Model of Usability Evaluation of Web Portals Based on the Fuzzy Logic

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Abstract: This paper presents a model of usability evaluation based on fuzzy logic which results from a need to establish a common approach to deal with the usability evaluation of various kinds of systems. The model definition arises from the methodology of fuzzy usability evaluation that was presented in the previous research of the authors. As a result of a particular evaluation, usability score is obtained. The score combines various factors affecting the usability of target system. The authors demonstrate the model on the example of usability evaluation of Web portals. Paper also includes results and analysis of the case study and validation of the proposed model.

Key-Words: Usability, usability evaluation, usability engineering, fuzzy logic, software engineering.

1 Introduction and previous research

Usability of software becomes an important aspect of software quality [3], [7], [9], [13]. Usability can be arranged in various types of software [1] and other types of user interface, even maps [17]. While usability studies are widespread, the issue of Web site usability evaluation remains still very young area of interest.

Usability engineering has got quite powerful methods for testing multiple factors; we assume that there must also exist a lightweight, wide acceptable and easily evolved methodology for evaluating the usability of Web sites that should maximally respect that users' evaluation cannot be always accurate, reliable and qualified as a single number (score). There is no clear consensus how to measure usability yet, obtaining a score – value that would be significant, meaningful and enough accurate to be compared [6], [19], [21], and be able to deal with the uncertainty, vague expressions that are surrounding the user language [18]. However, some conceptions were already presented for instance in [2], [19].

In our previous research [4], [5], we proposed a methodology of usability evaluation based on fuzzy principles allowing dealing with the uncertainty and vague expressions as a fundamental part of user language [18].

We would like to define and describe the model that deals with the uncertainty and vague expressions, as a fundamental part of user language [18], and present results of the performed case study. The case study demonstrates the functionality, agility and the wide possibilities of the fuzzy usability evaluation. The validity of the output was also compared to the results of existing method for obtaining a usability score of some user interface.

2 Problem formulation

Usability is a part of usefulness that is a part of practical acceptability – a one of components of system acceptability as it is possible to see in Figure 1.

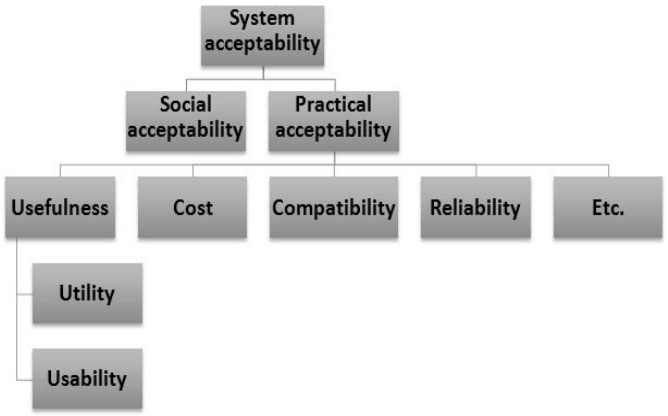

Figure 1: A model of the attributes of system acceptability (Source: [14])

Usability has multiple components and is traditionally associated with these five usability attributes found in [14]:

- Learnability
- Efficiency
- Memorability
- Satisfaction
- Errors

Current methods of usability evaluation do not provide any method how to obtain usability score, although some conceptions were already presented for instance in [2], [19] and in our previous. Another problem of these methods is that they are usually very expensive, time-consuming and unable to face

vagueness and ambiguities surrounding the evaluation process and their results are usually very difficult to analyze. From these reasons, there is a need to develop a model of usability evaluation that is:

- quick, precise and produces results that might be easily analyzed,
- allowing to get single-value score,
- able to deal with the users' language which is full of vague terms,
- based on mathematical principles,
- able to be used for usability evaluation of various kind of systems.

Following principles should be implemented in the model of usability evaluation based on fuzzy logic (model of fuzzy usability evaluation):

- Users do not express the overall score by using numerical values.
- Using their natural language, they evaluate a set of characteristic features that significantly affect usability.
- Users' mental load should be minimized so they can fully focus on the aspects of evaluation.

Usability score is a best approximation of expert knowledge stored in a special database.

