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Master Thesis

Measuring and improving the quality of user interaction with learning management systems.

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in the

Enterprise Information Systems research group
Computer science III

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Declaration of Authorship

I, Farid Hasanov, declare that this thesis titled, 'Measuring and improving the quality of user interaction with learning management systems.' and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

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RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITÄT BONN

Abstract

Faculty of Mathematics and Natural Sciences
Computer science III

Master of Computer Science

Measuring and improving the quality of user interaction with learning management systems.

by Farid Hasanov

In this work I have researched the methods of measuring a user's interaction with E-learning systems. My research was supported by a website created for collaborative presentations named Slidewiki. After providing a theoretical background, I was able to provide data about the conduction of an experiment and the subsequent results. Moreover, a number of solutions aimed at mitigating design flaws will be proposed here.

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Chapter 1

Introduction.

Throughout the course of the 1980s, computer ownership rocketed. Applications and games were developed rapidly, thus increasing the need to facilitate ever-increasing communication through the medium of software. The demand for a new field responsible for planning, design and use of the interfaces between people and computers gave a birth to a fledgling branch of computer science known as Human Computer Interaction (HCI for short). HCI is dedicated to carrying out services which simplify the design of user's interface and increase it's appeal.

This paper intends to analyse the interaction between the user and e-learning systems, where it is fulfilled via the user-interface of the program. Put simply, if the interface of the software is of good quality, the likelihood of interaction with the product will increase.

First, the term 'quality' must be defined. Generally, quality can be defined as 'the degree of excellence of a given product'. A definition of quality in the sphere of software programming was given by the International Standards Organisation (ISO) as *"The totality of features and characteristics of a software product that bears on its ability to satisfy stated or implied needs."*[2].

In real life, when primary demands are satisfied, a user will seek new products in order to satisfy his advanced needs. Rossi, Olsina and Covella highlighted this: *"While users are becoming more and more mature in the use of IT systems and tools, there is greater demand for the quality of software and Web applications that match real user needs in actual working environments."*[3].

This work aims to shed some light on the user's interaction with learning management systems. Having studied existing background literature, I will endeavour to apply it to my own model for the measure of quality regarding e-learning websites.

Accordingly, selected metrics, upon which the quality of interaction can be estimated, were chosen, and will be detailed in the third chapter of this paper. The selection of a HCI-specific method of evaluating interaction with a website will be covered in chapter 4. Finally, the performance of the selected user testing over the particular e-learning site known as: *"Slidewiki"* will be described in the last chapter. Following the testing, suggestions for improvement and mockups will be provided here. The motivation for selecting Slidewiki as my target website was it's uniqueness and originality. Being a new type of wiki website, it allows learners to obtain fast and free access to the learning material of universities across the world. In addition to this, Slidewiki possesses a unique functionality never seen in E-learning products before, which will be detailed in the following chapters. Despite all this advantages, the site isn't sufficiently attractive for learners and holds some flaws in the design of it.

By this research I hope to create a model, which will be based on the previous papers and will ease the process of measurement of the interaction between user and the e-learning systems with subsequent testing of it. Moreover, I believe that the core of this model will be sufficient for measuring the interface quality not only of LMSs, but also other types of websites.

Chapter 2

Related work.

The measure of interface quality is an issue that dates back to the roots of HCI. Existing research shows that there is an abundance of factors that correlate to Web interface quality. During preliminary research, I familiarized myself with most of these factors and gained some insights to aid in my work. In this chapter, the papers and publications that affected my future model will be structured and presented.

2.1 Approaches to measure a website quality.

Many authors created their own models to assess the quality of web products. Notable among them were Adel M. Aladwani from Kuwait University, and Prashant C. Palvia from The University of North Carolina at Greensboro, who developed an instrument to measure perceived web quality from the perspective of Internet users. [4]. While reviewing the older literature, the authors mentioned that: *"Three generic steps common in all these models include conceptualization, design and normalization."*[4] and based their new tool on this model. During conceptualisation, the main domain of a website is defined and the overall design is evaluated. In other words, this step is prioritized over content validity. The second step is the reduction of the metrics and the corresponding of each of them on a scale of "extremely unimportant" (1) to "extremely important" (7). Finally, nominalization is the testing itself, this being the step when the site is tested over user groups. In conclusion, the authors note that, unlike previous work concentrated on the general description of some specific aspects, their work is mostly about measurements efforts and construct identification. *"In this study, we moved beyond descriptive and narrative evidence to empirical evaluation and verification by developing a multi-dimensional scale for measuring user-perceived web quality."*[4].

An identical approach was used in this paper, where I have analyzed metrics first, then researched group methodology, before finally conducting the experiment itself.

Web quality itself cannot be described as a factor belonging to a single domain. Luis Olsina, Guillermo Covella, Gustavo Rossi[3] illustrated different types of quality while developing their tool for measurement. They disregarded selection of metrics, allowing ISO 9126 to self-select for them. This standard accentuates three different approaches to software quality - internal quality, external quality and quality in use. The author used those insights of ISO, and gave me the following definitions.

"Internal quality, which is specified by a quality model (similar to the ISO 9126 model), and can be measured and evaluated by static attributes of documents such as specification of requirements, architecture, or design; pieces of source code; and so forth."[3].
"External quality, which is specified by a quality model (similar to the ISO 9126 model), and can be measured and evaluated by dynamic properties of the running code in a computer system, i.e. when the module or full application is executed in a computer or network simulating as close as possible the actual environment."[3].
"Quality in use, which is specified by a quality model (similar to the ISO 9241-11 model), and can be measured and evaluated by the extent to which the software or Web application meets specific user needs in the actual, specific context of use."[3].
This separation of overall quality was found satisfactory, and I aim to illustrate that I decided to split the metrics and create several dimensions out of them. Additionally, my main interest in this paper pertained to ISO metrics. These metrics, which can be considered standard, will be shown in the third chapter.

A largely similar approach was taken in an Egyptian Informatics Journal[5]. This model was created for evaluating Web Based Applications (WBA). Although they use a model for commercial WBAs, one can adjust this model for every type of web product. The model goes by the name of WBAQM (Web Based Application Quality Model). It consists of three layers, and the overall schema is as follows:

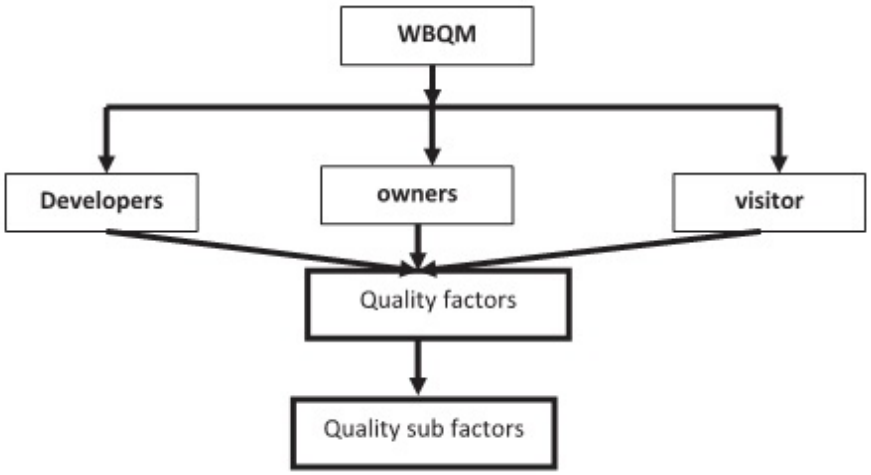

FIGURE 2.1: WABQM structure. [5].

Notable is that, in this model, separation can also be observed, although this time it is concerns that are separated. On closer inspection of this model and it's layers, an explanation for this approach is forthcoming.

Layer1: identifying WBA views. To understand the level of quality of WBAs, the purpose of the product needs to be clearly stated. The evaluation of quality is established by the owner of the product, who has his own needs and goals. Even more important is to state the needs and preferences of users, which often differ from the needs of an owner company. The construction of WBAs involves a wide range of developers, testers and designers. Hereby, their needs must also be stated. Accordingly, the WBAQM model's first layer consists of three sections: Developer concerns, Visitor concerns and Owner concerns.

Developer concerns. The firm and its customers need effective lines of communication with each other, especially in cases when face-to-face communication is impossible. *"The need to develop a sound WBA integrated of the visitors needs and owner promotion with various quality characteristics is most crucial problem for any WBA developer."*[6],[7],[8],[9].

Visitor concerns. WBA is used by a large group of visitors with various backgrounds in terms of knowledge, skills, needs. The goal is that WBAs can facilitate and ease users information-seeking and improve their performance. *"Visitor concerns involve quality factors that are most important to WBA visitors and are reflecting the needs and performance of the visitors with various characteristics."*[5].

Owner concerns. Many firms realised that, with the assistance of WBAs, they can obtain benefits such as faster transactions, faster connections to customers, and the ability to promote their products via a network. Based on the extensive literature research in the area of web quality models, it was found that a given firm's WBA owner is mainly

concerned with three quality factors: differentiation, popularity, and profitability.[5].
For each of those concerns they attached the corresponding criteria:
Developer's criteria: *portability*, *maintainability* and *reusability*. Every single one of them has some sub-factors.

The visitors' perspective is based upon domain dependent and independent factors. Domain independent factors are common between all WBAs. That involve four factors: *usability*, *accessibility*, *content quality* and *credibility*. Conversely, domain dependent factors are those that differ from WBA to WBA. These factors include: *security*, *functionality* and *internationalization*.
Finally, the 'owner factors' are: *differentiation*, *popularity*, and *profitability*.
Although three different perspectives are offered here, this work intends to concentrate solely on the customer's requirements.

This work is dedicated to user interaction, therefore skipping over the other two perspectives. However, some metrics that I aim to discuss are better measured by developers or website owners during the development stage.

2.2 Quality dimensions of a website.

The overall dimensioning of the metrics was developed from the work of Eelko K.R.E. Huizingh[10]. In his paper, he outlines two basic dimensions of every website: content and design. Huizingh distinguishes three basic types of content: informative, transactive and entertainment.
Most of the metrics used for evaluation could be stored in one of these dimensions. This will be discussed more broadly in future chapters. To content and design I would like to add the technical dimensions of a website, in order to get a full scope of assessment criteria.

A number of useful metrics, together with advice about the design, were found in the PhD thesis of Melody Yvette Ivory "An Empirical Foundation for Automated Web Interface Evaluation"[11]. A whole chapter of her work is devoted to the survey of existing work, mentioning useful metrics and giving a considerable amount of advices. She splits the design of a website into the three dimensions: Information design, Navigation design and Graphic design. However, once again this paper did not mention the technical dimensions of website assessment. From those two works, most of my metrics

were selected, but measures have to be structured.

The structuring of metrics used for the assessment of interface design was taken from "Quality Assessment Methodologies for Linked Open Data" by Amrapali Zaveri, Anisa Rula, Andrea Maurino, Ricardo Pietrobon, Jens Lehmann and Sören Auer[12], who were carrying out research to assess the quality of Linked Open Data (LOD). Although their research domain differs from that done here, the fact that the Internet consists solely of data has allowed the use of some of their insights. They worked over an example of a flight-searching website and proposed a number of metrics that can be used accordingly. With regard to quality dimension, they kept a strict rule of explanation, definition, metrics, examples, and therefore obtained a commendable structure in their paper. Below is an indication of the dimensions used in their work. The dimensions were divided into 6 groups, some of which occur in more than one group. The groups are: Contextual, Representation, Trust, Intrinsic, Dataset Dynamicity, Accessibility. The dimensions which pertain to one or two groups are: Completeness, Relevance, Amount of data, Verifiability, Reputation, Believability, Licensing, Provenance, Representational Conciseness, Representational Consistency, Understandability, Interpretability, Versatility, Accuracy, Objectivity, Validity of documents, Conciseness, Interlinking, Consistency, Timeliness, Currency, Volatility, Availability, Performance, Security and Response Time.
An effective model showing the interaction between dimensions and their groups is proposed by the aforementioned authors.

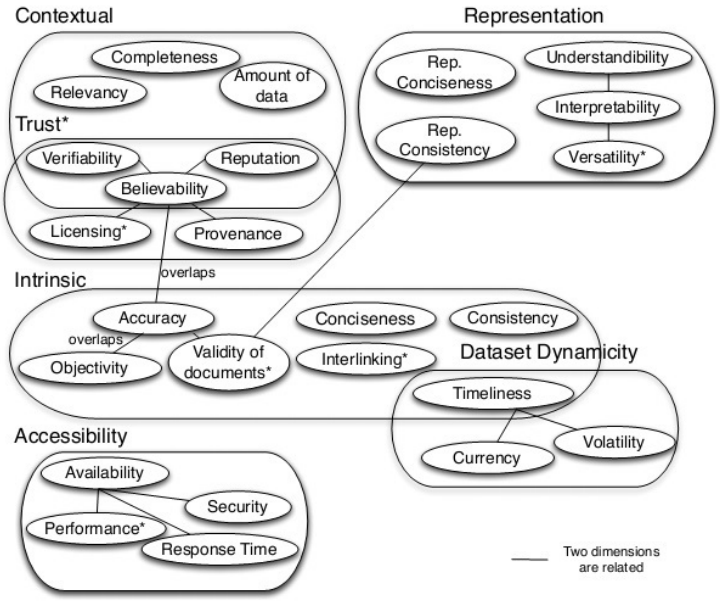

FIGURE 2.2: Linked data quality dimensions and the relations between them.[12].

My work aims to illustrate that many of these dimensions share striking similarities, and can be combined in order to facilitate research and avoid repetition. As mentioned, these criteria weren't expressly created for measuring the quality of a website, but rather for a broader domain. Therefore, not all have been applied to my work. However, the diagram illustrated above was rather straightforward therefore it served as an efficient benchmark for my paper.

Mirjam Seckler, Silvia Heinz, Javier A. Bargas-Avila, Klaus Opwis, Alexandre N. Tuch[1] conducted a study where user interaction with web forms was measured. These forms, despite offering a rather limited way of communication, still remain one of the core interaction elements between user and product. A range of activities, such as registration, subscription services, customer feedback, checkout, data input, search forms and sharing information, to name but a few, can be carried out with their aid. As part of their experiment, they took three major newspaper websites and carried out an eye-tracking user test over them. One group used websites with original forms, while the other made use of augmented forms. Variables between the two groups were approximately the same; a sample t-test was conducted over the participant groups, and showed no significant differences between them regarding age, level of education, computer background, web knowledge, on-line shopping experience and Internet usage. After that they conducted a Chi-square test which also showed no major difference between groups.

Unlike the user groups, the selected forms weren't the same. Three different forms containing flaws according to 20 form guidelines were chosen[13], taking into account the ranking of these forms *"one could be classified as one of good quality (Spiegel.de), one of medium quality (nzz.ch) and one of rather poor quality (sueddeutsche.de)"*[1]. Then the flaws were improved so all of the forms could fit to the 20 guidelines, in order to test them using the second group. So the first group received the original flawed forms, while the second group were provided with an improved version.
After the test data was collected using special applications, users were posed two questions; "What did you like about the form?" and "What did you perceive as annoying about the form?"
Before working with actual testing forms, the participants were asked to fill a trial form. The experiment showed that users performed better with the improved versions of forms rather than with the original ones. Fewer trials occurred while using the improved versions of all three forms.

TABLE 2.1: Number of trials until form was successfully submitted.[1].

Form	Trials	Original	Improved
Sueddeutsche	1	10	24
	≥ 2	22	9
NZZ	1	9	24
	≥ 2	23	9
Spiegel	1	22	28
	≥ 2	11	4

TABLE 2.2: Average task completion time in seconds.[1].

Form	Condition	N	M(SD)	Time Improvement
Sueddeutsche	original	32	113(36)	
	improved	33	85(25)	-25%
NZZ	original	32	105(46)	
	improved	33	70(20)	-33%
Spiegel	original	32	104(66)	
	improved	33	85(30)	-18%

"As a consequence of the number of submissions, improved versions of all forms also performed better regarding task completion time than their original counterpart."[1]. Additionally, the researchers discovered that the total amount of eye fixations for the improved form was lower than the amount for the original ones. Notably, the participants liked the overall design of the original forms more that of the improved forms *"While participants assigned to the original form condition mentioned significantly more often missing format specifications and insufficient identification of required and optional fields, participants assigned to the improved form condition more often criticize the layout of the whole site and not issues about the form itself."*[1].

From this research, the authors aimed to show that web designers can be advised to develop their products by applying appropriate guidelines, in order to decrease the amount of errors and trials. This work differs from the previous ones, for the reason it didn't indicate any metrics of a quality rather a method for their appliance.

2.3 User interaction with LMS.

In this section articles and research directly concerning Learning Management Systems (LMS for short) or, as some authors call them, e-learning systems will be described. In general, e-learning refers to the use of Internet technologies that serve to deliver information or solutions concerning academic issues or material used for teaching in both primary and high education facilities. *"It needs to also support collaboration, offer interaction, implement Web-based activities as part of learning framework, and assist both novices and experts".*[14].

