Sustainable Efficiency and Usability for E-Learning Systems

Practical guide

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Overview

This Guide has been written as a continuation of the efforts made during the SF-HEAT project to apply usability best practices in the design and development of the e-learning system of the project.

The main idea that underlies the methodology behind the Guide is that educational effectiveness and efficiency crucially depends on the usability of the e-learning system. The Guide focuses on a simple practical approach related to a modified ADDIE model for sustainable usability improvement of the e-learning system.

The guide has the following structure:

In the beginning, the approach of the guide is outlined and the phases and corresponding activities are described together with the overall usability testing organization.

Next, the usability methods proposed in the guide are presented and related to the phases of the usability improvement procedure.

Finally, there is a detailed description of the three tests proposed in the Guide with instructions for their administration. All methods are presented in a format that allows immediate application by a non-professional with minor changes.

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1. Phases in E-Learning System Improvement

In this guide, we present a simple practical approach for usability and User eXperience (UX) improvement based on the ADDIE model. Its goal is to provide step-by-step instructions about three standard methods for usability testing which would allow non-specialists to perform them in the context of an educational quality assurance system.

The traditional ADDIE e-learning system development approach (Analysis, Design, Development, Implementation, and Evaluation) has the following stages:

- **Analysis** – Comprises activities intended to understand what has to be changed, based on evaluation and research. In and cyclic iterative approach as the one proposed here, this stage comes after evaluation or new learning goals (e.g. new learning scope, format, trainee group) and serves to identify and formulate changes of the e-learning system in terms of interface, content, modules, etc. aimed at specific objectives to be met;
- **Design** – On the basis of the Analysis phase results, specific changes in the interface, content, etc. are designed detailing the ways to achieve the new goals;
- **Development** – The e-learning system is changed based on the design from the previous phase;
- **Implementation** – The training takes place with the new interface.
- **Evaluation** – In this phase all the elements of the education quality assurance procedure are used, including those related to the usability of

the e-learning system. The results from this procedure are used in the next iteration of the cycle, namely in the Analysis phase.

While the ADDIE model is generally used for design and development of software systems from scratch, here we adapted it as a model for e-learning system improvement. The process can be schematically illustrated by the diagram shown in Fig. 1.

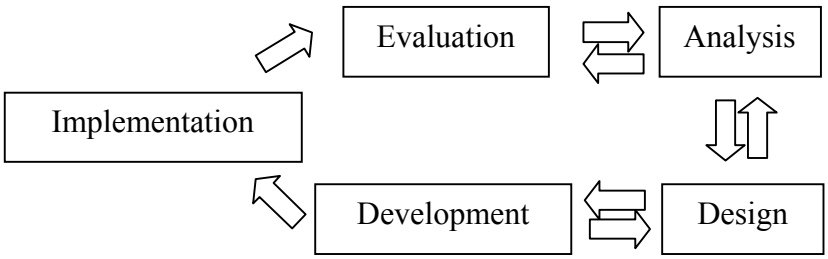

Figure 1. Modified ADDIE model for e-learning system improvement.

One cannot overstate how important the evaluations and corresponding feedback throughout the entire training program are. It is crucial to gather information during each of the phases of the modified ADDIE process shown in Fig. 1 and consider the evaluation as an on-going activity throughout the whole learning cycle.

The modified ADDIE model for e-learning improvement follows the more general PDSA (Plan, Do, Study, Act; see for details Langley et al., 2009). The Evaluation phase of the modified ADDIE model corresponds to the Plan and Do phases of PDSA, and the Analysis phase to the Study and partly to the Act phase, and the Design, Development and Implementation phase to the Act phase, respectively.