3 Problem solution

Since the methodology of usability evaluation had been developed and proposed in our earlier works [4], [21], this paper deals with the problem of defining a model of the usability evaluation based on fuzzy logic, its validation and generalization for any kind of system. Process of proposed fuzzy usability evaluation is possible to see on Figure 2.

As proposed in [4], the generic model is based on a set of criteria selected thoroughly and sensitively according to the characteristics of the target environment representing the major aspects that affects the usability of the target system.Since it is not appropriate to model vagueness, uncertainty and ambiguity using classical binary logic [18], the model is based on the fuzzy logic [20], [8]. Although, any total convincing argument cannot be presented, fuzzy theory has according to [18] as the only theory clean mathematical framework provided by fuzzy sets [20].

The solution how to treat uncertainty that inheres in users' evaluations, however fuzzy, vague, or imprecise the idea seems to be, is to express them in the form of fuzzy numbers [18]. The users, instead of stating numbers from some scale (e.g., 0 to 100), qualify the evaluations using their natural language. Since the users' evaluations do not have a form of crisp measures, these input variables are expressed as fuzzy measures [8].

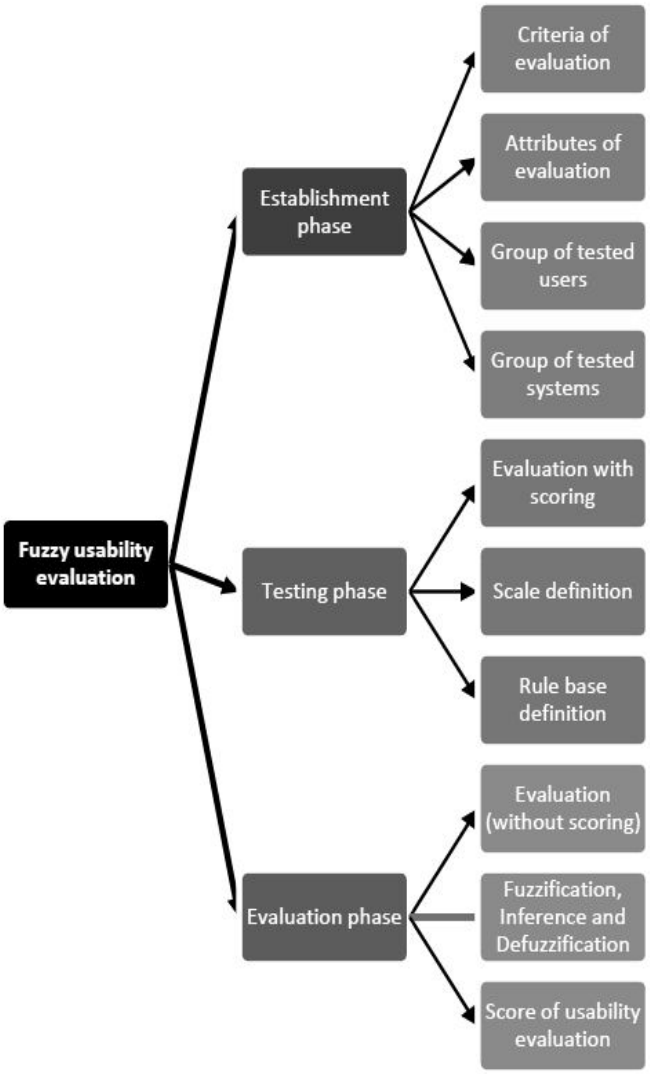

Figure 2: Fuzzy usability evaluation process (Source: own)

3.1 Model of fuzzy usability evaluation

The methodology of fuzzy usability evaluation [4], [21] provides detailed guideline how and what is necessary to perform a usability evaluation process and obtain usability score. The conclusion of our previous research stated that the methodology is suitable for usability evaluation of possibly any kind of system and its user interface.

It is important to point out that the methodology contains implicitly implemented model of fuzzy usability evaluation that was not discussed earlier, since the methodology serves more for practical application rather than the theoretic.

