FLEXIBLE APPROACH TO TESTING EDUCATIONAL AND E-COMMERCE WEBSITES

Enfoque de pruebas flexible para sitios web educativos y de comercio electrónico

Mendielieva Mariia[1], Vovk Oleksandr[1], Gnatovych Volodymyr[2]
[1] Department of Media Systems and Technologies, Kharkiv National University of Radio Electronics, Ukraine
mariia.mendielieva@nure.ua, oleksandr.vovk@nure.ua
[2] Reddit, San Francisco, California, USA
gnatovych@gmail.com

Abstract

Conducting testing on websites in working conditions allows identifying missed errors, mitigates the risk of their recurrence, and minimizes the impact of such errors on users' experience. The article discusses an approach to testing key functions of educational and e-commerce websites using a combination of usability and functional testing methods. This approach enables finding errors in key websites' functions, reducing the risk of missing errors on educational and e-commerce websites and increasing users' confidence. The study includes some experimental data for risk score evaluation for missed errors on educational and e-commerce websites and recommended risk mitigation measures.

Keywords: testing approach, usability testing, functional testing, risk analysis, risk mitigation.

Introduction

Testing is an important stage in the software development lifecycle; however, it is necessary to consider that it can also be conducted in working conditions based on requests from users or the development team (Smashingmagazine Usability research, 2024).

On the one hand, hidden costs may unintentionally arise when testing is ignored during the development of web systems, and there is a rush during the software release. Likewise, fixing errors after a product is released is usually more expensive than addressing them in the early stages of development. In addition to these direct costs, there can also be indirect costs (Devroom, 2025). Furthermore, IT specialists often work on projects aimed at improving an existing website. According to surveys, about 53.8% of software development companies agreed that adapting to and meeting customer requirements is the biggest challenge for IT teams (Goodfirms research, 2018).

On the other hand, customer satisfaction on websites is closely related to UX (user experience). According to a report by Microsoft (Microsoft, 2017), 56% of consumers stopped engaging with a brand due to poor customer service, which includes digital interactions through the website as well.

In terms of flexibility, working websites' ability to adapt to the specific project's situation depends on the project's needs, available resources (human, financial, technical, etc.), the type of delivery and its risks, as well as the scope of the product's use and the project's corporate culture (Cerquozzi et al., 2023).

Purpose

The aim of this research is to develop a more efficient and flexible approach to testing educational and e-commerce websites, which consists of a combination of usability and functional testing methods.

Objectives:

- Analysis of educational and e-commerce sites for testing;
- Tests implementation and execution;
- Analysis of errors found and risks score evaluation for missed errors on websites;
- Development of recommendations to minimize the risk of missed errors;
- Development of options for the use of a testing approach, depending on the possible type of the website's project.

Selection of websites for testing

Usability and functional testing of the key functions of four websites (educational and e-commerce) has been conducted. The key functions included navigation, use of filters and promo codes. Additionally, website design evaluation has also been completed.

The choice of these websites' key functions was determined by the fact that clear navigation is important for modern users (Nielsen Norman Group, 2000) as well as the ability to find and select quickly the necessary information, for instance, by using filters (Wizzy, 2022). In addition, e-commerce websites' popular features include the use of discount promo codes (Wecantrack, 2025) and the presence of interactive quizzes that give recommendations based on user's responses (Okendo, 2023).

The key functions of websites selected for testing and their target audience are listed below:

1. NURE website https://nure.ua/ – the educational website of the Kharkiv National University of Radio Electronics (NURE). The main functions of this website are informational and navigational, as users search for the necessary information. The primary audience of this website includes students (18–24 years old) and faculty members of the institution, as well as applicants (under 18 years old) and their parents (35–54 years old).

2. Dim Ria website https://dom.ria.com/ – an e-commerce website for real estate rental and sales. The main functions of the Dim Ria website are property search and the use of filters. Users enter search parameters such as city and property type and can also apply filters to refine the results (e.g., by neighborhoods or amenities). The primary audience of this website includes families looking for apartments or houses for long-term rent (35–54 years old) and students (18–24 years old) or professionals seeking temporary housing for personal needs (20–34 years old).