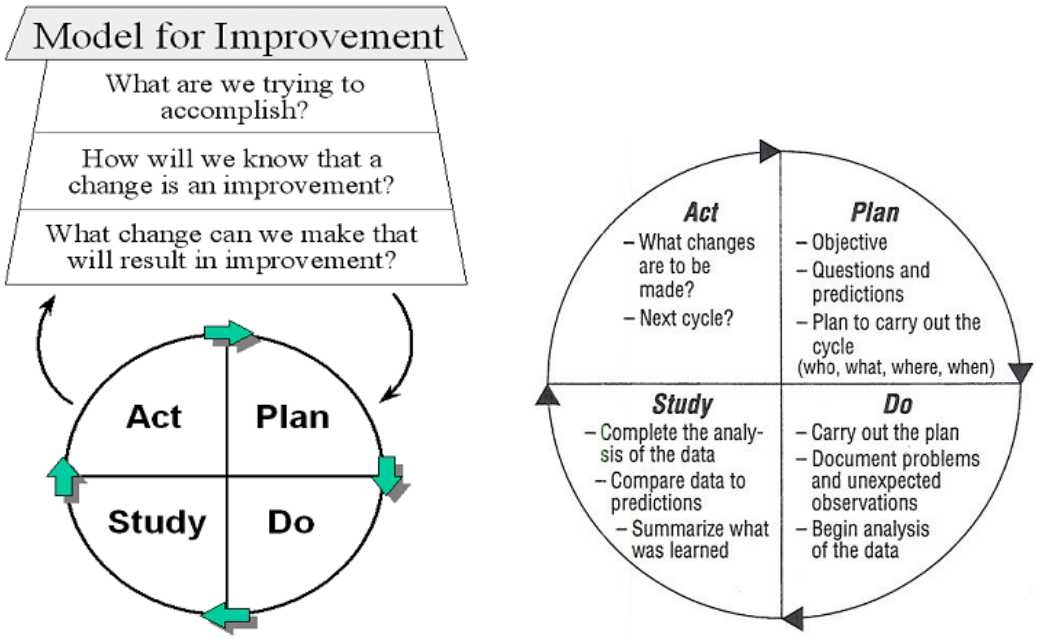

Figure 2. The PDSA model of improvement (Langley et al., 2009).

2. Methods for e-Learning Sustainable Usability and UX Quality Assurance

In the preceding section we dealt with how the standard ADDIE model can be adapted to usability improvement of an existing e-learning system. In this and the following sections, a stand-alone kit of usability methods will be presented in sufficient detail to be used without any additional information.

Before proceeding, we remind what is usability and what are the main objectives of usability methods.

2.1. Usability

Usability is defined as the extent to which the E-Learning system is easy to use, easy to learn and allows users to accomplish specified goals *effectively* and *efficiently*. An additional component that should be added is that working with the system involves a high degree of *satisfaction (*Nielsen & Mack, 1994; Jacko & Sears, 2002; Krug, 2000). The latter is closely related to the so-called User eXperience (UX) which is much more subjective and qualitative. These terms can be defined as follows (ISO 9241-11):

- **Efficient** use of the e-learning system is related to the productivity, as work accomplished per unit time. For e-learning, a measure of efficiency would be the time or number of clicks trainees need to access a lesson or obtain some information, or the time needed to acquire some competence;

- **Effectiveness** is related to how well users are able to perform the task. For e-learning, such a measure would be the level of acquisition of the competences required, no matter how long it has taken;
- **Satisfaction** is determined by users' subjective experience. An e-learning system can ensure effectiveness and efficiency but if users do not feel comfortable and emotionally positive in using it, the potential of the system wouldn't be fully taken advantage of.

While the content and the instruction design approaches are essential for achieving the goals of training, in improving the quality of e-learning systems usability has an equal importance. This is related to the fact that e-learning systems have the potential to overcome the limitations of traditional learning in many respects (if not all). Moreover, e-learning systems involve intense interaction of the learner with complex interfaces to the learning content and thus the quality of the overall process depends crucially on the optimality of this interaction with respect to the following usability requirements:

- Learners interact easily and naturally with the system.
- There is no need of prior training for using the system.
- Learners can benefit from and use all the tools provided by the system.
- Interaction with the system elicits positive emotions.

2.2. Usability testing

As discussed in the previous sections, checking the usability of the system is a constant process that is an essential part of the training quality assurance process. The present guide focuses on the case of a running course or educational program and usability testing should be thought as part of evidence based quality evaluation procedure together with evaluation of learning objective achievements evaluation. Usability tests should be performed during and after completion of meaningful units

of the training – e.g. after completion of a course, or by recording usability issues identified by the teachers or/and the students. After each cycle of usability testing adjustments to the system should be made. The process is repeated again and again iteratively in the lifetime of the course or training.

