UNIVERSIDADE LUSÓFONA

State of Art in Web Forms (2012-2017)

A literature Review in HCI field

Conceição Costa, Carla Sousa, Pedro Alves

12/26/2017

This Study aims to identify design guidelines for complex Web Forms. A Systematic Review of the Literature (SRL) process was conducted with a schematic scientific database search on the field of Human Computer Interaction (HCI), including IEEE, Ebsco and ACM, by using a specific advanced search formula and only peer reviewed papers. In the Identification phase 1127 results were obtained. In the Eligibility phase a final sample of 13 studies was reached. From this sample a content analysis was performed using NVivo software (v11). Results, conclusion and future work are presented.

Contents

Introduction

Filling forms is more and more a common and frequent task in web interaction and very relevant in online businesses. No one enjoy filling web forms. Therefore, designing web forms that enhance users' efficiency is mandatory in a growing digital environment. Some business areas, being it e-government or selling airline tickets need long forms that are critical for those businesses and very demanding to customers. Having the easier and simple form in the area could mean being ahead of competition. So, making it simple is a complex task for developers.

The main goal of this study is to explore the existing scientific evidence regarding best practices or guidelines in the design and development of complex web forms. To achieve this goal a Systematic Review of the Literature (SRL) process was conducted in the field of Human Computer Interaction (HCI).

Method

Sample and Selection Process

The process of gathering data begun with a schematic scientific database search on the field of Human Computer Interaction (HCI), including IEEE, Ebsco, and ACM, by using a specific advanced search formula, based on five main criteria, described in Table 1. This process constitutes the Identification phase.

Table 1 - Search Criteria

Criteria 1	*[(Complex) AND (Web Forms)]*
Criteria 2	*[(Web Forms)AND(heuristics)]*
Criteria 3	*[(Web Forms)AND(design)]*
Criteria 4	*[(Web Forms)AND(usability)]*
Criteria 5	*[(Web Forms)AND(user experience)]*

The next phase was based in the guidelines selection, developed to match, as much as possible, the research objective. First, papers should approach the problematic of web forms. Second, they should, directly or indirectly, provide insights regarding long/complex web forms design, evaluation or usability, considered useful to better understand the good practices in this field. Only peer reviewed papers were included.

Using the above defined guidelines, 1127 results were obtained. The selection process throughout the final sample is represented in Figure 1. The process was developed in two phases. First, in the Screening phase, the guidelines were applied at a superficial level, meaning that only titles, abstracts and general information was considered. In the Eligibility phase the guidelines were followed, by thoroughly analyzing each study, before select the final sample. The expression “Complex Web Forms” was not found in the scientific publications in the HCI field.

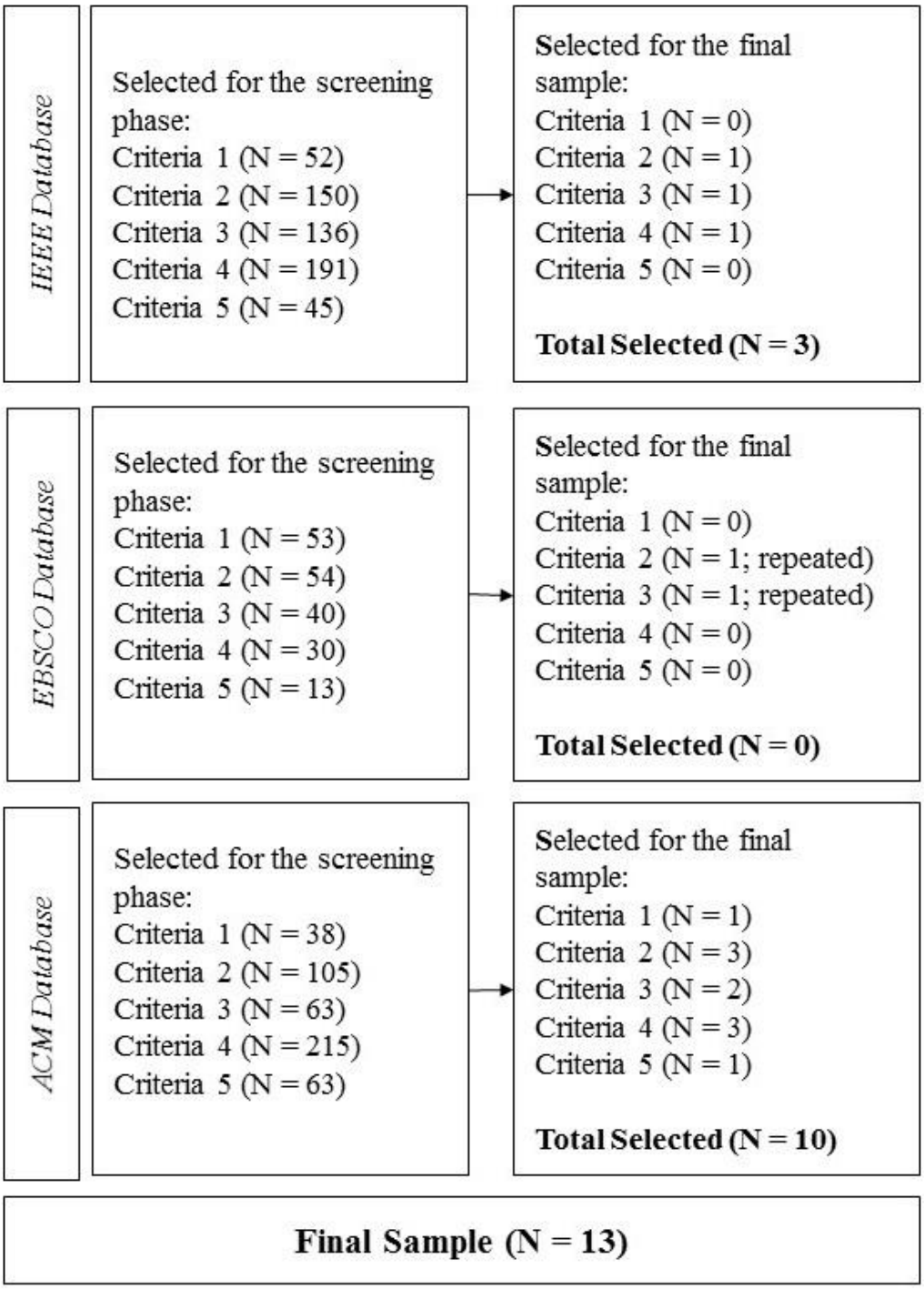

Figure 1 - Flow-Chart representing the selection process

After the completion of the above described process, we obtain a final sample of 13 studies. The title of each study, year and authors are listed in Table 2.

