[1.]Vernes VINČEVIĆ, [1.]Mahir ZAJMOVIĆ

QUALITY MODELS AND WEB APPLICATION VALIDATION METHODS

[1.]University of Vitez „VITEZ", Faculty of Information Technologies, Školska 23, 72270 Travnik, BOSNIA & HERZEGOVINA

Abstract: There are various quality models and web application validation methods used to ensure a high level of performance, functionality and usability. There are various quality models and web application validation methods used to ensure a high level of performance, functionality and usability. Research on the quality of websites of educational institutions refers to the aspect of usability, performance and functionality through a designed survey questionnaire and analysis of the results at the end of the research. The focus of the work will be on the research and analysis of the quality of several websites of educational institutions in central Bosnia that are in use and are still in use. The methodology used in the work is an anonymous questionnaire, a software tool for measuring success, statistical methods and a scientific method of analysis and synthesis.
Keywords: web application validation methods, websites of educational institutions, questionnaire, statistical methods

1. INTRODUCTION

There are various quality models and web application validation methods used to ensure a high level of performance, functionality and usability. There are various models and methods of validation that are applied in practice such as ISO 25010 quality model, McCall's model, usability quality model ISO 9241–11, and others. The usability quality model ISO 9241–11 focuses exclusively on the usability of web applications and defines three components of usability such as efficiency, user satisfaction and avoidance of user errors. In addition to the quality model, we have several validation methods that can be applied and are often used in practice, such as the method of user testing and evaluation, expert evaluation, automatic software testing and surveys and questionnaires for collecting opinions and feedback from users through structured surveys. This method helps us to analyze the results of a survey about a web application or website that is in use and is the subject of research in this paper, to get a general insight into user satisfaction and to evaluate and assess the quality of the mentioned web pages, which will be the focus of the research in this paper. Using appropriate quality models and validation methods is key to ensuring the successful development and implementation of web applications and web pages that meet high standards of performance, usability, design and user experience [1].

Since we have various applications in use, web and mobile applications are specific compared to others. In order for the application to be as good as possible during the development process, various aspects must be taken into account, e.g. such as quality assurance, protection, etc. For example, malicious attacks on the websites of state, military, and financial organizations often occur, and therefore it is necessary to implement certain measures to protect the content on the website. With web–based software, the situation is quite different. "A recent survey of Web software development managers and practitioners shows that Web–based companies depend on whether customers use their sites, and most importantly, whether they return to them . Users will return only to sites that meet their needs [2].

2. OVERVIEW OF THE QUALITY MODEL

The term quality is used in various ways, there is no clear definition. The definition of quality according to the ISO 9000 standard is "Quality is the degree to which a set of inherent characteristics meets requirements". Theoretically speaking, there are various approaches to quality, but the generally accepted definition is: "Quality is customer satisfaction". Everything starts from customer satisfaction. Since the topic is web page quality, the focus will be on the analysis of quality features such as usability, for example several web pages, and further elaboration regarding access to quality will not be the topic of the paper.

The quality model, like any model, should define and emphasize the features (characteristics) that are most important for a specific need [3]. Quality models arose from the need to include different aspects of observation in software quality assessment. From the theoretical aspect, there are a large number of quality models described in professional literature, and they have in common that they support the same approach to this problem. Each model defines a set of characteristics (features) that we judge to be important. Each model emphasizes a particular feature of the software that is measurable e.g. reliability, usability, etc.

Some of the accepted quality measurement standards are: ISO/IEC 9126 standard, SQuaRE standard, ISO/IEC 2501n, etc. The literature mentions several attributes that must be analyzed when evaluating the quality of a website, namely: a) Web properties; b) life cycle and c) quality characteristics. They called the quality model organized in this way WQM (from Eng. Web Quality Model). In addition to this model, there are WEF (eng. Website Evaluation Framework), WebQualTM, C–INACAMI technology (from Eng. Contextual–Information Need, Concept model,   Attribute, Metric and Indicator), SNSQUAL model, etc. The following examples show how to format a number of different figure/caption combinations. Note that the table borders are shown as broken lines for guidance only; they should not, of course, be shown in your actual paper.