In what follows, we present three usability methods. The presentation of the methods follows closely Grinberg & Hristova (2012). These methods assess usability from different perspectives and along different dimensions. Therefore, the proposed methods are by no means interchangeable or substitutable but complement each other. Proper application of these methods will uncover the most important problems of the e-learning system usability and will inform its improvement. These three methods are the classical pillars of usability research:

- Heuristic (expert) evaluation;
- User testing;
- Questionnaires and attitudes measures assessing user satisfaction.

The User testing should be performed during the Implementation phase by observing the actual behavior of the students when interacting with the e-learning system in the classrooms. The Satisfaction questionnaires can be administered at the end of the courses as a separate Evaluation or during the Implementation phase at meaningful moments in the training. The Heuristic (expert) evaluation should be done during the Design and Development phases. Table 1 gives the recommended usability methods for each phase.

Table 1. Phases of the modified ADDIE improvement model and usability tests.

ADDIE phase	**Usability method(s)**
Analysis	Heuristic evaluation
Design	Heuristics evaluation, User testing
Development	Heuristics evaluation, User testing
Implementation	User testing, Questionnaires

Evaluation	Questionnaires, User testing

2.2.1. Heuristic evaluation

During Heuristic Evaluation the test of the system is performed by trained experts. Evaluation is based on well-defined and broadly accepted usability guidelines (Nielsen, 1994). The aim of evaluation is to ensure that e-learning system is built in a way that conforms to usability standards and that information is presented in a manner that maximizes its educational value As a result of the evaluation, detailed recommendations of the improvements of the system are provided.

2.2.2. User testing

The second method proposed is User Testing (Jacko & Sears, 2002; Diaper & Stanton, 2003; Nielsen & Mack, 1994). In the study the representative trainees are asked to perform specified tasks with the e-learning system. Their performance is monitored on a number of performance measures such as the time needed to accomplish the task, number of participants that fail to accomplish the task, etc. It is very important to test the e-learning system with real users, because neither the designers nor the usability experts can foresee all the potential problems a naïve user can encounter. The difficulties experienced by users as revealed by this method are analyzed and recommendations how to overcome them are suggested. User testing provides information about the actual problems that users experience while performing basic tasks with a e-learning system.

2.2.3. E-Learning System User Satisfaction Questionnaire

The method uses questionnaires to assess the user satisfaction with using the e-learning system. Users are asked to express their opinion and experience in working with the system. Thus one can receive information about the things users like and things that they do not like and should be improved. The easy and pleasant working with the system is a guarantee for a more efficient learning interaction.

3. Heuristic evaluation

3.1. General description

A heuristic evaluation is a technique for usability testing that provides a review of the E-Learning system from experts in usability (Nielsen & Mack, 1994. Purpose of the heuristic evaluation is to ensure that E-Learning system is build in a way that conforms to usability standards and that information is presented in a way that maximizes its educational value. Heuristic evaluation is performed by several (3-5) trained usability experts without the user involvement.

The heuristic evaluation is performed on the basis of recognized usability principles called 'heuristics' that are considered to be important. Heuristic is a well-established rule or standard. The heuristics are aligned with widely recognized and established standards for graphical user interfaces and design of electronic systems. The heuristic rules are developed using the major findings from studies on human-computer interaction. They also incorporate knowledge form psychology and cognitive science about the human cognitive processes such as perception, learning, memory, and thinking.

As a result of heuristic evaluation we get a list of usability problems present in the E-Learning system. For each problem we have a rating of its importance with respect to usability. In addition, we get recommendations on how to resolve the problems and how to improve the system.

Rough description of the heuristic evaluation process is as follows. In the first stage the experts perform a systematic inspection of the E-Learning system interface design for usability. Each expert is working individually and is evaluating the system using a standardized usability checklist. Each expert is checking for potential usability problems. For each usability problem, a rating of its importance on a standardized scale is made. Finally, recommendations for resolving of each noticed problem is

given. At the next stage of heuristic evaluation all individual expert evaluations are combined. At the final stage, a detailed report with usability problems found and recommendations for improvement is developed.

Heuristic Evaluation could be performed on each stage of E-Learning system design and implementation – development, testing, actual usage. However, it is strongly recommended that Heuristic Evaluation should be performed before the E-Learning system is actually implemented in courses involving trainees.

The Heuristic Evaluation process is performed following the following steps:

- preparation of the materials
- training of the experts
- conducting the evaluation
- aggregation of individual evaluations
- final report

Each of these steps is described in the following.