Table 2 - Final study sample

Title of the Study	Author(s)	Year	Reference
Validating Mobile Phone Design Guidelines: Focusing on the Elderly in a Developing Country	J. Biljon, K. Renaud	2016	validating [1]
Evaluating Information Visualization via the Interplay of Heuristic Evaluation and Question-Based Scoring	M. Hearst, P. Laskowski, L. Silva	2016	chi2016 [2]
Using fNIRS in Usability Testing: Understanding the Effect of Web Form Layout on Mental Workload	K. Lukanov, H. Maior, M. Wilson	2016	2 CC [3]
Learning Web Form Design by Using the KLM Form Analyzer: A Case Study	C. Katsanos, N. Tselios, N. Karousos, M. Xenos	2015	katsanos [4]
Model-Based Development of Accessible, Personalized Web Forms for ICF-based Assessment	D. Rupprecht, J. Etzold, B. Bomsdorf	2015	ruprecht [5]
Designing Effective Web Forms for Older Web Users	H. Li, P. Rau, K. Fujimura, Q. Gao, L. Wang	2014	numeros [6]
Designing Usable Web Forms - Empirical Evaluation of Web Form Improvement Guidelines	M. Seckler, S. Heinz, J. Bargas-Avila, K. Opwis, A. Tuch	2014	designing [7]
Evaluating the Accessibility and Usability of Top Saudi E-Government Services	A. Al-Faries, H. Al-Khalifa, M. Al-Razgan, M. Al-Duwais	2013	alfaries [8]
Aspect-driven, Data-reflective and Context-aware User Interfaces Design	T. Cerny, K. Cemus, M. Donahoo, E. Song	2013	cerny [9]
End-User Recommendations of Mobile Services: From Physical Encounters to Digital Service Sharing	K. Mattila, Z. Ahmet	2012	matila [10]
Selective attention in web forms: an exploratory case study with older	S. Sayago, J. Guijarro and J. Blat	2012	selective [11]

people			
User-friendly locations of error messages in web forms: Put them on the right side of the erroneous input field	M. Seckler, A. Tuch, K. Opwis, J. Bargas-Avila	2012	1 CC [12]
Working towards Usable Forms on the World Wide Web: Optimizing Date Entry Input Fields	J. Bargas-Avila, O. Brenzikofer, A. Tuch, S. Roth, K. Opwis	2011	2011-work towards [13]

Procedure

The coding guide used in this study is based on a general review of previous, aligned with this sample characteristics. The coding was adapted based on a formative analysis of the coding frame and in a iterative and continuous process of refining. The final coding guide is described in Figure 2.

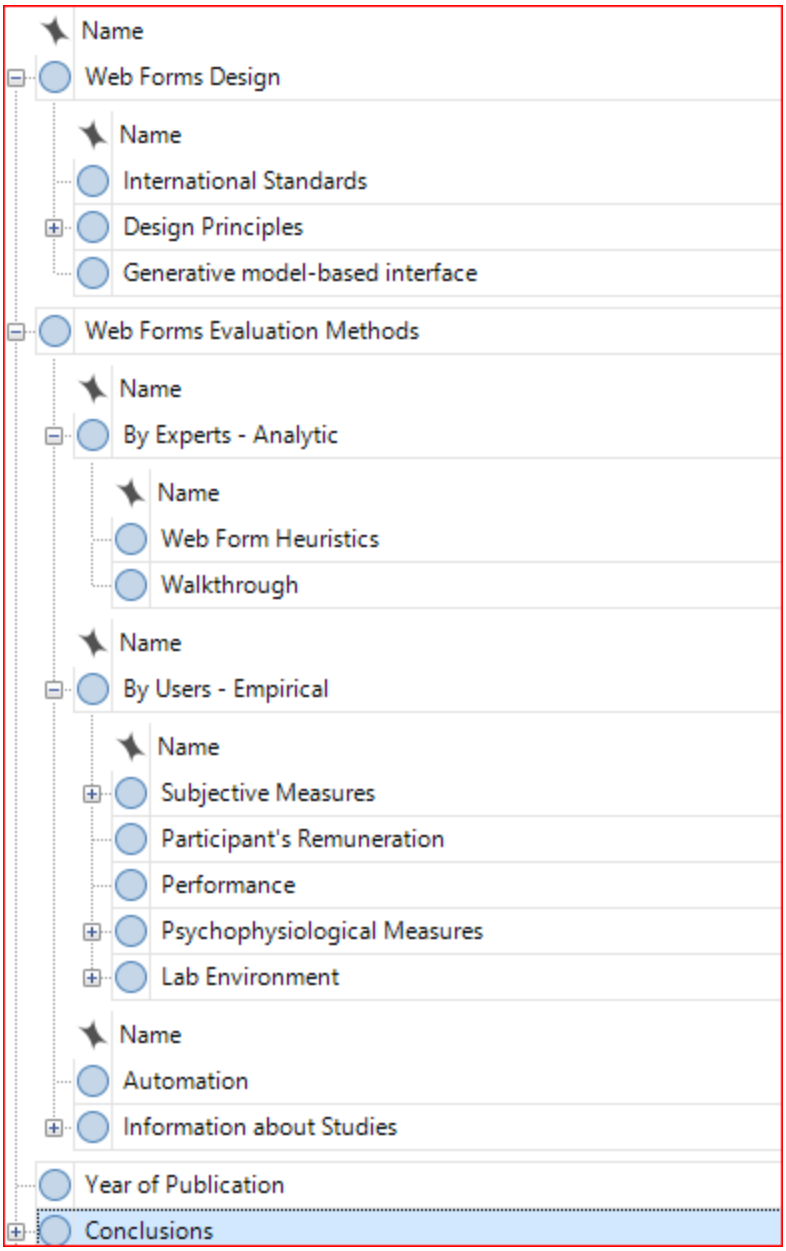

Figure 2 - Coding Guide

The coding was designed to provide evidence to better answer and explore the research goal previous described. Data analysis was conducted using NVivo software (v11). The publications' sample (sources in NVivo) was therefore categorized according the coding guide.