3. METHODOLOGY

The focus of the work will be on the research and analysis of the quality of several websites of educational institutions in Central Bosnia that are used and are still in use. Research on the quality of websites of educational institutions refers to the aspect of usability and performance through a designed survey questionnaire and analysis of the results at the end of the research. The research was conducted during 2022, in which parents, teaching and IT staff of educational institutions participated. Website performance was measured and testing using the software tool SolarWinds Pingdom. The usability of the website is evaluated through survey questions, which are finally analyzed and presented in the paper. The methodology used in the work is an anonymous survey questionnaire, a software tool for performance measurement, statistical methods and a scientific method of analysis and synthesis. The paper used a small sample of 40 randomly selected respondents, but presented a methodology and quality model that can be applied to a larger sample as well. The respondents are students and their parents. The work and results of the research show the analysis and quality model of the selected web pages based on the research of the given data set. The above results can serve as input information to web developers and web page designers when improving the user experience and design of this type of project.

Usability is the process of creating a website for easy user use. A website is useful if users can easily use it and accomplish the tasks they are on it for. Usability is a quality attribute that assesses how easy the user interface is to use and perform specific tasks in a specific environment [4]. During the design process, the word usability is used in the simplicity improvement activities that are carried out in the design process. This includes software and websites. The quality of usability includes ease of use by the website user, efficiency, performance and speed of opening links, etc., satisfaction with the design and interface of the website and how user–friendly it is. If users are satisfied, it is known in practice that they will visit the desired website again.

Many projects fail or become very complicated for several reasons, such as the lack of a development plan, wrong methodology, resources, inexperience of the profession, budget, etc. Reasons that could have been avoided in time. That is why it is always necessary to have a general work plan in order to minimize project risk. An example of the application of good practice of website development greatly speeds up and facilitates the development of a project. Attributes for analysis in our research are: usability, functionality and performance of the website with the use of statistical methods. The literature mentions several attributes that must be analyzed when evaluating the quality of a website, namely:

— web properties;
— life cycle and
— quality characteristics.

The authors of the study believe that these aspects are mutually orthogonal. They called the quality model organized in this way WQM (Web Quality Model). The paper presents the quality model (Figure 1) and the basic scheme of the WQM quality model as well as its organization. Quality is assessed from different aspects, including the entire development process from the initial to the final phase. The assessment of the quality of a software product depends on the context in which the software is viewed. An important turning point in the standardization of software quality and methods for its measurement was the adoption of the ISO/IEC 9126 standard at the end of 1991 [3].
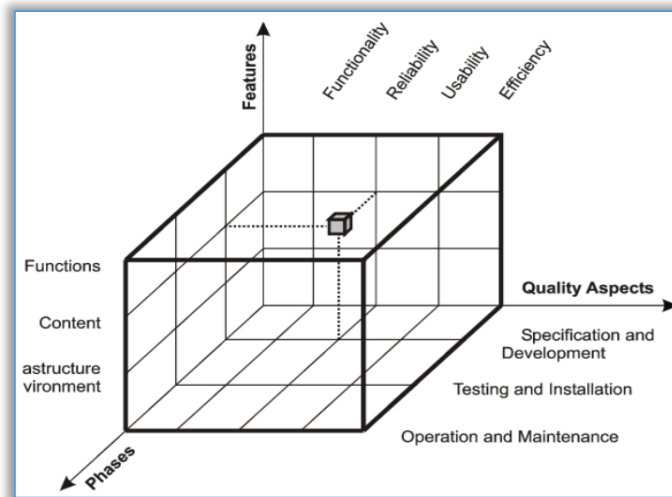
Figure 1. Graphical scheme of the basic WQM quality mode

The following descriptions show the practical application of the WebQEM methodology for the purpose of evaluating the quality of several web sites of educational institutions from the area of SBK, as well as statistical methods in the analysis and assessment of quality. Of course, due to realistic constraints, we have to treat WebQEM outside the C–INCAMI framework and narrow the focus of the evaluation quite a bit. We will focus primarily on their practical demonstration. The focus will be on the analysis, evaluation and assessment of usability attributes. Based on the defined criteria, we analyzed and evaluated 15 (fifteen) websites in use from the area of SBK from the field of education, including 4 (four) universities. We observed some design and functionality flaws that hinder the successful use of the mentioned web applications and suggested possible solutions.