3.2. Tool

Here the general principles for usable E-Learning system design are presented. Each such principle is decomposed in several simple heuristics. Compliance to these guidelines and heuristics ensures that the E-Learning system is usable: it is used effectively, efficiently and with high degree of satisfaction.

What follows is a list of the main usability guidelines with brief description and some examples of heuristics used.

A. Up-to-date system

System design should reflect the learning needs and incorporate advantages of electronic systems.

Examples for heuristics used:

a. The system includes a table of contents.

b. The system includes a glossary.

c. All pages are printable.

d. There are tools for self-administered tests that provide feedback

B. Module design

At the beginning of each module information should be provided concerning objectives, outcomes and estimated time needed to complete the module.

Examples for heuristics used:

- Learning objectives are stated in the beginning of each module.
- Each learning module has a stated rationale for learning.
- Each learning module provides an estimate of the time needed to complete the module.

C. Visibility of the system status

At every moment the user should know what is going on. In order to achieve that, the system should provide feedback on what is going on.

Examples for heuristics used:

- Current location within the system is shown clearly: The menu reflects the current location as users navigate through the system.

- Current location within the system is shown clearly: A row at the top of the page shows the complete path to the current page.
- Whenever the system delays output, an appropriate message is shown.

D. Match between the system and the real world

The E-Learning system should speak the users' language. Generally accepted conventions and expectations should be followed.

Examples for heuristics used:

- Icons used are concrete and familiar.
- Menu choices fit logically into categories that have readily understood meanings.
- Selected colors and color schemes correspond to common expectations about color codes.

E. User control

Users of the E-Learning system should have opportunity to control the system and freedom to navigate throughout it. Each trainee should be able to proceed in his own speed and to go back if needed.

Examples for heuristics used:

- There is a link to the beginning of the lesson, module, and system
- Users can accomplish tasks using any sequence of steps that they would like.
- A button or link saying 'Back' allows the user to get back to a previous location.
- A button or link saying 'Next' allows the user to proceed.

- If registration is required, users can see what the system offers before they have to register.

F. Consistency

The E-Learning system should be consistent in all its parts and modules.

Examples for heuristics used:

- Every page of the system is clearly identifiable as belonging to the system by pattern, logo, color etc.
- The entire systems uses identical terms

G. Error prevention and recovery

The E-Learning system should be designed carefully in a way which prevents errors. However, if errors occur, the system should provide constructive feedback.

Examples for heuristics used:

- Every step that a user needs to make is explained, or is pretty obvious.
- The interface provides visual cues, reminders, list of choices, contextual help, screen tips.
- All elements on the interface are labelled. The labels unambiguously mark the elements.
- All error messages clearly state what happened.
- Error messages are constructive and clearly state what the user can do to solve the problem.

H. Recognition not recall

The E-Learning system should be designed in a way that relies mainly on recognition abilities rather on recall. Users' working memory load should be minimized in order to be able to performed tasks efficiently and without frustration.

Examples for heuristics used:

- Users do not have to remember information from one part of the dialog to another.
- Instructions for use of the system should be visible or easily retrievable whenever appropriate.
- Colors used for visited and unvisited links are easily seen and understood.

I. Functionality and efficiency of use

Navigation throughout the system should be easy. Work with the system should be effective and efficient.

Examples for heuristics used:

- Tasks can be accomplished with the minimum possible number of steps.
- Major/important parts of the system are directly accessible from the main page.
- The content loads quickly.
- Clear and consistent navigation options are offered.

J. Visual clarity

The graphic design of the E-Learning system should be clear. It should be aesthetic and not too overloaded. In this way the relevant parts could be made visually prominent and distinctive.

Examples for heuristics used:

- System design and layout is clear.
- White space is sufficient; pages are not too dense
- Important objects are given extra visual prominence through: relative contrast, position, color, size.

K. Text

The text in the E-Learning system should be easily readable both on screen and on printed versions.

Examples for heuristics used:

- Font size is neither too large nor too small.
- Font's styles are restricted to two (or, at most, three).
- The text does not cover the entire screen horizontally.
- The text is scannable.
- Fonts (style, color, size) are easy to read in both on-screen and printed versions

L. Help and Instructions

Ideally, the E-Learning system could be used without help or instruction. However, as this is rarely the case, help or instructions should be provided. They should be clear, constructive and concrete.