The model of fuzzy usability evaluation (Figure 3) is a multi-layer process of obtaining a usability score as a result of an evaluation provided by user of the system. The structure of the model is decomposed into three layers, where each of them consists of procedures that need to be executed before moving down to the next layer.

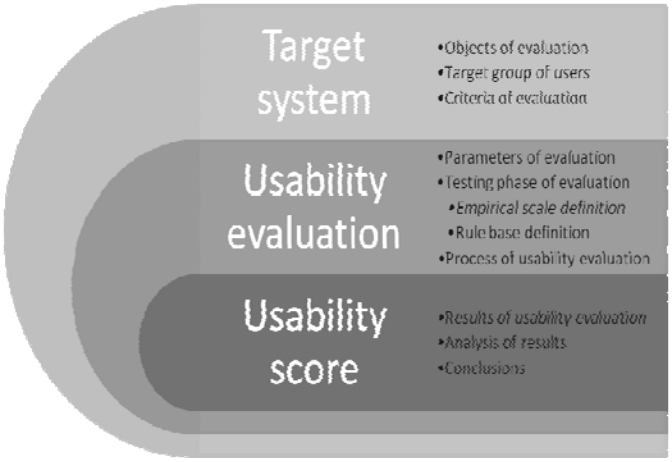

Figure 3: Results by users (Source: own)

The first layer describes the evaluated system, its users and the criteria. The process initiates with the definition of the evaluated systems. The object of evaluation is a homogenous class of systems with the same or similar structure and behaviour. The system is more specifically defined as an object that interacts with human being. These humans are thereby users of the system and the medium of interaction is the user interface [14]. The existence of these three factors is required for the usability evaluation.

As we defined the object of evaluation, we need to closely specify the users that will evaluate. This group might be defined as a non-empty group of various users of the system who interact with the system for some purpose. If it is not possible to select all users of the system, the sample group should be representative to the entire user population. The users should be heterogeneous in terms of characteristics (e.g., age, experience, height).

Since it is necessary to inquire group of users in order to obtain results [14], [16], it must not be impossible or difficult to select a group of typical users and to realize suitable form of usability testing. The users must be also able to express the evaluation in some form that represents some state of value, whether expressed by words, facial expressions or signals.

The key aspect of the accuracy and significance of the fuzzy usability evaluation model is the proper determination of the criteria that affect the usability of the system.

A thorough analysis of each system's structure, behaviour and interactions helps establishing a finite set of criteria that have some impact on usability. We consider this procedure as the most important and relatively time consuming (Table 1) in the entire process of usability evaluation.

Table 1: Importance and time of particular procedures (Source: own)

Procedure	**Importance**	**Time**
Objects of evaluation	Normal	Short
Target group of users	Normal	Short
Criteria of evaluation	Highest	Long
Parameters of evaluation	High	Very short
Empirical scale definition	Very high	Normal
Rule base definition	Very high	Long
Results of usability evaluation	Normal	Very short
Analysis of results	High	Normal
Conclusions	High	Very short

By entering second layer of the model, the tasks become more specific and related to the usability evaluation. The goal is to perform a usability evaluation with desired amount of users and group of systems.

We defined objects and subjects of the evaluation and we need to discuss various parameters of the evaluation. Since we are using specific constructs and elements of the fuzzy logic, each criterion of the evaluation has a defined universe of discourse, finite number of states of the linguistic variable, shape and parameters of the membership functions. The number of output membership functions for usability, shape and other parameters of membership functions of this linguistic variable must be decided.

Each variable stands for one criterion. The criteria are linguistic variables and their values linguistic states [8], [20]. We suggest to define finite number (at least 5) input variables and one output variable denoted as Usability. The model has therefore multiple inputs and single output. The universe of discourse of each variable is expressed by number of membership function that may have different shape and universe of discourse [8], [20]. Each membership function is denoted by some linguistic state corresponding to some value of the linguistic variable.

The model of fuzzy usability evaluation uses fuzzified measures instead of single-valued inputs. The reason for that was explained in [4], [21]. We believe that this way is the only one that allows carrying the uncertainty throughout the entire process, especially when expressing the evaluations. However, we may choose an artificial scale of meanings of the evaluation words and carry the process on with it. We suggest defining an empirical scale based on users' experience and feelings, unless a well-defined empirical scale was obtained from previous.