Usability is the process of creating a website for easy user use. Usability is a quality attribute that assesses how easy the user interface is to use and perform specific tasks in a specific environment. The criteria for evaluating the usability of web pages according to this model are: web page loading speed, layout of elements on the page, compatibility with web browsers, pleasant design, navigation, search function, site map, content, simplicity, enabling use by people with special needs, page optimization which affects the performance and formats of multimedia content [5].

General quality rating scale: 1–not good quality, 2–satisfactory, 3–average quality, 4–good quality and 5–excellent quality. The rating of some sites will show whether improvements are needed or not. In this pilot study, we analyzed and tested 15 websites of "educational institutions" from the area of SBK Canton based on the above–mentioned criteria of usability of web applications (web pages, portals, etc.). Ratings range from 1 (insufficiently applied characteristic) to 5 (excellently applied characteristic).   The web addresses of the analyzed sites are:

— WS1 – Mixed secondary school Busovača – website; https://www.mssbusovaca.com.ba
— WS2 – Vocational High School Bugojno – web portal; https://www.srednjastrucnaskolabugojno.ba
— WS3 – Mixed secondary school Donji Vakuf – web portal; https://www.mssdvakuf.ba
— WS4 – Mixed secondary school Novi Travnik – web portal; https://www.mssnt.ba
— WS5– Mixed secondary school Fojnica – website; https://www.smsfojnica.com
— WS6 – Mixed secondary technical school Travnik – web portal; https://www.msts–travnik.net
— WS7 – Mixed secondary school Vitez – web portal; https://www.mssvitez.com
— WS8– Secondary school Ivan Goran Kovačić Kiseljak – web portal; https://www.ssigkkiseljak.ba
— WS9 – Nikola Šop Jajce High School – website https://www.sssjajce.com
— WS10 – Mixed secondary school Gornji Vakuf – website; https://www.mssgv.ba
— WS11 – Secondary school Vitez – website; https://www.ss–vitez.mozks–ksb.ba
— WS12 – Kreševo High School – website; http://www.ss–kresevo.ba
— WS13 – Middle School Zijah Dizdarević Fojnica – website; https://www.srednja–mjesovita–skola–zijah–dizdarevic–kiseljak.business.site
— WS14 – First Elementary School Bugojno – web portal; https://www.prva–bug–jaklic.mozks–ksb.ba

⸺ WS15 – Mixed Secondary School of Economics – Website; https://www.mseus.ba

Web usability is a qualitative attribute that determines the extent to which the graphical interface of a website is easy to use. We can say that a usable website allows the visitor to quickly and easily find the desired information. Research on web content accessibility guidelines (WCAG), which offers development and creates a process in collaboration with individuals and organizations around the world, is essential and creates an important goal that provides a single common standard for accessing web content that meets the needs of individuals, organization and government at the international level, and certain test visuals are used in the usability testing of websites and are referenced according to the standards offered by the accessibility guidelines [6].

4. RESULTS

Some of the more important features that we will mention in the research and related to usability are website loading speed, layout of elements on the page, compatibility with web browsers, pleasant design, navigation, search function, site map, content, simplicity, enabling use by people with special needs , page optimization that affects performance, multimedia content formats, etc. Usability is a quality attribute that assesses how easy the user interface is to use and perform specific tasks in a specific environment.

After the survey was conducted, the results of the aforementioned pilot study were presented. After processing the questionnaires, the results are shown in table 1. The analyzed web sites are marked abbreviated from WS1 to WS15. Figure 2 shows a view of web site display usability ratings: WS1 to WS15 (from the first analyzed site to the fifteenth, abbreviated WS1 to WS15), according to defined criteria.