Examples for heuristics used:

- There is Help or Instructions on using the system.
- Instructions should list the concrete steps to be carried out.

In the preliminary stage of Heuristic Evaluation of a E-Learning system a standardized usability checklist is prepared. All usability principles should be present in the checklist. Each principle is broken into several simple heuristics. Each such heuristic should be concrete and unambiguous.

The complete checklist for Heuristic evaluation of E-Learning system is presented in Appendix 1.

The rating scale for assessing the importance and severity of the usability problems is also prepared. The scale is as follows:

- 4 = severe usability problem: mandatory to fix before the E-Learning system could be used
- 3 = major usability problem: important to fix, working on this problem should be given high priority
- 2 = minor usability problem: working on this problem should be given lower priority
- 1 = cosmetic usability problem: the problem could be fixed if extra time is available on the project

3.3. Participants

Heuristic evaluation is performed by 3-5 trained experts without trainees' involvement.

3.4. Procedure

3.4.1. Training of the experts

Before starting the Heuristic Evaluation all experts that will take part in it should receive specific instructions on conducting the evaluation. The meaning of each heuristic should be made clear to all of the experts. Formal instructions on working with and on filling-in the checklist are also provided.

3.4.2. Conducting the heuristic evaluation

Evaluation is performed by 3-5 trained experts (usability specialists). Each expert evaluates the system alone. This ensures independent and unbiased evaluation from each expert. The system is tested with respect to the checklist prepared. The evaluator goes through the E-Learning system several times and inspects for problems with respect to the heuristics.

For each problem found, all fields in the table should be filled in: the place the problem is found; severity rating; recommendations. The experts' comments and recommendations should be as specific and concrete as possible. If a given heuristic is violated in several elements of the E-Learning system, each instance is noted.

If an expert has additional comments or additional problems (not included in the checklist) are found, they should also be reported in the manner just described.

After the filled-in Heuristic Evaluation table is completed, it is presented in electronic format.

3.4.3. Aggregation of individual evaluations

Only after all evaluations have been completed are the evaluators allowed to communicate and have their findings aggregated. All experts are gathered together and discuss the problems found. Next, an aggregate evaluation is prepared.

3.5. Results

As final result of Heuristic Evaluation a report is prepared. In the final report usability problems found and recommendations on how improve the design and effectiveness of the system are presented.

For each problem identified the following information is provided in the final report:

- description of the problem
- concrete element or part of the system where it is found
- which usability heuristic is violated
- severity of the problem
- recommendations on how to resolve the problem

4. User Testing

4.1. General description

User testing is a usability method that provides information about the actual working of the trainees with the E-Learning system (Proctor& Vu, 2005; Jacko & Sears, 2002; Rubin, 2001; Lewis & Rieman, 1994; Nielsen & Mack, 1994; Kunyavski, 2003; Dumas & Redish, 1999). The purpose of user testing is to investigate the effectiveness and efficiency of working with the E-Learning system. An advantage of user testing is that it is performed with the actual users of the E-Learning system. Thus we receive information on the functionality and efficiency of the system. User Testing helps in identifying problems and offering possible solutions on the basis of user actions.

During the user testing the trainees perform specific predefined tasks that are important for working with the E-Learning system. Their behavior, actions, and comments are recorded and analyzed. As a result of user testing quantitative data is obtained, possibly together with some subjective, qualitative information. Quantitative data are obtained with regard to already specified measures. Such measures could be the percentage of tasks that were accomplished, time needed to accomplish the tasks, number of errors, number of clicks, etc.

Difficulties that repeat themselves between many participants reveal elements in the E-Learning system that should be redesigned by the developers of the E-Learning system.

User testing is performed when the first prototype of the E-Learning system is ready. It's also used during the design cycle and following iterations to measure the work done thus far on improvement of the system.