3. Drink Arizona website with a coffee quiz page https://drinkarizona.com/pages/coffee-quiz/ – a website's page for beverage sales with an interactive quiz that recommends a drink for a user. The target audience for this website includes young people (18–30 years old) interested in new beverages and cocktails, as well as adult beverage enthusiasts (35–54 years old). The main functions of the quiz are navigational and informational. In most cases, the quiz is taken to receive beverage recommendations.

4. MakeMyTrip website with a How2Go page https://www.makemytrip.com/how2go - an e-commerce website for searching and booking travel tickets for various types of transportation and routes within India. The target audience for this website includes travelers, families (35–54 years old) and students (18–24 years old) planning a vacation. The main functions of the website are searching and comparing tickets, as well as using discount promo codes. Users can filter results by price, travel time, and other options. Most often, users enter the departure point, destination, and travel dates. The website displays available options with prices, travel times, and other parameters.

Risks of missed errors on websites

During the testing, quantative feedback was received from experts and end-users by conducting heuristic testing, usability task-based testing, AI heatmap analysis, and functional black box testing. Tables 1 to 4 illustrate errors found during usability and functional test execution.

An impact assessment on the user's experience was performed for each error found on websites through expert evaluation, using a 5-point scale: where 1 represents a minor impact (the error does not lead to serious consequences) and 5 represents a catastrophic impact, when the error causes a complete failure of the website or its functionality, or it results in a significant loss of users.

Experts also assessed the probability of the error's recurrence on the website, using the scale from 0 to 1: where 0 indicates the error is impossible and 1 indicates it is a guaranteed event.

Once those values were obtained, the risk score for each error was calculated using the formula below:

$$R = P \times I, \quad (1)$$

where P = probability of an error's recurrence on the website and I = impact of an error on user's experience on website. Finally, the results were added to the Tables 1-4.

Analysis of the test results

When the risk score was calculated, all risks were sorted according to their value. This enables decisions to be made regarding which risks require immediate attention and which can be left unattended or addressed with minimal measures.

Table 1. *Errors found during testing of NURE website*

Risk type	Error	Impact, I	Probability of error's recurrence, *P*	Risk Score, *R*
UI/UX	Not all submenu items are visible on small screens	4	0,8	3,2
Search	Search is inconvenient (through the search bar)	4	0,8	3,2
	The search does not start if the cursor is not placed on the search bar	4	0,8	3,2
	The search returns irrelevant results, for example, it's difficult to find anything about the scholarship ranking using the keyword 'scholarship'	4	0,7	2,8
	The search button was hard to find	3	0,8	2,4
	Search with an empty field returns some results	3	0,7	2,1
UI/UX	There is no support for standard accessibility features (keyboard navigation, partial hover support, all focus states)	3	0,6	1,8
	The carousel on the homepage seems doubtful	2	0,6	1,2
Navigation	Opening the wrong courses, displaying a white page	4	0,3	1,2

Source: *Own elaboration.*

Table 2. *Errors found during testing of Dim Ria website*

Risk type	Error	Impact, I	Probability of error's recurrence, *P*	Risk Score, *R*
Filters	Inconvenient to cancel the filters due to their large number	3	0,8	2,4
Navigation	Search by street name returns irrelevant results when the name is typed manually	3	0,7	2,1
	Touchpad gestures work poorly on the map	3	0,6	1,8
UI/UX	The website frozes on the smartphone when closing the cookies banner	2	0,5	1
Filters	Results are returned when applying the 'Search by ID' filter and future dates in the 'Submission Period' filter	2	0,5	1
UI/UX	Font size of the headings on the homepage is a bit large	2	0,3	0,6

Source: *Own elaboration.*

Table 3. *Errors found during testing of Drink Arizona website*

Risk type	Error	Impact, I	Probability of error's recurrence, *P*	Risk Score, *R*
Navigation	Product has not been added to the cart	4	0,8	3,2
	The page with popular drinks does not open	4	0,8	3,2
	Inconvenient to cancel selected option	3	0,8	2,4
	The Back button is very small in comparison with other elements	3	0,8	2,4
UI/UX	Too bright colors	2	0,8	1,6
	Discounted item is overlapped by the accessibility icon when trying to view popular products	2	0,8	1,6
	Unclear how many questions are in the quiz	2	0,7	1,4

Source: *Own elaboration.*

Table 4. *Errors found during testing of MakeMyTrip website*

Risk type	Error	Impact, I	Probability of error's recurrence, *P*	Risk Score, *R*
Navigation	When navigating to the ticket selection page, additional page for ordering the ticket opens, from which it's impossible to return to the How2Go page	4	0,8	3,2
Filters	'Oops, something went wrong' error appears when applying a filter that returns no results	4	0,7	2,8
Navigation	The page with tickets for certain types of transportation (book flight, book train) does not load	4	0,6	2,4
	Inconvenient to change the route destination points	3	0,8	2,4
UI/UX	The interface is overloaded with details	3	0,8	2,4
Search	The search for a non-existent route doesn't start, and there's no indication of a reason	3	0,7	2,1
	The route search freezes on the smartphone	3	0,7	2,1
Promo Codes	The promo code is automatically canceled when using an already applied promo code again through the coupon input field	3	0,6	1,8
UI/UX	Big padding in the route search results gives the impression that not everything has been loaded	3	0,5	1,5
	Reduce the number of advertising banners to simplify and minimize the information	2	0,7	1,4

Source: *Own elaboration.*

Based on the obtained testing data, it is clear that first priority should be given to addressing issues related to inconvenient and unclear navigation, incorrect work of filters and search, as well as improving the responsiveness of the websites.

Risk response planning for missed errors on websites

The risk management plan was developed, based on the obtained risk score values. This plan includes a risk mitigation strategy, namely the implementation of control measures to reduce the likelihood of the risk occurring or its impact.

Obtained risk score values for educational and e-commerce websites show that the identified risks can be grouped into categories, such as errors in search, navigation, filters, promo codes and UI/UX. In order to reduce the risks of missed errors on websites, an expert assessment identified the following control measures:

1. Search errors:
   - regularly test the search for relevant results
   - conduct usability tests and improve the interface based on users' feedback
2. Navigation errors:
   - test critical links
   - regularly test all or at least critical API-integrations
   - conduct tests to assess users' comprehension of the interface
   - simplify steps of key functions
   - conduct usability tests and improve the interface based on users' feedback
3. Use of filters errors: develop user-friendly filters and categories for quick search.
4. Use of promo codes errors: develop user-friendly promo codes.

5. UI/UX errors:

- create a mobile version of the website or ensure its responsiveness
- regularly test website on different devices
- conduct usability tests and improve the interface based on users' feedback
- follow WCAG accessibility standards, conduct accessibility tests

Thus, based on the experts' assessment data, significant attention must be paid to website testing in order to reduce the risks of missed errors on websites. To identify errors related to UI/UX, usability testing should be performed (Didenko & Vovk, 2020), along with testing for responsiveness (Hliuza & Vovk, 2023). Functional testing should be conducted to find errors related to functionality and business logic, particularly using black-box testing methods. However, when only usability testing is performed, it can be difficult to detect functionality errors (for example, on websites with complex dynamic elements such as menus, animations, and data displayed that change depending on user actions) (Mendielieva & Deineko, 2024).

In most cases, to significantly reduce the number of errors on educational and e-commerce websites and, accordingly, minimize their impact on users, it is necessary to improve the website's interface design and simplify its key functions, taking into account users' feedback.

Approach to testing educational and e-commerce websites

In order to obtain a high-quality approach to website testing in use, it is necessary to determine the complexity of the website and project, as well as the level of formality of the testing approach that will be acceptable in the existing conditions. If changes are planned in the product's design or code, it is important to remember that testing of changes in the product in use includes both assessing the success of the implementation of changes and checking for possible regressions in parts of the system that remain unchanged (which usually makes up the major part of the system) (Cerquozzi et al., 2023).

According to the feedback from participants of the software development process, the degree of formality of the system testing approach is currently influenced by the following project metrics:

- criticality and complexity of the system
- size of changes in the system
- project constraints (scope, time, budget, resource, etc.)
- maturity of the development process of a system

However, it is important to remember that the level of thoroughness in testing and in the documentation of results depends on the available resources, such as the allocated people and time for testing. Additionally, when choosing a testing method, its speed, resource requirements (e.g., the number of testing participants involved), as well as its advantages and disadvantages must be taken into account.

When assessing the complexity of a website, several factors are considered, such as the number and variety of website's features, the presence of interactive elements, integration with external systems, the complexity of the code and frameworks, the ability to handle large amounts of data, the complexity of interface and content elements, and the presence of security-enhancing mechanisms, etc. The more of these factors are present on the website, the more complex it is.

Advantages and disadvantages of the testing methods used during the experiment were considered:

1. Heuristic Testing

Advantages:

- fast execution
- identifies major defects in the website's design and usability

Disadvantages:

- requires finding a group of experts
- the result depends on the expert's experience
- it is possible to get inaccurate results due to discrepancies in experts' opinions, which requires retesting
- the method does not find critical navigation or filtering errors on complex websites like MakeMyTrip
- the method does not find medium-severity errors related to unoptimized mobile design, script performance issues, and slow loading webpage times on mobile devices

2. Usability Task-Based Testing (Hliuza *et al.,* 2024)

Advantages:

- proper selection of experts allows finding a large number of critical usability and functionality errors
- provides valuable information about user satisfaction with the website

Disadvantages:

- requires finding respondents, which can take a lot of time
- if the wrong group of respondents is selected (age, computer knowledge level, experience with similar products, etc.), inaccurate results may be obtained
- poorly formulated questions in surveys may lead to poor-quality results
- if developers and testers are not involved in the testing process, the number of critical errors found will be significantly lower

3. AI Heatmap Analysis

Advantages:

- fast result processing
- can be used without access to the website's code

Disadvantages:

- requires obtaining approval from the project manager before using the service
- the method does not identify a significant number of critical errors

4. Functional Testing (Mendielieva & Deineko, 2024)

Advantages:

- identifies major critical defects related to functionality
- the defects found often overlap with usability issues, indicating the importance of the identified problems
- finds errors both in the interface and in the interaction between the interface, API, server and external services.

Disadvantages:

- the method does not allow to perform a qualitative assessment of the interface's ease of use
- experienced QA engineer is required to quickly create test scenarios that find errors

To identify typical situations in projects when testing of a website in use is required, a survey was conducted among IT specialists involved in the development of software products. Based on their experience, seven possible project options were identified:

1. A website of low complexity, the development team is small (2-5 people). There are limited resources and time allocated for testing, the testing process is not formally defined. Changes are planned for the website's UI/UX part (e.g., mobile adaptation of the site, interface optimization). No changes are planned for the server-side.
2. A website of low complexity, the development team is small (2-5 people). There are limited resources and time allocated for testing, the testing process is not formally defined. Changes are planned for the server-side of the website (e.g., performance optimization, integration with external services). No changes are planned for UI/UX part.
3. A website of medium complexity, the development team is medium-sized (5-10 people). There are limited resources and time allocated for testing, the testing process is not formally defined. Changes are planned for UI/UX part and the server-side, including the website's API.
4. A website of medium complexity, the development team is medium-sized (5-10 people). There are sufficient resources and time allocated for testing, the testing process is formally defined. Minor changes are planned for UI/UX part (e.g., simplifying key elements, such as filters) and for the server-side (e.g., implementation of cloud technologies or integration with payment systems).
5. A website of medium complexity, the development team is medium-sized (5-10 people). There are sufficient resources and time allocated for testing, the testing process is formally defined. Significant changes are planned for UI/UX part (e.g., simplifying navigation on the site, mobile adaptation, optimizing the shopping cart and promo codes). No changes are planned for the server-side of the website.

6. A website of high complexity (but with low traffic), there is a large development team (10-30 people). There are sufficient resources and time allocated for testing, the testing process is formally defined. Minor changes are planned for UI/UX part and the server-side will be modified (e.g., optimization of the server architecture).
7. A website of high complexity (with high traffic), there is a large development team (10-30 people). There are sufficient resources and time allocated for testing, the testing process is formally defined. Changes are planned for the UI/UX part, as well as improvements for the server-side.