Websites that have been rated: Criteria for usability evaluation	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8	WS9	WS10	WS11	WS12	WS13	WS14	WS15
1. Website download time															
A. Initial loading efficient	4	5	3	4	5	4	3	2	3	4	5	4	3	2	4
2. Arrangement of elements on the website															
A. Existence of the logo - left corner (identification block)	5	5	5	1	5	4	3	3	3	3	3	3	3	3	3
B. Navigation – clear and noticeable	2	4	4	3	5	4	4	4	4	4	4	4	4	4	4
3. Website content															
C. The date of the last revision of the page is clearly marked, as well as the date of the entity that implemented it etc..	1	5	1	5	5	5	2	2	5	5	5	2	2	5	5
4. Communicability (navigation and search)															
A. The navigation is clear, noticeable, stable	2	5	3	4	5	4	3	3	3	4	5	4	3	3	3
B. Availability of information (no more than three clicks, for example)	3	4	3	3	4	5	2	2	3	3	4	5	2	2	3
C. Instructions for using the site or site map	1	2	2	3	4	4	4	4	2	3	4	4	4	4	2
5. Web browser compatibility															
A. The website is equally effective with different browsers such as Mozilla Firefox, Microsoft Edge, Google Chrome, Opera, Safari, etc.	3	4	4	4	4	5	5	5	5	5	5	5	5	2	5
B. Alt tags for photos	2	4	2	3	4	4	2	2	4	2	2	4	2	2	4
C. Text and background contrast (for the visually impaired)	2	4	3	3	4	4	3	3	4	3	3	4	3	3	4
D. Responsive page (adaptable for tablets or smartphones, automatic resolution adjustment)	1	4	2	2	5	4	4	4	4	4	4	4	4	4	4
6. Adaptation to people with special needs															
A. Adaptation to people with special needs	2	3	2	2	3	3	3	2	3	3	2	3	3	2	3
Overall evaluation of the usability of the "web site"	2,56	4,13	3,15	3,03	4,66	4,33	3,44	3,36	3,72	3,95	3,45	3,87	3,78	2,51	3,91

Figure 2. Web site display usability rating: WS1 to WS15, according to defined criteria

After web evaluation and evaluation, the best web site was the web site of the mixed high school "Zijah Dizdarević" Fojnica, and rated the best grade on a scale of 1 to 5, grade 4,66. Because the web site of this educational institution has all the necessary elements on the website that have been positively evaluated and designed and evaluated by parents and students who use it. The website has the following essential things implemented in the website such as the initial loading speed of the website was measured by a software tool and it loads quite fast, the position of the ident logo is in the upper left corner and there is a link to the home page, the navigation is good and is positioned at the top of the page, with drop–down menus, the content is along the left side of the web page, and along the right

are links (internal and external) that are related to the theme of the page or banners, the footer contains the necessary links to pages with basic information and the website (federal ministry, cantonal, rules of use, contact information, etc.), then the home page is aesthetically well designed and up–to–date with a high–quality layout of objects for the school theme, then made according to the principles of UX/UI design, it is responsive and designed for all devices, so it is an internet portal that is an example of a quality, well–organized web application. Figure 3 shows of performance measured by the SolarWinds Pingdom software tool for the website in question.
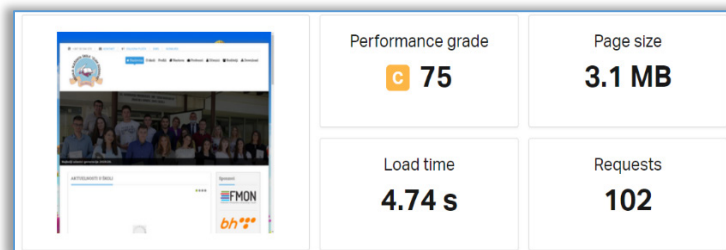
Figure 3. Performance measurement (load speed, page size, etc.) and analysis using the SolarWinds Pingdom software tool for mixed high school "Zijah Dizdarević" Fojnica

On the Figure 4 is shown layout of the home page of the mixed high school "Zijah Dizdarević" Fojnica web portal. User communication is enabled through the form, and moving through the page is quite easy and simple. There is no sitemap, but the site's search engine can be used to find the target topic. Links to other pages of the site are useful, meaningful and correct as well as external links. The user knows at all times where a click on a link or banner will take him. The navigation is clear, noticeable, consistent and transparent. Each graphic and audio attachment is adequately placed and illustrates the accompanying text. Videos load quickly, their role is clear.