4.2. Method

4.2.1. Specifying the tasks

Before the beginning of the User Testing the tasks that will be used should be specified. The tasks should be important and representative of working with the E-Learning system. Examples for such tasks are:

- finding an unfamiliar word in the dictionary
- printing the content of a lesson
- finding the information on how to contact the instructor

4.2.2. Specifying the goals and measures

The next step in performing the User Testing is to determine what specific information is needed as a result of the study. The goal of efficient E-Learning system must be broken down into specific, quantitative measurements. Possible usability measurements of efficiency are

- average time needed to perform a specific task
- fraction of participants that accomplished the task
- number of elementary actions (like clicks and scrolls) that are needed to perform an action
- number of errors made while performing a task
- type of errors while performing a task

4.2.3. User testing worksheet

A worksheet is prepared for each of the tasks. For each task the following fields are present:

- task description
- time working on the task
- if the task is accomplished or not
- sequence of actions performed
- user's comments and remarks

4.3. Participants

5 to 10 trainees who are representative of the target users participate in user testing.

4.4. Procedure

4.4.1. Training of the observers

After the specific tasks and measures are determined, the usability experts that will serve as observers should get acquainted with the tasks and measures specified.

4.4.2. Conducting the user testing

5 to 10 trainees who are representative of the target audience are asked to perform the specified tasks. Each participant is tested individually. At the beginning of the session the instructions are given and purpose of testing is explained to the participant, as well as what the participant is supposed to do. As users very often assume that the problems they encounter in using the system are their fault, it is very important to assure the users that the study is not testing them but the system.

During work with the system, the user's actions and comments are recorded by the observer. The observer should refrain from interacting with the user, but only watch how the user is working. The expert should note if the user has problems or difficulties, but not help or correct the user in order to accomplish the task.

The testing session is also videotaped. In such a way the performance could be analyzed in further meeting of more usability experts. With regard to the privacy issues user faces should not be included in the videos made.

At the end of the testing, the user can state any comments about the E-Learning system. The user is also asked for suggestions and recommendations for improving the system.

4.5. Results

The observer writes a user testing report listing the problems and offering recommendations based on their findings. Recordings from all users are summarized and analyzed.

For each task the summarized information is presented, e.g.:

- mean time to accomplish the task
- number of users that fail to accomplish the task
- typical sequence of actions to accomplish the task
- number of errors in performing the task
- type of errors made

This information helps to identify what are the difficulties that trainees have and makes it possible to answer the question why users failed to accomplish certain task.

In the final report an analysis of the reasons for problems with working with the system is presented. Recommendations on how to overcome the problems are made on the basis of this analysis.

5. User Satisfaction Questionnaires

5.1. General description

Subjective attitudes and satisfaction are an important factor in usability evaluation of the E-Learning system. A commonly used method for gathering such information is by means of self-administered questionnaires. The purpose of such study is to guide redesign and improvement of the E-Learning system. User satisfaction questionnaires help to determine areas that should be improved in the subsequent iterations (Proctor& Vu, 2005; Jacko & Sears, 2002).

The questionnaire developed aims at assessing different aspects of users' interaction with the E-Learning system:

- ease of working with the E-Learning system
- flow of presentation of information
- visual presentation and design of the system
- text readability
- writing style
- help and instructions on using the system

5.2. Tool

5.2.1. Design of the questionnaire

In design of the questionnaire several aspects of the user satisfaction while working with the system should be addressed. The questionnaire should not be very long and in the same time it has to capture all major issues concerning use of the E-Learning system.

Ease of working with the E-Learning system

- 1. The E-Learning system is easy to use.
- 4. The content of the pages loads quickly.

Course materials and feedback

- 14. I can easily access course materials.
- 12. I can easily check my progress in the courses.
- 15. I receive helpful feedback on my progress with the study material.

Overall organization of the system

- 13. The overall organization of the E-Learning system is easy to understand.
- 12. There is consistency of layout, terms, and actions in the system.
- 7. Information on each page is well organized and structured.
- 8. I can easily navigate to specific parts of the system (e. g. beginning of the module).

- 11. I know where I am in the E-Learning system at any given moment.

Visual presentation and design of the system

- 5. I like the design of the E-Learning system.
- 3. Icons used in the E-Learning system are easily understood.
- 6. Text (font, size, colour) is easy to read.

Instruction and help on using the system

- 9. Instructions on using the system are easily found.
- 10. Instructions on using the system are easily understood.
- 15. The E-Learning system provides error messages that help me quickly fix the problem.

Subjective satisfaction

- 2. I feel comfortable using the E-Learning system.

The questionnaire is presented in Appendix 2.

5.2.2. Preparation of the test material

Questionnaire developed is administered in a computerized or (preferably) web-based mode of presentation. In such a way gathering of information is easier and there is no chance for data entry mistakes.