Results

In agreement with the study goals and publications criteria the most 50 frequent words in sources (publications) are related with web form design guidelines (or heuristics) and evaluation with users (Participants) (Figure 3).

Figure 3 - Cloud of the 50 most frequent words, with stemmed words

Most Relevant Authors

Regarding the most relevant authors in this field, all the direct authors of the sample and all the cited authors were considered. The 10 most cited authors are listed in Table 3. To better understand their fields of study, a brief description of each author is presented in Table 3.

Table 3 - The top ten of cited authors

Author	Count	Weighted Percentage (%)
Javier Andres Bargas-Avila	25	1,18
Klaus Opwis	23	1,08
Alexandre Nicolas Tuch	13	0,61
Sandra P. Roth	11	0,52
Olivia Brenzikofer	9	0,42
Christos Katsanos	9	0,42

Nikolaos Tselios	9	0,42
Josep Blat	7	0,33
Jakob Nielsen	7	0,33
Sebastien Orsini	7	0,33

Table 4 - Most cited authors detailed information

Javier Andres Bargas-Avila	Javier Bargas-Avila holds a PhD in Cognitive Psychology. He leads the UX research teams at Google working on large advertiser products, located in Zurich, San Francisco, New York, Los Angeles and Seattle. Before joining Google, he was the manager of the HCI lab at the University of Basel (Switzerland). He published over 30 peer reviewed papers in HCI journals and conferences, covering topics such as user satisfaction, mental models in website perception, website aesthetics, web form usability and internationalization of products.
Klaus Opwis	Klaus Opwis is a faculty member at the Institute of Psychology, at the University of Basel - UNIBAS (Switzerland). His main areas of interest are interactivity, visual attention, metacognitive learning and digital games are some of his research interests.
Alexandre Nicolas Tuch	Alexandre Nicolas Tuch is a PhD, currently working as a scientific project leader at the Swiss Health Observatory (Obsan). His main research areas are: user experience, usability, cognitive psychology and human-computer interaction.
Sandra P. Roth	Sandra P. Roth affiliation is the Department of Psychology - Center for Cognitive Psychology and Methodology at the University of Basel (Switzerland). She has written articles in the fields of usability, web forms and visual complexity.
Olivia Brenzikofer	Olivia Brenzikofer affiliation is the Department of Psychology - Center for Cognitive Psychology and Methodology at the University of Basel (Switzerland). Her main research interests are: user experience, prototyping, usability and task analysis.
Christos Katsanos	Christos Katsanos is a PhD in Human Computer Interaction, currently working as an Assistant Professor at the University of Patras (Greece). His main research interests include Human-Computer Interaction, information retrieval in the web, methodologies and tools for evaluating web usability, web accessibility, user modelling, educational technologies.He is a member of the HCI research group since December 2004 and member of the Technical Chamber of Greece (TEE) from 2004.

Nikolaos Tselios	Nikolaos Tselios is an Assistant Professor in the Dept. of Educational Sciences and Early Childhood Education at the University of Patras and an Adjunct Professor at the Hellenic Open University. He has over 100 publications (25 journals among which 19 are WoS-indexed) and 2 patents, with 1500 known citations and h =19 (i-10 =32, g =33). He is a member of the Technical Chamber of Greece, ACM SIGCHI, Greek A.I. Organization and Greek society of ICT in Education.
Josep Blat	Josep Blat is a Professor of Computer Science at Universitat Pompeu Fabra (Barcelona), where he founded the Engineering School and the ICT Department. Graduated in Maths, Blat got his PhD from Heriot-Watt, Edinburgh, he was a Post-doc at Université Paris-Dauphine. He was head of the Maths & CS Department at Universitat de les Illes Balears for several years. He leads the research group in Interactive Technologies with activity in graphics, HCI and learning.
Jakob Nielsen	Jakob Nielsen, Ph.D., is a User Advocate and principal of the Nielsen Norman Group which he co-founded with Dr. Donald A. Norman (former VP of research at Apple Computer). Dr. Nielsen established the "discount usability engineering" movement for fast and cheap improvements of user interfaces and has invented several usability methods, including heuristic evaluation. He holds 79 United States patents, mainly on ways of making the Internet easier to use.
Sebastien Orsini	Sebastien Orsini affiliation is the Department of Psychology - Center for Cognitive Psychology and Methodology at the University of Basel (Switzerland). His main research areas are web forms design and user satisfaction.

Web Forms Design

In a total of 13 sources web forms design was approached in 11 sources with a total of 75 references (Figure 4).

Figure 4 - Web form design subject in sources

Design Principles were found in 11 sources with a total of 67 references. Date input and type of errors in date entries, web forms for old users, information structure, web conventions and

particularly form content, form layout, input types, error handling, and form submission have been studied with experts and users. In Table 5, a selection of design principles from sources is presented.