Graphics and animations make a significant contribution to the site, they are not offensive and do not distract the user. The site is usable and optimized for all browsers with noticeable loading speed. Information is crucial for a portal/web application. On the pages of this portal, there is a large amount of useful information from the field of school work, new notifications, news from the school, various competitions, the content is dynamic and easily updated. The site has all the necessary modules and the consistency of the visual elements is consistent. Information is easy to find in well–organized web content.
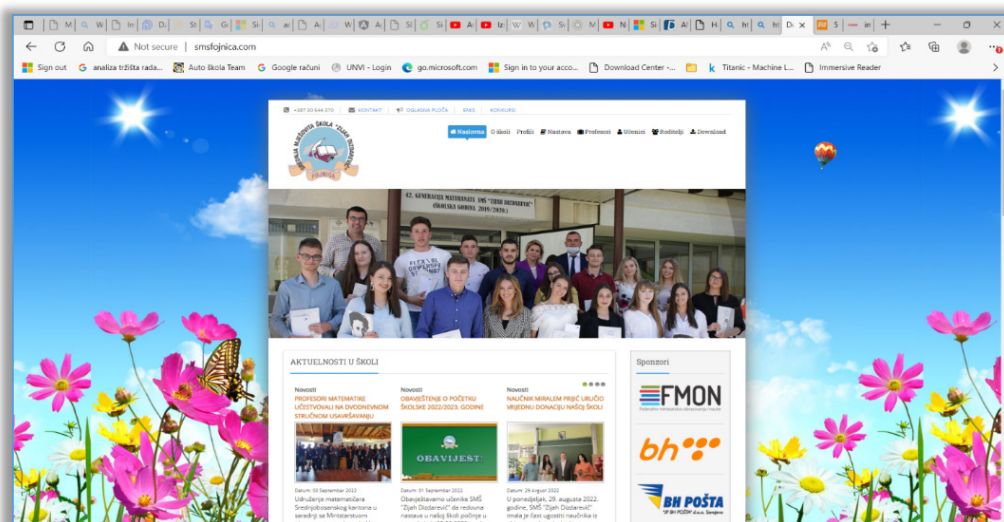

Figure 4. Layout of the home page of the mixed high school "Zijah Dizdarević" Fojnica web portal

After web evaluation and evaluation, the worst website is from the website of the Busovača Mixed High School in Bosnia and Herzegovina, and rated the best grade on a scale of 1 to 5, grade 2,56. Because this page, based on the criteria during the web evaluation, did not have all the elements needed on the website that we will list below, then it was not designed in accordance with UI/UX practices, users cannot find the necessary information, information is outdated, there is an error during loading and etc.

As the worst rated, the listed page has disadvantages that are reflected in the following things as the school management created the site using the classic html language and all pages are in .html format, and when loading for the first time as well as when switching to each page, the error "clear the browser's cash" appears, using his example he showed what unprofessionalism and amateurism mean in web design, look picture 3 and 4, then the initial load is extremely slow with the above error, the logo is placed in the middle of the page and is not a link, navigation is only on the first page. the rules of UX/UI design were not respected and the theme on the page does not correspond to the theme of the school, there is a lot of outdated information, there is no revision of the creation or updating of the site, the banner on the home page is too big and takes up a large part of the page, which is not necessary.

Figure 5 shows An error message on the server where the website is hosted (worst rated). Initial load is extremely slow with the above error. The logo is placed in the middle of the page and is not a link. Navigation is only on the first page. The rules of UX/UI design were not respected and the theme on the page does not correspond to the theme of the school. There is a lot of outdated information, there is no revision of the creation or updating of the site.
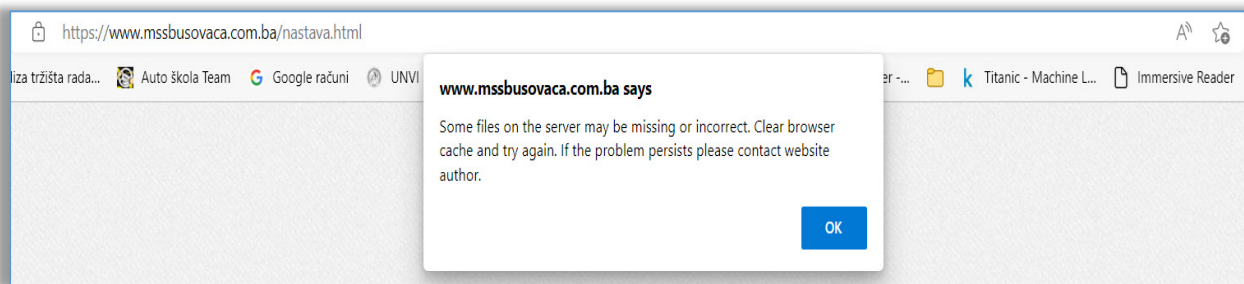

Figure 5. An error message on the server where the website is hosted

On the Figure 6 shows is layout of the home page of the Busovača Mixed High School web portal The banner on the home page is too big and takes up a large part of the page, which is not necessary. The home page is a page that serves no purpose. It informs the user that the site is loading if you click on the ok button, and next to it the links are non–functional and inactive. We don't know which side we're on and where we came from, because it's a confusing feeling for the user. There is no content index, the text is complicated, short, does not follow the same font and size, and the graphic elements that are placed next to the text and for which the user expects to be a link to a wider explanation, are of no use, they do not even have an Alt tag, or a text description viewed from the aspect of UI/UX techniques. The mentioned page should be revised and improved. The research is new and original on a smaller sample in Central Bosnia where almost all schools for analysis are included.

Figure 6. Layout of the home page of the Busovača Mixed High School web portal

We have extended the usability analysis measured with the SolarWinds Pingdom tool to Universities/Universities that exist in the area of Central Bosnia and thus increased the sample. The results obtained by measuring with the help of a software tool with basic parameters are shown in the following table 2, which shows the comparison of the performance of the quality of usability of web sites.

Table 1. Comparison of the performance of the quality of usability of web sites

No.	University name and domain name	City	Performance				
			Performance Rating[a]	Page size	Load time	Requests	Security (SSL certificate)
1.	International University https://iu–travnik.com/	Travnik	67 (d)	11,1 MB	12,63 sec	251	Yes
2.	University of Travnik www.unt.ba/v2/	Travnik	75 (c)	1.3 MB	3,44 sec	73	Yes
3.	University/University of Vitez www.unvi.edu.ba	Vitez	71 (c)	11,3 MB	7,19 sec	155	Yes
4.	CEPS Kiseljak High School https://www.ceps.edu.ba/	Kiseljak	63 (d)	18,5 MB	3,39 sec	160	Yes
a)	A brief analysis of the measurement results: The first element (Rating) is not crucial, but the third element (Loading speed) is much more important. From the above, we conclude that the University's website with version 2 loads the fastest and has a rating of 75. Geographic server location: test from Europe–UK – London (closest to Bosnia and Herzegovina) ** An example of the average rating of a website is 95 with 109 requests in 2–3 seconds.						

On the Figure 7 shows is an example of measuring (testing performance) a web site–a for an International university in Travnik. Show is performance measurement (loading speed, page size, number of loading elements, etc.) and analysis using the software tool Pingdom for the website www.iu–travnik.com (International university in Travnik).
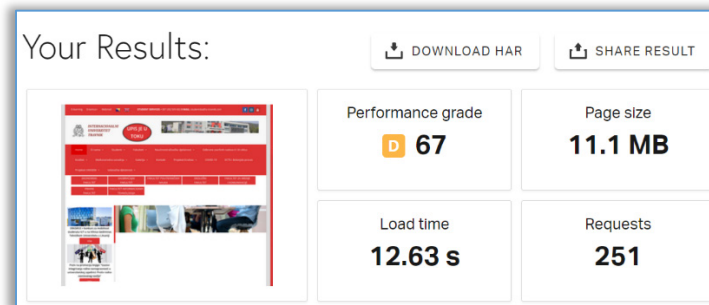