5.3. Participants

Trainees should fill in the questionnaire after working with the E-Learning system. 20-30 participants are needed in order to have statistical validity of the user satisfaction measures.

5.4. Procedure

5.4.1. Conducting the test

20 -30 participants should answer the questions after working with the E-Learning system. The average time of questionnaire completion is about 5 to 10 minutes.

The questionnaire is filled-in by the learners after gaining some experience with the E-Learning system. An appropriate time for administration of the questionnaire is after the end of the second or third day of working with the system.

Each participant fills in the questionnaire and submits it (if questionnaire administration is computerized) or returns it to the person administering the study (if the paper version is used).

5.5. Results

5.5.1. Analyzing the data and making recommendations on the system

After enough learners (20-30) have filled-in the questionnaire data obtained are summarized. Mean user satisfaction ratings on each item are computed and analyzed.

5.5.2. Final report

The E-Learning system is evaluated with respect to the ratings. Positive and negative aspects of user interaction with the system are summarized. Directions of improvement of the system are presented on the basis of questionnaire data.

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Appendix 1
Heuristic Evaluation Materials

Instructions

Before beginning heuristic evaluation, please read the following instructions!

The Heuristic Evaluation is performed by means of the checklist provided. Please, examine the E-Learning system carefully and fill-in the Heuristic Evaluation Table provided in the Excel file. The table should be filled-in the following manner.

In the first column of the table Heuristic Evaluation rules are presented. You should examine the E-Learning system and evaluate if the given heuristic rule is present or is violated. You should mark your evaluation in column 2 using the following notation:

‘+’ means that this specific heuristic is followed in the E-Learning system

‘0’ means that this specific heuristic is not applicable to the particular E-Learning system

‘-’ means that this specific heuristic is violated in the E-Learning system

If you have any comments, you can write them down in column 5.

Only for heuristic rules that are violated (you marked them with ‘-‘ in column 2), you should fill-in the columns 3, 4, and 6.

In column 3 you should describe in detail the location or element in the E-Learning system where the problem is found.

In column 4 you should provide ratings of the importance (severity) of the problem found. You should make the ratings using the following scale:

4 = severe usability problem: mandatory to fix before the E-Learning system could be used

3 = major usability problem: important to fix, working on this problem should be given high priority

2 = minor usability problem: working on this problem should be given lower priority

1 = cosmetic usability problem: the problem could be fixed if extra time is available on the project

In column 6 you should write recommendations and possible solutions for the problem.

If a given heuristic is violated in more than one location, you should provide separate row in the table for each element or page where the problem is found.

Heuristic Evaluation checklist

Heuristic rule	**2**	**3**	**4**	**5**	**6**
System design	**Expert evaluation**	**Location**	**Severity**	**Comments**	**Recommendations**
The system includes a table of contents.					
The system includes a glossary.					
Unfamiliar words are highlighted and linked to the glossary.					
All pages are printable.					
There are tools for self-administered tests that provide feedback					
Module design					
Learning objectives are stated in the beginning of each module.					
Each learning module has a description of its learning outcomes in observable, measurable terms.					
Each learning module has a description of the activities it contains.					

Each learning module has a stated rationale for learning					
Each learning module provides an estimate of the time needed to complete the module					
Content organization					
Content about the names of things and parts of things is mastered before content about the manipulation of those things.					
Content needed most often is in a prominent place.					
“Reference” or “More About” links are used for less important content.					
Visibility of the system status					
Current location within the system is shown clearly: The menu reflects the current location as users navigate through the system.					
Current location within the system is shown clearly: A row at the top of the page shows the complete path to the current page.					
Whenever the system delays output, an appropriate message is shown.					
Confirmation screen is provided for form submittal					

Match between the system and the real world					
Icons used are concrete and familiar.					
Selected colors and color schemes correspond to common expectations about color codes.					
Menu choices fit logically into categories that have readily understood meanings.					
Input data codes are meaningful.					
The command language employs user jargon and avoids computer jargon.					
User control and freedom					
There is a link to the beginning of the lesson, module, system					
It is clearly identified.					
A button or link saying 'Back' allows the user to get back to a previous location.					
A button or link saying 'Next' allows the user to proceed.					
No orphan pages – the system never goes into a mode where the user is not allowed to access the menu.					