It is strongly recommended to select a medium significance or a tolerance of the evaluation expressions on the entire population. We suggest choosing a spread

of two sigma (2σ) around the mean value of each evaluation expression [4], [21].

On this place, we should decide how to divide the group of users into the testing users and the users that will actually evaluate the usability of selected systems. It is also useful to choose a type of testing that we want to perform. Whether it is a personal, e-mail or telephone assisted inquiries or group sessions, the decision lies upon the evaluator.

It is necessary to define the empirical scale that explains which values represent the evaluation expressions. This is done by inquiring a group of testing users that evaluates the usability both by using word expressions and by numeric score of each criterion [4], [5].

The evaluator may use the results of testing to define the fuzzy rule base [4], [21]. Since it would be complicated to define all possible fuzzy rules, each of the sets of evaluations obtained during the evaluation with scoring helped to establish the fuzzy rule base. Rules were generated automatically using the techniques for automatic rule generation described in [21].

Once the empirical scale is defined and rule base is equipped with the expert knowledge, regular usability evaluation may be initiated. During the evaluation, desired number of users evaluates criteria affecting the usability of selected systems. The result of usability evaluation is a set of evaluated criteria in form of word evaluations.

Each set of evaluations is first fuzzified, the knowledge is derived from the fuzzy rule base using inference mechanism and resulting aggregated fuzzy set defuzzified into the single real number [8], [18]. Resulting value is the score of usability evaluation defined on range from 0 to 100 points.

Third layer of the fuzzy usability evaluation model processes obtained results. This will be described on an example of real usability evaluation.

4 Case study – Usability evaluation of selected Web portals

The primary objective of the study is to perform usability evaluation of selected Web portals of Public administration – WPPAs. The study has following main goals:

- to perform usability evaluation of selected WPPAs,
- to obtain usability score of each evaluated WPPA,
- to analyze results and make appropriate conclusions,
- to validate the results by using known method that allows to express the output by a score.

The study respects the methodology of fuzzy usability evaluation proposed in [4], [21]. The methodology consists of the following phases:

- Establishment
  - Utility of usability evaluation process
  - Object of the evaluation
  - Target group of users
  - Criteria of the evaluation
  - Parameters of the evaluation
- Testing
  - Empirical scale definition
  - Rule base definition
- Evaluation
  - Usability evaluation
  - Score of usability evaluation
- Analysis and conclusions
  - Analysis of results
  - Conclusions

The most important task in these phases are concretely described in Table 2.

Table 2: Parameters of the usability evaluation (Source: own)

Procedure	**Description**
Object of evaluation	10 various WPPAs by choosing WPPAs of largest cities of the Czech Republic and partially by random choice.
Target group of users	20 users were divided into 10 testing users and 10 users to evaluate usabilit, that was further divided according to the following criteria: sex, age, skills and experience.
Criteria of evaluation	Accessibility, Instant comprehension, Information retrieval, Recency, Navigation simplicity, Design preference, Orientation, Amount of graphics, Loading speed
Parameters of evaluation	8 input variables denoted as the criteria and 1 output linguistic variables denoted as Usability. Linguistic variables have triangular membership functions, 3 linguistic states (low, medium, high) and universe of discourse in range from 0 to 100. The tolerance has spread of 2 sigma around the mean value. Evaluation was performed personally (80%) and by e-mail (20%).
Empirical scale	10 testing users evaluated 5

Procedure	Description
definition	randomly chosen WPPAs providing: 50 different sets of evaluations, and 450 relations in the form (linguistic_evaluation; numeric_evaluation).

The initial problem of performing a usability evaluation of the Web portals has been solved by establishing the methodology of usability evaluation based on fuzzy approach and developing the Fuzzy Usability Evaluator [4], [21]. However, there is a need to validate its functionality and to verify the accuracy and efficiency of the model. From these reasons it needs to be performed a study of usability evaluation based on proposed methodology.

4.1 Utility of the study

Prior to the execution of the other procedures, the utility of usability evaluation needs to be identified. The process must have positive impact on the target system and its characteristics (quality, satisfaction, efficiency, reliability, etc.) [10], [14], [21].

The purpose of the study is to establish an objective measure of quality of use of selected WPPAs to arise the interest and competiveness on the field of Public administration. Although one may argue that evaluating usability of a WPPA has practically no utility, since there is usually one Web portal of each, there are several arguments that prove its significant utility [21]:

- According to the detected problems, proper person can make a decision that will improve the usability of the WPPA.
- The results of usability evaluation might initiate performing of additional tests that will detect severe lack of usability.
- Although the Public administration is not a private sector, the knowledge of score may increase the interest in further development, amount of available resources and competiveness among the participants.
- Good presentation not only satisfies the public but may also attract investors or private subjects to carry business in the particular area.
- Information services provided by the WPPA save additional time and costs (telephone, electricity, etc.) that might be used somewhere else.
- Results might be broadly analyzed, described and segmented according various kinds of users' profiles (e.g., families, tourists, students, retired).

4.2 Object of the evaluation

In order to evaluate the usability in this study, a set of ten various WPPAs has been selected. The selection was made by choosing WPPAs of largest cities of the Czech Republic and by random choice. In terms of quality, not only good WPPAs were chosen, there are also those that do not conform to usability guidelines. In these cases, users' opinions are very important since they might reveal the lack of usability. Table 3 contains list of evaluated WPPAs.

Table 3: List of the evaluated WPPAs (Source: own)

Name of the city	URL of the WPPA
Brno	http://www.brno.cz/
Chrudim	http://www.chrudim-city.cz/
Hradec Králové	http://www.hradeckralove.org/
Jihlava	http://www.jihlava.cz/
Opatovice nad Labem	http://www.opatovice-nad-labem.cz/
Ostrava	http://www.ostrava.cz/
Pardubice	http://www.mesto-pardubice.cz/
Praha	http://www.praha.eu/
Přelouč	http://www.mestoprelouc.cz/
Svitavy	http://www.svitavy.cz/

4.3 Target group of users

The group of typical users of the evaluated systems should be easily defined. It is necessary to inquire group of users in order to obtain results [14], [16]. Hence, it must not be impossible or difficult to realize suitable form of usability testing.

General profile of a typical user of the WPPA is described in [21]. From such universe were chosen 20 users and divided into two following groups:

- 10 testing users,
- 10 users to evaluate usability of selected WPPAs.

Latter group was further divided to meet the following criteria:

- Sex,
  - 50% men,
  - 50% women,
- Age,
  - 30% users of age between 15 and 25 years,
  - 50% users of age between 26 and 55 years,
  - 20% users older than 55 years,
- Skills and experience,
  - 20% users with no or low level of computer skills and experience with Web browsing,
  - 60% users with average computer skills and experience of Web browsing,
  - 20% users with high or expert computer skills and experience of Web browsing.

4.4 Criteria of the evaluation

A finite number of major aspects affecting the usability of evaluated systems must be defined. It is recommended to perform thorough study of these characteristics [21].

The set of criteria defined previously in [4] lists the most important characteristics of the WPPAs and is therefore suitable for usability evaluation. Table 4 lists the criteria and the questions used in the questionnaire during the evaluation.

Table 4: Criteria affecting usability of WPPAs (Source: own)

Criterion	Evaluating question
Accessibility	Specify how easily is the Web site's content legible (readable) and viewable for you.
Instant comprehension	How much do you consider the information instantly comprehensible?
Information retrieval	How simply (and fast) is to find some kind of information on Web site?
Recency	How much do you consider the information found on the Web site actual?
Navigation simplicity	Evaluate simplicity and level of comprehension to the Web site's navigation.
Design preference	How much does the graphic design of the Web site fulfill your expectations or meet your preferences?
Orientation	How good is the knowledge of your current location through the Web site at any moment during the browsing?
Amount of graphics	Qualify your level of satisfaction with the amount of graphics appearing on the Web site.
Loading speed	Evaluate the speed by which the Web site's elements are loaded.

4.5 Parameters of the evaluation

Each selected criterion of the evaluation – variable that helps to explain usability has a defined universe of discourse, finite number of states of the linguistic variable, shape and parameters of the membership functions.

The number of the output membership functions for usability, shape and other parameters of membership functions of this linguistic variable must be decided.

Some of the parameters necessary for the usability evaluation process are listed in Table 5.

Table 5: List of parameters of the usability evaluation (Source: own)

Parameter	Value(s) of the parameter
Construction of fuzzy elements	8 input and 1 output linguistic variables Input variables are denoted in the same way like the criteria Output variable is denoted as Usability
Parameters of variables	Each linguistic variable has triangular membership functions, 3 linguistic states (low, medium, high) and universe of discourse in range from 0 to 100
Scale	Empirical scale based on the users' evaluations
Level of significance	Spread of two sigma around the mean value
Structure of the evaluation	Testing phase to define empirical scale and fuzzy rule base Usability testing: personally (80%), e-mail questionnaires (20%)

4.6 Empirical scale definition

It is necessary to define the empirical scale that explains what values represent the evaluation expressions. This is done by inquiring a group of testing users that evaluates the usability both by using word expressions and by numeric score of each criterion.

During the scale and rule definition phase, 10 testing users were inquired, while each of them evaluated five randomly chosen WPPAs providing:

- 50 different sets of evaluations,
- 90 evaluations of criteria,
- 90 various scores per user,
- 450 relations in the form (linguistic_evaluation; numeric_evaluation).

4.7 Rule base definition

The evaluator may use results of testing to define the fuzzy rule base. That however depends on the level of evaluator's knowledge. Properly defined rule base is the most important factor that determines precision of the output.

Since it would be complicated to define all possible fuzzy rules, each of the 50 sets of evaluations obtained during the evaluation with scoring, helped to establish the fuzzy rule base. Rules were generated automatically using the techniques for automatic rule generation implemented in FUE and described in [21].

The automatic rule generation is more efficient than definition of the entire fuzzy rule base by an expert [5], [21]. First, it would take a lot of time and effort to create enough rules and second the number of errors would be

probably high. The proposed way is more convenient because the user itself defines the most frequent evaluations that might occur. Human expert reviews the rules and according to own knowledge and experience, makes a conclusion. There should be however manually generated some number of rules by thorough analysis of the current rule base.

4.8 Process of the usability evaluation

Once the empirical scale is defined and rule base is equipped with the expert knowledge, regular usability evaluation may be initiated. During the evaluation, desired number of users evaluates each criterion of selected systems. The result of usability evaluation is a set of evaluated criteria in form of word evaluations.

Each set of evaluations is first fuzzified, inferenced with the help of knowledge stored in the fuzzy rule base and afterwards defuzzified to the form of single real number. The resulting value is the score of usability evaluation and is defined on range from 0 to 100 points.

The usability evaluation was performed by 10 users, who evaluated 10 selected Web portals of Public administration from the list in Table 3.

Personal inquiries were performed on a personal computer equipped with Windows XP and fixed Internet connection (ADSL 4 Mbps/256 Kbps).

Tested users were explained that the evaluation may be qualified by using any expression stating some level of preference or dislike. Each session took about 5 – 15 minutes according to the experience and skills of the user. Photo from usability test laboratory you can see in Figure 4.

Figure 4: Usability test laboratory (Source: own)

E-mail questionnaires used the same structure of questions as the personal inquiries. Users were instructed how to perform evaluation. Users sent filled questionnaires back to the evaluator and these were processed the same way like personal inquiries.

5 Results

After performing all evaluations, the results can be analyzed. One may compare results to find the best alternative or analyze how different classes of users evaluate selected systems.

Depending on the purpose of the usability evaluation, the evaluator is able to make various kinds of conclusions that may involve other fields of interest. The interpretation of results relies on the evaluator and desired goal of the usability evaluation process.

5.1 Score of the usability evaluation

First, let us analyze the overall results by portals. The overall results are summarized in Table 6. Three defuzzification methods were used – center of gravity (COG), height method (HM), weighted center of area (WCA). They are further described in [21]. The score of WPPA on the first position is very high taking in mind, that 10 different users evaluated the usability. The average score of the worst evaluated WPPA is just slightly below the average value.