Figure 7. Performance measurement (loading speed, page size, number of loading elements, etc.) and analysis using the software tool Pingdom for the website www.iu–travnik.com

The research will use primary data shows is results of statistical research, obtained through answers from a survey questionnaire that was delivered to a specific group of website users (students and their parents). The survey questionnaire was previously designed for this population and has 17 (seventeen) questions, and the processing of the survey questions was done in MS Excel Data Analysis tool.The sample is a set of N=40. On the table 3 shows is tabular overview the descriptive statistics report of the research.

Table 2. Descriptive statistics of research

Question/Variable	Mean	St.dev	Min	Max	N
Evaluate the overall quality of your school's website in terms of its usability	3,38	0,98	2	5	40
Evaluate the overall quality of your school's website in terms of functionality and reliability	3,61	0,93	2	5	40
Evaluate the overall quality of your school's website in terms of functionality and rleiability	3,32	0,97	2	5	40

We took into account only the key variables for the analysis of all results. Based on the analysis, it can be concluded that the respondents agree with the statement that the analyzed websites are quite usable, communicative, interactive, user friendly and are overall satisfied with the website from the aspect of usability, but that they need improvements. Respondents agree to a lesser extent that the website is good and of good quality in terms of performance and some improvements are needed. Using the standard deviation, we determined that there is no large deviation around the average value of the answers, and we tentatively conclude that it is a homogeneous group of answers. Based on the conducted research, it can be concluded that the surveyed users of a given school are greatly influenced by how the website is organized, then whether they can find quality information and whether the information is updated, as well as the quality of the content posted on the web portal "can to find or not". The arithmetic mean in the table (one variable) of 3.38 (interval of 3.38–3.61) shows that

respondents in this sample of N=40 users agree with the stated statements from the anonymous questionnaires that were the subjects of the research. In the continuation of the research results, the factor analysis of important variables will be presented. On the table 3 shows is factor analysis, correlation and reliability of data. We tested the reliability of the obtained data using the Cronbach Alpha test, which showed mean values of around 0.40, which is a satisfactory or acceptable value due to the small sample, and thus showed that the data on this sample is quite reliable. Factor analysis served to reduce the number of interrelated variables from 17 to 3, which are internally related (assertions). The result of the factor analysis shows that the collected data from the research are interrelated, which shows values from 0.266 to 0.378, which means that we will not reject any variable because it is not below 0.25 on the reliability scale, which tells us that the connection between the variables is good, but it must work on improving the above sites.

Table 3. Factor analysis, correlation and reliability of data

Important variables	Survey Question/Variable	Mean	St.dev	Factorial association	Reliability (Cronbach Alpha– ANOVA)	N
1P – independent	Rate the overall quality of your school's website in terms of usability	3,02	0,88	0,266	0,38	40
2P – dependent	Evaluate the overall quality of your school's website in terms of functionality and reliability	3,31	0,90	0,378	0,28	40
3P – dependent	Rate the overall quality of your school's website in terms of performance	3,34	0,99	0,294	0,37	40

*Cronbach Alpha scale $= 0.3 \leq \alpha < 0.4$ – satisfactory (acceptable) for all variables (independent and dependent) due to a small sample

5. CONCLUSION & FUTURE WORK

Through the analysis, we perceived that the website is a complex project and in its development, a multidisciplinary team of experts from this field needs to participate and that they must follow certain development methodologies. Analyzing the usefulness and usability of a website in a certain organization can bring certain benefits such as increasing profits, detecting potential problems, proposing professional and specific changes to achieve better performance and user satisfaction, so it is an expert recommendation for a successful and high–quality website.