Considering the results of the analysis of the testing methods shown above and taking into account the possible types of projects, the following testing approaches were formed:

1. For Project #1 the use of heuristic testing and AI heatmap analysis will be appropriate, as it will ensure quick execution of test scenarios and finding of the most critical usability errors on the website. When there is a small team on the project, three usability experts can be involved in testing and simple but effective test documentation can be prepared (test plan, test scenarios, test results, defect reports).
2. For Project #2 heuristic testing and functional testing can be applied, as they will ensure quick execution of usability test scenarios and provide more focus on finding critical defects in the interaction between the interface and the API/services. Usability testing is recommended, especially if the way of user's interaction with the website has been changed. When there is a small team on the project, three usability experts can be included in testing, and simple but effective test documentation can be prepared.
3. For Project #3, heuristic testing and functional testing can be used, which will ensure quick execution of usability test scenarios and allow thorough finding of critical defects in the interaction between the interface and the API. When there is a small team on the project, three usability experts can be involved in testing and simple but effective test documentation can be prepared.
4. For Project #4, heuristic testing, AI heatmap analysis, and functional testing can be used, which will ensure the finding of the most critical defects and the proper allocation of testing efforts, with a focus on functional errors. Attention should be given to preparing test documentation (test plan, tests, defects) and thorough preparation of the results report.
5. For Project #5, the use of heuristic testing, AI heatmap analysis, usability task testing, and functional testing will be appropriate, as it will provide a comprehensive evaluation of the website's interface usability and the correctness of the key functions. Attention should be given to preparing test documentation (test plan, test cases, defect reports) and results report.
6. For Project #6, heuristic and functional testing can be applied, as it will provide a quick check of usability and identify the most critical defects in the interaction between the interface and the API. Attention should be given to preparing test documentation (test plan, tests, defects) and thorough preparation of the results report.
7. For Project #7, heuristic testing, usability task testing, AI heatmap analysis and functional testing should be used, which will provide a high-quality understanding of the functionality of the most important features of the website. To obtain high-quality usability data, it is advisable to involve a large number of participants from the target audience and ask them to complete test tasks on various devices and browsers. Attention should be given to preparing test documentation (test plan, tests, defects) and thorough preparation of the results report.

Discussion

The results of this study illustrate development of an approach to testing key functions of educational and e-commerce websites using a combination of usability and functional testing methods.

Collected quantitative data from end users provided a comprehensive understanding of the usability of websites tested and the impact of errors found during testing on end user. In addition, the assessment of the impact of errors on the user's experience and the probability of error recurrence on the website was performed. This data allowed to calculate risk score for each error and outline risk mitigation measures on websites.

Although the probability of error recurrence and impact of errors on the user's experience were assessed using experts' evaluation, and this approach was simple and effective for risk score calculation, historical statistical data regarding defects found and use of error logs can give a more precise estimate of probability of missed errors. Moreover, using wider forms of missed error impact, such as financial losses, net promoter score, churn rate and operational risks (e.g., data loss), can more accurately assess the impact of missed errors.

In our opinion, the use of such a complex evaluation of risks impact and probability shows a promising direction in the field of web application testing.

Conclusions

The article describes an effective and flexible approach to testing educational and e-commerce websites in use. The proposed approach was successfully implemented and used for evaluating the quality of the websites nure.ua, the real estate rental website dom.ria.com, the coffee quiz website drinkarizona.com and the website for searching trip routes and finding travel tickets makemytrip.com/how2go.

The experimental data obtained for the risk scores values for missed errors on educational and e-commerce websites showed that priority should be given to addressing issues related to inconvenient and unclear navigation, malfunctioning filters and search functions, as well as the websites' responsiveness.

The identified risks were grouped into categories, and to reduce the risks of missed errors on websites, mitigation measures were suggested through expert evaluation, which are related to conducting usability and functional testing on the websites.

Considering the advantages and disadvantages of testing methods, as well as the possible types of website projects, seven potential approaches for testing educational and e-commerce websites were developed.

To conclude, it is primarily necessary to improve the website interface, taking into account users' feedback, in order to significantly minimize the negative impact of errors on end users and reduce the number of errors on educational and e-commerce websites.

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