Table 5 - Aspects in web forms design

" **Page layout and Mental Workload:** Wästlund et al [15] compared two web page layouts, one in which all the text is on single page, and one where the text is separated over four pages, and concluded that users experienced less workload with the divided web form. Further research [17] also suggest splitting long web forms into several pages in order to improve the process. It is suggested that the longer it takes for a task to be completed (short or long term) the more the perceived frustration users experience [16, 18].	Direct Source - [3] Indirect/In-Text Sources - [15,16,17,18]
"Form Content. There are many diff erent aspects to consider when designing web forms. One of the basic guidelines of user-centered design is to map the natural environment, which is already familiar to the user, as closely as possible to the virtual one [20]. If users are familiar with a concept in real life, it is probable that they will also understand this concept if it is applied to the online environment. In the case of web forms, this may, for example, be achieved by using a layout analogous to paper forms. Beaumont et al. [19]state that users' preferred input types for providing answers online are text boxes." "... Beaumont et al. [19] suggest keeping an intuitive order of the questions, for example, first ask for the name, then the address and, at the end, for the telephone number." "...Mandatory fields...this is often realized through the use of asterisks. Pauwels et al. [21]examined whether highlighting required fields by color coding leads to faster completion time compared to an asterisk next to required fields. Participants were faster, made fewer errors, and were more satisfied when the required fields were highlighted in color."	Direct Source - [13] Indirect/In-Text Sources - [19,20,21]
"Form Layout. "Penzo [23] examined the position of labels relative to the input field in a study using eye-tracking. He compared left-, right- and top-aligned labels and came to the conclusion that with left-aligned labels people needed nearly twice as long to complete the form as with right-aligned labels. ... The fastest performance, however, was reached with top-aligned labels, which required only one fixation to capture both the label and the input field at the same time. As a result of this study, Wroblewski [22] recommends using left-aligned labels for unfamiliar data where one wants users to slow down and consider their answers. On the other hand, if the designer wants users to complete the form as quickly as possible, top-aligned labels are recommended. Another advantage of top-aligned labels is that label length does not influence placement of the input fields. ... In terms of form layouts, Robinson [24] recommends that a form	Direct Source - [13] Indirect/In-Text Sources - [22,23,24,25,26]

should not be divided into more than one column. A row should only be used to answer one question. Concerning the length of input fields, Wroblewski [22] recommends matching the length of the field to the length of the expected answer. This provides a clue or affordance to users as to what kind of answer is expected from them. Christian et al. [25] examined the date entry with two separated text fields for month and year. Participants gave more answers in the expected format (two characters for the month and four for the year) if the field for the month was half the size of the one for the year. In another study by Couper et al. [26], people gave more incorrect answers if the size of the input field did not fit the length of the expected input."	
"**Input Types**. Another question in web form design relates to which input type should be used. (...) If the number of possible answers has to be restricted, radio buttons, checkboxes, or drop-down menus can be used [27]. These input types are also recommended to avoid errors, prevent users from entering unavailable options, and simplify the decision process. Radio buttons and drop-down menus are used for choosing only one option (single choice); with checkboxes, users can select as many options as they like. Concerning the use of drop-down menus and radio buttons, Miller and Jarrett [28] see the advantage of radio buttons in the fact that all options are visible at once whereas the advantage of drop-down menus lies in the saving of screen real estate. With the help of the Keystroke-Level Model [29], it can be theoretically calculated that interaction with a dropdown menu takes longer than interaction with radio buttons, mainly because of an additional point and click (PK) needed to open the drop-down menu. ... According to Miller and Jarrett [28], radio buttons should be used when two to four options are available; with more than four options they recommend using drop-down menus. When drop-down menus are used, Beaumont et al. [19] suggest arranging the options in an order with which the user is already familiar (e.g., for weekdays, the sequence Monday, Tuesday, etc.). Where there is no intuitive sequence, an alphabetical order should be considered. If users are required to indicate multiple options, Bargas-Avila et al. [30] show that checkboxes (instead of list boxes) enhance usability and user satisfaction—at least when a smaller number of options are provided. A frequent issue concerning data input is the design of date entries. With date entries, it is important that they are entered in the expected format to avoid confusion between month and day. There are many different ways of designing input fields for date entries and many possibilities for how they have to be completed. Christian et al. [25] examined date entries where the month and year field consisted of two separate text boxes. Their study revealed that 92.9%– 95.8% provided their answer in the correct format when symbols (MM and YYYY) were used to state the restrictions. Positioning the date instructions to the right of the year field led to fewer correct answers. Linderman and Fried [27] suggest using	Direct Source - [13] Indirect/In-Text Sources - [27,28,29,19,30,25]

drop-down menus to ensure that no invalid dates are entered."	
"**Error Handling**. It is important to guide users as quickly and error-free as possible through forms. Errors should be avoided from the start by explaining restrictions in advance. Often, errors cannot be avoided; in this case, it is important to help users to recover from them as quickly and easily as possible. To assure usable error messages in the web, Nielsen [31] and Linderman and Fried [27] state that an error message must be written in a familiar language and clearly state what the error is and how it can be corrected. Nielsen [31] also advises never deleting the completed fields after an error has occurred, as this can be very frustrating for users. Bargas-Avila et al. [32] compared six different ways of presenting an error message, including inline validation, pop-up windows, and embedded error messages. People made fewer consecutive errors when error messages appeared embedded in the form next to the corresponding input fields or one by one in a pop-up window. This was only the case if the error messages showed up at the end after clicking the send button. "Subjects clearly preferred and expected error messages on the right side. An explanation can be that because the western reading system goes from left to right, the reaction to an input should be on the right side as well. **Error Categorization** when entering dates in forms: (1) Wrong format. The user enters the correct day (e.g., his/her birthday), but chooses a wrong format. This can happen for instance when the required format is month-day-year, and the user enters first the day and then the month and year, or when two-digit numbers are enforced, but the user enters the date using single digits. Format errors stem usually from insufficient communication of the applied format restrictions or from users overlooking the instructions. (2) Wrong date. The user enters the wrong date. This usually happens if the wrong keys are pressed on the keyboard or the wrong entries are selected in a menu or calendar widget."	Direct Source - [13] Indirect/In-Text Sources - [31,27,32]
"Form Submission. At the end of the fill-in process, the form has to be submitted. This is usually realized through a button with an action label. Linderman and Fried [8] suggest disabling the submit button as soon as it has been clicked to avoid repeated submissions due to long loading time. Some web forms also present a reset or cancel button in addition to the submit button. Many experts recommend eliminating such a button as it can be clicked by accident and does not provide any real additional value [1, 8, 15]. After a successful transaction, the company should confirm the receipt of the user's data by e-mail [1, 8]."	Direct Source - [13]

In terms of International Standards WCAG 2.0 accessibility criteria and the XForms W3C recommendation are referred by 2 sources with 3 references. WCAG (Web Content Accessibility Guidelines) 2.0 is the ISO/IEC 40500:2012 and covers a wide range of recommendations for making Web content more accessible. These guidelines will make content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photo-sensitivity and combinations of these. Following these guidelines will also often make Web content more usable to users in general. In the source were this standard is mentioned research was conducted to investigate the accessibility and usability of a representative sample of top Saudi e-government services [8].

The XForms W3C is mentioned by Rupprecht, Etzold, and Bomsdorf [5] as the "most notable standard for web form description". In Table 6 the XForms W3C is presented.

Table 6 - WCAG 2.0 and XForms W3C

WCAG (Web Content Accessibility Guidelines) 2.0	**Source**
It has 12 guidelines that are organized under 4 principles: perceivable, operable, understandable, and robust. For each guideline, there are testable success criteria, which are at three levels: A, AA, and AAA.	[14]
XForms W3C recommendation	**Source**
" It separates structure (Model), content (Instance) and presentation (User Interface), abstracting the user interface and enabling interaction across different modalities and devices. Cardone et al. [33] used these possibilities to simplify web form programming by creating an XForm based programming model which is able to automatically create functional web form applications which include input validation and code generation. Honkala [34] is using the user interaction related features of XForms to create a configurable processor which is able to create different form layouts for diverse environments. These approaches make use of XForms features for form structuring and validation to generate forms for various screen sizes but XForms itself misses various aspects. It is neither designed for realizing generative, individual user interfaces nor does it support instant accessibility features.	Direct Source - [5] Indirect/In-Text Sources - [33,34]

Web-based form generation

Only 1 source in 13 mention Web form generation [5] in a self-assessment form for people have problems in reading and understanding the content of the form. In this work the understanding of

the forms was supported by means of so called clarifying communication elements: from simple, static images to video animations.

Web Forms Evaluation Methods

Under this category sources were classified as presented in Figure 5, taking in account evaluation by experts, users and/or automatically and relevant information about the study.

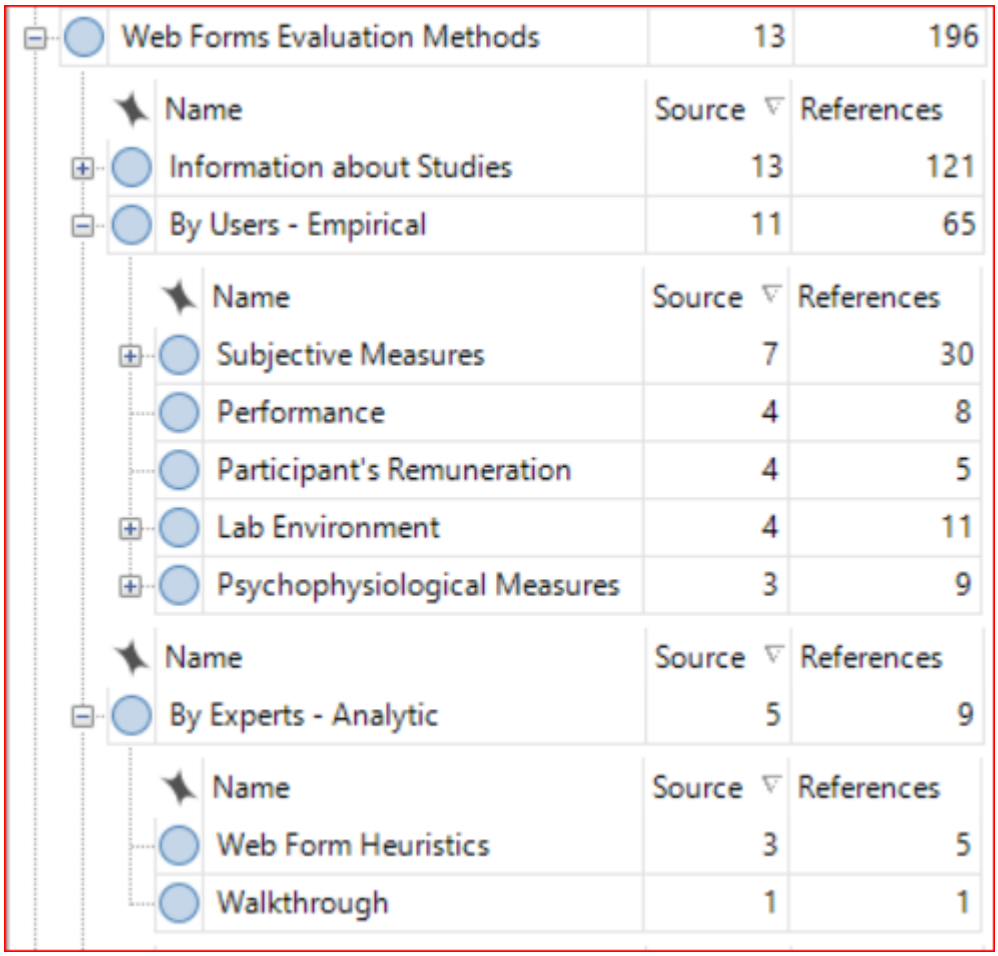

Figure 5 - Web Forms Evaluation Methods in Sources

All studies' goals (Table - 7) are related to finding the most adequate user interface design and most of them are related with Web Forms design. Its word to notice that only 1 study mention old users' performance and 2 studies are related with accessibility what means that at this particular sample testing with users with special needs is not the rule. Only 1 study is related with mobile phone User Interface.

Table 7 - Studies' goals

Studies' Goals in Sources	Source
"This study addressed the following research questions to discuss the effects of task complexity and information structure on older users' performance: 1. Does task complexity influence the performance (task time, error, satisfaction, mental workload, and disorientation) of older people? 2. Does information structure influence the performance (task time, error, satisfaction, mental workload, and disorientation) of older people? Moreover, is the decision complexity advantage also applicable to older users?"	Direct Source - [6]
"The goal of this study is to examine different error message locations. The present study aims to investigate how six embedded error message locations differ regarding efficiency, effectiveness, satisfaction and preference ratings."	Direct Source - [12]
"This study was conducted as online experiment, where six different date entry designs were compared using a one-way related design."	Direct Source - [13]
"The aim of this usability study is to evaluate a web form filling interface for the insurance domain. (...) In this paper, we examine the prospect of using fNIRS to measure MWL within a typical usability study"; fNIRS - Near Infrared Spectroscopy; MWL- Mental Workload;	Direct Source - [3]
"Our current research conducts an empirical study that aims to evaluate the accessibility and usability of Saudi e-Government services, which responses to the following questions: (1) What accessibility guidelines are violated? (2) What are the most common types of accessibility problems? (3) How usable are the services? The goal was to identify whether the services met WCAG principles and at what conformance level, highlighting the pattern these principles are commonly violated in the e-Government services. For usability evaluation using expert reviews, Bargas-Avila et al. [7] 20 guidelines for forms usability were used."	Direct Source - [8]
"(...) it aims to reflect runtime-information and structures already captured in the application, while extending them to provide an appropriate CUI."; CUIs - Contextaware/Adaptive UIs; UI -User Interface.	Direct Source - [9]
"The aim of this paper is to study the use of KLM-FA in teaching KLM modelling and web form (re)design. In specific, this paper investigates students' learning performance after participating in a KLM-FA mediated activity, perceived educational experience	Direct Source - [4]

with KLM-FA, perceived usability of KLM-FA."; KLM-FA - Keystroke Level Model-Form Analyzer;	
"This paper focuses on ICF assessment for and by people with dyslexia caused by cognitive impairments. It presents a cost-effective approach to semi-automatically generated, accessible web-forms."; ICF - International Classification of Functioning, Disability and Health;	Direct Source - [5]
"(...) design and implement a mobile phone interface tailored to the needs of elderly South Africans. The resulting prototype was evaluated with two groups of South African elderly mobile phone users."	Direct Source - [1]

In terms of sampling method, only 8 sources indicate it, being convenience criteria to recruit participants used in 7 sources. In terms of users/participants characteristics they are potential final users of the Web services. In one study a sample of Web sites with heavy traffic was selected and analysed by experts, before the evaluation with users. In terms of business area (Figure 6), only 8 sources refer to it. One of the studies is simultaneously Education and E-Commerce.

Context of the Study	8	21
Name	Sources	Reference
E-Commerce	3	7
Education	2	2
Tourism	2	3
Governamental	1	1
Insurance	1	2
News websites	1	2
Finantial Services	1	1
Software Engineering and Artificial Intelligence	1	1

Figure 6- Business area of the Web sites/prototypes used in studies

Most of the studies in sources are with final users (11), while studies by experts only are less common. Automatic tools to simulate the web form filling by a person appeared in 1 source.

Subjective Measures

In evaluation with users validated scales and tailor made satisfaction questionnaires are mentioned in 7 and 6 sources respectively. In Table 8 the validated scales from sources are presented, from the most to the less frequent used in this sample.

Table 8 - Validated scales from sources

Validated Scales
The NASA-TLX (Task Load Index), a multidimensional subjective scale to measure perceived mental workload [35] was used in 4 studies in sources.
The Self-Assessment Manikin (SAM) is a nonverbal pictorial rating scale with the three dimensions pleasure, arousal and dominance [36] and is the most common tool to measure affect in the field of user experience.
The WOOS questionnaire measures perceived orientation in online shops. It contains seven questions about the structure, efficient location, meaningful naming and orientation in the online shop. Participants rated these seven questions on a 5-point Likert scale [12].
The System Usability Scale (SUS) is a "quick and dirty" method of evaluating the usability of different websites, software, and other human-machine systems [37].
The Form Usability Scale (FUS) is a validated questionnaire for measuring the usability of online forms [38]. It consists of 9 items each to be rated on a Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree).

Psycho Physiological Measures

Only 2 sources make reference to the usage of Eye Tracking Systems and in 1 source to Near Infrared Spectroscopy (fNIRS) as a tool for objectively and concurrently measuring mental workload during usability testing, probably to the cost related to this kind of systems at the time of the studies and even actually when compared to subjective measures.

Performance

In terms of user performance, time efficacy (task completion time, number of trials to submit a form, error types and errors rates) and effectiveness of corrections (number of trials to submit a form, error types) are the most common metrics in sample.

Evaluation by Experts

The 20 design guidelines provided by Bargas-Avila et al. [39] are mentioned by 3 sources and are the only heuristics for Web forms in sample (Table 9).

Table 9 - 20 guidelines for usable form design (Bargas-Avila et al. [39])

Form content 1. Let people provide answers in a format that they are familiar with from common situations and keep questions in an intuitive sequence. 2. If the answer is unambiguous, allow answers in any format. 3. Keep the form as short and simple as possible and do not ask for unnecessary input. 4. (a) If possible and reasonable, separate required from optional fields and (b) use color and asterisks to mark required fields.
Form layout 5. To enable people to fill in a form as quickly as possible, place the labels above the corresponding input fields 6. Do not separate a form into more than one column and only ask one question per row. 7. Match the size of the input fields to the expected length of the answer.
Input types 8. Use checkboxes, radio buttons or drop-down menus to restrict the number of options and for entries that can easily be mistyped. Also use them if it is not clear to users in advance what kind of answer is expected from them. 9. Use checkboxes instead of list boxes for multiple selection items. 10. For up to four options, use radio buttons; when more than four options are required, use a drop-down menu to save screen real estate. 11. Order options in an intuitive sequence (e.g., weekdays in the sequence Monday, Tuesday, etc.). If no meaningful sequence is possible, order them alphabetically. 12. (a) For date entries use a drop-down menu when it is crucial to avoid format errors. Use only one input field and place (b) the format requirements with symbols (MM, YYYY) left or inside the text box to achieve faster completion time.
Error handling 13. If answers are required in a specific format, state this in advance, communicating the imposed rule (format specification) without an additional example. 14. Error messages should be polite and explain to the user in familiar language that a mistake has occurred. Eventually the error message should apologize for the mistake and it should clearly describe what the mistake is and how it can be corrected. 15. After an error occurred, never clear the already completed fields. 16. Always show error messages after the form has been filled and sent. Show them all together embedded in the form. 17. Error messages must be noticeable at a glance, using color, icons and text to highlight the problem area and must be written in a familiar language, explaining what the error is and how it can be corrected.
Form submission 18. Disable the submit button as soon as it has been clicked to avoid multiple submissions. 19. After the form has been sent, show a confirmation site, which expresses thanks for the submission and states what will happen next. Send a similar confirmation by email. 20. Do not provide reset buttons, as they can be clicked by accident. If used anyway, make them visually distinctive from submit buttons and place them left-aligned with the cancel button on

the right of the submit button.

Automation

One source mentions the KLM-FA (keystroke-level model) Form Analyzer Tool [40], an online application that simulates web forms filling by users. Some criticism has been made to KLM model and tool since it gives only time calculations, therefore it's never predicts how real people feel and behave.

Conclusion

In the present study all the studies aim to improve Web Forms usability and evaluation main paradigm is doing it in a Lab with users.

The designation "Complex Web Forms" was not found in sources. An explanation could be this expression is not common in academic HCI field, besides all the authors refer to forms design as the most complex.

Heuristic guidelines or Design principles are present in 11 sources, used in inspection methods by experts and/or to explain usability problems and fix their correction in studies with users.

In one of the sources [7] results shows the effectiveness of 20 design guidelines provided by Bargas-Avila et al. [39] in web forms of real company websites. Results indicate that improved web forms lead to faster completion times and fewer form submission trials. Data from subjective questionnaires and interviews show increased user satisfaction. Therefore, UX guidelines and particularly the 20 design guidelines (see Table 9) should be applied to Lightweightform, as well a selection of 'case studies' representative of complex web forms should be tested with target audience/users in order to give insight to the 'best' information architecture and workflow for every form generated by Lightweightform.

Limitations and Future Work

One of the limitations of the present study is the number of studies in final sample, meaning that the 'subject' of designing web forms has not been researched recently in the field of HCI.

Another limitation is there are no empirical evidence in sample about the efficacy of the 20 guidelines on mobile devices and touch screens. Design principles such us "using dropdown menus for date entries", for instance, could not be directly applied to touch and small screens.

Another issue is that design is continually changing and people can learn new ways of doing things in technological devices and accommodate to it, even if the interaction paradigms are against 'guidelines'.

In terms of future work and thinking particularly on the Lightweightform tool, the web forms should 'learn' from the users difficulties in filling it and adapt the interface in real time, while allowing the update of heuristics database for Adaptive and Intelligent Web Forms.

More combined research from HCI, Cognitive Sciences and Computer Sciences, particularly in the field of Artificial Intelligence, is needed.

References

[1]J. Biljon and K. Renaud, "Validating Mobile Phone Design Guidelines", *Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists on - SAICSIT '16*, 2016.

[2]M. Hearst, P. Laskowski and L. Silva, "Evaluating Information Visualization via the Interplay of Heuristic Evaluation and Question-Based Scoring", Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16, 2016.

[3]M. Seckler, A. Tuch, K. Opwis and J. Bargas-Avila, "User-friendly locations of error messages in web forms: Put them on the right side of the erroneous input field", Interacting with Computers, vol. 24, no. 3, pp. 107-118, 2012.

[4]C. Katsanos, N. Tselios, N. Karousos and M. Xenos, "Learning web form design by using the KLM form analyzer", Proceedings of the 19th Panhellenic Conference on Informatics - PCI '15, 2015.

[5]D. Rupprecht, J. Etzold and B. Bomsdorf, "Model-based development of accessible, personalized web forms for ICF-based assessment", Proceedings of the 7th ACM SIGCHI Symposium on Engineering Interactive Computing Systems - EICS '15, 2015.

[6]H. Li, P. Rau, K. Fujimura, Q. Gao and L. Wang, "Designing Effective Web Forms for Older Web Users", Educational Gerontology, vol. 38, no. 4, pp. 271-281, 2012.

[7]M. Seckler, S. Heinz, J. Bargas-Avila, K. Opwis and A. Tuch, "Designing usable web forms", Proceedings of the 32nd annual ACM conference on Human factors in computing systems - CHI '14, 2014.

[8]A. Al-Faries, H. Al-Khalifa, M. Al-Razgan and M. Al-Duwais, "Evaluating the accessibility and usability of top Saudi e-government services", Proceedings of the 7th International Conference on Theory and Practice of Electronic Governance - ICEGOV '13, 2013.

[9]T. Cerny, K. Cemus, M. Donahoo and E. Song, "Aspect-driven, data-reflective and context-aware user interfaces design", ACM SIGAPP Applied Computing Review, vol. 13, no. 4, pp. 53-66, 2013.

[10]K. Mattila and Z. Ahmet, "End-user recommendations of mobile services", Proceeding of the 16th International Academic MindTrek Conference on - MindTrek '12, 2012.

[11]S. Sayago, J. Guijarro and J. Blat, "Selective attention in web forms: an exploratory case study with older people", Behaviour & Information Technology, vol. 31, no. 2, pp. 171-184, 2012.

[12]M. Seckler, A. Tuch, K. Opwis and J. Bargas-Avila, "User-friendly locations of error messages in web forms: Put them on the right side of the erroneous input field", Interacting with Computers, vol. 24, no. 3, pp. 107-118, 2012.

[13]J. Bargas-Avila, O. Brenzikofer, A. Tuch, S. Roth and K. Opwis, "Working towards Usable Forms on the World Wide Web: Optimizing Date Entry Input Fields", Advances in Human-Computer Interaction, vol. 2011, pp. 1-8, 2011.

[14] The World Wide Web Consortium (W3C), "Web Content Accessibility Guidelines (WCAG) 2.0", W3C, 2008. [Online]. Available: https://www.w3.org/TR/2008/REC-WCAG20-20081211/. [Accessed: 05- Jan- 2018].

[15]E. Wästlund, T. Norlander and T. Archer, "The effect of page layout on mental workload: A dual-task experiment", Computers in Human Behavior, vol. 24, no. 3, pp. 1229-1245, 2008.

[16]K. Bessiere, I. Ceaparu, J. Lazar, J. Robinson and B. Shneiderman, "Social and psychological influences on computer user frustration", in Media Access: Social and Psychological Dimensions of New Technology Use, E. Bucy and J. Newhagen, Ed. Mahwah, NJ: Lawrence Erlbaum Associates, 2018, pp. 169-192.

[17]C. Jarrett and G. Gaffney, Forms that work. Amsterdam: Elsevier/Morgan Kaufmann, 2009.

[18]V. Mendoza and D. Novick, "Usability over time", Proceedings of the 23rd annual international conference on Design of communication documenting & designing for pervasive information - SIGDOC '05, 2005.

[19]A. Beaumont, Usable forms for the Web. Birmingham: Glasshaus, 2002.

[20]J. Garrett, The elements of user experience. Berkeley, Calif.: New Riders, 2011.

[21]S. Pauwels, C. Hübscher, S. Leuthold, J. Bargas-Avila and K. Opwis, "Error prevention in online forms: Use color instead of asterisks to mark required-fields", Interacting with Computers, vol. 21, no. 4, pp. 257-262, 2009.

[22] L. Wroblewski, Web Form Design: Filling in the Blanks, Rosenfeld Media, 2008.

[23]M. Penzo, "Label Placement in Forms :: UXmatters", Uxmatters.com, 2006. [Online]. Available: https://www.uxmatters.com/mt/archives/2006/07/label-placement-in-forms.php. [Accessed: 06- Jan- 2018].

[24]D. Robinson, “Better web forms,” 2003. [Online] Available: http://www.7nights.com/dkrprod/gwt_four.php. [Accessed through Google Scholar].

[25]L. Christian, D. Dillman and J. Smyth, "Helping Respondents Get It Right the First Time: The Influence of Words, Symbols, and Graphics in Web Surveys", Public Opinion Quarterly, vol. 71, no. 1, pp. 113-125, 2007.

[26]M. Couper, M. Traugott and M. Lamias, "Web Survey Design and Administration", Public Opinion Quarterly, vol. 65, no. 2, pp. 230-253, 2001.

[27]M. Linderman and J. Fried, Defensive design for the Web. Thousand Oaks, California, USA: New Riders Publishing, 2004.

[28]S. Miller and C. Jarrett, Should I use a drop-down? Four steps for choosing form elements on the Web. Effortmark Ltd, 2001.

[29]S. Card, T. Moran and A. Newell, "The keystroke-level model for user performance time with interactive systems", Communications of the ACM, vol. 23, no. 7, pp. 396-410, 1980.

[30]J. Bargas-Avila, O. Brenzikofer, A. Tuch, S. Roth and K. Opwis, "Working towards Usable Forms on the Worldwide Web: Optimizing Multiple Selection Interface Elements", Advances in Human-Computer Interaction, vol. 2011, pp. 1-6, 2011.

[31]J. Nielsen, "Error Message Guidelines", Nielsen Norman Group, 2001. [Online]. Available: https://www.nngroup.com/articles/error-message-guidelines/. [Accessed: 06- Jan- 2018].

[32]J. Bargas-Avila, G. Oberholzer, P. Schmutz, M. de Vito and K. Opwis, "Usable error message presentation in the World Wide Web: Do not show errors right away", Interacting with Computers, vol. 19, no. 3, pp. 330-341, 2007.

[33]R. Cardone, D. Soroker and A. Tiwari, "Using XForms to simplify Web programming", Proceeding of WWW 2005, pp. 215-224, 2005.

[34]M. Honkala and P. Vuorimaa, "A Configurable XForms Implementation", IEEE Sixth International Symposium on Multimedia Software Engineering.

[35]S. Hart and L. Staveland, "Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research", Advances in Psychology, pp. 139-183, 1988.

[36]P. Lang, "Behavioral treatment and bio-behavioral assessment: computer applications", in Technology in mental health care delivery systems, J. Sidowski, J. Johnson and T. Williams, Ed. Norwood, NJ: Ablex, 1980, pp. 119-137.

[37] J. Brooke, “SUS: A Quick and Dirty Usability Scale”, in Usability Evaluation in Industry, P. W. Jordan, B. Thomas, B. A. Weerdmeester and I. L. McClelland, London: Taylor & Francis, 1996, pp.189-194.

[38] A. Aeberhard, “FUS -Form Usability Scale. Development of a Usability Measuring Tool for Online Forms”, Unpublished master’s thesis, University of Basel, Switzerland, 2011.

[39]J. Bargas-Avila, O. Brenzikofer, S. Roth, A. Tuch, S. Orsini and K. Opwis, “Simple but Crucial User Interfaces in the World Wide Web: Introducing 20 Guidelines for Usable Web Form Design”, in User Interfaces, R. Matrai (Ed.), 2010.

[40]N. Karousos, C. Katsanos, N. Tselios and M. Xenos, "Effortless tool-based evaluation of web form filling tasks using keystroke level model and fitts law", CHI '13 Extended Abstracts on Human Factors in Computing Systems on - CHI EA '13, 2013.