Table 6: Results by portals (Source: own)

Score	WPPA	COG	HM	WCA
1st	Jihlava	92.17	89.92	91.37
2nd	Ostrava	89.10	86.27	88.48
3rd	Hradec Králové	85.55	83.28	85.15
4th	Brno	83.75	79.19	83.97
5th	Praha	82.87	80.51	82.31
6th	Pardubice	81.71	80.10	80.34
7th	Opatovice nad Labem	77.06	72.87	78.95
8th	Přelouč	76.38	72.91	78.03
9th	Chrudim	57.56	56.04	57.21
10th	Svitavy	44.28	46.13	45.21

The average scores of different defuzzification methods are very similar. As can be also seen, HM defuzzification method mostly produces lower scores than COG whose values are very similar to those obtained by WCA method. The authors consider the COG method as the most preferable.

Another interesting analysis of overall results is performed by classifying users according the predefined users' criteria:

- Sex
- Age
- Experience

These results are depicted in Figure 5.

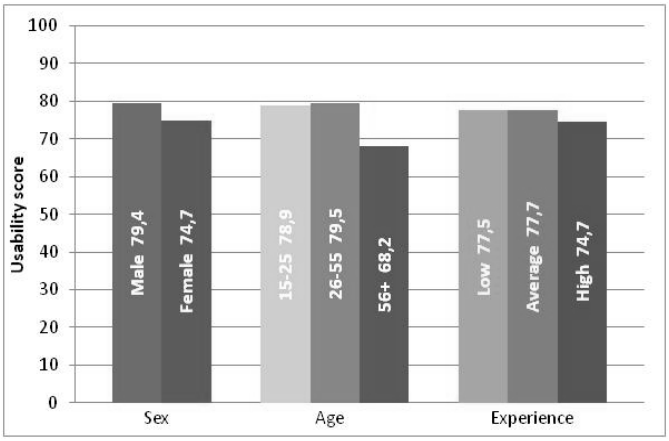

Figure 5: Results by users (Source: own)

As can be seen from Figure 5, the women in the sample evaluated with slightly lower score. As for the age, users from 15 to 55 years together evaluated very similarly, while users older than 55 years evaluated with significantly lower scores on average 68.2 points. Finally, classifying according to the experience brought similar results, which is according to the fact that users as non-experts evaluated usability just by using their natural language, very good demonstration that used criteria are not confusing. As can be seen, the average score of evaluation by experienced users is lower. This might be explained by a fact, that advanced users are more critical, since they have learnt to distinguish between what is good and what is not.

5.2 Validation of the results

In order to validate the reliability of proposed methodology of fuzzy usability evaluation, the results of study need to be validated. The validation is based on performing a usability evaluation using some known method of the usability engineering [14], [15], [16]. For the validation is chosen the same group of users and WPPAs that was evaluated in the study.

Likewise, the results were validated by evaluating set of criteria affecting the usability of Web portals. The criteria are similar to the ones used for evaluation of the usability in the study. Choosing a set of completely different criteria is not suitable due to the following reasons:

- The fundamental aspects that truly affect the usability of WPPAs were already defined. Thus, it would be inefficient and redundant to define another set.
- The score of usability evaluation might be significantly different if the evaluation is based on another set of criteria.

As stated at the beginning, although there is no clear consensus how to measure usability obtaining a score of usability evaluation, there are some concepts that instruct how to obtain some simple measure. For instance, [19] presents SUS score based on evaluating criteria on some scale. The most suitable seems to use the Likert scale [11] with range of values from 1 to 7. Users evaluate the fact by choosing the value of scale in simple questionnaire (see Table 7). These criteria were previously presented in some studies [2], [12]. The overall score is than computed as presented in [19].

The questionnaire consists of five questions. Users evaluate by assigning values from 1 to 7, where 1 means that user strongly disagree and 7 that strongly agree with the statement.

The overall results were than compared to the ones presented previously. See Table 8 for comparison.