Shu-Sheng Liaw, Hsiu-Mei Huang and Gwo-Dong Chen[15] proposed that e-learning is based on the following three criteria;

- LMS are networked and it allows instant updating, storage/retrieval, distribution, and sharing of instructions or information.
- E-learning is delivered to an end-user via standard Internet technology demanding no more than a computer and the Internet connection.
- It must offer a broader view of learning, exceeding the traditional methods of education and training.

It is often challenging to understand the user's interaction with LMS if such factors as learner and instructor are ignored. Later, a variety of statements mentioned by researchers will be provided here in order to validate this idea. Therefore the relations between individuals, be it learner with learner or learner with instructor, should be taken into account as well. Furthermore, according to the authors, e-learning must possess the following characteristics.
First, it must offer a multimedia environment.
Second, they must consist of a mixture of various types of information. Those pieces of information must be able to be called up easily in a clear and consistent way, independent of a system's structure.
Third, an e-learning system needs to offer a high level of communication, where users possess an interactive system which allows them to collaborate with each other. On the other hand, it must allow instructors to correlate and observe the learning process.
Fourth, LMS have to feature support networks for information assessment. Users must benefit from obtaining an interactive network, with a useful information and service exchange between them.

Fifth, they must support cross-platform environments, allowing services to be executed on various machines with different operating systems. *"In an e-learning system, information and resources from around the world can be accessed by anyone from anywhere in the world as long as he/she has a computer with an Internet connection."*[15].
This paper shows that LMS are a special type of website and should be highly dedicated to interaction between users, who should easily be able to state their opinions and questions about the content of the website.

In the work carried out by Pei-Chen Sun, Ray J. Tsai, Glenn Finger, Yueh-Yang Chen and Dowming Yeh[16], factors that correlate with user satisfaction while interacting with LMS will be presented. As they wrote in their article *"E-Learning is basically a web-based system that makes information or knowledge available to users or learners and disregards time restrictions or geographic proximity"*.[16]. According to the aforementioned statement, e-learning undoubtedly has a range of benefits over traditional learning. However, it inevitably suffers from a number of drawbacks, and most obvious among these are issues relating to resources, guidance and, in most cases, eye-to-eye interaction. The researchers created six dimensions to assess user satisfaction with LMS, namely:

- Student dimension
- Instructor dimension
- Course dimension
- Technology dimension
- Design dimension
- Environmental dimension

From those dimensions, 13 factors emerged, and each of the factors has a correspondence to the dimensions.
Factors concerning the learner's dimension are:

- Learner attitude towards computers
- Learner computer anxiety
- Learner Internet self-efficacy

That means that if the learner is practical with computers and the Internet, the level of his or her satisfaction with LMS will be higher.
Instructor's factors are:

- Instructor response timeliness
- Instructor attitude toward e-learning

When an instructor is quick to respond and really interested in the subject of e-learning, the users of LMS tend to be more involved in a process of learning.
With regard to course factors, authors related:

- E-Learning course flexibility
- E-Learning course quality

Technology factors are:

- Quality of technology
- The Internet

Design factors are:

- Perceived usefulness
- Perceived ease of use

Finally Environmental factors will be:

- Diversity in assessment
- Learner perceived interaction with others

It is easy to mention that some of those factors are not dependent on e-Learning software owners and developers, however other factors could be amended by them in order to increase user's interaction experience and therefore his or her satisfaction with the product. Later, the research group conducted a classical survey in order to determine which of these factors have stronger influence on usability of LMS, and which do not. *"From stepwise multiple regression analysis, seven variables are proven to have critical relationships with e-learner satisfaction, namely learner computer anxiety, instructor attitude toward e-learning, e-learning course flexibility, course quality, perceived usefulness, perceived ease of use, and diversity in assessment."*[16].

The authors confess that their research gave unexpected results, indeed, according to their experiment, satisfaction during interaction with LMS is mostly affected by the learner and the instructor.
However, for my research I decided to take into account all of these factors. Nowadays, the majority feel relatively confident with computers, and I can therefore state that a learner's anxiety with computers diminishes as time passes by. I have taken into consideration variables which I as an examiner may affect, and in future will try to amend those.

Research of a similar nature was undertaken by Shu-Sheng Liaw[17], in which he underlined the same dimensions as previous authors. Here the author emphasized the multimedia aspects of LMS, articulating that it allows users to easily understand complicated content, therefore easing his or her interaction with the E-learning system. Moreover, the author noted that use of multimedia increases communication between learners.
From the three works discussed, I have identified two strengths of LMS, namely communication and multimedia. The emphasis of my subject website should therefore be placed upon those factors.

Having taken various insights from those works, I have decided to draw up my own method for the assessment of Slidewiki. Some articles provided me with metrics while others supplied methods that can be used for their measurement.

Chapter 3

Measures of website quality.

In this chapter readers will become familiarized with the criteria I have taken from previous research. Specifically, these metrics were used during the user testing of the target website. Here the criteria will be combined and categorized according to the meaning.

As mentioned in the previous chapter, the first level of structuring for the criteria was based on the work of Huizingh[10], who named just two factors: **Content**[10] and **Design**[10]. Some authors used the term **Information**[18] instead of content, but in this case the meanings are identical. Every other dimension can be linked to those two factors. So, generally speaking, if the content and design of a website are competent, it can be assumed that the website is of high front-end quality. *"Content refers to the information,features, or services that are offered in the Web site, design to the way the content is made available for Web visitors."*[10]. *"Content is a king."*[19], [20]. *"Ultimately, users visit your Web site for its contents. Everything else is just the backdrop."*[21], [3]. Huizingh has distinguished three basic types of content: informative, transactive and entertainment.
By design, Huizingh was referring to the way the content elements are presented in relationship to each other and the user. The design of the site should meet several criteria that will be shown later. I would like to accentuate that design rules or advice are not applicable to every type of website, hence informative, entertainment and transactive websites, by necessity, have different structures.

To these two dimensions, technical implementations of quality must be added. Those criteria are structured as content measures, design measures, technical measures and other measures.

3.1 Category 1. Measures of Content quality.

The content is the combination of all the information that is available on the website. These measures serve to gauge the quality of information available. The criteria are listed below.

Accuracy[22] - is the condition of something being true. Accuracy is mostly measured in percentages and it shows how close the current value is to the true one. In the view of a web domain, information on the website should match real world information. Some sources[23], [24], [25] correspond accuracy as the answer to the following questions:

- Is the information reliable and correct?
- Is there an editor who verifies the information?
- Does the Web site provide a means of communicating with the author or Webmaster?

Example. Assume the situation of a football transfer. A great deal of unknown private web sites can write about the transfer of certain player to a new club, and most of this information can be dismissed as rumors. However, if the website happens to be the football club's official page, we can be assured that this transfer is to take place and the information can therefore be regarded as accurate.
Metric. Accuracy is measured in percentages. Generally, there are two ways to measure accuracy. The first one is to calculate the fraction of the number of correct elements divided by total number of elements and then multiply the number to 100 in order to get a percentage. If all the elements are correct, the fraction will result in 100% and therefore maximum accuracy.

If it is to measure the accuracy of content, one could be satisfied by measuring the accuracy of the words, expressions and sentences.
Let us assume that there are N words (expressions, sentences) and Nc of them that are correct. By correct words (expressions, sentences) I mean those that are facts and cannot be disputed. Thus, the accuracy will be:

$$Acc = \frac{Nc}{N} * 100\% \tag{3.1}$$

The second way is to take into account the questions listed before, and to calculate accuracy depending on the answers. So in order to achieve 100 % accuracy the following

formula can be used:

$$Acc = W_{auth} + W_{links} + W_{verif} \tag{3.2}$$

Where:
Acc = Accuracy, measured in %; W_{auth} = The availability of means to connect to an author, at most 30%; W_{links} = The availability of references to external sources, at most 30%; W_{verif} = The availability of person who checks information, at most 40%.

Relevancy[22], **Informational fit-to-task**[26]. *"Something is relevant to a task if it increases the likelihood of accomplishing the goal, which is implied by task."*[27] or *"The extent to which information is applicable and helpful for the task at hand."*[28]. Information held on the site should be consistent and fit to the main purpose of the task.
Example. To demonstrate relevance, let us consider a user who wishes to learn about the latest football results. For this task, "Livescore.com" is a relevant site, since it provides all the results of recent games. However, this site is not relevant or fit for the task of learning about the teams or the players. Another example is when a user wishes to perform a purchase online, for this task "Amazon.com" is the relevant website.
Metric. For relevance, I created a metric based on the user's answers to the following questions[29]:

- Was the information on the site related to your expectations?
- Is the site named appropriate to the task?
- Is there a clear statement of Purpose of the site? Purpose must be clear within a few seconds. Did you got any clue to the Purpose from the name of the site?

To all of the questions I proposed 4 types of answers: "Not relevant", "Somewhat relevant", "Mostly relevant", "Relevant". Each of these answers is given the corresponding coefficient of 0 to "Not relevant", 0,33 to "Somewhat relevant", 0,66 to "Mostly relevant" and finally 1 to "Relevant".

Each of questions has it's own weight in percentage. For information it will be 60% and will be denoted as W_{Inf}, since it is considered to be vaguer than the name or clarity of the purpose of the website. The purpose and name will get a weight of 20% each, and are denoted as W_{Purp}, W_{Name} correspondingly. This weight in percentages is to be

multiplied with the coefficient.

The final formula of relevance would look like:

$$Rel = W_{Inf} + W_{Purp} + W_{Name} \tag{3.3}$$

Usefulness[30] is hard to describe as single measure, for the reason that it rather gathers several of them. Let me take a mathematical point of view and assume a site that is a superset of another site. Put another way, assume that website A has all the functions of website B, plus some advantages. Then I can name site A useful while B is considerably less useful compared to A, there being no need to use B. Usefulness at some point intersects with **Innovativeness**[26], since new options will move a product forward in a race with its competitors. Misic and Johnson[31] assumed that every site should have some **Unique Features**[30] or **Uniqueness of Functionality**[31] that will highlight the current site from the other ones. Here it can be deduced that uniqueness brings innovation. Despite this, the interface can also increase the usefulness of a site. Experience shows that if a product has a cozy, user-friendly interface, users will find this site preferable to the new ones.
Example. If it is assumed that a certain website has a better interface, more options to ease the user's interaction, and is more ergonomic than competitors, then it is definitely more useful.
Metrics. It is not an easy thing to measure usefulness, it being much simpler evaluate other aspects which constitute usefulness. A good way to perform the measurement is to compare the product with its competitors and find out the advantages and drawbacks of a particular piece of software. This method is known as benchmarking, and is widely used in a great deal of companies who compare their goods to those of competitors.

Currency[31] is the necessity to keep the website up to date so users will get the latest information. Currency refers to *"The age of data given as a difference between the current date and the date when the information was last modified by providing both currency of documents and currency of triples."*[32]. If some pages from the document are deleted, then corresponding links to those pages should also be removed.
Example. Assume there is a page with information about the city of Bonn. Doubtless, this site will contain information about the history, culture and other obvious features of Bonn. Current events in Bonn should be added onto the page so it always up to date, and the content of the website should be checked regularly, therefore satisfying the currency aspect.

Metric. There exists no need to conceive user testing or survey to measure currency, since this is the responsibility of the website developers. Currency as well can be measured as a time since the website's content was last updated, for instance 1 year, 2 month or 6 hours.

3.2 Category 2. Measures of Design quality.

Friendliness [33], [30] - is a property that eases the user's interaction with the software product.
An effective method of easing interaction is to allow the user to avoid error. Thus, links to the page of personal or payment information should be specially highlighted or a corresponding message should be displayed. Another good option is to allow the user to reach a page via several links. Additionally, some parts of the content could be correlated to friendliness. The site shouldn't contain content or graphics that could be considered insulting by certain groups of people.
Example. For instance, a site that contains the lyrics and chords of thousands of songs is given. Assuming that a user looks for a specific song, a friendly interface will allow the user to search for it or navigate to it via several clicks. Another reliable way is to put a list for the most popular songs. By means of this, the system can store visited links by the user in order to assist him or her in future.
Metric. The most effective measurement of Friendliness is to closely observe user interaction with the website. Attributes such as time taken to perform an action and amount of mistakes he makes while working should be taken into an account during this test.

Customization [22]. As The Free Dictionary[34] described, *"Customization is a process of modification (something) according to a customer's individual requirements."* Hereby the author means that a good website should be adjusted individually to fulfill the customer's or targeted group's demands.
An example of this is Google's Gmail. Besides customization of themes and colors, it allows such individual options as a signature, folder sorting, and a spam classifier.
The metric here will be a boolean stating whether customization exists or not on the website.

Ease of use[22]. Ease of use pertains to the convenience of working on the website. The website shouldn't contain any ambiguous or broken links, text should be self-explanatory, and all commands, choices and options have to be understandable or at least manual, and helping options should be available.
Example. A well-known site for football and other sports' games latest results, "Livescore.com"

is really easy to use in my opinion. The links are simple to understand, current games and most popular championships are shown by default and the menu allows easy navigation between championships.

Metric. Ease of Use is a subjective criterion and varies from user to user, hence it should be measured via a user group test. For that I need two criteria: time taken by user to perform some actions and number of errors he or she made. By actions, I mean basic forms of interaction with the website, such as registering on the site, opening certain pages, and downloading some material from the site. The time it takes to carry out those actions won't be the same for experienced users as for the newcomer to the site. Moreover, in order to calculate the percentage, the time factor shouldn't be taken into account, because a figure of more than 100% can be attained. Therefore, the best way is to use the ratio between time spent by the first-time user and that taken by the experienced user. For that I will use the following formula:

$$t = \frac{t_{exp}}{t_{pil}} \tag{3.4}$$

The value of t will be 1 if $t_{exp} = t_{pil}$ meaning the pilot user acted in the same manner as an experienced user, and the websites interface is on its best value.

The same strategy is used towards errors made during some navigation. The number of errors the user performed will be denoted as N_e . Here the number of errors will be divided by 5. Number 5 is randomly taken and, from my point of view, is the most optimal figure, since I expect at most 1 or 2 errors to occur during performance of a small task. Again, by using the ratio, I acquire the following formula:

$$\varepsilon = \frac{N_e}{5} \tag{3.5}$$

Here the value of ε will represent the optimal quality if the number of errors is 0. And for the poorest quality, when the user performs 5 or more errors, the value of ε will be 1. Accordingly, a final formula of $1 - \varepsilon$ will be used. The final equation for measuring the percentage of ease of use is as follows:

$$Eu = \frac{t + (1 - \varepsilon)}{2} * 100\% \tag{3.6}$$

Ease of navigation[31], [30], **Organization**[22] or **Structure**[30]. The website should be organized and structured, according to design rules, in order not to confuse a user. Well-conceived and structured websites tend to be successful. To measure this factor, I need to use not just psychological measures via user preferences and tastes, but also some technical measures to assure that every link works as expected and without delay. More about structure will be defined in the navigational part of a design. Every page of the document should be able to be accessed without large amounts of time or effort. Navigation is executed via links or a search function. A range of authors are able to provide a considerable amount of information pertaining to this. *"Use moderate levels of breadth with minimal depth (e.g., two levels) in the information architecture"* [35]. The breadth of a website defines an amount of links on one page, while the depth of a link implies an amount of links/pages that have to be clicked/visited to access the current one. *"A large number of links impedes navigation."*[36]. *"Avoid broken links."*[37], [36],[20]. A broken link is a link that is not functioning any more. *"Use clear headings with related links (i.e., link clustering) to enhance scent."*[38]. *"Effective navigation requires small pages (views), few clicks between pages, and strong scent."*[20]. *"Weak scent (i.e., ambiguous link text) impedes navigation."*[39],[40], [38], [36]. *"Similar link text across links impedes navigation."*[36]. *"Do not use a shell strategy (i.e., fixed navigation bar content); use navigation bars at the top and bottom of pages vs. down the sides."*[36]. *"Avoid using 'Click Here' for link text."*[20]. *"Support multiple modes of ending information (i.e., directed searching and browsing)."*[41],[42]. *"The navigation scheme should be easy to learn, consistent, efficient, and relevant to the type of site (i.e., entertainment and information sites use different navigation schemes)."*[41] *"Use breadcrumbs (i.e., displaying a navigation trail) vs. long navigation bars."*[20]. The purpose of breadcrumbs is to ensure that the user always can take one or several steps back without using the "back" button.

For example, a sports database site holds a huge amount of the latest results, recent news, team information, player information and so on. Good navigation should allow the user to quickly roam through the site, including breadcrumbs, so he or she can go back without pressing the "back" button, thus quickly providing the user with the desired information.

Metric. To measure navigational options, one should check whether all links are clickable, highlighted, and are delivering where they are expected to deliver, and check the overall structure of website, and make sure that "breadcrumbs" are available.

Search functionality[22],[43] - is a feature available on the most websites allowing users to skip the step of checking every page by quickly fetching a required one. *"Support search; users use search half of the time."*[44]. *"Make the scope and results of searching clear."*[36]. The search field should be in the upper part of a website, since

users intuitively look for it there.
Example. An effective search should sort documents by relevance, include auto-complete and work fast. For instance if a Wikipedia user searches for "Football", the most relevant result will be article about the game itself, rather than "World football championship".
Metric. The measure should be conducted through the following questions:

- Did you use search field?
- Was the search result clear enough?
- Was it easier to search or to navigate manually?

Below, I will describe how to measure the relevance of search results. The required document should be among the first five returned after searching. In the best case, it has to be the first one. The classical way to measure relevance is a fraction where the nominator will be the amount of relevant returned documents and the denominator the amount of all returned documents. The formula is as follows:

$$SR_1 = \frac{Nreq}{N} * 100\% \tag{3.7}$$

However, this formula doesn't take into account the place of the required document among the fetched ones. The desired document should be in the first position of the returned results. Therefore, formula 3.7 cannot be used in here. Accordingly, it is assumed that the best way is to use the term known within software development as 'associative arrays'. The idea is that in two arrays, the values of the first one are bound to the corresponding ones of the second. One array will hold values from 1 to (e.g. 10) and represent the position of the desired document in the returned list. The second will hold values from 100% to 0% and will represent the percentage of relevancy. So if the desired document is the second among 10 returnees, the relevance will be 90%, and if the amount of the returned documents is 20, then relevance will be 95%. Here in both cases the desired document is the second one, however in the second case the number of returned documents is twice the number of case 1. For that reason the relevance in there is 95% not 90%. The closer the document to the begging the bigger the relevance will be. This number will be divided by 2, because in this context maximal weight required is 50%.

The formula to measure search functionality is as follows:

$$S = W_{AF} + W_{Rel} + W_{Sort} \tag{3.8}$$

Where:
S = Search Functionality, which is measured in %; W_{AF} = the fact that autofill is present, at most 20%; W_{Rel} = the fact that search results are appear in a relevant order, at most 50%; W_{Sort} = the fact that search results can be sorted, at most 30%

Contextual control ability[45] or **Intuitive operations**[26] are operations that could be performed by users intuitively without constant feedback about being true. The next step in the control chain is coming intuitively from the context of the previous one.
Example. To access the website of a master program in the computer science of Uni Bonn, a user will intuitively navigate departments/faculties, natural sciences, mathematics and informatics, and therefore reach the list of programs. A further example is the location of forms. For instance, in most cases, the register or login form is located on the upper right or sometimes on the upper left part of software, and the user intuitively navigates there to register. The same rules are applicable to the main menu, search field and other main forms.
Metric. The best way to measure this is to follow user actions while he or she works on a website. The Eye Tracker device can be particularly useful in this regard.

Cohesiveness by grouping main control objects[45]. Cohesiveness is a term used in a variety of sciences as physics and botany, and denotes an act of elements grouping together. A good way to achieve cohesiveness in website interface is to use the Gestalt Laws. Based on human psychology, these laws are used by designers in every area. The crux is that similar objects are better grouped together, and that users tend to break complicated objects down into simple ones.
Example. Let's take a computer keyboard; It can be considered as a whole, but it can also be seen as being grouped from parts like numbers, arrows, letters, control keys, and so on. Software examples are many popular social networking sites, such as "Facebook.com" and "Coursera.com".

Direct control permanence[45] is a state of conserving the main control bar in every page.
Example. Let's take a well-known social network website as Facebook. Icons such as friends, messages and notifications are always on the top of the web site and, independent of internal pages (profile, news feed, apps/games), always conserve their dislocation. This bar tends to be either on the top (Facebook, LinkedIn) or on the left side of page (Fraunhofer website). There are cases when the main navigational bar is on the top and the secondary is on the left (Uni Bonn website).
Metric could be Boolean stating "yes" when direct control permanence is present on the

site, or "no" otherwise.

Finding main page[31] - often referred to as the home page - is another criteria for a website evaluation. *"Home page: main entry pages to a site that typically provide a broad overview of site contents."*[30]. By design, a home page should be unique and contain navigation to other pages within the site. Also, the home page is the only page that should be accessible from any other page.
Example. Many sites use the logo of product as the key to a main page(Amazon, Uni Bonn).
Metric. There are only a boolean way to measure the home button, stating whether the link is present or no.

Web-related criteria such as finding contact information[31] is a special link or field used to retrieve all the information about an author or website developer, such as e-mail, people, phones. Most websites hold this information in the "about" or "contact" link. Within this field, software looks more like a product on a market with information about it's manufacturers, and also could include some warranties and EULA. This will create a web page with a presentable view. Apart from just applying this field to a product, the developers or owners of a site should be accessible and regularly check emails, guest-books and forums. In case of user testing, the questions below could be correlated with the current aspect:

- Did you find about page?
- Could you get the contact information of the website developers?
- Is there enough means of communication to request support?

Example. A great deal of modern websites have an informational page, as well as contact information. For example, "Amazon.com" possess a page full of contacts, terms and policies and support for users. However, the best contact information, from my point of view, was found on the well-known website "coursera.com".
Metric. One way to measure the success of the contact information of a website is to measure the time it takes a user to find those contacts, starting from the home page. Another method could be to measure the number of clicks it takes to find a contact information.

Color and style[31], **visual appeal**[26], **graphics**[30]- different names are used by different authors to emphasize the importance of coloring and designing a web product. Advice like *"Use distinct link and visited link colors."*[20], [46] are heeded and applied on nearly every website. *"Use link and visited link colors that are similar to default browser colors (shades of blue, red, and purple)."*[20]. *"Use default browser colors for links."*[36]. The following lines were written about combinations of colors: *"Use color combinations determined to be good (i.e., high contrast) via research studies."*[47]. *"Avoid using black backgrounds."*[37]. *"Use high contrast between background and text."*[37], [20].
An example is the Facebook social network. Color schemes are blue and white and they are harmonically disseminated within the whole site.
Metric. Not applicable, as color and style is an object of preference.

3.3 Category 3. Measures of technical implementation quality.

Speed[22], [43], [31], [26], **access to the website**[30]. Major technical criteria responsible for quick access to every page and website itself. The website should be accessed without crashes and loaded within a certain period of time, as well as reacting quickly to the user's commands and queries. Furthermore, the download time of pages shouldn't be long, in order to prevent a low number of visits. *"The response time depends on several factors such as network traffic, server workload, server capabilities and/or complexity of the user query, which affect the quality of query processing."*[12]. In addition, the source code should be written in such a way that the database can quickly retrieve all required information.
Example. I presume that the best speed performance could be observed in all the products of Google.
Metric. The time of the database's responses to the user's queries should be measured. Another way to assess the client server structure is to measure the time between the user's request and server's response to the query.

Security[22], [43] - this criteria could be one of the main concerns of web users. *"The possibility to restrict access to the data and to guarantee the confidentiality of the communication between a source and its consumers."*[48]. Website owners are obliged to protect the data of users such as payment details, passwords and personal information against hacker attacks, viruses and information leaks.
Example. Based on a general assumption, I would point to sites such as "Amazon.com"

and "Gmail.com", which could be nominated as secure ones.
Metric. Being a rough technical aspect, security can be measured only by professionals in a field of data protection and malware detection.

Internet Standards[43] *"are used as guidelines for the development of Internet software which conforms to generally accepted rules for communication between applications."*[43]. These are standard technologies used while developing a website so the product could be opened via every browser without crashes and delays. When a standard is missing or augment, the software does not functionalize as expected. One classic example of these problems is the formatting of graphics and videos. However, here an absence of perfection in browsers should also be taken into account (i.e. Internet Explorer), especially while opening embedded videos from mobile devices. Nowadays, HTML5 has granted web developers an easier life, allowing them to use videos without side plugins, and allowing such actions as drag and drop and cross platform performance, thus making it easier for developers.
Metric. To measure whether sites are written according to Internet standards, it is necessary to go through it's code and have the product tested by a group of developers.

Interactivity[22] or **Responsiveness**[18]. This is the ability of a computer program or website to "talk" to the user. 'Interactive' is taken to mean that the site will respond to the user's commands, such as clicking, typing, drag and dropping or any other action done by the user to manipulate the website.
Example. Websites such as "Google.com" and "Youtube.com" are considered to satisfy the rule of interactivity since they are quite straightforward and perform in an expected way.
Metric. The best way to measure interactivity is to commence a user test of a product. However, there is a less expensive alternative to developer testing. Since most issues in this field could arise with technical problems or carelessness, developers could find these complications by themselves.

Portability[2] - an aspect that is a standard used by International Standardization Organisation. *"A set of attributes that bear on the ability of software to be transferred from one environment to another."*[2]. Hereby ISO consider that every website should be available on different browsers and from various platforms, such as tablets, smartphones, and so on. Using modern technologies, nowadays every website is accessible from smartphones or tablets, but not every website has a successful interface on its portable version. For this reason, many products have a special application (Facebook, VRS.info, Coursera) that eases access to a product from portable devices.

Example. A great deal of websites today perform well on tabs and smartphones. Of particular note are, Facebook, the Uni Bonn website, and Wikipedia, among others.
Metric. Overall, the performance of the mobile version should be checked in order to gauge the portability of the website.

Maintainability[2]. *"A set of attributes that bear on the effort needed to make specified modifications."*[2], this is how ISO defines it. To satisfy this factor developers should code their software in a way that it can always be updated and altered.
Example. Sites such as "Facebook" or "Google" are built in a such a way that developers can make everyday changes upon them.
Metric exists in the form of the feedback of the software developer who works on the site to the one who wrote the source code of the site.

Functionality[2] - one of the most general attributes in measuring web quality, but nevertheless awarded with a place on the ISO measures, hence will be named and described here. *"A set of attributes that bear on the existence of a set of functions and their specified properties. The functions are those that satisfy stated or implied needs."*[2] Put simply, functionality is the quality of a product to have a practical use.
Example. Nearly every website that works without bugs and shows its content in a proper way can be named functional.
Metric. An easy way to show functionality in percentages is to take the ratio of working tools and links (WL) on the website to overall tools and links of the website (TL).

$$Functionality = \frac{WL}{TL} * 100\% \tag{3.9}$$

Reliability[22], [2], [33] - *"A set of attributes that bear on the capability of software to maintain its level of performance under stated conditions for a stated period of time."*[2] Reliability closely intersects with **Trust**[26]. Generally, trust is a sociological term and a fundamental explanation of it is when one party relies on another to perform expected actions. In the case of web domains, reliability explains two factors, namely how software could perform within a certain period of time, and the amount of people who can trust the website.
Example. Take a website such as "Amazon.com". Thousands of users entrust it with their credit and debit card information. After so many years in the market, the functionality of Amazon has never decreased but increased, and can therefore be considered reliable and trusted.
Metric. The following questions can be asked to determine the reliability.

- Would you like to revisit this website?
- Do you think you can rely on it?

The simplest way to determine the mathematical measure of reliability is to take the ratio of the amount of the people who visited the website more than once (SV -Several visits) to the number of the total visits within a certain period of time(TV Total visits). The only thing that should be taken into account is that all the users should spend some period of time on the website or to perform a couple of actions (visiting one or two links, scrolling, and various other actions).

$$Reliability = \frac{SV}{TV} * 100\% \tag{3.10}$$

3.4 Category 4. Other measurements.

Efficiency [2] - This criterion is another one from the ISO-named criteria. *"A set of attributes that bear on the relationship between the level of performance of the software and the amount of resources used, under stated conditions".*[2]. Every website has some purpose, not only for the users of the web network, but also for the owner. Most of them are businesses which bring income for the owners - some of them are charities, but even they bring some revenue in the form of donations for owners. If the expenses for the web product are much higher than the revenue it brings, then it can be stated that the website is inefficient.
Example. Immediately obvious in this regard are such well-known sites as "Google" and "Facebook". Both of them were created with minimal expenditure, and later brought billions to their founders.
Metric. Efficiency can be measured by funds as well as by time, technical efforts, amount of people involved and so on. The same could be said about revenue, not only in terms of money, but also the amount of visits, satisfaction and interest of the public in the product. If a website runs for a year but has a low amount of visits, it can be called inefficient.

Usability[2] - another standard criteria that has very wide field of description. Many people understand usability as ease of use or user friendliness. ISO defines it as: *"A set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users."*[2]. Another definition from ISO is: *"The capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions."*[2] As a general rule, usability is the

prime attribute that bounds nearly 80% of the aforementioned factors. Therefore, if software answers to usability demands, it can be considered successful.
Example. From my point of view the best exemplification of usability is Google. It has a straightforward interface, where every tool is working Google can be said to satisfy all the measures mentioned in this chapter.

A range of measures proposed by an array of authors was shown in this chapter. Bellow the figure summarizing the measures and their dimensions is illustrated:

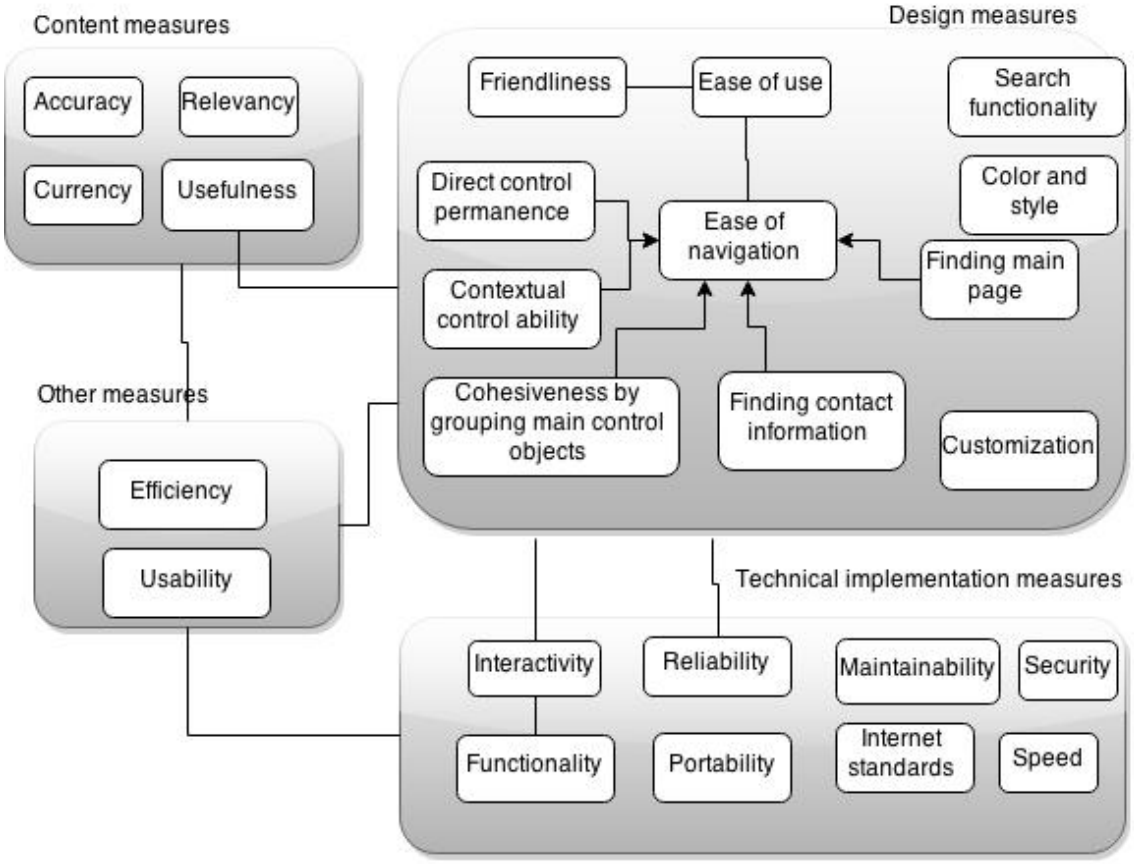

FIGURE 3.1: Metrics and Dimensions of them.

As was shown on the image some metrics are related to each other and in some cases (Interactivity, Reliability and Usefulness) are related to other dimensions as well. The dimension "Others" is connected to the rest of three dimensions since it's metrics depend on the other ones.
Aforementioned metrics could be used for measuring the quality almost of every website. For the LMS the multimedia metric was added in order to measure the means of communication within the website. All of the research done for Slidewiki was based on these metrics. Most of the content measures weren't measured, since Slidewiki is an

open source and I presume that the content is an entity entered by users rather than developers.

Luis Olsina, Guillermo Covella and Gustavo Rossi have made rather useful and indisputable note here. It is rather obvious that final users are mainly interested in using the software or Web application, i.e. their interests are how software performs and for what purpose it exists, rather than in knowing the internal facets of the source code or the maintainability of it. *"For this reason, when the external quality requirements are, for example, defined from the end user's standpoint, generally usability, functionality, reliability, and efficiency are the most important. Instead, from the maintainer's viewpoint, analysability, changeability, stability, and test-ability of application modules are the most important."*[2].

Chapter 4

Usability assessment methodologies.

In this chapter, the reader will be familiarized with several techniques known in HCI for measuring the quality of a website. In addition, he or she will find a table of advantages and drawbacks for each method. At the end of the chapter, the method for the evaluation of the Slidewiki will be presented and motivated.

Survey.
According to[49], surveys are a well-defined and well-written set of questions to which an individual responds directly. A survey cannot be used alone as a method for website evaluation. Before a survey, the user interacts with the product by fulfilling several tasks. The tasks are basically the same for every type of website, and included are so called red routes. Red routes are critical tasks that can be fulfilled by the system. This is the main reason why people use the current product. By focusing on the red routes I can be sure that other options do not impede the main ones. For Slidewiki, red routes will be registered in a system, view/edit presentation, creating a deck.

After conducting the first interaction and completing the red route action, users are asked about 20-30 questions about a website's design. Surveys usually involve 15-30 or even more participants. Participants are usually from different demographic areas, various computer knowledge backgrounds, different specializations, different ages and genders. This is in order to ensure that the current product is available for everybody without exceptions. Surveys are one of the most commonly used methods to estimate the quality of most products(not only software). The reason is the cheapness and ease of surveying. The drawback of surveys is that they are not always precise and could be considered as biased. A further drawback could be the misunderstanding of survey

questions by participants. A table representing the advantages and disadvantages of the survey method is shown here:

Table 4.1: Pros and Cons of survey method.

Advantages	**Drawbacks**
Gather data from every type of user	Information is not 100% precise
Cheap	Need to gather a big group of participants

Eye Tracking.

The best method to measure user interaction with a website is the eye-tracking approach. An eye tracker is a machine that shows the user's pupil movements across the website. Eye tracking is the process of measuring where one is staring - the so-called gaze or the general movement of an eye. An eye tracker is a device for measuring eye positions, eye movement and some of them even measure the speed of eye movement. Eye tracking is the best, because it gives indisputable data which is 100 percent correct and independent of the user's intentions. It will be a challenge for the user to mislead the machine or himself during an eye tracking session. Moreover, some minor issues with software can be shown by the eye tracker, which traditional research methods fail to reveal. Researchers can analyze the visual path of eye movements across the site via the monitor or the printouts. In those printouts, fixations are noted by the round dots, while the lines are saccades, representing fast eye-movements. People tend to use those quick movements between fixations of the pupil. Saccades are mostly used while reading, quick gazing, or searching for something in a small area. The eye tracker helps to monitor how a certain object (link or field) is accessible to a user's eye, how quickly it will be found, and where he or she will look for it.

Below a comparison table of the advantages and drawbacks of the eye-tracking method will be provided.

Table 4.2: Pros and Cons of eye tracking method.

Advantages	**Drawbacks**
Sound and correct data	Expensive device
Shows what does the decision making process look like	Device dependent in case of damage it can show the wrong data
Shows what attracts attention	
Shows where important tools should be placed.	
Shows what links or fields are looked upon but not clicked	

The process of eye tracking may look like a normal user interaction testing, as in conventional methods, there are some goals that the user aims to achieve. The goals include registering in the system, creating a presentation and translating a deck, among other targets. However, in this instance, instead of asking a user how easy it was to find a particular option, answers will be elicited via his eyes movements. When the researcher asks the user to fulfill some task, like registering on the site, he or she can figure out whether the location or design of the registration form is good enough. This happens by gathering eye-tracking data like the number of fixations, fixation duration, time of saccades and so on.

Over years of research in web design, a number of discoveries were made with the assistance of an eye tracker. By researching user's eye movements, Nielsen in 2006[50] found that users check an opened page in an "F-shaped pattern". First they check the upper horizontal bar, then a quick vertical glance down, after it second short horizontal view and later user keeps scrolling down over the content. Of course all of this happens within seconds, and takes place when then user has just opened a new page.
Nielsen tracked user's eyes on different types of websites, and noticed that "F" patterns can be revealed in almost every type of a web page. There are cases when the "F-shaped pattern" slightly varies (e.g. a search engine page elicits what looks more like an "E-shaped pattern"), but still holds. With the assistance of this research, website designers know where to put key parts of their interface in order to ease the user's interaction with it.

Analytical tools.

Another interesting means of measuring website quality is to use such features as the traffic measurer, bounce rate assessor and counter. This will not measure the quality of website interface, but rather the preference of the current page or overall website by the user. Bounce rate is the amount of pages the user visits on the current website before he "bounces off" it. This can show how long the website can hold the interest of the user, and in which order he or she roams through it. The counter will count the amount of visits to the relevant website. Nowadays, this tool is not frequently used, since both traffic analyzer and bounce rate counter include that option.
The advantage of this method is that it gives sound and precise data. However, this data is regarded as insufficient, since it will reveal the weak pages of the product but not the weak places on those pages. By other words, it shows the popularity of the website or of the pages in it, but fails to reveal the issues with the design. Another small drawback that it takes much longer to gather data, often from weeks to months. These analyzers are best used before conducting any other research methodology.
Below the table of web analyzers is shown:

Table 4.3: Pros and Cons of software tools method.

Advantages	**Drawbacks**
100% Precise data	Data is not complete
Many free services	Takes more time to produce results
No need to gather any groups	

For Slidewiki this is not applicable, since it is a learning management system and therefore doesn't have a stable period of usability. During vacation periods, the amount of visits decreases, while during exam times it achieves an apex of visits.

Single user observation.

Single person observation is another easy but relatively precise method of interface evaluation. The process starts by selecting a few (sometimes even one) participants who best fit the target group of the product. All the required background user data is collected by interviewing a candidate, after which he or she is asked to interact with the product in several ways. Interaction cases could be roaming through the product interface or following the red routes, thus allowing a great deal of measurements to take place. First of all, interviewers measure the time required to achieve each task. There are cases when the amount of clicks, wrong mouse draws or wrongly opened links are also measured. After the test, the user is briefly surveyed about his experience with the product. Because of the precise measurements, followed by a quick questioning session, a single person test could give better results than surveying 30 or more people. Furthermore, this method is sometimes easier to carry out, since no large venue is required. The drawback will be that all the results are dependent on one or few individuals.

The table of single user case is shown below:

Table 4.4: Pros and Cons of user's observation method.

Advantages	**Drawbacks**
Combination of survey and observation	One person dependent
Cheap	
Do not require a big group of participants	

Four different methods were presented in this chapter. Each of them could be useful in a different way for evaluation of the Slidewiki interface quality. Bellow the table of comparison of those metrics is drawn. Five main aspects of each method like time to perform an experiment, amount of users required, the precision of results, area of usage (what it reveals) and cost of the testing were evaluated here.

Table 4.5: Comparison of methods for website evaluation.

	Survey	**Eyetracking**	**Tools**	**Single user**
Time	1-2 hours	1-2 hours	1-2 month	1-2 hours
Users	15-30	1-2	0	1-2
Precision	Average	Top	Top	High
Usage	Shows issues	Shows issues	Shows popularity	Shows issues
Cost	Free	Expensive	Mostly free	Free

This table shows that the best research methodology is testing with an eye-tracker; it loses only at price.

After slight consideration of the methods, I decided which one is more suitable for Slidewiki. The website is in an early stage of development, and still suffers from obvious errors and bugs, and some design aspects are not perfect. The basic requirement is to find some obvious flaws and, to that end, an eye tracker would be the best solution. Due to financial restrictions, this was unviable, and so an alternative method was proposed. Taking into account all these aspects, a decision was made to implement single user testing. In the next chapter this process will be broadly described.

Chapter 5

SlideWiki usability analysis.

5.1 Slidewiki.

Here the test website will be introduced to the reader. Slidewiki was created by AKSW research group under Creative Commons license. The primary aim in creating Slidewiki was to give an opportunity for students to get familiarised with the materials presented during particular classes. Lecturers are welcomed to post slides on the website to help everyone gain access to the learning material. Instead of merely reading, users can perform some changes to the presentation while keeping the original version untouched. In the case of group assignments or projects, Sildewiki allows students to collaboratively work upon the creation of presentations. Due to these unique features, Slidewiki removes the necessity to send a presentation to each other, allowing collaborative work to flourish. Its academic nature means that Slidewiki can be used in a business environment where the presenter can share his presentation with an audience, so people can easily follow him or her. The site allows it's users to export PowerPoint presentations from a local machine. Another feature of the website is that presentation can be tagged as unseen so no one except the creator can see it. An integrated search engine allows the user to quickly find the required presentation or slides. The simple hierarchical system is organised so as not to cause any deception for the user. While creating a presentation, the user can choose from a variety of themes or transitions in order to design his or her project. Additionally, unlike normal PowerPoint options, Slidewiki has options such as Code Snippets to include and highlight pieces of code, and integrated LaTex compilers, in order to enable users to add mathematical formulas to their presentations. Moreover, users can discuss presentations and add comments to them. Also, effective options such as an examining mode are included in the Slidewiki, so users can check their knowledge of the subject. The innovative feature of the embedded Google translator is an essential

part of Slidewiki. This cutting-edge feature turns Slidewiki into the benchmark for other slide sharing platforms.

This is to be considered a general overview of the premise upon which this research was conducted. It is obvious to see that Slidewiki has all the options of LMS, and boasts a number of groundbreaking innovations. The site has great potential, and as such invites research. Unfortunately, some of the aforementioned characteristics have problems in their design. Below these issues will be observed more broadly, and augmentations for them will be proposed. First, however, a general description of the research method and data about the testers will be shown below.

5.2 Method.

As was mentioned in previous chapters, it was decided that a single user observation test was to be conducted. To this end, three users, whose demographical data will be described in the following table, were chosen.

Table 5.1: The data of users participating in the experiment.

Users	**Gender**	**Age**	**Occupation**	**Computer skills**
User 1	Female	19	Student Engineer	Good
User 2	Male	25	IT helpdesk	Excellent
User 3	Male	22	Economics Graduate	Average

In order to perform interaction with the Slidewiki, users were asked to complete the following actions:

1. Register on Slidewiki
2. Open deck "Open education handbook"
3. View couple of slides
4. Try to save it/download it
5. Go back to the main page
6. Open the "Test" presentation
7. View it in a different language (translate it)
8. Comment on it
9. Change some themes and transitions

10. Use KeyNode JS to play presentation
11. Edit "Test" presentation according to taste
12. Create a new presentation
13. Add extra slide to it
14. Add an extra sub-deck to it
15. Create a slide with different text colors and image
16. Use text effects such as bounce, highlight
17. Create a question to your slide
18. Check the special effects of your deck (Build4impress)
19. Go back to the home page
20. Try to contact the website owners
21. Import the presentation available on desktop
22. Open a user page
23. Message him/her
24. View his activities
25. Search using the searchfield for the presentation "Semantic Web Lectures"
26. Exam yourself in there

Users weren't asked any specific questions, however they were requested to give feedback for each step performed by them. After finishing all the stages, they were asked to give comments and suggestions. A screen recording tool was used in order to keep the video of the tester's interaction with the product for further exploit. In the next paragraph the issues, violated metrics and possible solutions will be presented.

5.3 Issues ans Solutions.

From hereon in, the following structure will be used: Group of Issues, Issues and their sources, Images of Issues, Violated Metrics, Proposed Solutions and Mockups.

Issues with slide download.

It is key to mention the download problems occurring when the user tries to save a deck for off-line viewing.

Issue 1 - Simplification. The issue is dedicated to simplify downloading or exporting options of a presentation. For now the available options are to download a deck and to export it as SCO. In both cases the presentation could be viewed in off-line mode using a browser. But the downloaded file is archived with a lot of Java script files, even more folders and one HTML file, possibly misleading users that do not have any web-development ideas. Even for those accustomed to this, it will be more pleasing to see just one file instead of an archive full of useless files. There is a way to save a presentation as a PDF, but for that, a user should click the "print deck" button and then export it into PDF using the printing options of a browser. According to the design rules, the site should be self-sufficient, and for that reason export as PDF has to be performed without the browser's aid.

Source. This issue was discovered during my own experience with the website and was later confirmed by all three users.

Issue 2 - State of the button. It was reported by users that the download button appears only when the whole presentation is selected. However, when the slide or sub-deck is selected, "Download" does not appear in the run down menu.

*Source.*This issue was discovered by two out of three users during the experiment.

Issue 3 - Finding the button. Another small problem that arose regarded difficulty finding the "Download" button.

Source. This issue was discovered by two out of three users during the experiment.

Metrics violated: **Friendliness, Ease of use.**

According to formula 3.6 Ease of use of the downloading feature is 32% for the first user, 42% for the second user and 51% for the third one.

In the following pictures, the issues can clearly be seen.

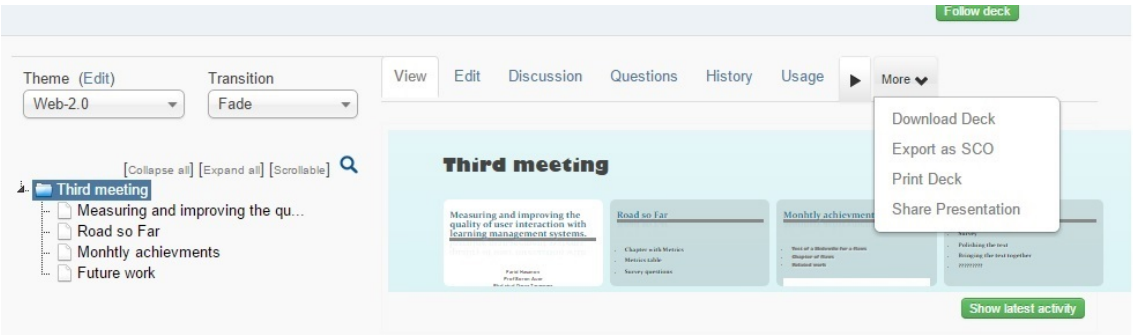

FIGURE 5.1: Current state of download button.(Deck selected).[51].

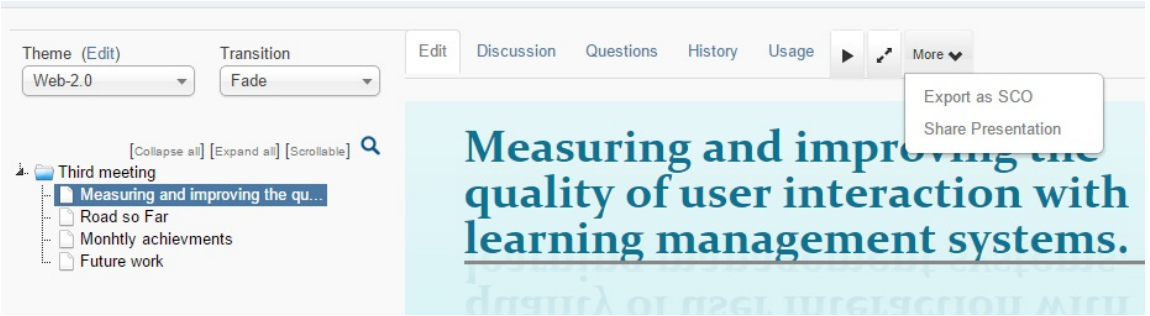

FIGURE 5.2: Current state of download button.(Slide selected).[51].

Possible solution. One of the vaguest modifications imposed here was adding an option to download a deck as PDF. This link will instantly open a PDF file, either in the browser or using the PDF viewer installed on the system. The option to save or print this file will be provided by the PDF viewer rather than by the website. Obviously, this new link will remove the obligation of using the "Print deck" link. In the current version of Slidewiki, in order to download a presentation as a PDF, the user has to print a deck before using the browser's "Save page" or "Print" command. I propose that the option of a "Download Deck", which involves downloading a deck as a web file which can be viewed as a HTML file, be renamed to "Download Deck as a web file". This will eliminate misunderstandings with other types of deck download. Moreover, here the link to download a presentation as a Powerpoint file was added. Additionally, "Download" is an independent button now and appears just before "More" in the panel.
Mockup. For the sake of repetition, a mockup for issues will be provided at a later point.

Issues with special tools. With tools allowing a user to create special effects with slides, such as "Builder 4 Impress" or "Impressionist", three slight issues occurred.
Issue 1 - Finding the buttons. It is difficult to find those tools, since they are located in the "(Edit)" link standing near transitions and colored in transparent gray.
Source. This issue was discovered during my own experience with the website and was later reiterated by all three users.
Issue 2 - Usage of the tools. There is no documentation or hints for the user describing how the tools are used.
Source. This issue was discovered during my own experience with the website and was later reiterated by all three users.
Issue 3 - Navigation violation. The tools are opened in a new page just over the current one. In order to return, the user has to press the "Back" button of the browser, which is incompatible with the design rules.
Source. This issue was discovered during my own experience with the website and was later reiterated by two users.

Metrics violated: **Ease of Navigation, Ease of use.**
Here ease of use wasn't properly measured, due to the fact that users couldn't even find the tools. In fact, the tools were discovered by accident, so the ease of use for the tools would be 0%.
Current State:

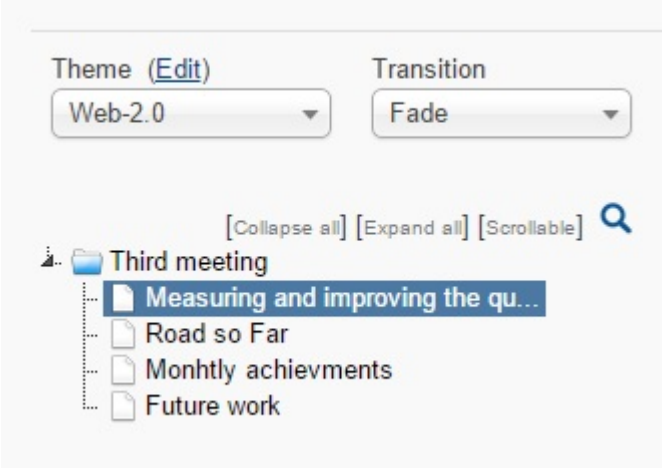

FIGURE 5.3: Current state of edit theme button which leads to the tools.[51].

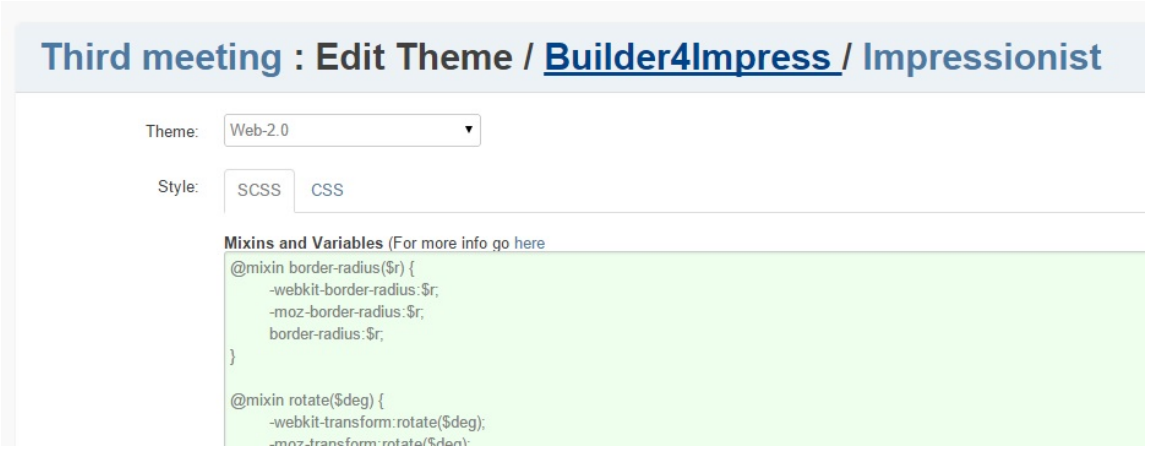

FIGURE 5.4: Current state of the tool buttons.[51].

A possible solution would be to move the tools into a front view and add hints to them. Of course, the tools will be opened in a new tab, enabling the user to easily continue working over the presentation. This also will satisfy the "breadcrumbs" rule and remove the necessity of the pressing the "back" button.
Mockup. Once again, to avoid repetition, the mockup for these issues will be provided later.

Issue with exam mode. Here the sole issue with the examination mode will be presented.

Issue - deception of the link placement. During viewing of presentations, the testers couldn't start the examination session quickly. In order to enter the testing mode, the user needs to scroll over all the questions and open the exam mode below.

Source. The flaw was discovered by two users during interaction.

Metrics violated: **Ease of use, Organization.**

Whilst attempting to find the exam mode, the first user spent twice as much time as the experienced one, and wrongly clicked 4 links before finding the right one. The overall ease of use figure for her in the exam mode task is 35%. The second user was slightly faster, achieving 67%. For the third user the figure stands at 58%.

Current State. The issue is presented in the following figure:

FIGURE 5.5: The current state of exam mode activation.[51].

*Possible solution.*The exam mode is moved directly to the upper panel.

Mockup. The sketch handling all the aforementioned issues is located below:

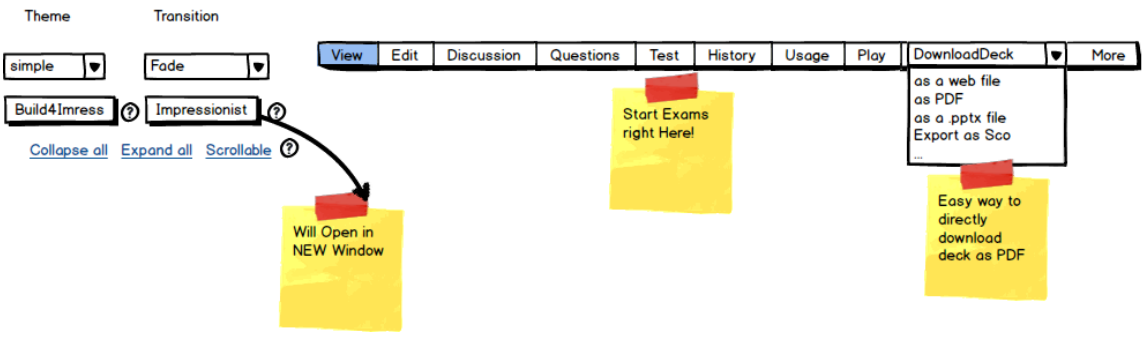

FIGURE 5.6: Mockup for download, tools and exam buttons.

Issues with slide editing. During creation of slides a new problem arose. Most of the flaws are correlated with image scaling in the slides, however the first one pertains to text formatting.

Issue1 - Text format special tools. In the editing panel of a slide, options such as "Bounce

text", "Shake text", "Pulsate" and "Highlight" are absent, although they can be added via source code. This puzzles even software developers, since they cannot know which HTML options are written in source code and which are not. However, for the average user this could be more serious, since experience shows that he or she won't be satisfied with roaming through lines of code in order to add some effect to his or her presentation.
Source. This issue was detected by my preliminary research. The testers were asked to perform some of the text formatting, but obviously they weren't aware of how to find those options.
Metric violated: **Ease of use, Friendliness, Navigation.**
Here the ease of use is 0% for every user, since no one could figure out how to add those options to the text.
Current state. The figure below illustrates that options of additional formatting are present on the site.

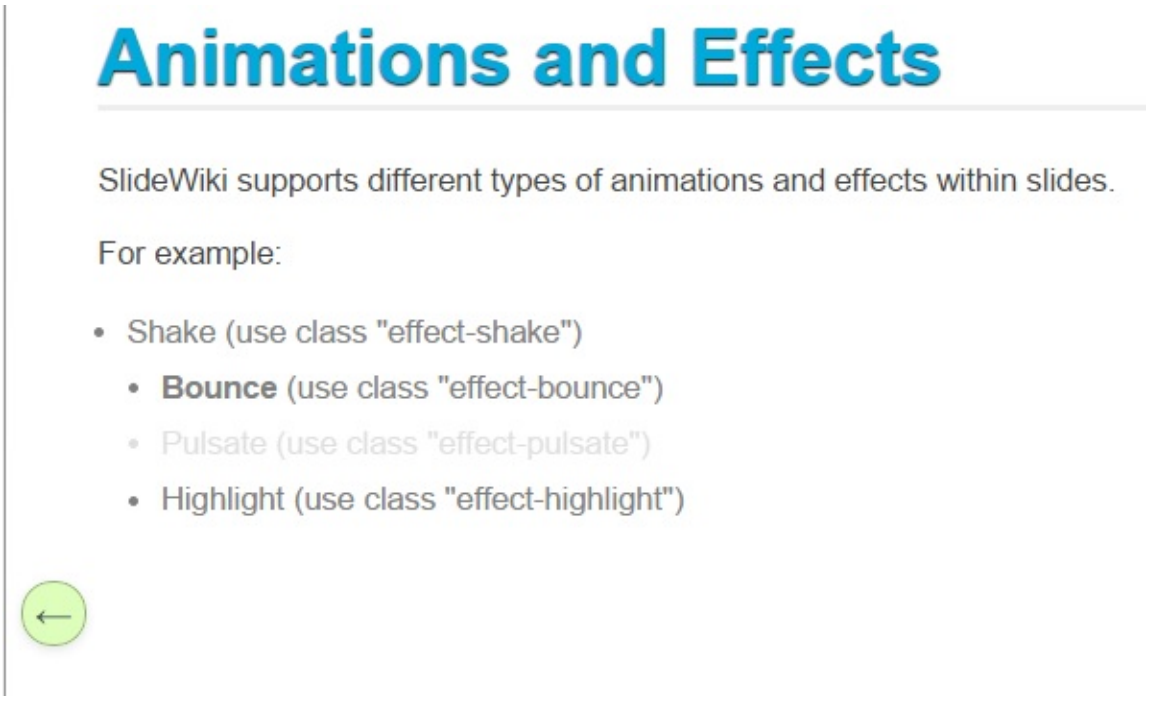

FIGURE 5.7: Example of bouncing, pulsating text.[51].

This figure shows that options of additional formatting could be added through the source code.

FIGURE 5.8: Source code of special text formatting.[51].

Figure showing that options of additional formatting are not available on the panel.

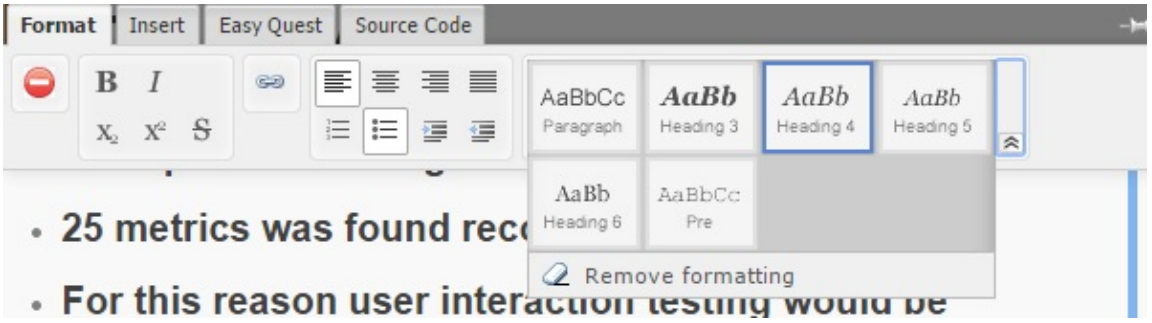

FIGURE 5.9: Panel of formating which shown that special options cannot be added from there.[51].

Possible solution. The only probable solution is to add those options into the format tab of the slide editing panel.

Mockup. The proposed solution is presented in the picture below:

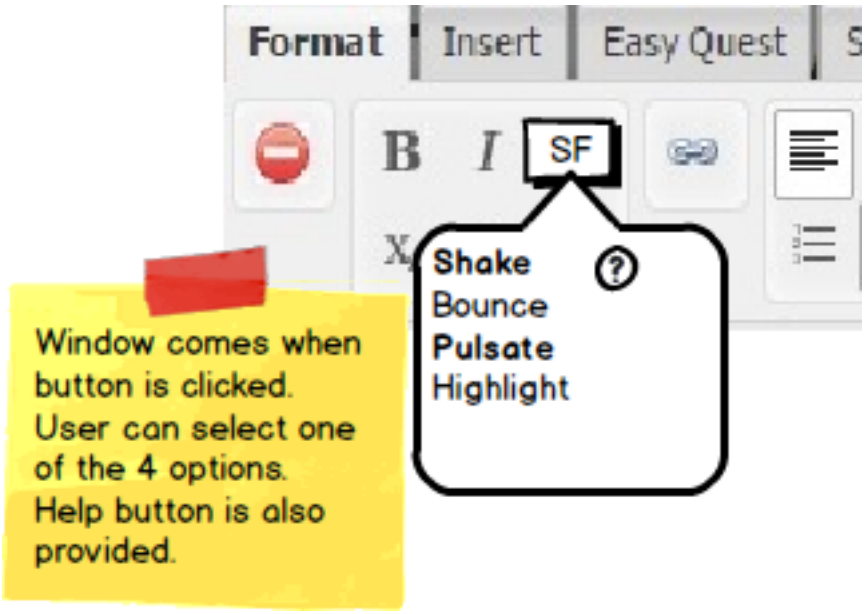

FIGURE 5.10: Proposed mockup for Special Functions (SF) button.

Other defects occurred while inserting an image into the presentation. The process starts with clicking an insert image button from the GUI panel which opens a new window. In that window, the user can either upload an image or insert an image URL.

Issue2 - Image still keeps its original size. After entering an image onto a slide, no ways to scale or even highlight the image were found. The only way to influence an image is to add HTML tags to the source code, but since Slidewiki is supposed to be available for everyone, this is not an option. An effective solution is to allow the user to manually move and scale the image by highlighting it, without diving into a source code.

Source. This issue was discovered during my own experience with the website and later was reiterated by all users.

Issue3 - uploading a .pptx presentation. The image wasn't scaled properly and gained a black background. Microsoft PowerPoint has effective options for creating diagrams and pie charts. Unfortunately, they are not transmitted from .pptx to slidewiki. Simple shapes such as circles and rectangles created in MS PowerPoint didn't appear in Slidewiki. Instead of addressing the problem of transmitting a diagram, it would be advantageous to add an option for creating diagrams inside Slidewiki itself. So even if the diagram is not transformed it will be easy to simply add a new one.

Source. This issue was discovered during my preliminary testing of the website.

Issue4 - overlap of the image panel. There is a small bug when the user opens an insert image window, in that the panel of slide editing stays overlapped on it, therefore causing discomfort. This panel should be removed when every other window opens.

Source. This issue was discovered by one user during a test.

Metrics violated: **Interactivity, Responsiveness, Functionality**

*Current state*is represented on the image below:

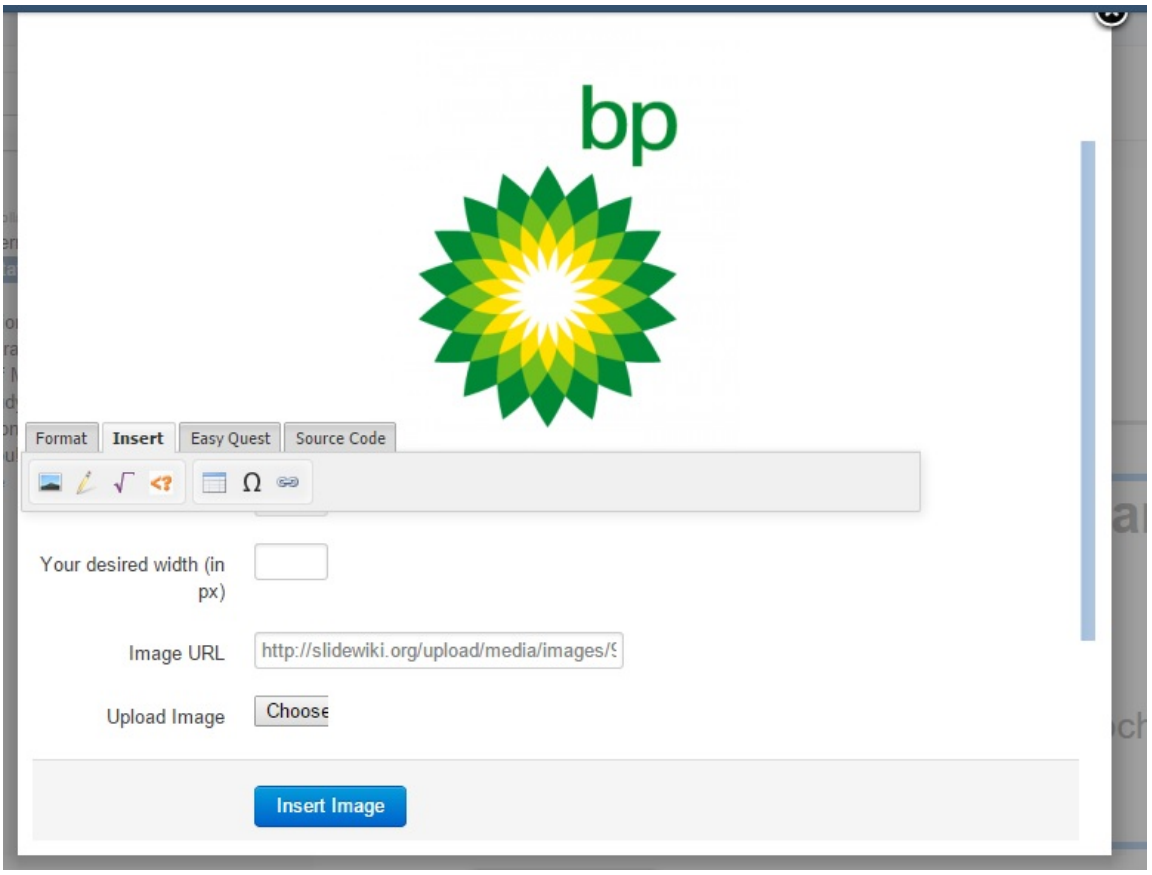

FIGURE 5.11: Original image upload.[51].

Possible Solution. Below the mockup for a new image form is given.

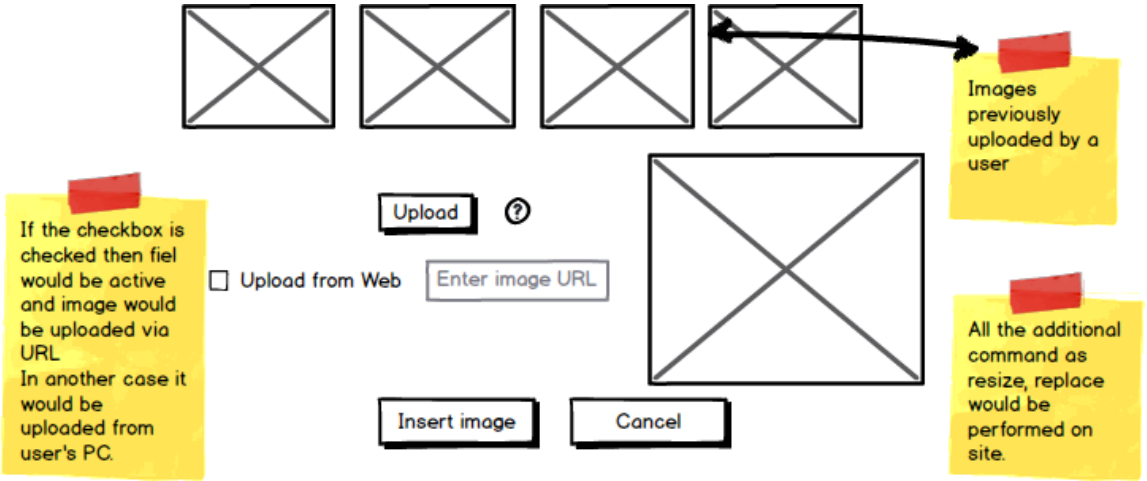

FIGURE 5.12: Mockup for image upload.

This form is similar to the original one but now many options have been simplified. The upper panel with a row of images previously uploaded by a user has been kept. This panel simplifies the upload of redundant images without spending time uploading. Below a new checkbox has been included in order to switch between different types of

upload. When the checkbox is checked, the "Enter image URL" field is activated and an upload is performed from the web. Another option is to press the "Upload" button directly, this will open the "Browse for images" window and upload an image from the PC. All the fields to resize and replace the image have been removed as well as the field, indicating the original size of the image. Replacing and resizing will be performed directly on the slide after uploading an image. This method is easier and more user friendly.

Issue5 - Adding slides. Users were complaining that adding a new slide is time-consuming to find and perform. It takes time to guess that a right click on the slides hierarchy could be performed.

Source. Two users raised this issue, as they experienced slight delays while attempting to increase the number of slides.

The current state looks like:

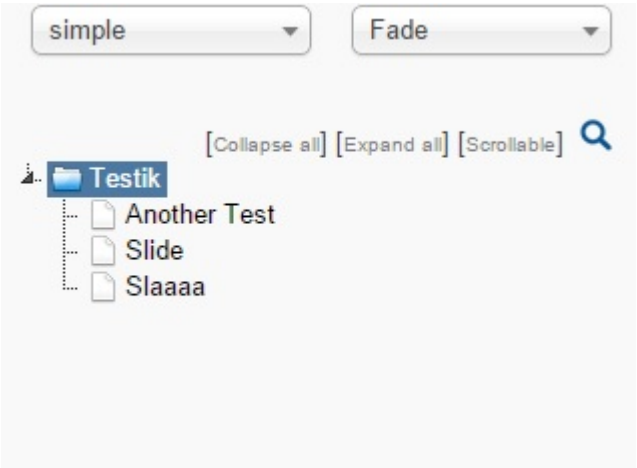

FIGURE 5.13: Slide adding original.[51].

Metrics violated: **Ease of use, Friendliness.**

Here, the first user made 3 mistakes and carried out a task within 47 seconds. The ease of use is 25%. The second user spent more time and made more errors. The result is only 14%. For the third user it was 34%.

Possible Solution. Since not everyone guesses to right click over the slides, perhaps some note explaining this possibility should be added to the website. However, the best way to solve the slide-adding problem is to provide two small buttons for slide and deck adding. The overall picture looks something like this:

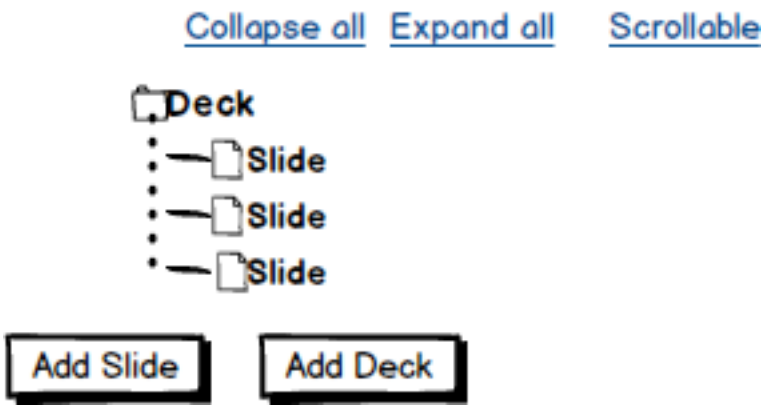

FIGURE 5.14: Slide adding mockup.

Of course these two buttons will move down each time the amount of slides or decks is increased. This will raise the speed of the user's interaction with the product since it takes less time than right clicking.

Issues with search functionality. Several issues arose in terms of searching for the website. The structured overview of them is shown here.

Issue 1 - Relevance. Search results could be sorted only by date, and relevance of decks were not taken into account. For instance, if one puts into a search field an existing deck such as "Semantic Data Web Lecture Series", the desired deck won't even appear on the first page. All the results containing the words "Semantic", "Data", "Web", "Lecture" and "Series" are shown there and they are ordered by date only. The issue is that, while querying from the database, every word in the expression is queried separately, whereas ideally the whole expression should be queried, then parts of it, before finally the words themselves.

Issue 2 - Auto fill Another aspect is form auto fill. Auto fill should be created in such a way that it will propose the options of existing presentations or decks. For instance, if the user types "Open E", auto fill should provide "Open Education" rather than "Open Edit". Therefore, instead of searching for every type of auto filling, it should scan the database to match the existing ones.

Issue 3 - Result sorting. The third issue is that the user cannot view search results in different languages, however that option is available there. The scope of search results stays the same in spite of the selected language. Either those commands are not functioning, or there are some bugs in them.

Source. Three previous issues were discovered during my own experience with the website and later were reiterated by all users.

Issue 4 - Tag Cloud. One user complained that the Tag Cloud takes up too much space and is annoying because it is not always used.

Source. This issue was mentioned by one user.

Possible solution. It is better to be hidden and appear only when called. More information and a mockup for this issue will be provided below.

Metric violated: **Search functionality.**

According to formula 3.8 search functionality will be 0% for Slidewiki.

The problem is illustrated here:

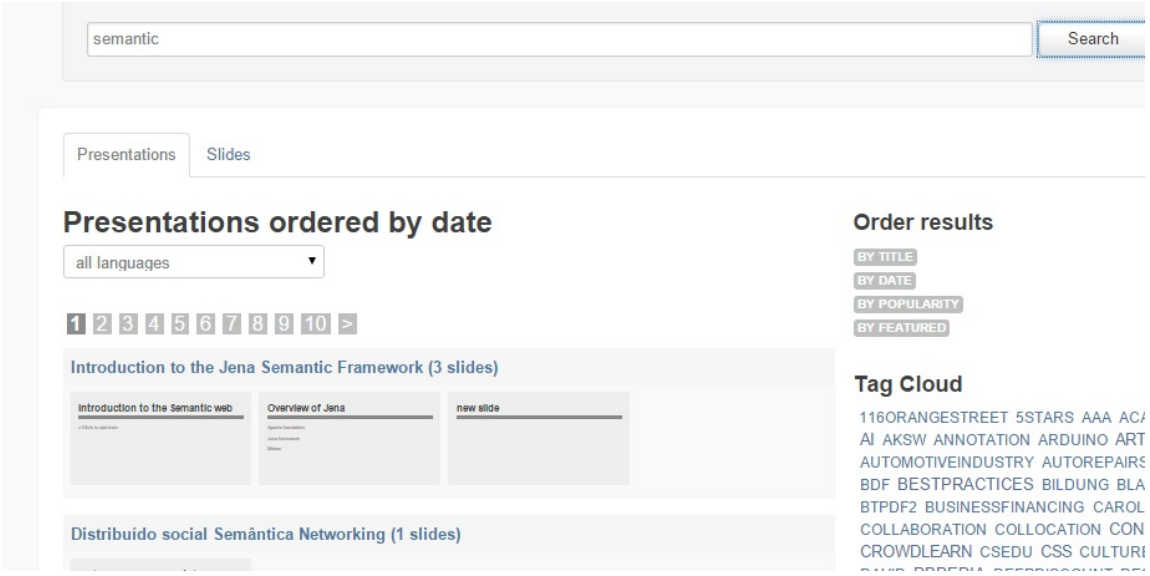

FIGURE 5.15: Original search.[51].

Possible Solution. Some mockups aimed at improving the search functionality will be shown here. The first solution looks like a "Brute-force approach"

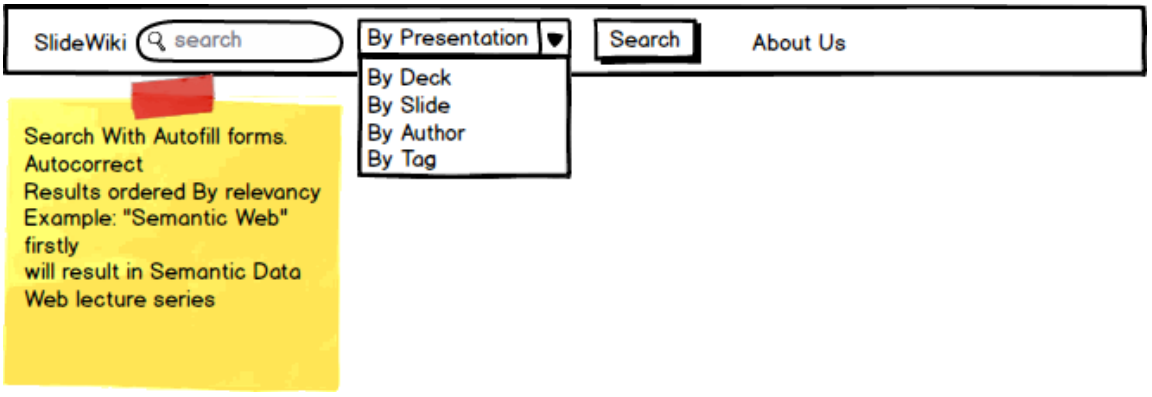

FIGURE 5.16: Mockup for search. Solution 1

Using this approach, the user should select one of the filters before searching for data. The drawback of this approach is that, each time it is used, some filters have to be applied.

The second solution will be called the "Double search". This mockup differentiates clearly between searches and separates the author from all the other instances.

FIGURE 5.17: Mockup for search. Solution 2

The obvious drawbacks will be, once again, selecting the filter, and the fact that it could be harder for a developer to code two search engines. However, the user now has two different search domains: Content and Authors.
The third solution provides an advanced search menu which does not differ greatly from the one Slidewiki possesses, but gives more options for filtering. Using this approach, the original search parameters of Slidewiki should be kept. The figure below will be opened after the user clicks "search".

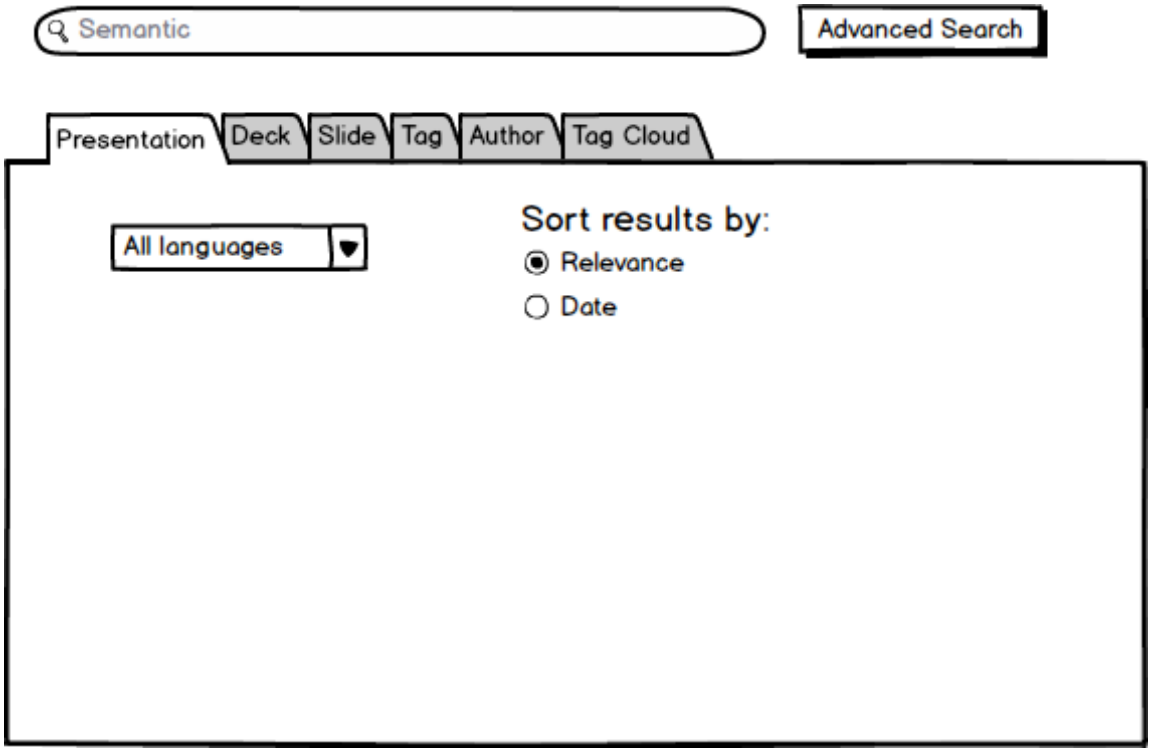

FIGURE 5.18: Mockup for search. Solution 3

The advantage of this approach is that the user can quickly search for something and already see the results. In case of dissatisfaction he or she can change the domain from presentations/decks to authors. This solution saves time if the search object is highly relevant. So if a user searches for "Semantics", he will get a result for "Semantic web

lectures" at once without using the advanced search. Hereby I assume that this approach should be favoured over the previous two. Concerning searching for an author, the search should be fulfilled not only by the user's login name, but also by his real name or e-mail address. To this end, coders should create a bind between login name, real name and e-mail and index them in database. In addition, here, a fixture for the Tag Cloud issue is proposed. The Tag Cloud will be moved to the tabs menu and can be accessed from there. The user can activate the tags by selecting them, thereby opening more space to the left and allowing the display of more search results.

Issues with user page. User page is not lacking flaws and bugs as well.
Issue - edit link. When a user enters his or her page, an option to edit the profile appears in brackets in a translucent color, an issue which can impede the user's interaction.
Metric violated: **Ease of use, Navigation.** According to my own interaction, this link was found after several wrongly visited pages and by accident. Ease of use for that option therefore stands at 33%.

The image of an issue is shown below:

FIGURE 5.19: Edit button of user's page.[51].

Issue2 - Avatar. Slidewiki is connected to a global avatar service, Gravatar, which reads an image associated with e-mail from Gravatar and loads it onto Slidewiki. But if the user does not possess a Gravatar account or uses another email in Slidewiki then he or she has to upload the image manually. The editing page has a field "Picture", and there is an empty field nearby. No button "Upload image" or "Save image" was found. After

entering a link into that field, the site opens an error page and says, via browser alert, "Changes were saved successfully". However, the picture stays the same if Gravatar is connected, or the user profile stays without picture in case of no connection.
Metric violated: **Functionality.** Functionality of avatar image is 0%.
Current state. The issue is shown bellow:

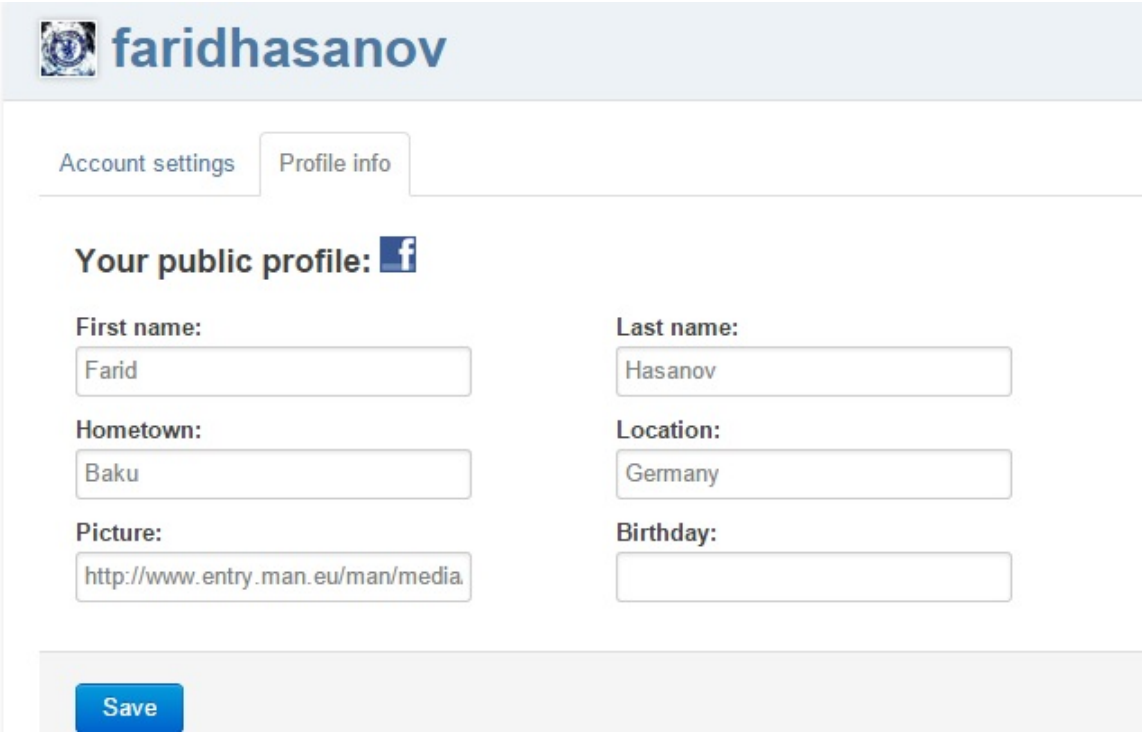

FIGURE 5.20: User's page upload image.[51].

Issue3 - Absence of user's information. The user can enter his or her information which is saved in the database, but it isn't displayed anywhere. Only the owner of the account can see his or her details, which is practically useless.
Metric violated: **Functionality.** The functionality of this option is 0%.
Current state:

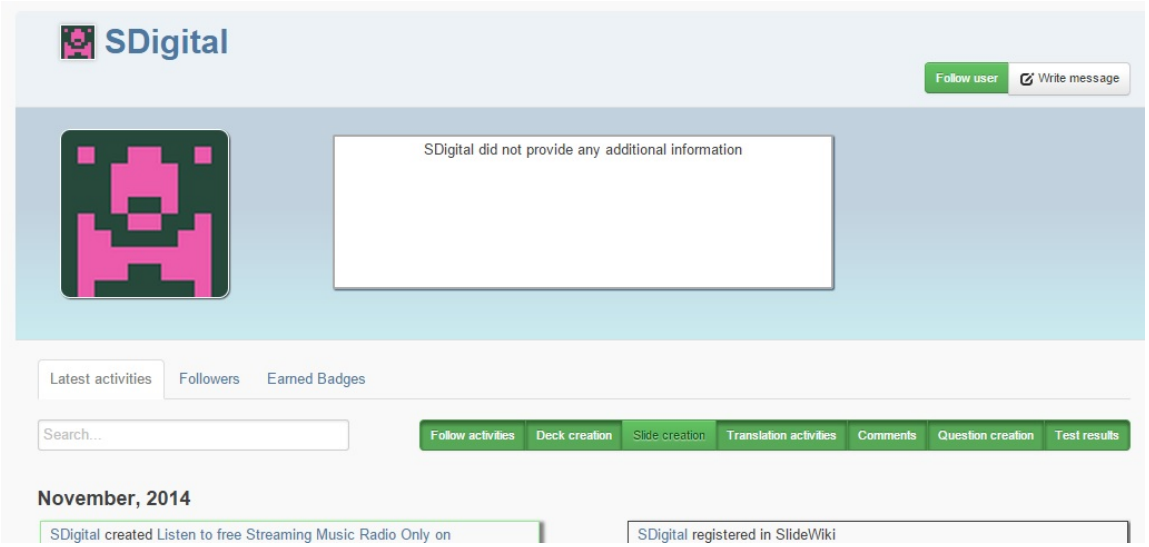

FIGURE 5.21: User's page.[51].

Source. Three previous issues were discovered from my own experience with the website, and were later identified by two, and in the case of the profile picture, by all three users.

Issue4 - activity bar of users. The green bar has the option of switching on and off different user activities such as "follow", "deck creation", "translation", "tests" and so on. The design of the bar requires time in order to understand how to interact with it.

Metrics violated: **Color and Style, Graphics.**

Source. The issue was discovered during my own experience with the website and later was confirmed by one user.

Issue5 - Time to open activities. Another small drawback concerning the activity bar, in that users were dissatisfied with the fact that rectangles showing recent activities were opened one-by-one, or two-by-two, when "Show more..." is pressed.

Metric violated: **Friendliness.**

Source. The issue was was brought to light by one user.

Current state. The problems with the activity bar are shown on this figure:

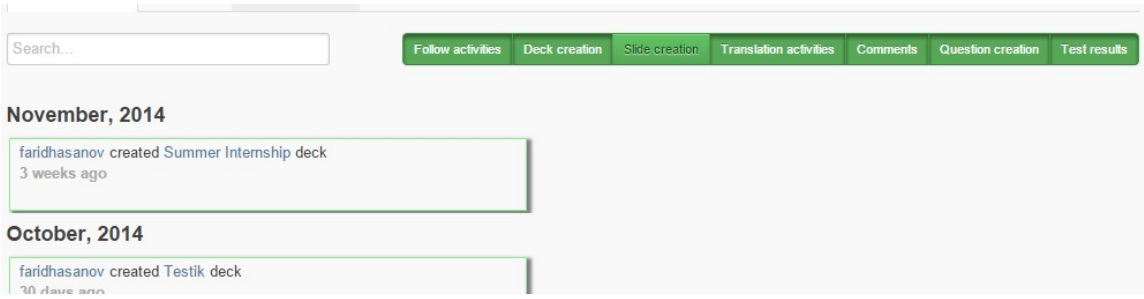

FIGURE 5.22: Activity bar.[51].

Possible Solution. First, a mockup of solution will be presented.

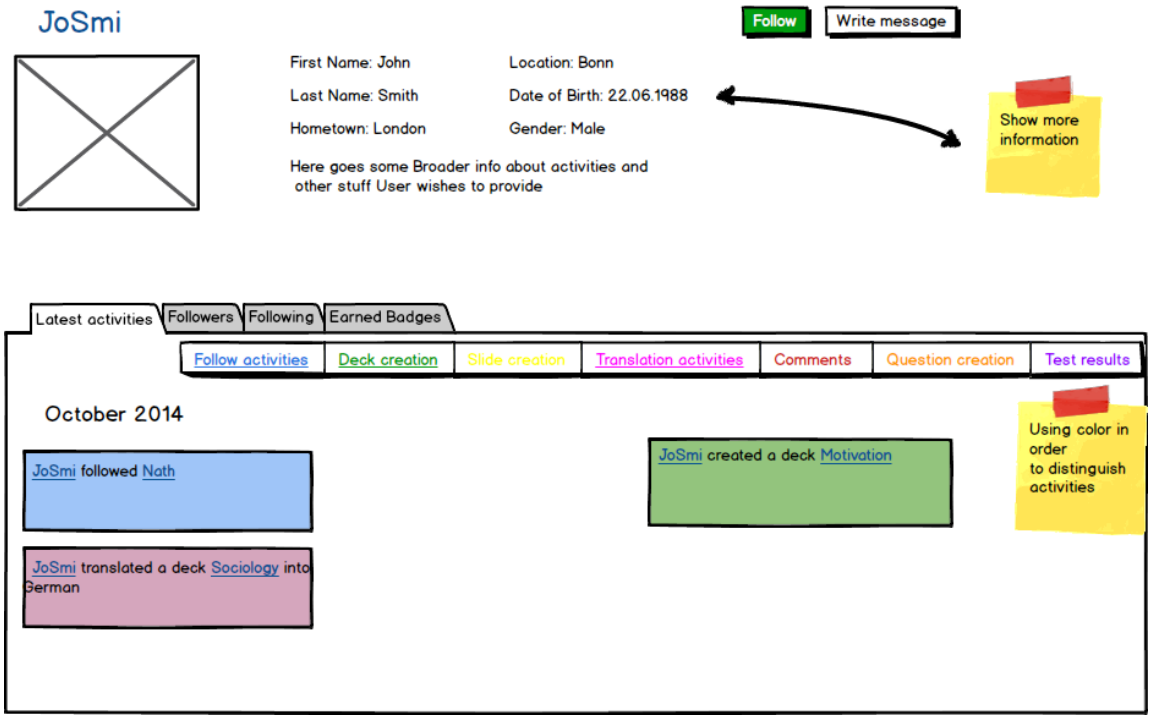

FIGURE 5.23: Mockup for user's page.

The space to the right of the image now provides more information about the user in an effectively structured way. This information is still the subject of user preference and not considered mandatory. Below, a space for providing broader information is located. In the current version of Slidewiki, only this area is present on the user's page. In the field below a new tab, "Following", is added in order to display the people the user is following. The biggest innovation is the simplification of the "Latest activities" of a user, in terms of ease of viewing. As before, every activity opens in different colored rectangles when the corresponding button is activated. The drawback here is that all the buttons are of the same color and it is hard to follow which button calls which rectangle. This issue was fixed by adding the corresponding colors to the buttons. Now, the "Follow activities" button is blue and the rectangle displaying the user's follow activities will also be shown in blue, and this will apply to every button.

If it is a page of a logged in user, it is obvious that, instead of a "Write message" button, an "Edit Profile" button will be displayed, and the overall profile will look like this:

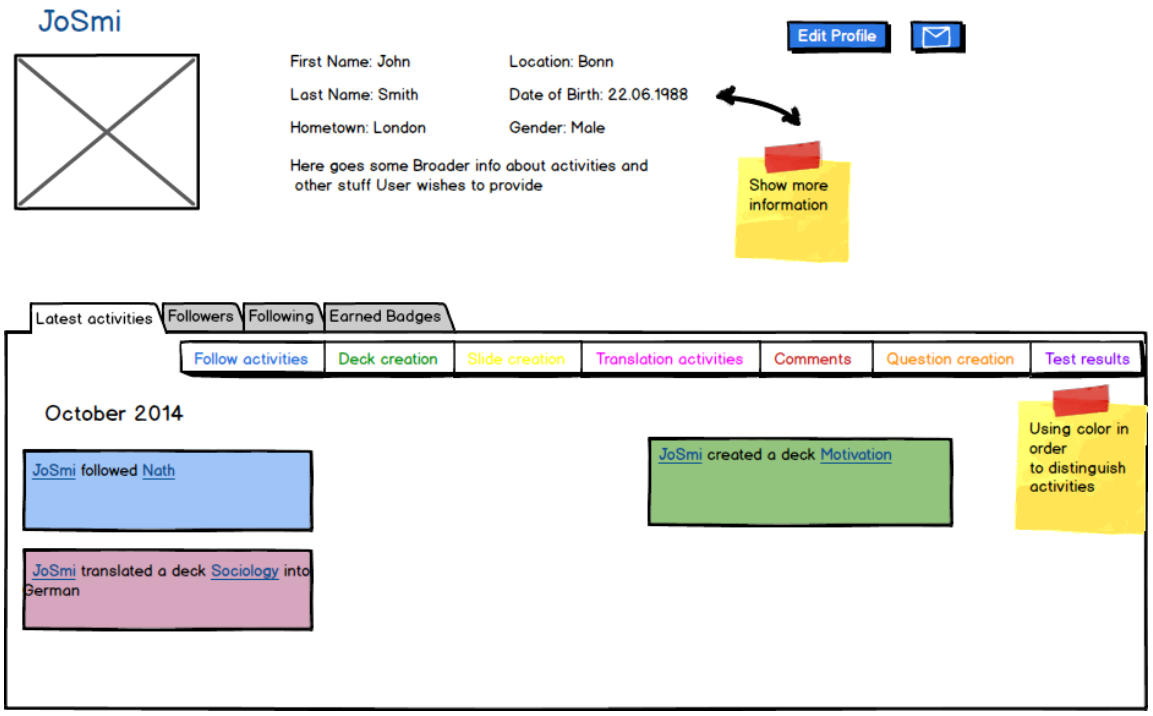

FIGURE 5.24: Mockup for user's own page.

After "Edit Profile" button is clicked, the following editing page will be opened:

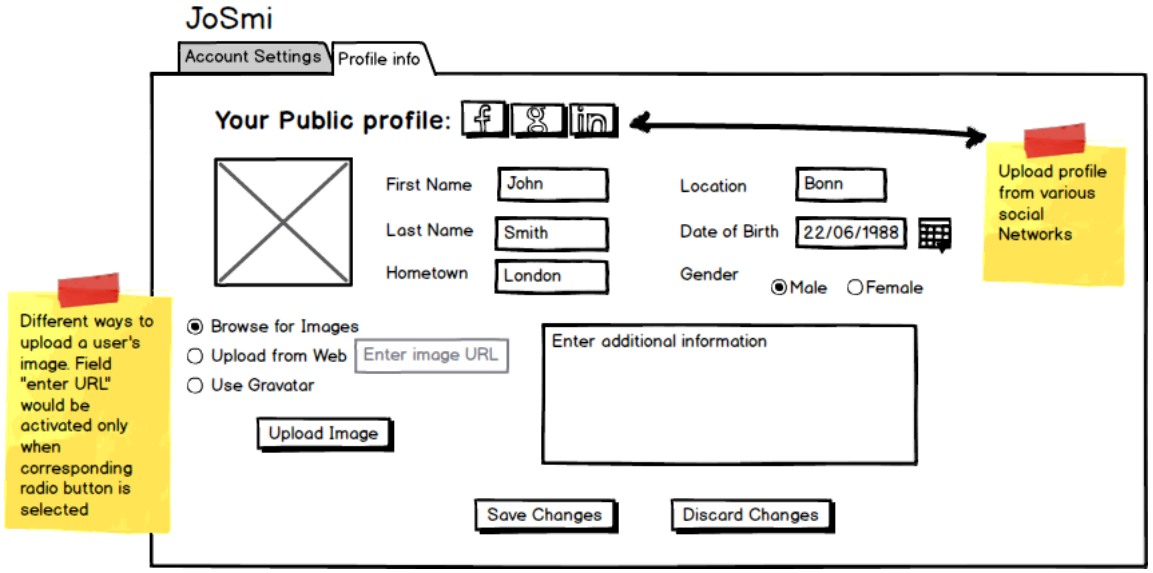

FIGURE 5.25: Mockup for user's edit page.

The majority of the interface is identical to the older one, and the option to load a public profile from various social networks is still present in here. Below, the general editing options of the profile info can be found. A major change was implemented upon the upload of the avatar. Now, the user has three options: to upload an image from a local machine, to upload from the web(when the button is pressed, the text field will be activated automatically), or to use Global Avatar. When the image is chosen and the

"Upload Image" button is pressed, a new profile picture will appear in the corresponding area. Changes will take effect only after the "Save Changes" button is pressed, and the user can discard all the changes by pressing the corresponding button.

Issues of informative character. Here, flaws concerning the 'about' page and other informative links will be demonstrated.

Issue1 - wrong displacement of license page. A link to a page about license information opens only on the edit page and has misled the users.

Current state:

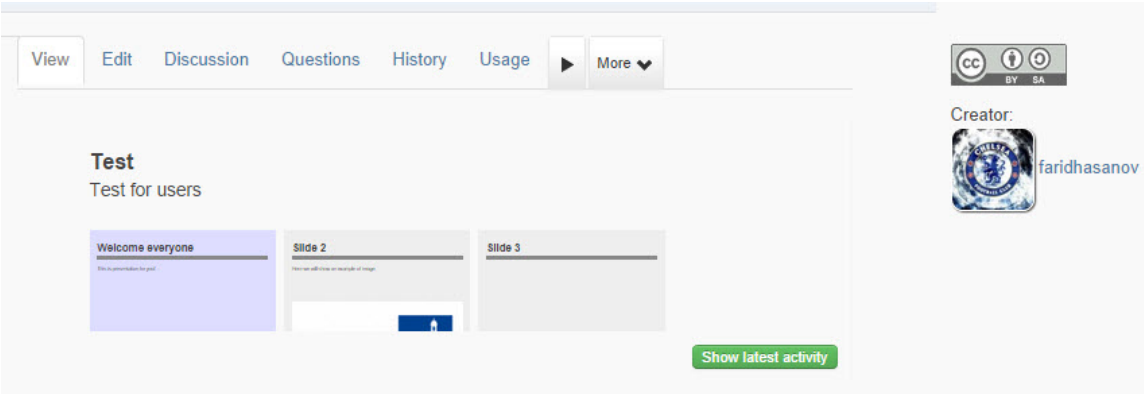

FIGURE 5.26: License information of Slidewiki.[51].

During the test, the user stated that he wanted to press this button, because he thought that this was also a tool for slide editing.

Metric violated: **Organization.**

Source. One user mentioned this drawback.

Possible Solution. Taking into an account this remark, the decision was made to remove that icon totally, thereby clearing some space. License information can be placed into the "About" tab of the header panel. Creator information can also be placed below the presentation. As well as freeing space for editing, this will also guarantee that, while changing slides when the transition type "Cube" is selected, the edges of the presentation will not be cut.

Issue2 - Contact information. Users met some complications searching for a contract person. They were either going to the footer or scrolling the upper navigation bar of the website.

Metrics violated: **Organization, Web-related criteria such as finding contact information**. For the first user it took 1 minute and 3 seconds to correctly find the owners information. 3 wrong pages were visited and scrolled in order to achieve the goal. Exactly a minute was spent by the second user on the same task. However, the number of wrong clicks was 0, due to the fact that he searched the main page, or more

precisely it's footer, for the contacts. The third user was more successful, achieving his goal within 34 seconds.
Source. Two users stated that this was an issue.
Possible Solution. The proposal is to add a separate line in the "About" menu, named "Contact us". This link will open as a page in the website itself with all the contact information, or direct a user to the site of the research group.

Translating issues. Some minor problems occurred with the embedded Google translator.
Issue1 - size of button. First of all, the language information and 'translate' button are small, and it requires effort to find and click them.
Metric violated: **Organization.**
A Possible Solution could be to move it closer to the left, near the name of the presentation, and to increase the size. The new appearance would be not dissimilar to the name of a presentation and below would be the ability to change it.
Issue2 - translation from the translated copies. There is no way to translate from the translated copy of a presentation. Translation is possible only from the original.
Metric violated: **Friendliness.**
*Source.*One user brought up this issue.

Footer issue. Several testers mentioned that the footer of the website has a flaw.
Issue - organization of the footer. The footer is organized in a confusing and unappealing manner, with the section titled "About" creating particular frustration. Users noted that it isn't aesthetically pleasing that the aforementioned page is located between the presentations and the footer. Metrics violated: **Organization, Color and Style**.
Source. Two users found the style of the footer unappealing.
Current state. The image below indicates the original state of the footer:

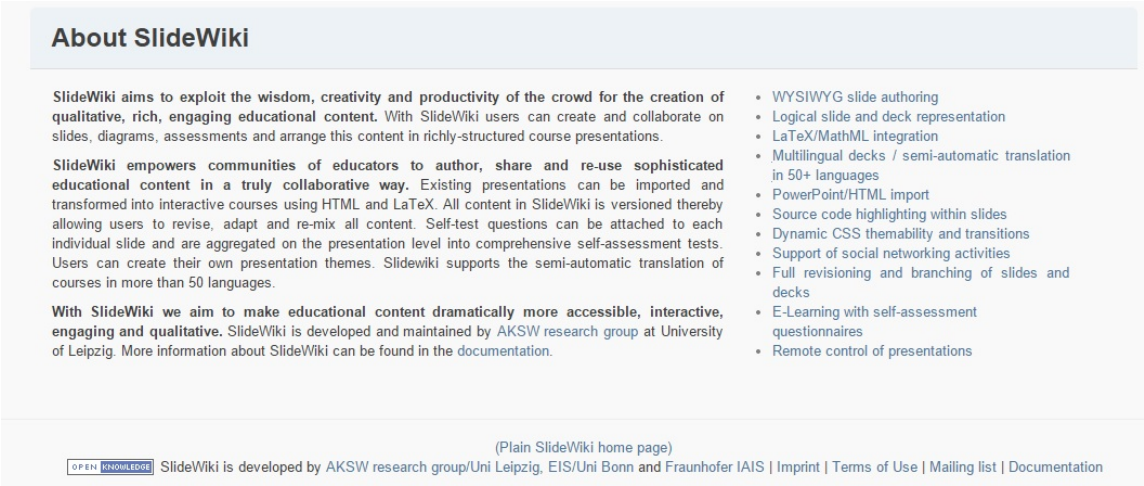

FIGURE 5.27: Original footer.[51].

Possible Solution. The decision was made to remove the "About" section and to feature it on a separate page. The rest of the links are to be arranged in more visually appealing way, according to the design rules.

FIGURE 5.28: New footer mockup.

5.4 Recommendations and proposals.

During their user testing, users were asked also to give some comments about the overall design of a website. This experiment gave its own results, as some minor dissatisfactions were detected. Some ideas about how those problems can be removed and how the overall design quality can be increased are presented below.

One of those ideas was to substitute a home button with the logo of Slidewiki. This could be dismissed as merely cosmetic, but experts believe that it can strengthen the overall design of a website. A great deal of successful websites have the same option for their homepage.

Turning to the home screen itself; this is the face of the website and all the users will judge the product by this page. Experience shows that users who tend to be unhappy

with a home-screen will bounce off the website as quickly as they entered it. The home screen of Slidewiki consists of several presentations stacked in columns such as Featured and New Presentations. There is ongoing research that proposes individualizing them for each type of user, according to his or her preferences. This will be performed by reading data from their social networks and applying the filters for presentations to show. This will be possible only in the case of the user being logged into the website via his or her social network profile. One tester mentioned that it is hard to distinguish where one presentation ends and another one begins on the home screen. In HCI , this is known as Row Striping or "Zebra Striping" [49]. It proposes using similar shades in order to separate rows in table. The picture below illustrates this:

TABELLE | ZU HAUSE | AUSWÄRTS | KREUZTABELLE

Platz		Verein	Spiele	S	U	N	Tore	Diff	Pkt
1.	(1.)	FC Bayern München	3	3	0	0	12:2	+10	9
2.	(2.)	Eintracht Frankfurt	3	3	0	0	9:3	+6	9
3.	(3.)	Hannover 96	3	2	1	0	9:4	+5	7
4.	(4.)	FC Schalke 04	3	2	1	0	7:3	+4	7
5.	(6.) ↗	Borussia Dortmund	3	2	1	0	6:2	+4	7
6.	(7.) ↗	1. FC Nürnberg	3	2	1	0	5:3	+2	7
7.	(5.) ↘	Fortuna Düsseldorf	3	1	2	0	2:0	+2	5
8.	(14.) ↑	SC Freiburg	3	1	1	1	6:6	0	4
9.	(8.) ↘	Borussia Mönchengladbach	3	1	1	1	4:4	0	4
10.	(12.) ↗	VfL Wolfsburg	3	1	1	1	1:4	-3	4

FIGURE 5.29: Zebra striping example.[49].

Using the same structure of striping it can be ensured that users can clearly distinguish between the different types of data shown.

Another proposal was to move the Slidewiki news panel down, and put it in the column where the latest activity and statistics are located. So it will look like one neatly-arranged column starting with News, followed by Latest Activity and it ending with Statistical data.

Motivated by existing research in the field of e-learning [15], [17],the decision to create a multimedia communication system for the website was taken. This will ease user interaction and eliminate the necessity to rely on e-mails. The button for checking

the messages will be located near the "Edit Profile" button. When the user navigates onto it without clicking, a pop up window will appear, showing recent messages and basic options. This can be clearly seen in the following image:

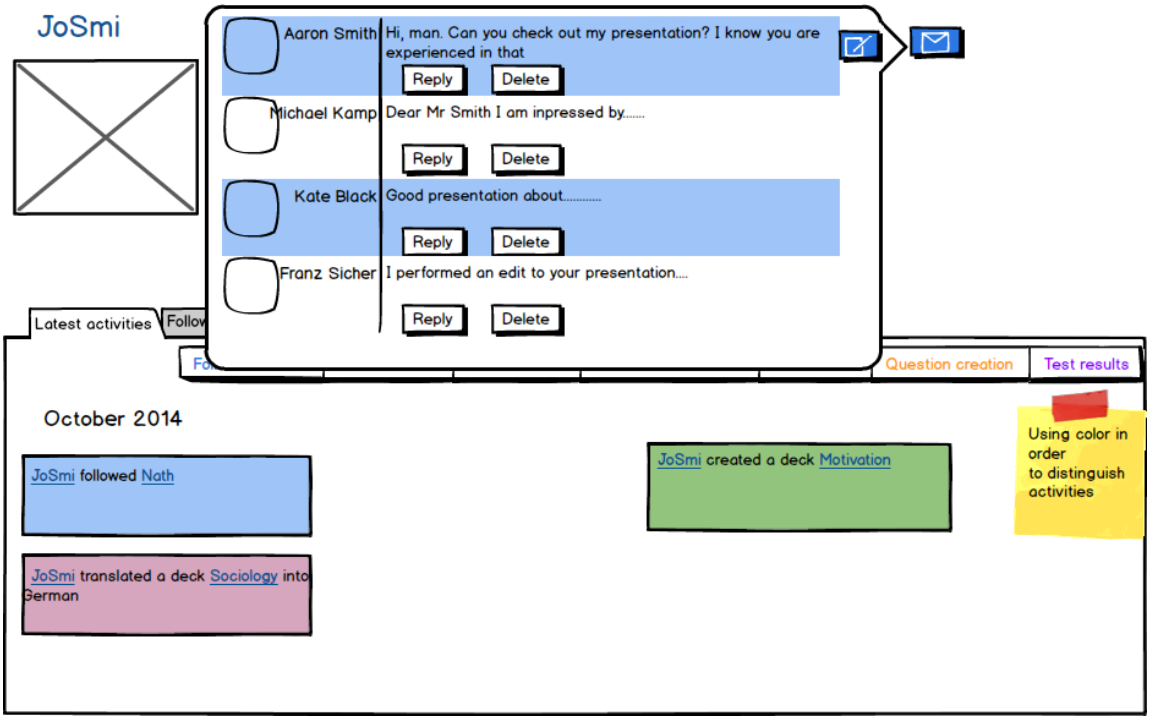

FIGURE 5.30: Messages without clicking on the button.

As mentioned before, this window opens directly over the user page window. Messages are separated with different colors in order to clearly distinguish between them. In the case of a message button being clicked, the following page will be opened in a new window:

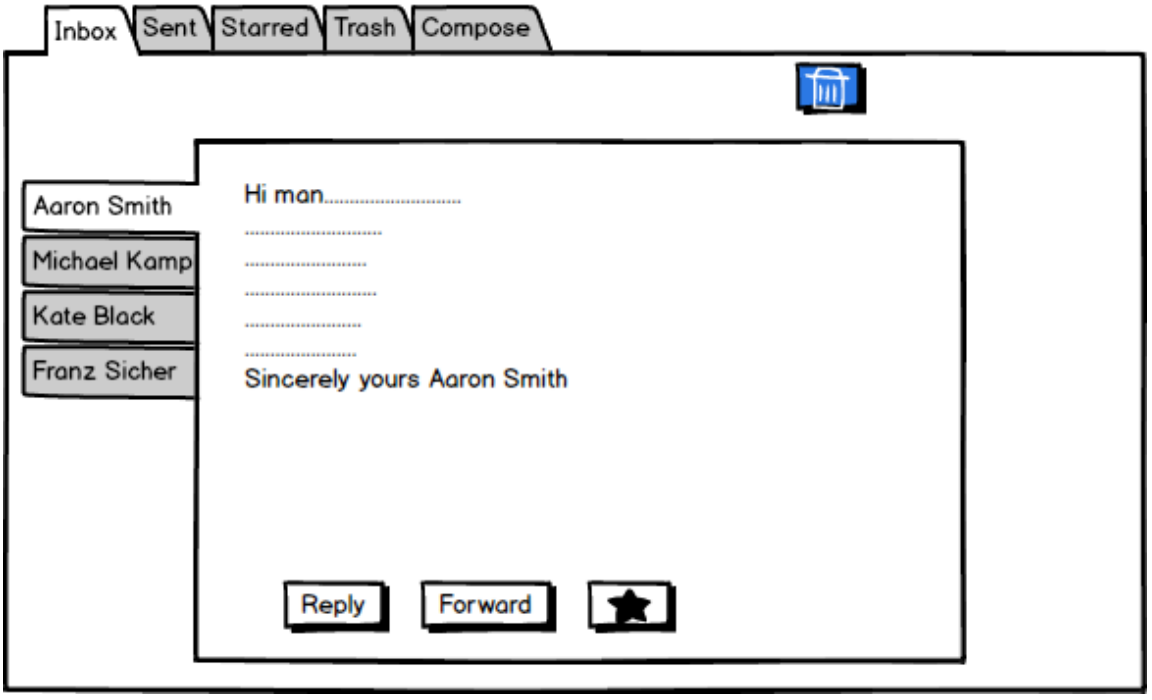

FIGURE 5.31: Messages page.

Here every message can be viewed separately and more options such as "Forward" and "Star" are available from here.

So much to say about the areas of primary concerns for the users concerning the website. A large number of flaws and bugs were covered here, what are to be augmented.

5.5 General metric measurements for Slidewiki.

Here, some metrics presented in chapter 3, and an analysis of how well Slidewiki complies with them, will be provided. Some of them were already mentioned during the description of user testing (Ease of Use, Friendliness) and some can be measured either by professionals (Security) or by website owners (Maintainability, Efficiency). The remainder are presented here.

Accuracy. Since Slidewiki is considered to be an open-wiki type project it is hard to measure accuracy. However, the formula 3.2 still can be used for that. The only aspect of this formula which is satisfied by Slidewiki is means of communication with the author. Therefore, accuracy will be only 30%.

Relevancy. Using formula 3.3 it can be stated that Slidewiki is 100% relevant to the task. Users were clear as to the purpose of the website within a short period of time, the name of the software is suitable, and the website is a wiki product dedicated to slides.

Usefulness. Taking into account all the innovations present on the Slidewiki, the website can be considered to be useful.

Currency. Here the assumptions are twofold. The latest modifications to content by adding presentations or viewing them were implemented the previous day. However, the latest update by developers to the website's news was carried out on the 27th of April 2014.

Customization. For now, the only place where adjustments exist in the Slidewiki is the presentations interface. There, users can change the theme of the presentation as well as the transitions for it. There is a project that will provide users with custom presentations according to their preferences.

Contextual control ability. There are some areas of the website where control is violated. One good example of it was described earlier, with additional tools such as "Builder4impress".

Cohesiveness by grouping main control objects. As mentioned by one of the users, this parameter was violated by the location of the CC license information link.

Direct control permanence, however, was never brought to our attention as being violated. Therefore this metric is fully satisfied.

Finding main page. No errors were found during navigation to the main page by any users. This parameter is satisfactory within the site.

Speed. Unfortunately, speed is the weak part of Slidewiki. However, speed wasn't measured precisely and the website is prone to long loading times for presentations (up to 10 seconds), freezing and crashing. Students who have worked with Slidewiki were surveyed and most of their complaints were about the speed.

Internet Standards. The website was tested on several platforms from several browsers. The overall performance was good and no specific errors were encountered. So one can articulate that Slidewiki is written to be compliant with Internet standards.

Portability. Overall, it could be claimed that the website is sufficiently portable, the mobile version performing much like the desktop one.

Functionality. This criteria was measured according to the actions users are supposed to carry out while working on the website. Among the 23 tools mentioned, 4 of them were not working according to the formula 3.9, so the functionality of the site is 82%.

Reliability. This parameter wasn't tested separately, although according to the reviews from users and testers, Slidewiki is considered to be unreliable.

Here all the metrics representing the created model were tested upon the Slidewiki and corresponding results are shown. A number of issues pertaining to the website were revealed with the assistance of this model. This marks the end of the research and corresponding user testing.

Chapter 6

Conclusion and Future work.

In this paper, a model has been created which could prove useful for evaluating a user's interaction with learning management systems. Having completed the literature review, a motivation for using specific type of metrics and methodologies in order to achieve a goal has been identified. The system was tested upon the website using three subjects and has revealed numerous flaws in Slidewiki. The model created is quite straightforward and can be used by everyone, and the metrics, if slightly amended, could be applicable for nearly every type of website. The experiment, however, is unique for each website. The actions performed by the subjects vary from product to product. Some of the measures such as currency, finding the main page, finding contact information, ease of navigation, functionality, direct control permanence could be automated. Moreover, others such as speed and security should be measured by professionals or by professional software. Some scholars may argue that this experiment could be considered relatively irrelevant because only one methodology was used and with alimited amount of participants. Doubtless, further research could reveal more problems with the design of Slidewiki, however they will not carry such a level of importance as the current findings.

As for future work, I would mention that all of the mockups described in the previous chapter should be realized into the website. Subsequently, perhaps new research could be launched in order to determine the effects of the putative alterations carried out on Slidewiki. It would be beneficial to conduct an eye-tracking user test with regard to Slidewiki. This research will reveal more issues correlated with the design of the website. In addition, I recommend the site undergo further testing in order to optimise technical aspects, such as security. It is to be hoped that this research will prove beneficial for the

project and that, if all the solutions demonstrated in the previous chapter are applied, the design of the website will be much improved.

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