dimensions, a one-tailed t-test was used. The impact of medical background and prior MeSH experience on the questionnaire outcome were estimated using t-tests, whereas the impact of tasks on the

respective outcome was measured using ANOVA. The statistical analysis was conducted using Python.

3. Results

The recently published multilingual MeSH browser is compared to the official MeSH browser using an online questionnaire. 34 Participants submitted the questionnaire and 73,5% stated a medical background and 76,5% an interest in medical terminology. 33% had heard of it prior participation and 35% had worked with MeSH before. Participants were evenly distributed between both websites, with 5-7 participants per task group.

Table 1. Means and standard deviations of overall rating and main dimensions of WEQ. Below, the results of t-tests between the two website groups in the respective dimension. *) For the layout dimension, t-test was not applicable due to insufficient Likert-Type data. Mann-Whitney-U showed no significant difference.

Website	Overall Average		Content		Navigation		Layout	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Scheible et al.	3.63	0.52	3.71	0.57	3.58	0.54	3.29	0.81
NLM	3.13	0.46	3.13	0.52	3.08	0.61	2.86	0.95
t-test p-value	0.003		0.002		0.009		-*	
t-test t-value	2.97		3.07		2.5		-*	
Cohen's D	1.02		1.05		0.85		-*	

The multilingual MeSH browser scored higher mean ratings than the official MeSH browser in all questionnaire dimensions as shown in Table 1. The increase was shown to be highly significant between the websites in terms of content and navigation. The significantly higher rating of content is surprising, given that both browsers offer the same information during the study. This indicates that a modernized layout can increase users' assessment of the information provided. In the layout dimension, no significant difference was found. Notably, it is the least represented dimension in the design of the questionnaire.

The background of participants only had a significant impact on the rating of content by users familiar with MeSH ($p=0.025$; $t=-2.126$). This is not surprising due the participants highly likely familiarity with the website. The selection of tasks assigned to participants showed no significant impact on the outcome of the questionnaire. This could be due to the small sample size.

Qualitative feedback showed that participants of both groups would like detailed usage instructions accessible on the particular MeSH browser's landing page as well as an always accessible search bar.

4. Discussion

This study compares the design of the multilingual MeSH browser by Scheible et al. [5] to the official MeSH browser by the NLM using an established questionnaire. It shows that the new MeSH browser provides better usability in terms of content and navigation

than the official system by the NLM. We demonstrated that implementing Material Design can lead to significant improvements in usability for a simple information retrieval system in medicine. This validates previous findings by Pinandote et al. [8], who demonstrated increased content delivery effectiveness and efficiency for responsive web pages using Material Design in general. The achieved improvements were also backed by using design principles from cognitive science, i.e. reducing visual complexity and using trust-inducing colors according to Reinecke et al. [9]. In addition, the multilingual MeSH browser shows that the usage of existing standards and established development frameworks can simplify the engineering of medical web applications.

Since this study focuses on users' subjective experience without the use of attention tracking, improvements can't be traced to specific design choices. At the same time, the low number of participants limits the statistical significance of the results and makes a decisive evaluation of the impact of tasks posed as familiarization impossible. Lastly, collecting data on age and sex of participants would enable more differentiated results.

5. Conclusions

We used an online survey based on an established questionnaire to evaluate the usability of two MeSH browsers. The multilingual MeSH browser was shown to have significantly improved usability over the official MeSH browser.

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