Successful websites are easy to use, usable, pleasant to view content, have relevant and useful content, have good performance, visual design and leave a good impression on visitors [7]. Based on this pilot research, we conclude that there are several characteristic mistakes when it comes to building a Web portal that developers or IT consultants should take into account, namely design and optimization. In Bosnia and Herzegovina, there are a large number of websites that were created without any effort regarding design, especially UI/UX principles and the application of methodology from this industry. We evaluated the quality through the usability attribute, on the basis of which we derived useful conclusions and information. Compared to small sites, more serious institutions order a project (ideal and main) when it comes to the website of the institution in question, and more and more focus is placed on the project of creating a website or application following the latest approaches and methodologies in the field of UI/UX design in order to increase website quality [8].

The assessment of the usability of the websites of educational institutions in Bosnia and Herzegovina is of great importance because it contributes to improving the user experience, promoting inclusivity and efficiency in education, and improving the digital strategy of educational institutions. Incomplete or outdated information on the website can confuse users and reduce the credibility and quality of the educational institution, as we learned from this research.

At the end of the analysis, we can also give recommendations for improving these key features when creating each web site where web portal designers must "pay attention" to the functionality, usability and performance of a web page, as was the case with the high school web pages analyzed. There was a shortcoming and we can see that we obtained values in the range from 3.14 to 5.0 through statistical and other evaluation analysis, and improvements are needed in terms of website functionality and performance. Recommendations for loading speed are quality hosting where the page loads, choosing the right software technology for specific different purposes and type of website. The main feature of a quality website is its design, usability and that it serves a purpose. Recently, clients or website visitors

are also the ones who notice the good and bad elements on the website. Client satisfaction comes first when it comes to this aspect of website quality assessment.

Many websites on the Internet lack the functionality and purpose for which they are intended. A big disadvantage of this is because the website is not designed according to the principles and stages of software engineering development. Websites were not created respecting the principles of UX/UI techniques, which are important for a quality site. Large corporate websites are often created as functional, where you can usually find all the necessary information about them, but not infrequently outdated [9]. Assessing the usability of the websites of educational institutions in Central Bosnia is important for several reasons, as it directly affects the user experience of students, teachers, parents and other interested parties. Some of the key aspects of the importance and importance of the usability of these websites include: accessibility of information, quality of information, improvement of the reputation of the educational institution, improvement of the digital strategy of educational institutions, etc.

As digital technologies and user expectations change, educational institutions in Central Bosnia and the whole of Bosnia and Herzegovina should regularly evaluate and adapt their websites to ensure that they remain relevant and effective. Continuous optimization of the user experience is crucial for the satisfaction of all users [10]. Well–designed websites can significantly facilitate access to education, while poorly designed ones can be an obstacle in the learning and communication process. A similar study was done in secondary Bosnia as a doctoral dissertation entitled "Effects of teacher interaction in secondary education and the electronic learning management system" which deals with the issue and introduction of software solutions in the teaching process during the Covid pandemic in 2021, authored by PhD Nešad Krnjić, who greatly improves the user experience in this issue.

References

[1] Skalar J 2014 Principles of Web Design, Sixth Edition, Cengage Learning EMEA, Canada, USA
[2] Ahn T, Ryu S and Han I 2007 The impact of Web quality and playfulness on user acceptance of online retailing, Information & Management **44**(3) 263–275
[3] Violeta T 2017 Development of application software, Singidunum University, University book, Third Edition, Belgrade, Serbia
[4] Offutt J 2002 Quality Attributes of Web Software Applications, IEEE Software: Special Issue on Software Engineering of Internet Software **19**(2) 25–32
[5] *** Europen standard, ISO EN 9126 1991 Software Product Evaluation – Quality Characteristics and Gudelines for Their Use, Nešad K 2022 Effects of teacher interaction in secondary education and the electronic learning management system, University of Vitez, Vitez, Bosnia and Hezegovina, Doctoral Thesis
[6] Tena L 2023 Analysis and comparison of website design and usability, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia, Master's thesis
[7] ***Roland Petrasch 1999 The Definition of Software Quality–: A Practical Approach https://www.researchgate.net/
[8] ***Brian Shackel 2009 Usability – Context, framework, definition, design and evaluation https://www.researchgate.net/
[9] ***Andreas Komninos 2021 Usability and UX interaction design https://www.interaction design.org/literature/article/an–introduction–to–usability