Table 7: Questionnaire for results validation (Source: own)

Criterion / Scale
I like the graphic interface of the Web portal: Strongly disagree 1 2 3 4 5 6 7 Strongly agree
The information provided by the Web portal is easy to understand: Strongly disagree 1 2 3 4 5 6 7 Strongly agree
It is easy to find information I needed: Strongly disagree 1 2 3 4 5 6 7 Strongly agree
I am satisfied with how easy is to use this Web portal: Strongly disagree 1 2 3 4 5 6 7 Strongly agree
Overall, I am satisfied with this Web portal: Strongly disagree 1 2 3 4 5 6 7 Strongly agree

Table 8: Results of validation (Source: own)

User	**WPPA**	**Evaluation No.**					**SUS**	**COG**
		1st	**2nd**	**3rd**	**4th**	**5th**		
User 1	Ostrava	7	5	6	7	6	**86.67**	85.15
	Hradec Králové	7	7	7	6	6	**93.33**	96.38
User 2	Svitavy	1	4	1	3	3	**23.33**	28.89
	Chrudim	2	6	5	2	3	**43.33**	47.48
User 3	Praha	6	6	7	7	6	**90.00**	96.36
	Přelouč	5	6	6	4	5	**70.00**	73.94
User 4	Chrudim	4	6	6	7	6	**80.00**	81.84
	Přelouč	6	6	7	6	6	**86.67**	95.91
User 5	Hradec Králové	7	5	6	7	6	**86.67**	84.13

	Svitavy	4	4	2	3	4	**40.00**	66.85
User 6	Praha	6	7	4	6	6	**80.00**	89.68
	Brno	6	5	6	6	6	**80.00**	87.48
User 7	Opatovice nad Labem	5	6	4	5	6	**70.00**	82.22
	Hradec Králové	7	6	7	7	7	**96.67**	96.37
User 8	Svitavy	4	6	5	3	5	**60.00**	79.41
	Brno	6	7	6	6	6	**86.67**	87.29
User 9	Pardubice	5	7	7	7	6	**90.00**	89.17
	Přelouč	5	6	6	5	5	**73.33**	73.94
User 10	Opatovice nad Labem	2	6	3	5	5	**53.33**	64.61
	Svitavy	1	4	3	3	3	**30.00**	27.64

The results of randomly chosen WPPAs evaluated by both methods show very good level of consistency. The differences might be caused by the different complexity of criteria and lower precision of the SUS method, since it cannot take all values between 0 and 100. However, it is also natural that users might have changed opinion between both sessions that were performed with slight time gap.

5.3 Conclusions of the study

The goal of the study was to evaluate 10 selected Web portals serving the Public administration. The defined empirical scale proved its versatility taking in mind that group of testing and "regular" users were different.
Although the sample of users that participated in the test is lower, the study gives a methodological example how to perform the usability evaluation of Web portals.

The Web portal that reached the highest score of usability evaluation in this study combines all features of the good Web site. The design style is relatively simple, uniform and easily manageable. Furthermore, the portal is being updated and it is legible with optimal amount of graphic elements.

Looking at the other results of evaluation, one can make useful conclusions. For instance, in case of the Web portal of Hradec Králové, a decision to put recent information on the homepage would increase usability score, since most of the users evaluated the criterion Recency with neutral and negative evaluations as they were unable to find recent information anywhere. In case of Pardubice or Přelouč, the amount of graphical elements might be reconsidered.

6 Conclusion

This work proposes model of usability evaluation which truly represents the user language, allowing users to feel free expressing their thoughts even if they are not fully able to explain or interpret them. The model allows performing a usability evaluation of almost any kind of system. As a result of a particular evaluation, a score is obtained. The score combines various factors affecting the usability of particular system.

This paper also demonstrated the possibility to perform usability evaluation of the Web portals by facing the uncertainty and vagueness that surround the user language. The results show that the usability evaluation has measurable output. The accuracy of the output was validated. The accuracy of the output was validated. Together with the usability score – unique indicator of the quality of use for each evaluated portal, several conclusions and recommendations might be made.

Although utility and reasons to maintain quality of private and public services are different, there is a number of factors why measure, compare and improve the quality of use of the public information services as the one presented hereby – Web portals.

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