If registration is required, users can see what the system offers before they have to register.					
The user can cancel all operations					
All actions that users can perform at any particular time are overtly obvious.					
Users can accomplish tasks using any sequence of steps that they would like.					
Consistensy and standards					
Every page of the system is clearly identifiable as belonging to the system by pattern, logo, color etc.					
The entire systems uses identical terms					
If an option appears at a certain place, it is always show at that location.					
Buttons have names that correspond to their function.					
Error prevention and recovering					
The interface provides visual cues, reminders, list of choices, contextual help, screen tips					
Every step that a user needs to make is explained, or is pretty obvious.					

Examples are provided. (For example, in new record forms, a sample entry for every field is shown.)					
If users have to enter dates, allow them to pick the date from a popup calendar.					
All elements on the interface are labeled. The labels unambiguously mark the elements					
The feedback that users receive is friendly and encouraging (not unfriendly and punishing).					
Error messages are part of the system design					
All error messages clearly state what happened.					
Error messages are constructive and clearly state what the user can do to solve the problem					
Recognition rather than recall					
Users do not have to remember information from one part of the dialog to another.					
Objects, actions, and options are visible.					
Instructions for use of the system should be visible or easily retrievable whenever appropriate.					

Good labels and descriptive links.					
Colors used for visited and unvisited links are easily seen and understood					
Functionality and efficiency of use					
Tasks can be accomplished with the minimum possible number of steps.					
Major/important parts of the system are directly accessible from the main page					
The content loads quickly.					
Clear and consistent navigation options are offered.					
The functions of links and controls are clearly identifiable/labelled					
Links, buttons and controls are clearly marked as such.					
All controls, links and buttons work correctly.					
Link titles are informative.					
All graphic links or controls are also available as text links					
The interface does not require users to alternate between input devices to accomplish an action.					

Visual clarity					
System design and layout is clear					
White space is sufficient; pages are not too dense					
Unnecessary animation is avoided					
Bold and italic text is used sparingly					
Important objects are given extra visual prominence through: relative contrast, position, color, size					
Page backgrounds are white or pale pastel colors, with contrasting colors and saturations used for text, buttons etc.					
Text					
Font size is neither too large nor too small.					
Font color contrasts well with the background.					
Fonts styles are restricted to two (or, at most, three).					
Sans serif fonts are recommended for headlines, serif for body text					

Line length is short: users do not have to scroll horizontally.					
The text does not cover the entire screen horizontally.					
The text conveys the message in clever or interesting way.					
The text is scannable.					
The text uses highlighted keywords.					
The text uses meaningful sub-headings.					
Each paragraph contains one idea.					
Bulleted lists are used when appropriate.					
The word count is reduced to the smallest possible minimum.					
No spelling errors on the system.					
All text is grammatically correct					
Fonts (style, color, size) are easy to read in both on-screen and printed versions					

Help and instructions					
There is Help or Instructions on using the system.					
Help or Instructions should be informative, yet not too long.					
Instructions should list the concrete steps to be carried out.					

Appendix 2
User Satisfaction Questionnaire

Please, fill in this questionnaire after you finish the work with the E-Learning system.
Your opinion is very important for us in order to be able to improve the system you are using.
Please, answer carefully all of the questions below.

For each of the questions below mark the position that best represents your experience working with the E-Learning system.

---

1. The E-Learning system is easy to use.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

2. I feel comfortable using the E-Learning system.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

3. Icons used in the E-Learning system are easily understood.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

4. The content of the pages loads quickly.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

5. I like the design of the E-Learning system.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

6. Text (font, size, colour) is easy to read.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

7. Information on each page is well organized and structured.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

8. I can easily navigate to specific parts of the system
(e. g. beginning of the module).

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

9. Instructions on using the system are easily found.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

10. Instructions on using the system are easily understood.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

11. I know where I am in the E-Learning system
at any given moment.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

12. There is consistency of layout, terms, and actions in the system.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

13. The overall organization of the E-Learning system
is easy to understand.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

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14. I can easily access course materials.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

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15. The E-Learning system provides error messages
that help me quickly fix the problem.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

16. I can easily check my progress in the courses.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

17. I receive helpful feedback on my progress
with the study material.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

If you have any additional comments and recommendations on the E-Learning system you used, please, write them here: